

Centennial Coal

Specialist Consultant Studies Compendium Volume 2 – Parts 6 to 11

Continued Operation of the Charbon Colliery

November 2009

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Volume

CHARBON COAL PTY LIMITED

Charbon Colliery Continued Operations Report No. 753/03

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Charbon Coal Pty Limited ABN: 71 064 237 118

Continued Operation

of the

Charbon Colliery

Surface Water Assessment

Prepared by

GSS Environmental

November, 2009

Specialist Consultant Studies Compendium: Part 6

Surface Water Assessment

for the

Continued Operation of the Charbon Colliery

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November, 2009

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EXECUTIVE SUMMARY

An application for project approval under Part 3A of the *Environmental Planning and Assessment Act 1979* is to be made to permit the continued operation of Charbon Colliery, including extraction of coal from five small open cuts and one underground mine. R.W. Corkery & Co. Pty. Limited was commissioned by Charbon Coal Pty Limited (the "Proponent") to prepare an *Environmental Assessment* in support of the Project Application. GSS Environmental (GSSE) was subsequently engaged to prepare a Surface Water Assessment as part of the *Environmental Assessment*.

This report has been prepared to fulfil the requirements detailed in the Director-General's Requirements relating to the preparation of a Surface Water Assessment. The key aspects addressed within the Surface Water Assessment include the identification of potential surface water impacts as a result of the project, a description of the proposed mitigation and management measures to be implemented to address these potential impacts, licencing requirements, recommendations for ongoing surface water monitoring, and a site water balance, including a discussion on water sources, water security and predicted discharges from site.

A number of first order and one second order ephemeral drainage lines would be disturbed by the proposed development. The second order creek is very poorly defined with no defined bed and banks, and is unlikely to provide any significant riparian habitat with no vegetation other than grasses due to previous clearing of the area. This ephemeral drainage line is reflective of all drainage lines running through the proposed development areas, and as such, no significant impact on the local hydrology is anticipated. Notwithstanding this, it is recommended that any ephemeral drainage lines disturbed as part of the proposed mining operation be rehabilitated in accordance with DECCW requirements.

GHD was commissioned by Charbon to develop a water balance for the site to support the Surface Water Assessment. The results of the water balance simulation indicate that for a low rainfall year there would be significant water stress at the site as a direct result of reduced rainfall, increased evaporation and continued water demand. During these years additional water would need to be extracted from Reedy Creek Dam to meet water demands. It is predicted that between 109ML/year and 185 ML/year would need to be extracted from Reedy Creek Dam to meet water demands on site throughout years 1, 4 and 7 of operation,, depending on rainfall conditions.

The water balance developed for the proposed operations at the Colliery indicate that the water to be extracted from Reedy Creek Dam and the Groundwater Bores would increase compared to the existing situation to meet increasing site water demands. In average rainfall years, the demand from Reedy Creek Dam is predicted to increase by approximately 15 ML per year, with water extracted from Bores 1 and 2 to approximately double from 2.6ML to around 5.5 ML per year.

Two new licenced discharge points (LDPs) would be required at Charbon throughout the continued operation of the mine, as well as continued operation of the existing LDPs 1, 2 and 3. One LDP (LDP 4) is proposed downstream of the Pit Top and Infrastructure Area, and another (LDP 5) is proposed downstream of the Central and Western Open Cuts.

Under average rainfall conditions, minimal discharges are predicted to occur from LDP 2 over the life of the mine, with no exceedance of the current EPL volumetric discharge limits predicted. The model indicates however that the average daily discharge during a discharge event in a wet year may exceed the current EPL limit of 5000kL/day between three to six times a year, however it is noted that this is only expected to occur in extreme rainfall events.

The water balance model indicates that discharges from LDP 3 under average rainfall conditions in Year 1 of operation may exceed the current EPL limit of 5000kL/day on one occasion. The frequency and volume of discharges increase in a wet year, with discharges predicted to exceed EPL limits on up to eight days per year under these wet conditions. As expected, the water balance predicts that as the mine life progresses, the discharges from LDP 3 would decrease. This is due to mining in the catchment area reporting to LDP 3, namely the Southern Open Cut, progressively ceasing and rehabilitation of the area occurring.

In developing the water balance it was necessary to make several important assumptions about site water flows due to limited actual metered data available from site. Many of the parameters in the model were estimated, and whilst the model was calibrated to match existing conditions as much as possible, further flow data is required to confirm the model outputs. It is recommended that the model be reviewed and updated when this data becomes available. It is recommended this review and update be completed, and in particular the predicted volume and frequency of discharges from LDP 2 and LDP 3 verified, before a decision is made on whether the current EPL would require varying.

As mining operations expand into the Central, 8 Trunk and Western Open Cut Areas, three additional Pollution Control Dams would be required so that sufficient sediment controls are in place to ensure discharge water quality limits are met. In addition, sediment basins would be constructed within the final landform to ensure the risk of offsite impacts on surface water resources are minimised as vegetation becomes established on rehabilitated areas.

1 INTRODUCTION

1.1 Overview

Charbon Colliery currently employs both underground and open cut mining methods to produce up to 1.3 million tonnes (Mt) of run-of-mine (ROM) coal annually, with approval to mine up to 1.5 Mt. Charbon Colliery is located in the western coal fields of New South Wales, south of the townships of Kandos and Charbon, and is approximately 230 km northwest of Sydney as shown in **Figure 1**.

An application for project approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is to be made to permit the continued operation of Charbon Colliery, including extraction of coal from five small open cuts and one underground mine. R.W. Corkery & Co. Pty. Limited (RWC) was commissioned by Charbon Coal Pty Limited (the "Proponent") to prepare an *Environmental Assessment* in support of the Project Application. GSS Environmental (GSSE) was subsequently engaged to prepare a Surface Water Assessment as part of the *Environmental Assessment*. Approval is sought for the following activities.

- Mining of approximately 5.2 million tonne (Mt) of coal at a maximum rate of:
 - 700 000t per year using open cut mining methods in the Western and Southern Outlier, Southern Open Cut Extension and 8 Trunk, Central and Western Open Cuts; and
 - 900 000t per year using underground mining methods in the Western Underground;

with the maximum quantity of coal mined annually not exceeding 1.5Mtpa over a maximum of 15 years.

- Transportation of ROM coal from the proposed mining areas to the existing approved CHPP using the existing underground coal transportation infrastructure and existing and upgraded internal haul roads.
- Processing of a maximum of 1.5Mt per year ROM coal at the existing CHPP.
- Transportation of a maximum of 250 000t of ROM and product coal per year to the Proponent's customers by public road.
- Transportation of a maximum of 20 000t product coal per year to the Charbon Lime Works by private road.
- Transportation of a maximum of 1.5Mt ROM and product coal per year to the Proponent's customers by rail.
- Placement of waste rock material within proposed in-pit waste rock emplacements.
- Expand and upgrade the existing reject emplacement area to allow for placement of Project-related fine and coarse reject material.
 - Construction of associated infrastructure, including:

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Note: A colour version of this figure is available on the Project CD

Part 6: Surface Water Assessment



6 - 11 **CHARBON COAL PTY LIMITED** Charbon Colliery Continued Operations Report No. 753/03

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- three new pollution control dams;
- the Western Underground surface facilities area;
- new and upgraded haul roads; and
- the 2 Trunk ROM Coal Loading Facility.
- Progressive rehabilitation to create a final landform that would generally mimic the existing landform.
- Continued use of existing site infrastructure for the life of the Project.

The locations of these activities are shown on **Figure 2**. In addition to the above, approval is also sought for the continued operation of those existing approved activities that would be ancillary to the operation of the proposed activities following completion of mining of the Charbon Underground and Southern Open Cut. Those activities would include, but would not be limited to, the following.

- Operation of the CHPP and train loading facility.
- Use of the offices, staff amenities, workshops, roads, Reedy Creek Dam and associated infrastructure, waste water treatment plants, underground mine infrastructure and surface water management structures and other site infrastructure.

1.2 Methodology and Scope of this Report

This Surface Water Assessment supports the *Environmental Assessment*. The key aspects addressed within the Surface Water Assessment are as follows.

- The collation of relevant data, including meteorological (rainfall events), surface water flow regime (water quality and quantity), catchment characteristics, surface water features, and surrounding land uses. Information has been collected from a literature review of Charbon Colliery and NSW government records, and from site inspections undertaken on 15 and 16 April 2008 by Rod Masters and Chad Stockham (GSSE), and on 11 June 2009 by Rod Masters and Dean Jarvis (GSSE).
- The identification of the key issues, relevant assessment criteria and constraints relating to surface water.
- The existing controls for management of surface water at Charbon Colliery.
- The proposed surface water management measures to be implemented throughout the continued operations at Charbon Colliery.
- The recommended safeguards and mitigation measures to be implemented to ensure that potential surface water impacts are managed and appropriate criteria are met.
- A site water balance, based on a detailed site water balance undertaken by GHD (2009).

• Recommendations for ongoing surface water monitoring.

An assessment of the impacts of the Project on surface water flow regimes within the Study Area (refer **Figure 2**) and surrounding natural drainage.

This document fulfils the requirements detailed in the Director-General's Requirements (DGRs) relating to the preparation of a Surface Water Assessment, as discussed further in Section 2.

1.3 Study Area

The proposed mining development areas along with the Study Area for the Surface Water Assessment are shown in **Figure 2**.

1.4 Objectives

The key objectives of surface water management at Charbon, as addressed in this Surface Water Assessment, are as follows:

- Prevention of the flow of sediment into watercourses and the flow-on impact of sedimentation on receiving waters, ie. Reilys, Reedy and Stony Creeks.
- The management of ephemeral watercourses in accordance with the expectations of the relative Government Departments (primarily Department of Environment, Climate Change and Water (DECCW)), including the rehabilitation of the ephemeral first and second order streams to be disturbed as part of the continued operations.
- The control of surface flows on rehabilitated areas to ensure minimal soil loss and adequate soil moisture for plant growth.
- The control of discharges from the site to ensure that all discharges are within the volumetric and water quality criteria set out in the existing EPL.
- Prevention of the inflow of water into the active work area wherever possible.
- Ensure there is sufficient water available to meet site water requirements.

1.5 Literature Review

The following project specific documentation has been reviewed by GSSE as part of the Surface Water Assessment.

- *Proposed Southern Open Cut EIS*, International Environmental Consultants Pty Ltd (March 2003).
- Charbon Colliery Mining Operations Plan 2006, Centennial Coal (September 2006).
- *Hydrogeological Review Charbon Colliery*, C M Jewell & Associates Pty Ltd (March 2008).

- 2005 Charbon Coal AEMR, Centennial Coal Company Limited (Not dated).
- 2006 Charbon Coal AEMR, Centennial Coal Company Limited (March 2007).
- Surface Water Monitoring Data (April 2004 May 2009).
- EPL Licence L528.
- Catchment Action Plan (CAP), Central West Catchment Management Authority (February 2007).
- Charbon Colliery Water Management Plan and Erosion and Sediment Control Plan, Centennial Coal Company Limited (June 2007).
- Report on Charbon Colliery Mine Water Balance, GHD (September 2009).
- *Managing Urban Stormwater: Soils and Construction Volume 1, 4th Edition,* Landcom (2004) (the Blue Book Volume 1).
- Managing Urban Stormwater: Soils and Construction Volume 2E Mines and Quarries, Department of Environment and Climate Change (DECC) (2008) (the Blue Book Volume 2E).
- NSW State Rivers and Estuaries Policy, NSW Water Resources Council (1993).
- *Guidelines for Controlled Activities Riparian Corridors and In-stream works,* former Department of Water and Energy (DWE).
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZECC (2000).

2 DIRECTOR-GENERAL'S REQUIREMENTS

The Director-General's Requirements (DGRs) for the Project were provided in a letter from the Department of Planning (DoP) on 19 December 2008 and reissued on 6 February 2009. **Table 1** provides a summary of the DGRs and related *Environmental Assessment* Requirements (EARs) provided by other government agencies relating to surface water and indicates where specific issues have been addressed within this document.

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		Page 1 of 2
Agency	Details of Requirements	Location in document where addressed
Department of	Include a detailed modelling of:	
Planning – Director	 potential surface and groundwater impacts, 	Section 6
Requirements	• a site water balance;	Section 7
rioquironioni	 a salinity balance; and 	Section 3.8.1
	• a detailed description of final void management.	Addressed in <i>Environmental</i> Assessment
Department of Water and Energy (31/10/08)	 The Environmental Assessment must include assessment of water supply and/or water interception and extraction against any Water Sharing Plan in force affecting the site. A full description of water supply to all stages of the proposal must be included, which includes: water source(s); explanation of any embargoes or full commitment declarations for the proposal; examination of the reliability of water supply to the proposal, including alternatives to site rainfall runoff harvesting in the event of a drought; demonstration of prioritisation and effective reuse of saline or other contaminated water within the proposal; and explanation of water circuitry and means to segregate contaminated, sediment-laden and clean water volumes within the proposal and 	Section 5 – Existing Site Water Management, Section 6 – Proposed Surface Water Impacts and Management and Section 7 – Site Water Balance
	proposal site.	
	The project possesses license with minimal conjunctive volume allocations. As site water demand will increase, an increased incidental groundwater inflow to the workings will occur, the Environmental Assessment must present a site water balance and ability to obtain license to account for inflows and/or extractions from groundwater. This must be explained in detail in the Environmental Assessment.	Section 7. Note information on groundwater licensing requirements is discussed in the Groundwater Assessment (Geo Terra, 2009)

 Table 1

 Summary of DGRs and EARs relevant to Surface Water Assessment

Table 1 (Cont) Summary of DGRs and EARs relevant to Surface Water Assessment

		Page2 of 2
	The <i>Environmental Assessment</i> report must include details on any watercourses and riparian corridors that may be impacted by the proposal including:	
	 a detailed description of how the watercourses and riparian corridors will be protected/managed; and 	Section 6.10
	identify if stream diversion/relocation is required	
Department of Environment and Climate Change (28/10/08)	DECC recommends that a water balance be prepared to model water management through the life cycle of the mine including the initial construction phase.	Section 7
	Where an offsite discharge is required, any discharge points will need to be identified in the EA with estimates of the frequency and volume of discharges and likely water quality for:	Section 3.8.1 – Water Quality, and Section 7.7 Water Balance Results
	Total dissolved and suspended solids;	
	Non Filterable Residue;	
	grease and oil;	
	nutrients;	
	• pH; and	
	Total Organic Carbon	
	The EA should consider any proposed discharge in terms of the NSW Water Quality and River flow Objectives and utilising the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).	Section 3.8

3 SURFACE WATER ENVIRONMENT

3.1 Rainfall / Climate

The climate in the area surrounding the Study Area is characterised by warm to hot days and cool nights during summer and frosty mornings followed by cool sunny days in winter. Rainfall tends to peak during the summer months, with thunderstorms and strong winds along the ridge tops. The region is also quite susceptible to extended periods of drought.

The most relevant long term rainfall data was obtained from the Bureau of Meteorology (BOM) monitoring station operating at Kandos (No.62017). This station has operated since 1951.

Whist rainfall is reasonably well distributed throughout the year; there is a slight peak in the summer months and marginally lower rainfall in autumn. On average, January is the wettest month of the year and April is the driest. The wetter months of December, January and March also have a reasonably low number of mean rain days suggesting the higher volumes of rainfall are associated with higher intensity storms falling over shorter periods of time. Such events are important when designing appropriate surface water management structures.

Table 2 contains the rainfall statistics for the 10th percentile (dry), 50th percentile (average) and 90th percentile (wet) rainfall years from the Kandos BOM station. This data assists in the design of appropriate sediment and erosion control structures for the site.

10 th Percentile (dry year)	466.14 mm
50 th Percentile (median year)	697.7 mm
90 th Percentile (wet year)	891.06 mm

Table 2Annual Rainfall Statistics (BOM station No. 62017)

3.2 Landform

The Study Area lies on the western slopes of the north-south oriented sandstone ridgeline of the Great Dividing Range. Topography within the Study Area generally consists of asymmetric rolling hills with elevations up to 900m AHD and valley floors at around 700m AHD to750m AHD. The hill slopes are steep and rocky, with the valley floors being areas of low gently sloping to flat land where the Illawarra coal measures are present beneath a thin cover of colluvial and alluvial deposits.

The proposed Central Open Cut area lies within the lower slopes of the Great Dividing Range sandstone ridgeline and runs across slopes of approximately 25% to 35% (**Figure 2**). The minimum elevation of the area is 740m AHD with a maximum elevation of 780m AHD and lies below steeper sections of the escarpment. The 8 Trunk Open Cut covers similar topography and elevations with slopes mainly between 15% to 25%. Both these areas have northwest to southwest aspects.

The Western Open Cut area also follows along the contours with an eastern aspect and slopes of around 30%. The minimum elevation of the area is 760m AHD with a maximum elevation of 790m AHD.

The Southern Open Cut Extension and Southern and Western Outliers cover the tops of three distinctive hill crests with maximum elevations of approximately 800m AHD. The minimum elevation is proposed to be around 760m AHD, with the disturbance areas having a range of natural slopes up to approximately 60%.

3.3 Vegetation

The current and previous flora surveys identified 267 flora species within the Study Area, of which 48 species were exotic species (AES/GES, 2009).

The flora survey identified eight vegetation communities within the Study Area as listed below:

- Grey Gum Stringybark Forest;
- Mountain Grey Gum Grey Gum Mountain Hickory Sheltered Forest;
- Apple Box Ribbon Gum Woodland;
- Stringybark Blakely's Red Gum Yellow Box Woodland;
- Inland Scribbly Gum Grey Gum Narrow-leaved Stringybark Woodland;
- Narrow-leaved Stringybark Sydney Peppermint Grey Gum Woodland;
- White Box Kurrajong Grey Gum Woodland;
- Yellow Box Blakely's Red Gum Woodland; and
- Cleared Land.

With regards to the management of surface water, the vast majority of the catchments within the Study Area consist of cleared agricultural land with minor shade trees and forested hills in the upper reaches. Rehabilitation programs for the open cut will progressively change runoff characteristics by increasing forested lands.

3.4 Surrounding Land Uses

The Study Area is located within a rural area, with the surrounding land uses consisting predominately of agriculture, coal mining, rural residential, agricultural lime production and residential. The land on the valley floor and adjacent side slopes within the Study Area have been predominately cleared of natural vegetation and is mainly used for stock grazing and coal mining and associated activities. Dense native bushland which is part of Kandos State Forest is located on the western side of the Study Area, and covers approximately 8.3 km2. Dense bushland also lies to the east of the Study Area within the Clandulla State Forest, situated to the west of the Wallerawang-Gwabegar railway line and covers approximately 12 km2.

3.5 Soils/Geology

Soils within the Study Area generally consist of Red, Yellow and Brown Podzolics (GSSE, 2009).

Red Podzolics within the Study Area generally consist of brown to reddish brown sandy loam topsoils, that are weak in structure, overlying light to medium reddish brown clays that are angular blocky and moderate to strong in structure.

Yellow Podzolics soils also feature throughout the Study Area. They consist of hard setting weakly structured brown loams to sandy loams. The subsoils generally display yellowish brown or yellowish orange medium to heavy clays, and are moderately structured with coarse angular blocky rough faced pods.

Smaller portions of the Study Area contain bleached loams which belong to the Three Sisters soil landscape unit. Topsoils generally display dark brown sandy to fine loams. Bright yellowish-brown sandy clay loams which are weakly structured are present in the subsoils.

Possible constraints that the soil may have on surface water management are described below in Section 6.2.2. More comprehensive detail on the soil characterises within the Study Area is contained in the Soil Assessment undertaken by GSSE (2009) and presented as Part 9 of this *Specialist Consultant Studies Compendium*.

3.6 Surface Hydrology

3.6.1 Regional Hydrology

Four catchments exist within the Study Area, namely the Reedy Creek, Reilys Creek, Stony Creek and Deep Creek Catchments. Deep Creek flows to the east of the Great Dividing Range, with part of the existing Charbon Underground Mine located beneath this catchment. The catchments relevant to the surface water assessment, namely Reedy Creek, Reilys Creek and Stony Creek, are illustrated in **Figures 3** and **4**.

Reedy Creek flows to the Reedy Creek Dam before then flowing into Cumber Melon Creek, the Cudgegong River and into Lake Windamere.

Reilys Creek also drains into Lake Windamere through Carwell Creek.

Lake Windamere (or Windamere Dam as it is sometimes referred to) forms part of the Macquarie-Bogan River Catchment in central New South Wales. The Bell, Talbragar, Cudgegong, Turon, Fish and Campbells Rivers are the major tributaries within this catchment.

The Study Area is located on the edge of the Macquarie-Bogan catchment, with the Great Dividing Range forming the boundary on the eastern side of the catchment areas. The Southwest Open Cuts are located on a ridgeline that forms a catchment between the Macquarie-Bogan River Catchment to the north and the Hawkesbury-Nepean Catchment to the south. It is noted however that the majority of the Southwest Open Cuts, including the entire Western Outlier and most of the Southern Outlier, lie within the Macquarie-Bogan Catchment.

Stony Creek has a catchment area of approximately 945ha and runs into Ulumbro Creek, which flows south west into the Capertee River, the Colo River and Hawkesbury River. It is also noted that only a very small portion of the Stony Creek Catchment lies with the Study Area.

3.6.2 Local Hydrology

The proposed Central Open Cut and part of the Western Open Cut are within the Reedy Creek Catchment. This catchment is approximately 1 042ha in size. Both proposed areas of development are located within the headwaters of the catchment. The proposed Central Open Cut would disturb one first order creek (refer **Figure 3**).

The majority of the proposed Western Open Cut and the entire area of the proposed 8 Trunk Open Cut are within the Reilys Creek Catchment. The majority of the extraction areas (approximately 68%) drain to large farm dams located within the lower sections of the drainage lines. The remaining area drains directly into Reilys Creek.

The proposed 8 Trunk Open Cut is located within the upper reaches of the catchment area and runs along the contours. A second order creek lies within the proposed development area along with a first order creek. Both of these drainage lines currently drain sequentially into a series of two large farm dams before discharging into Reilys Creek. The second order creek is very poorly defined (i.e. no defined bed and banks) as shown in **Plate 1**. The creek is unlikely to provide any significant riparian habitat with no vegetation other than grasses due to previous clearing of the area. This ephemeral creek line is reflective of all water drainage lines running through the proposed development areas.



Plate 1 Second order creek in the vicinity of the proposed 8 Trunk Open Cut

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Charbon Colliery Continued Operations Report No. 753/03



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Note: A colour version of this figure is available on the Project CE

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A significant portion (approximately 70%) of the Southwest Open Cuts occurs within the Reilys Creek catchment area. Approximately half of this area drains into farm dams before being discharged to Reilys Creek. It is estimated that the upper extent of two first order creeks will be disturbed by the Southwest Open Cuts (refer **Figure 4**). The remaining area of the Southwest Open Cuts drains southwards into the headwaters of Stony Creek.

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It is also noted that the Reilys Creek and Reedy Creek Catchments within the Study Area is part of the catchment area for the Windamere Dam which falls under the Water Sharing Plan for the Macquarie and Cudgegong Rivers. However, the Study Area is well upstream of the regulated section of the Cudgegong River and therefore this Plan does not apply. To a much smaller degree, the Study Area is also covered by the Water Sharing Plan under the *Water Management Act 2000* (WM Act) within the Sydney Basin Groundwater Management Unit N603 in catchments draining to the east and south of the watershed (Geo Terra, 2009). The easterly draining catchments contain a small component of the proposed Southwest Open Cuts (approximately 20ha).

3.7 Licenced Discharge Points

Charbon Colliery currently has three DECCW licenced discharge points (LDPs) covered under the Environment Protection Licence (EPL) 528. These points relate to the spray irrigation disposal of treated sewage (LDP 1), discharge from the Third Entry Erosion Pond to Reilys Creek (LDP 2) and discharge from the Southern Open Cut (SOC) discharge dam to Reilys Creek (LDP 3). The locations of the LDPs are shown on **Figures 3** and **4**.

3.8 Surface Water Quality and Assessment Criteria

EPL 528 held by the Proponent for the Colliery requires water quality monitoring to be undertaken at LDP 2 and LDP 3 when discharging. The concentration limits for both discharge locations are presented in **Table 3**.

Pollutant	Unit of Measure	100 percentile Concentration Limit	
Oil and Grease	milligrams per litre	10	
рН	рН	6.5 - 8.5	
Total Suspended Solids	milligrams per litre	50	
Source: EPL 528			

 Table 3

 Concentration limits for LDP 2 and LDP 3

The volumetric limits associated with all three of the discharge points are presented in Table 4.

Point	Unit of measure	Volume
LDP 1	kilolitres per day	20
LDP 2	kilolitres per day	5000
LDP 3	kilolitres per day	5000
Source: EPL 528		

Table 4Volume limits for LDP 1, LDP 2 and LDP 3

In addition, monthly water quality has been monitored at Charbon Colliery at a number of monitoring locations since 2004. These sites include the LDPs, namely LDP 2 and LDP 3, as well as monitoring locations upstream (US) and downstream (DS) of the Charbon Pit Top Area, namely Pit Top US and Pit Top DS. These monitoring locations are shown in **Figures 3** and **4**. The Pit Top US monitoring location was established to provide background data on the natural water quality within the Reedy Creek Catchment, whilst the Pit Top DS monitoring location was selected at a point downstream of the Pit Top but upstream from any other influences on the water quality. On only one occasion since January 2004 has there been flow at the Pit Top US at the time of sampling. This occurred in March 2006 and the water quality results are presented below in **Table 5** against the average downstream water quality data.

Importantly, the water quality results presented in **Table 5** indicate that the water quality measured downstream of the Charbon Colliery Pit Top is commensurate with the water quality observed upstream. The results are also within the ANZECC guidelines for pH, however are outside the trigger values for conductivity, with background levels naturally displaying high electrical conductivity levels.

	PIT TOP US (Sample taken 13/03/06) ¹	Average - PIT TOP DS (number of samples taken between Apr 04 – May 09)	ANZECC trigger values ⁴
рН	7.2	7.6 (56)	6.5-8.0
Conductivity (µS/cm)	2730	2092 (49)	30-350
Total Suspended Solids (TSS) (mg/L)	69	47.8 ² (56)	
Chloride (mg/L)	110	82.8 (56)	
Sulphates (mg/L)	1025	913.5 (56)	
Oil and Grease (mg/L)	0	1.1 ³ (38)	
1 Based on one sample taken on 13 th Mar 2 Includes an outlying value of 1320mg/L 3 Only 1 value analysed above detection I 4 Default triager values for slightly disturb	ch 2006. Area usually dry. recorded on 9 th May 2007. imits (61mg/L on the 9 th June 2006 ed upland NSW river (ANZECC 20). 20)	

Table 5Water Quality Results – Pit Top US and DS

Water quality monitoring is also undertaken in the dams located near the discharge points LDP 2 and LDP 3. These dams receive water pumped from the Charbon Colliery Underground workings, as well as surface water runoff. The average water quality results for both of these dams are shown below in **Table 6**.

Table 6
Average water quality results for dams located near LDP 2 and LDP 3

	3 rd Entry Discharge Dam (near LDP 2)*	SOC Sedimentation Dam (near LDP 3)**	EPL Licence concentration limits for LDP 2 and LDP 3
рН	8.2	7.91	6.5-8.5
Conductivity (µS/cm)	620	451	No limit specified
Total Suspended Solids (mg/L)	37.4	37.6	50
Oil and Grease (mg/L)	0.2***	0.1****	10
* Based on 49 samples taken from **Based on 20 samples taken from	Jan 2004 to Apr 2009 Apr 2004 to Apr 2009		- 2220)

*** Only 4 grab samples have recorded the presence of oil and grease (Jan and Aug 2004 and Jan and Apr 2009)

**** Only 1 grab sample have recorded the presence of oil and grease (May 2004)

One exceedance of the licence limits relating to Total Suspended Solids (TSS) occurred during discharge from LDP 2 during December 2005 and was reported in the Annual Environmental Management Report (AEMR). A TSS result of 72mg/L was recorded which was above the 50mg/L concentration limit. Apart from this event, the water quality characteristics shown in **Table 6** are within the required concentration limits set out by the EPL.

Discharges from the dams occur infrequently, with only two discharge events from LDP 2 and none from LDP 3 recorded in the four years between January 2005 and December 2008. Two discharge events occurred this year from LDP 2 on 3, 4, 5 and 6 February and 20 March 2009, with approximately 3.5 ML/day discharging, within the EPL discharge limit of 5 ML/day. The water quality results during these discharge events in 2009 are presented in **Table 7**. Further discussion on discharges from site is provided in Section 7 - Site Water Balance.

Date and Time of sample	рН	EC (µS/cm)	TSS (mg/L)	Oil and Grease (mg/L)
3/2/09, 1305	7.2	340	16	<2
5/2/09, 1000	8.4	545	11	<2
5/2/09, 1500	8.4	550	7	<2
6/2/09, 1416	8.4	580	14	<2
20/3/09, 1210	7.7	No sample	8	<2
ANZECC trigger values – slightly	6.5-8.0	30-350		
disturbed upland river				

Table 7Water quality results from discharge events (LDP 2) in Feb/Mar 2009

The water quality measured during all of the discharge events were within the required EPL limits.

3.8.1 Mine Water Quality

There is currently minimal groundwater make in the existing workings, nor is significant groundwater make expected in the proposed underground workings. Some rainfall infiltration is however expected into the proposed Western Underground. This has been estimated at an average of 4.5 ML/year, up to a maximum of 7.5 ML/yr (Geo Terra, 2009).

The small amount of water that is presently extracted from the underground workings at Charbon Colliery is not particularly saline, as illustrated in the water quality test results in **Table 8**.

 Table 8

 Water quality results of water extracted from existing underground workings

Location*	EC (uS/cm)	рН		
Mine water at Culvert	1020	7.9		
Cell 2	690	7.5		
Cell 2B**	200	7.9		
Note: Samples taken 13/12/07 by Ecowise Environmental				
*Each of these locations occur in the vicinity of the Third Entry Pollution Control Dam				
**This water is a mixture of water pumped underground from surface storages, as well as groundwater inflows.				

Whilst some data is available regarding salinity levels as presented in Tables 5 - 8 above, this data is very limited, with further data required to better understand salinity levels across the Study Area. The data presented in Table 5 indicates high conductivity levels both upstream and downstream of the Pit Top; however other data suggests relatively low conductivity levels in the water extracted from the underground and in the storages at LDP 2 and 3. Given the lack of data, a salinity balance was not able to be developed for the site at this time. It is recommended that further monitoring of electrical conductivity levels be undertaken in the water storages, at the LDPs and water extracted from the underground to enable a better understanding of salinity across the site. In addition, with regards to salinity it is noted that some further improve surface water quality in this area. These measures are discussed in Section 6.8.

3.9 Surface Water Features of Conservation Significance

None of the surface water features within the Study Area were found to have conservation significance.

3.10 Groundwater Connectivity

No significant groundwater source is likely to be intersected by the Project. Previous site records (such as the 2006 MOP and 2005 Southern Open Cut EIS) state that there is no record of sustained inflows of groundwater during mining into the open cut operations. Previous exploration bores at Charbon Colliery have not encountered any major water bearing strata above the Lithgow and Irondale seams.

Recent observations by C.M Jewell and Associates Pty Ltd (2008) at the Southern Open Cut have shown that there is no evidence of persistent groundwater seepage into the Southern Open Cut.

It is anticipated that shallow aquifers exist within the region that provide limited seepage inflow to some surrounding dams.

Within the Study Area, the regional aquifers lie from 39m to 66m below the elevation of the current workings. Mining at Charbon interacts with the Lithgow and Irondale coal seams. Both seams are above the regional aquifer and therefore groundwater inflow into the seams is minimal (GHD, 2009). The groundwater make in the existing Charbon underground is primarily a result of rainfall infiltration and leakage of water from the Third Entry Evaporation Dam into the 5 Trunk Disused Workings Underground Storage. Surface water is also pumped underground for operation of the continuous miner.

The regional groundwater level is also beneath the proposed open cut and underground workings. As a result, the regional aquifer system will not be intercepted, or adversely affected, by the proposed open cut and underground workings (Geo Terra, 2009).

Whilst no significant groundwater source is likely to be intersected, some rainfall infiltration into the Western Underground is anticipated. Geo Terra (2009) has estimated this inflow to be an average of 4.5 ML/year, with a range of 2ML/year to 7.5ML/year.

4 RELEVANT LEGISLATION, POLICY AND GUIDELINES

4.1 Introduction

A number of legislative requirements, government policies and guidelines relating to surface water management are applicable to the Project and have been considered in this Surface Water Assessment. The relevant policies, guidelines and legislative requirements are summarised below.

4.2 Legislation

The *Protection of the Environment Operations Act 1997* (POEO Act) is relevant to the Project as it contains requirements relating to the prevention of the pollution of waters. In this regard the discharge of water from the Study Area will need to be controlled to an agreed standard to reduce the potential for pollution of the receiving waters. As mentioned previously, Charbon Colliery has an existing EPL under the POEO Act for the discharge of 'dirty' water from site. As an outcome of this Surface Water Assessment, additional discharge points for the site are proposed. Charbon Colliery will therefore be required to seek a variation to the existing EPL under the POEO Act to include these discharge points. Further discussion on the proposed additional LDPs is provided in Section 6.11.

The *Water Act 1912* and WM Act contain provisions for the licensing of water capture and use. If any dams are proposed as part of the water management, consideration must be given to whether the dams need to be licensed. If the dams are not within the harvestable right of the property, or are not specifically exempt dams, it is likely that they would need to be licensed. It is not anticipated however that the Pollution Control Dams proposed in this assessment will need to be licensed, as these dams will be specifically for the purpose of erosion and sediment control. No clean water dams are proposed to be built and therefore it is anticipated that no licences will need to be obtained.

The existing Southern Open Cut Pollution Control Dam is currently licenced for the 'conservation of water and water supply stock purposes' (licence number 80SL095833 issued under Section 12 of the *Water Act 1912*). However, the water from this dam is currently used for pollution control purposes. Therefore, an application to the DECCW under section 116C of the *Water Act 1912* may be required to change the purpose of this licence to allow for the dam to be used for this purpose. See Section 6.11 for further discussion on licencing requirements associated with the continuation of mining operations at Charbon Colliery.

Whilst a controlled activity approval under the WM Act is typically not required for surface mining activities due to current surface mining lease/s being held, the general standards used by the DECCW in implementing the WM Act still need to be adhered to. In this regard, any guidelines referred to by the DECCW and the feedback provided by departmental officers would be considered. GSSE has considered the '*Guidelines for Controlled Activities – Riparian Corridors*' and '*Guidelines for Controlled Activities – In-Stream Works*' for watercourse rehabilitation and riparian zone rehabilitation.

Under Section 115 of the *Water Act 1912*, in areas where a Water Sharing Plan has not been gazetted, or under Section 56 of the WM Act in areas where a Water Sharing Plan has been gazetted, a mine has to be licenced as an Aquifer Interference Activity. Charbon Colliery is currently licenced by the DECCW via a Water Access Licence issued under the *Water Act*, *1912*. This means that if the proposed open cut or underground coal mining activities would intersect and require dewatering of the regional groundwater system, then the workings would have to be licenced under the relevant Act for an equivalent volume of groundwater. Further discussion on groundwater licencing requirements for the continued operation of Charbon is provided in the Groundwater Assessment (Geo Terra, 2009).

4.3 Policies and Guidelines

The Study Area is situated in the far western Macquarie-Bogan River Catchment and is covered by the Central West Catchment Management Authority (CMA). In February 2007, the Central West CMA published the *Catchment Action Plan for the Central West Authority* (CAP). The CAP identifies catchment issues and sets measurable management targets with respect to land practices and water quality. The water quality targets set by the CAP include the following:

- By 2016, electrical conductivity (EC) readings in the 50th and 80th percentiles respectively will be:
 - Macquarie River at Carinda, 500 EC and 800 EC;
 - Bogan River at Neurie Plains, 550 EC and 1450 EC; and
 - Castlereagh River at Coonamble, 315 EC.
- By 2016, improve surface and groundwater system health across the catchments, as measured by:
 - A 5% reduction in the modelled result for suspended sediment;
 - Temperature to be maintained or restored to within 2 degrees Celsius of median levels (ANZECC guidelines 1992);
 - A reduction in the duration of blue-green algal blooms duration above the high alert level;
 - No detection of hazardous chemicals above ANZECC guidelines, 2000;
 - Faecal coliforms reduced below primary contact levels at key sites in the catchment; and
 - Flow rules are in operation to meet the long term extraction limit and environmental water requirements, as defined by Water Sharing Plans.
- By 2016, 1,200,000ha (13%) of the catchment area is managed primarily to maintain or achieve optimal vegetation condition, and all vegetation types are represented in the catchment.
The NSW State Rivers and Estuaries Policy contains state-wide objectives for the protection and enhancement of watercourses. The proposed surface water management should be consistent with the Policy objectives. The key aspect of this would be to demonstrate that there is no degradation of Reedy Creek, Reilys Creek and Stony Creek as a result of mining activities.

In NSW, the most relevant and comprehensive guidelines for the designs of stormwater controls relating to mines is contained in the Blue Book Volume 2E. The principles of surface water control, including the design of erosion and sediment control structures, have been adopted where applicable in this Surface Water Assessment.

Water quality impacts will be assessed for aquatic ecosystems in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000). The watercourses within the site are considered to be *slightly to moderately disturbed ecosystems* as described in the ANZECC Guidelines, and the elevation of the site places the site in the *upland river ecosystem* category. Typical trigger values presented in ANZECC 2000 for slightly disturbed upland rivers in NSW are shown below in **Table 9**.

 Table 9

 Default trigger values for slightly disturbed upland rivers in NSW (ANZECC 2000)

	Trigger Value
рН	6.5 - 8.0
Conductivity (µS/cm)	30 - 350
Turbidity (NTU)	2 - 25

5 EXISTING SURFACE WATER MANAGEMENT

5.1 Overview

The primary objective of surface water management at Charbon Colliery is the separation of clean and dirty water.

The Southern Open Cut operation has a self contained water management system utilising large existing farm dams and constructed pollution control ponds to manage dirty water before discharge through LDP3 when required. The primary water storage dam associated with this mining area, the Southern Open Cut Pollution Control Dam, has an approximate capacity of 46ML (**Figure 2**).

The other disturbed areas within Charbon Colliery use clean water diversion channels where possible to divert clean water away from areas of disturbance. Where dirty water is generated in disturbed areas, water is directed into sediment dams or pollution control dams for suitable treatment and discharge through LDPs, or re-used for dust suppression or underground by the continuous miner. The dirty water associated with the Third Entry (open cut rehabilitation site, workshop and contractor facilities) drains to two large pollution control dams, referred to collectively as the Third Entry Pollution Control Dam, where water is discharged, when required, through LDP 2.

The Pit Top Area is also generally a closed system with dirty water running through a series of dams on site before flowing into Reedy Creek Dam, prior to being used for mining-related purposes. Anecdotal evidence from site indicates that Reedy Creek Dam does not normally overflow. The site water balance (GHD, 2009) indicates that some overflows may however occur. Further discussion on this is provided in Section 7 – Site Water Balance. Some changes to the surface water management around the Pit Top Area are proposed, and these are discussed in Section 6.8.

A third LDP (LDP 1) is located near the Pit Top Area which allows for the discharge of effluent from the onsite sewage treatment system via irrigation.

5.2 Water Sources

Charbon currently uses water for domestic purposes in the bathhouse and offices, and process water in the CHPP, for underground supply and dust suppression. Approximately 14ML of potable water is used per year for domestic purposes, and is sourced from the Kandos town water reticulation system.

Process water used in the CHPP, underground, and for surface dust suppression is sourced on site from existing storages and recycling. Approximately 138ML is used in the CHPP per year, and is sourced predominantly from recycled water from the Reject Emplacement Area (REA), with makeup water supplied from Reedy Creek Dam where required. Reedy Creek Dam is currently licenced for the 'conservation of water and water supply for industrial purposes' (licence number 80SL095832 issued under Section 12 of the *Water Act 1912*). Water for surface dust suppression is sourced from the Southern Open Cut Pollution Control Dam. As discussed in Section 4.2, the purpose of the licence associated with this dam will need to be varied to include pollution control purposes.

The existing and historic open cut mines have been operated as dry workings with no observable seepage, except possibly for short periods from ephemeral perched seeps following significant rain periods. The dirty water generated on site to be managed is therefore a result of rainfall runoff and is used to meet dust suppression requirements.

Eight bores are located within or near the Study Area, four of which are privately owned, with the remaining four owned by the Proponent. All of the private and the Charbon bores are located stratigraphically below the Irondale and Lithgow seams.

Four of the bores were installed by Charbon in the north of the Study Area in early 2007 to investigate the potential for groundwater supply to the mine. Two bores were unsuccessful (Piezometer 1 (P1) and Piezometer 4 (P4)), whilst two bores were completed as production bores (PB2 and PB3). Further information on groundwater bores is presented in the Groundwater Assessment (GeoTerra, 2009). Water to be extracted from the site bores is also discussed in Section 7 – Site Water Balance.

SURFACE WATER IMPACTS AND PROPOSED 6 MANAGEMENT MEASURES

6.1 Introduction

The following section outlines the anticipated surface water impacts, and the proposed surface water management measures to be implemented throughout the continued operations at Charbon Colliery, incorporating the proposed extension areas, to ensure these impacts are minimised. Water management measures are described for both the operational (mining) phase, as well as drainage controls to be implemented for the rehabilitated landform.

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As the proposed mining operation extensions would occur in various stages, changes in disturbance areas and water management needs would be experienced at various stages of the mine life. A number of scenarios were therefore chosen to represent the proposed water management measures to be adopted over the extended mine life. The proposed water management measures to be implemented in Year 1, Year 4 and Year 7 of mining operations at Charbon are illustrated in Figures 5, 6, and 7 respectively, and are described in Sections 6.2 – 6.5 below.

In describing the management of surface water at Charbon Colliery, the following definitions apply:

- Dirty water surface runoff from disturbed catchments such as the Open Cut extraction areas, which could contain significant concentrations of suspended sediment.
- Mine water water extracted from underground mining areas.
- Clean water surface runoff from undisturbed catchments or catchments relatively undisturbed by extraction, processing or related activities.

The key water management strategies proposed to be adopted across the site are summarised as follows:

- 1. Dirty water generated within the open cuts primarily as a result of rainfall/runoff, would be managed within the open cuts via in-pit sumps. This water would be directed to and contained within these in-pit sumps until it is necessary to pump the water to a pollution control dam.
- 2. As each open cut is progressively backfilled and rehabilitated, small sedimentation ponds would be constructed in accordance with the Blue Book Volume 2E within the rehabilitated landform to contain and treat runoff from these shaped rehabilitated areas, until vegetation becomes established.
- Mine water extracted from the existing underground workings would be managed 3. in accordance with the current mine water management system, where it is reused primarily as process water underground and as dust suppression water in the Open Cut.

4. Clean water diversions would be constructed wherever possible upstream of disturbance areas, such as the open cuts, to minimise the amount of dirty water to be contained and treated. However, given the steep nature of the landform across the Study Area, construction of these diversions may not always be possible. Where this is the case, clean water would be managed in conjunction with the dirty water.

6.2 **Overview of Mitigation Measures**

A number of mitigation measures are recommended to ensure the effective management of surface water on site, minimising the risk of any offsite impacts on surface water resources. An overview of these measures is provided below. How these measures would specifically be applied to each mining area throughout the proposed mine life of the continued operation of Charbon is then described in Sections 6.3 - 6.8.

6.2.1 Clean Water Diversions

An objective of water management within the Project Site is to segregate clean and dirty water flows where possible. Diverting surface water flows away from the active extraction areas and pollution control dams helps achieve this objective. Uncontrolled water flows over disturbed areas would also greatly increase the risk of erosion. By diverting clean water flowing from undisturbed areas away from the active areas of disturbance at non-erosive velocities to stable areas in adjacent drainage lines, the risk of erosion would be greatly reduced. Clean water diversions would therefore be constructed wherever possible.

Due to the steep gradient of the slopes along the high walls of the Central, 8 Trunk and Western Open Cuts, constructing clean water diversions above the disturbance area may not be possible. Slopes on the upper side of the disturbance areas are estimated to be typically 25% to 35%, with clean water diversions best suited for slopes up to 18.5%, and ideally less than 10%. Without these control measures in place, clean water runoff generated from catchments above the surface excavation areas are anticipated to flow into the active extraction area. For this reason, the dirty water management in these three areas are important in ensuring downstream drainage lines and creeks are not polluted.

The Southwest Open Cuts are located at the top of a ridgeline, with no upstream catchment. Subsequently, clean water diversions are not required for the Southwest Open Cuts.

Where clean water diversions can be implemented, the diversion banks would be constructed generally in accordance with Blue Book Standard Drawing (SD) 5-5 (attached as **Appendix 1**). A summary of the general minimum design specifications is as follows.

- Gradient of the diversion banks should be approximately 1%.
- Height of the bank should be at least 300mm.
- Channel depth should be at least 400mm.

- A level spreader (or sill) should be constructed at the bank discharge point to reduce the risk of erosion at this point, as per SD 5-5.
- Within ten days of construction, pasture should be sown to prevent erosion of the bank and drain.

The size of these clean water cut-off drains may be restricted by the steep topography and shallow nature of the soils overlying bedrock. A risk based approach can be adopted to allow flows up to a designated storm event to be diverted, beyond which clean water would be permitted to flow into the active work area. Clean water diversion channels would be designed to convey the ten year ARI storm, as recommended by Volume 2E of the Blue Book for temporary drainage controls, where the duration of disturbance is 1 to 2.5 years.

The diversion banks should be inspected monthly, or following a significant rain event to ensure that they are capable of carrying the surface water flow of the catchment at non-erosive velocities or concentrations. In the event that significant erosion is observed, the diversion bank should be upgraded to cater for high flows in accordance with Blue Book SD 5-6 (attached as **Appendix 1**).

6.2.2 Dirty Water Capture and Treatment

Construction of a number of sediment basins would be required to ensure dirty water generated throughout the continued operations of Charbon is appropriately captured and treated to ensure the risk of any offsite impacts relating to surface water is minimised.

The sizing of the sediment basins to be constructed in the final landform has been calculated in accordance with the guidelines laid out in the Blue Book Volume 2E, for areas with disturbance greater than three years with a capacity such that they would be able to effectively treat runoff from up to the 90th percentile, five day rainfall event for the region.

The Soil Assessment conducted at Charbon (GSSE, 2009) concluded that some of the Brown duplex clays / subsoils present in the Study Area have a moderate erosion potential, with Emerson ratings of 3(1) to 3(3), which indicates a moderate to slight potential for dispersion and surface hardsettingness. If the topsoil of these soil units is disturbed or removed and the subsoils are exposed, the potential for erosion may be increased. Disturbance occurring within the vicinity of a drainage line could impact on downstream water quality through an increase in sediment loads. These soils should, therefore, be managed to ensure that the subsoils are not exposed without suitable controls being implemented. Some Red and Yellow duplex clays/ subsoils are present and displayed structural stability and little erosion potential, with Emerson ratings of 8/3/(1) and 8/5 respectively.

Given that the characteristics of the underlying material to be exposed during active extraction and replaced in the final landform is uncertain, the sediment control structures have been conservatively designed for Type D/F soils, which assumes that material may be dispersive. An inspection of the proposed sediment basins, once constructed, should be undertaken as part of the routine site environmental inspection program or following significant rainfall (i.e. >25mm within 24hrs) with the information such as to the general condition of the dam, evidence of overflow, condition of downstream catchments, water colour, evidence of eroding surfaces and approximate retained capacity recorded.

6.3 **Proposed Southwest Open Cuts**

6.3.1 Introduction

The majority of the Southwest Open Cuts occur within the catchment of Reilys Creek. Approximately half of this area drains into farm dams before being discharged to Reilys Creek. The remaining area of the Southwest Open Cuts drains southwards into the headwaters of Stony Creek.

It is estimated that the upper extent of two first order drainage lines (consisting of a total catchment area of approximately 3 ha) within the Stony Creek Catchment would be disturbed by the Southwest Open Cuts, as illustrated in **Figure 4**. Given that the area to be disturbed is at the top of the catchment of these ephemeral, first order drainage lines, and that they are unlikely to provide any significant riparian habitat, with no vegetation other than grasses due to previous clearing of the area, the impact of this disturbance on the local hydrology is not considered significant.

The key potential surface water impacts therefore to be managed within this area is the prevention of the flow of dirty water offsite into Reilys and Stony Creeks. The measures to be implemented are described below.

6.3.2 Mining Phase

Western and Southern Outliers

For the Western and Southern Outliers, dirty water would be contained within the disturbance areas (i.e. within the open cut pits). The extraction levels would be below the adjoining natural surface levels on all sides, thereby proving an effective bund containing all dirty water. The dirty water generated would be directed to in-pit sumps, where the water would be temporarily contained. When required, this water would be pumped via pipes to the existing Southern Open Cut Pollution Control Dam where it will then be used for dust suppression as required. (**Figure 4**) Water may be discharged from this dam in accordance with EPL requirement via LDP 3, which is located at this dam, within the existing water management system.

There will be minimal clean water entering the disturbance area at the Western and Southern Outliers due to these areas being located at the top of catchments. Hence, clean water diversions are not proposed.

Southern Open Cut Extension

The dirty water generated within the Southern Open Cut extension would be managed under the existing water management system for the Southern Open Cut (see Section 5.1), with dirty water directed to the Southern Open Cut Pollution Control Dam, where it can be re-used for dust suppression, or discharged in accordance with EPL requirements as required.

6.3.3 Rehabilitation Phase

Western and Southern Outliers

In conjunction with the earthworks required to create the final landform of the Western and Southern Outliers it is proposed that small sedimentation basins would be constructed to provide treatment of potentially sediment-laden runoff from these areas until the vegetation becomes established. The advantages of constructing small sedimentation basins within the final landform are that they allow for 'at source' control of sediment, along with minimising the disturbance area. Contour banks would be constructed within the final landform to direct runoff from the rehabilitated areas to these sediment basins.

The small sediment basins have been successfully implemented at Charbon in the past in rehabilitation areas. An example of sediment dams used on site in the final landform is shown in **Plate 2**.

As described above in Section 6.2.2, the sizing of the sediment basins to be constructed in the final landform has been calculated in accordance with the guidelines laid out in the Blue Book Volume 2E, with a capacity such that they would be able to effectively treat runoff from up to the 90th percentile, five day rainfall event for the region.



Plate 2 Sedimentation basin located within an existing rehabilitation area at Charbon Colliery (June 2009)

The total volumes required for the effective treatment of runoff from the Southern and Western Outliers are therefore 3.8 ML and 3.6 ML respectively. Note this volume can be made up of a series of small dams constructed throughout the rehabilitated landform. The sizing calculations are attached in **Appendix 2**.

Southern Open Cut Extension

The rehabilitated Southern Open Cut extension area would utilise the existing Southern Open Cut Pollution Control Dam. The majority of the runoff generated from the Southern Open Cut extension rehabilitation area would naturally drain to this dam. Where this does not occur, contour banks would be constructed within the rehabilitated areas to divert water to the Southern Open Cut Pollution Control Dam, where it can then be discharged via LDP 3.

6.4 Proposed 8 Trunk Open Cut

6.4.1 Introduction

The proposed 8 Trunk Open Cut drains to Reilys Creek, and is located within the upper reaches of the catchment area and runs along the contours. A second order creek lies within the proposed development area along with a first order creek. Both of these drainage lines currently drain into a series of two large farm dams before discharging into Reilys Creek. The second order creek is very poorly defined (i.e. no defined bed and banks) as shown in **Plate 1** in Section 3.6.2. The creek is unlikely to provide any significant riparian habitat with no vegetation other than grasses due to previous clearing of the area.

The key potential surface water impact to therefore be managed within this area is the prevention of the flow of dirty water offsite into Reilys Creek. The measures to be implemented are described below.

6.4.2 Mining Phase

Dirty water generated within the extraction area of the 8 Trunk Open Cut would be contained within the extraction area by directing the water to an in-pit sump. When required, water would then be pumped from the in-pit sump to either the Southern Open Cut Pollution Control Dam or the Third Entry Pollution Control Dam. Water from the southern 75% (approximately 940m) of the 8 Trunk Open Cut would be pumped to the Southern Open Cut Pollution Control Dam, and water generated in the northern 25% (approximately 310m) would be pumped to the Third Entry Pollution Control Dam. If required, water could then be discharged through LDP 3 or LDP 2 respectively.

It is expected that the majority of runoff from the in-pit waste rock emplacement area would be directed to the in-pit sumps. Where dirty water cannot be directed to an in-pit sump, dirty water diversions would be constructed to direct water into the haul road table drains. Here water can be treated via mitre drains with temporary sedimentation controls at their outlets (e.g. sand bag weirs, sediment fence weirs), or directed to the Southern Open Cut Pollution Control Dam or the Third Entry Pollution Control Dam. It is noted however that little runoff is expected from these waste rock emplacement areas.

Clean water diversions are recommended to be installed above the proposed mining area where slopes are less than 10 degrees. They should be constructed so they spill ahead of the stripped areas in preparation for mining. Unfortunately, due to the steep nature of the terrain in the vicinity of the 8 Trunk Open Cut, it is believed that surface water diversions would be limited to small, isolated areas, however, such clean water diversions should be implemented where possible to minimise the dirty water collected in the in-pit sumps.

6.4.3 Rehabilitation Phase

As recommended for the Southern and Western Outliers, small sediment basins are proposed within the final drainage layout associated with construction of the final landform. The combined volume of the sediment basins required for the effective treatment of the 8 Trunk Open Cut area is 9.3 ML, *if clean water diversions can be constructed*. Note this volume can be made up of a series of small dams constructed throughout the rehabilitated landform.

If, due to the steep topography in the area, clean water diversions cannot be constructed, then the required capacity for effective treatment increases to 20.1 ML. This capacity can be made up of a series of sediment basins constructed within the final landform as well as sumps within the active part of the open cut pit while still operating prior to backfilling. The sediment basin sizing calculations, based on effectively treating runoff from up to the 90th percentile, five day rainfall event for the region, are attached in **Appendix 2**.

It is also recommended that the drainage lines disturbed as part of mining the 8 Trunk Open Cut be re-established within the final landform, in accordance with the '*Guidelines for Controlled Activities – In-Stream Works*' (former DWE, 2008) for watercourse rehabilitation and riparian zone rehabilitation. Further discussion on rehabilitation of drainage lines is provided in Section 6.10.

6.5 Proposed Western Open Cut and Underground and Associated Areas

6.5.1 Introduction

The majority of the Western Open Cut and underground and associated areas lie within the catchment of Reilys Creek, with the northern section within the Reedy Creek catchment. Once again, the key potential surface water impact to be managed within this area is the prevention of the flow of dirty water offsite into Reilys Creek or Reedy Creek. The measures to be implemented are described below.

6.5.2 Mining Phase

Water collected within the extraction area of the Western Open Cut would be directed into an in-pit sump. When required, water would be pumped out of this in-pit sump and into the approved Western Primary Pollution Control Dam, located to the north and downstream of the Western Open Cut, as illustrated in **Figure 5**. Approval for construction of this dam has been granted by the Department of Industry and Infrastructure NSW on 17 August 2009 as part of an approval to undertake a bulk sampling program under Exploration Licence 7123. This will involve expansion of a small farm dam, which exists in the location of the pollution control dam (refer **Plate 3**). This dam will be expanded to create the pollution control dam of the required capacity, as described further below.



Plate 3 Existing farm dam to be converted to the Western Primary Pollution Control Dam

In order to avoid any future requirement to further expand this dam, it will be constructed in a manner that will ensure sufficient capacity to manage surface water flows for the Western Open Cut and associated areas. As a result, the required capacity of the pollution control dam has been estimated based on containment of the 90th percentile, five day rainfall event for the region taking into account the proposed maximum area of disturbance associated with the project. The required capacity of the dam is therefore 4.8 ML. Calculations for this volume are contained in **Appendix 2**.

Runoff from the proposed ROM stockpile and infrastructure areas (Area 3 and Area 4) would also be directed to in-pit sumps to ensure containment. Water from these sumps would then be transferred to the Western Primary Pollution Control Dam as required. Some water would be extracted from this dam to be used for dust suppression.

Overflow from the Western Primary Pollution Control Dam would drain to the Western Secondary Pollution Control Dam, to be located near the Project Site boundary, for further containment prior to discharging offsite. This dam would be approximately 10ML in capacity. A new LDP (LDP 5) would be required here for the outflow of the Western Secondary Pollution Control Dam (refer **Figure 5**), with the dam enabling any discharge to be controlled and measured. Further discussion on licensing requirements is presented in Section 6.11.

Whilst no significant groundwater inflow is anticipated in the Western Underground, some rainfall infiltration into the underground workings is expected. This has been estimated at an average of 4.5 ML/year to a maximum of 7.5 ML/yr from the Lithgow seam, (GeoTerra, 2009). Rainfall infiltration collected in the underground workings would be pumped to an in-pit sump located within the disturbance area of the Western Open Cut. This water would then be pumped or would flow to the Western Primary Pollution Control Dam, and then the Western Secondary Pollution Control Dam before being discharged off site via LDP 5, if required.

As discussed above in Section 6.2.2, the proposed pollution control dams, including the Western Primary Pollution Control Dam, have been designed to effectively contain and treat a 90th percentile five day rainfall event for the region. Whilst water from the Western Underground would also be pumped to this dam, the water to be sourced for dust suppression (200kL/day) from this dam over the five day event is greater than the additional water flowing to the dam from the underground at 76.5 kL/day (estimated at a maximum of 20.5 kL/day (7.5ML/yr) from rainfall infiltration and 56kL/day from underground workings from the continuous miner). The capacity of this dam is therefore considered sufficient to effectively treat the 90th percentile five day rainfall event and water from the underground, assuming that dust suppression water is consistently sourced from this dam over this period. In the instance where this is not the case, such as on a 'non-work day' where dust suppression water is not required, then the underground water could be periodically held in the open cut sump, until such time as the water level in the Western Primary Pollution Control Dam is drawn down providing sufficient capacity.

Due to the steep nature of the upstream clean water catchment, construction of clean water diversions around the Western Open Cut would not be possible, and so any runoff generated upstream of the Western Open Cut would be managed within the in-pit sump. In addition, no upstream catchments report to the proposed ROM stockpile areas within Area 4 and as such, no clean water diversions are proposed here. It is recommended that clean water diversions are constructed near the Western Primary and Secondary Pollution Control Dams to limit the amount of runoff reporting to these dams.

6.5.3 Rehabilitation Phase

The Western Open Cut is situated on the boundary between the catchments of Reedy Creek and Reilys Creek, as illustrated in **Figure 3**.

As the Western Open Cut is progressively backfilled and rehabilitated, sediment laden runoff from the rehabilitation area located within the Reilys Creek catchment would be treated via a sedimentation pond, to be constructed in association with the drainage works for the area. The required capacity of the type D/F sediment basin (based on Blue Book guidelines) is 3.1 ML. Calculations of this required volume is contained in **Appendix 2**.

The sediment laden runoff within the rehabilitated areas of the Reedy Creek catchment (ROM stockpile area and northern section of the Western Open Cut) would be directed into the Western Primary Pollution Control Dam to allow for treatment.

6.6 Proposed Central Open Cut

6.6.1 Introduction

The proposed Central Open Cut is situated within the headwaters of the catchment of Reedy Creek, and would disturb one first order creek within the catchment (**Figure 3**). This ephemeral, first order drainage line is unlikely to provide any significant riparian habitat with no

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vegetation other than grasses due to previous clearing of the area. The key potential surface water impact to be managed within this area is the prevention of the flow of dirty water offsite into Reedy Creek. The measures to be implemented are described below.

6.6.2 Mining Phase

Dirty water generated within the extraction area of the Central Open Cut would be maintained within the disturbance area by directing the water to an in-pit sump. When required, water would be pumped from the in-pit sump to the Central Primary Pollution Control Dam, to be constructed downstream and adjacent to the Central Open Cut, as illustrated in **Figure 7**. Overflow from this dam would drain into the Western Secondary Pollution Control Dam and offsite via LDP 5 (discussed above in Section 6.4.2).

As with the Western Primary Pollution Control Dam, the required volume of the Central Pollution Control Dam has been based on the capacity required to contain the 90th percentile, five day rainfall event for the region in accordance with Blue Book guidelines. The capacity has also been calculated based on the assumption that a clean water diversion cannot be constructed upstream of the proposed open cut due to the steep nature of the terrain in the area. The required capacity of the dam is estimated to be 7.0 ML. Calculations for this volume are contained in **Appendix 2**.

6.6.3 Rehabilitation Phase

Where possible, sediment laden runoff would be directed through drainage works associated with the rehabilitation, into the Central Pollution Control Dam. Where this is not possible, small sediment basins would be constructed within the rehabilitation area to allow for 'at source' treatment of sediment-laden water. The combined required capacity of sediment basins to be constructed within the final landform for sediment treatment is 10.2 ML. Calculations for this volume are contained in **Appendix 2**.

6.7 Existing Third Entry Open Cut

Surface water management at the Third Entry Open Cut will continue as per existing arrangements, with runoff discharged from this area via the existing Third Entry Pollution Control Dam and LDP 2.

In addition the Third Entry Area has a water cycle that comprises rainwater collection from roofs, storage in rainwater tanks, water usage, and wastewater collection and storage within a pump out septic system.

6.8 Existing Pit Top Area

The Pit Top Area incorporates the existing mine infrastructure areas of the site, which includes the Reject Emplacement Area (REA), ROM Stockpile, Product Stockpile, Surface Facilities and CHPP, as shown in **Plate 4**. Water from this area currently drains through a culvert in the rail loop and into Reedy Creek Dam.

A toe dam collecting runoff and seepage currently exists at the base of the REA. The height and footprint of the REA is to be increased as part of the Project, resulting in the removal of the existing toe dam. A new pollution control dam is therefore proposed to be constructed within the rail loop (referred to as the Rail Loop Pollution Control Dam). This dam would be constructed downstream of the coal stockpile and mine water dam, as illustrated in **Plate 4** and **Figure 5**.

The proposed Rail Loop Pollution Control Dam would collect runoff from the REA, as well as all dirty water from the CHPP and stockpiles within the rail loop. The water levels in this dam would be managed via the existing pipe and pump network within the rail loop to minimise discharges from this dam, with the water to be preferentially re-used as process water in the CHPP and in underground workings.



Plate 4 Existing Pit Top Area

Should water discharge from the Rail Loop Pollution Control Dam in extreme rainfall events, the water would flow offsite into Reedy Creek Dam via the culvert in the rail loop. A new LDP (LDP 4) would therefore be required downstream of the rail loop. The proposed location of this new LDP is illustrated below in **Plate 5** and **Figure 5**. A v-notch weir would be installed to monitor the volume and frequency of discharges.



Plate 5 New licenced discharge point (LDP 4) location downstream of rail loop

Clean water would be diverted around the rail loop via the existing bund. This water would then discharge off site via the new LDP 4. Given that the water in the Rail Loop Pollution Control Dam would be re-used and managed to limit discharges, it is expected that the water reporting to LDP 4 would consist predominately of clean water diverted around the rail loop. The quality of this water would be monitored to ensure this is the case, as discussed in Section 9.

6.9 Upgrade of the Haul Road

An upgrade of the haul road would be required as part of the continued operations of the Charbon Colliery. To ensure any potential surface water impacts associated with the upgrade are minimised, the following measures would be undertaken:

- Roadside drainage, such as table drains, would be incorporated into the construction of the haul road, and be maintained regularly throughout the life of the Project.
- A series of mitre drains would be constructed to take water from the table drains away from the haul road to appropriate disposal areas. The runoff would be split at regular intervals to keep the volume of water in each mitre drain to an appropriate level. This could be achieved by spacing the drains as close together as practicable. The spacing would not exceed 50m, with the drains spaced closer together where gradient increases. Mitre drains would be revegetated as soon as practical after construction.

• Sediment fencing or sand bags could be used to control the sediment at the end of the mitre drains, and controls would be periodically inspected to maintain their performance.

A new drainage line crossing may be required near the Western Underground, where a new section of the haul road from the Western Underground would join the existing haul road. This crossing would be constructed in accordance with the Blue Book and DECCW requirements. It is not anticipated that the upgrade to the haul road would require any further new crossings to be constructed.

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6.10 Rehabilitation of Drainage Lines

As described in Sections 6.3 to 6.6, the proposed mining operations would disturb some ephemeral drainage lines, namely:

- one first order stream in the Central Open Cut;
- the extreme upper sections of first order streams in the Southern Open Cut Extension; and
- one first order and one second order stream within the 8 Trunk Open Cut,

Whilst all affected streams are in the upper reaches of the catchment and are not considered to be of conservation significance, it is likely that the relevant government agencies would require the restoration of these streams after mining. Stream rehabilitation works would be generally undertaken in accordance with the '*Guidelines for Controlled Activities – Riparian Corridors' and 'Guidelines for Controlled Activities – In-Stream Works'* for watercourse rehabilitation and riparian zone rehabilitation. Further details on actual rehabilitation works to be undertaken will be incorporated into the Site Water Management and Monitoring Plan for Charbon Colliery.

In general, the streams would be restored with adequate controls to minimise the erosion within the restored section of creek, along with controls to prevent the migration of any erosion upstream or downstream. Works within the restored streams would be undertaken in accordance with Section 5.3.3 of the Blue Book, with some keys design elements of the channel establishment works as follows.

- The channel should convey a 100 ARI storm event, assuming that the catchment is partially vegetated.
- For the minor first order creek lines, the channels should be generally trapezoidal in shape with 3:1 (H:V) bank batters and a base widths of 1m to 2m.
- For the second order section of creek line, the channel would be at least 3m wide at the base to accommodate for the larger flows predicted. Using the probabilistic rational method, the peak flow in a 100yr ARI storm event is around 4.2 m³/s.
- Natural meanders should be used instead of straight lines to reflect natural stream characteristics.

- The channel bed should be rock lined where required and constructed in accordance with the Blue Book, including the placement of appropriately sized rocks above a filter layer of suitable geotextile. Exposed earth bed and banks are not appropriate given the dispersive nature of the soils and would be avoided.
- Soil should be packed in between rocks to allow sedges and grasses to be established within the channel to provide for the long-term channel stability.

Following earthworks and channel establishment, a riparian corridor would be established with a minimum width of 20m, measured horizontally and at right angles to the flow from the top of both banks on the streams.

As a result of existing land uses within the Project Site, the existing watercourses are in a highly disturbed condition. The rehabilitation program would seek to achieve a long-term enhancement of the ecological value of the riparian corridor through the restoration of natural hydraulic conditions and the revegetation of appropriate vegetation.

In addition to the above, the keys aspects of the stream rehabilitation include the following:

- Design and construct the stream channel so that it would be stable for the long-term.
- Implement effective temporary erosion controls to provide for the short-term stabilisation of the riparian corridor.
- Restore naturally occurring soil to the riparian corridor, i.e. as stripped from area pre-disturbance.
- Restoration of the natural ecotone between the riparian and terrestrial areas (20m from top of bank).
- Establish a diverse range of locally occurring vegetation species.
- Establish a full range of vegetation types, including trees, shrubs and grass covers.
- No exotics species are to be introduced.
- Maintain the rehabilitated riparian corridor for two years after initial rehabilitation.

6.11 Licensing Requirements

In summary, the following licences relating to surface water management would be required:

- Two new licensed discharge points as follows.
 - LDP4, downstream of the Pit Top Area and Rail Loop.
 - LDP5, downstream of the Western Open Cut and Underground and Central Open Cut.

Dogo 1 of 2

 A variation to licence number 80SL095833 to change the purpose of this licence from 'conservation of water and water supply stock purposes' to pollution control purposes. This would then allow the extraction of water from this dam for dust suppression purposes.

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 It is also likely that the proposed new pollution control dams; namely the Central Primary, Rail Loop and Western Secondary Pollution Control Dams would need to be licenced under the WM Act, given that these dams would be constructed both for erosion and sediment control purposes, as well as containing mine water from active mining areas, and that water could be extracted for use in mining operations from these dams.

6.12 Summary of Proposed and Existing Dams

A summary of the proposed and existing dams at Charbon Colliery during both the operational phase and within the final landform is presented in **Table 10**.

Table 10 Proposed and existing dams

Location	Purpose	Combined Total Capacity (ML)	
PROPOSED DAMS			
During Mining			
Central Primary Pollution Control Dam	Pollution control of excess dirty water from the Central Open Cut	7	
Rail Loop Pollution Control Dam	Containment of dirty water runoff from the REA and infrastructure area	15*	
Western Secondary Pollution Control Dam	Enable controlled discharges from LDP 5	10	
Final Landform			
Southern Outlier (one or more)	Sediment control during rehabilitation	3.8	
Western Outlier (one or more)	Sediment control during rehabilitation	3.6	
Western Open Cut (southern section)	Sediment control during rehabilitation	3.1	
8 Truck Open Cut (with clean water diversions)	Sediment control during rehabilitation	9.4	
8 Truck Open Cut (without clean water diversions)	Sediment control during rehabilitation	20.1	
Central Open Cut - Central Primary Pollution Dam and small sediment basins	Sediment control during rehabilitation	10.2**	
*GHD (2009) ** this required volume at the Central Open Cut can be made up from the 7 ML pollution control dam and 3 x 1ML dams constructed within the final landform.			

Table 10Proposed and existing dams (Cont)

	,	Page 2 of 2
EXISTING DAMS		
Southern Open Cut Pollution Control Dam	Pollution control of excess dirty water from the Southern Open Cut operations, and from the majority of the proposed 8 Trunk Open Cut. Provides a source of dust suppression water.	46
Western Primary Pollution Control Dam	Pollution control of excess dirty water from the Western Open Cut and Underground. Provides source of dust suppression water.	4.8
Third Entry Pollution Control Dam	Pollution control of excess dirty water from the northern end of the 8 Trunk Open Cut. Provides source of dust suppression water.	35

7 SITE WATER BALANCE

7.1 Introduction and Overview

GHD Pty Ltd (GHD) was commissioned by the Proponent to prepare a surface and ground water balance for Charbon Colliery to support this Surface Water Assessment. An overview of the water balance is presented in this section. Full details of the site water balance are contained in the GHD report, *"Report on Charbon Colliery Mine Water Balance"* (GHD, 2009).

GHD used the Goldsim mine water balance modelling software (Version 9.60) (Goldsim Technology 2007) to represent the colliery water balance. A model representation of the water cycles associated with the existing mining operation was created using Goldsim. The results were then verified, as best as practicable, to match existing conditions and assumptions confirmed based on current knowledge of the site water balance, in particular for the drought period of 2006 and early 2007 when Reedy Creek Dam was very low.

Once the model was verified as appropriately representing site conditions, it was modified to include the proposed operations.

Daily time steps were used for the analysis, as daily rainfall data was the shortest period of data available.

7.2 Scope of Water Balance

The Colliery has three separable water cycles. These are:

- The supply of potable water, wastewater collection, treatment and an irrigation system from the residential cottages, mine office/amenities and bathhouse. Potable water is supplied from the Mid-Western Council reticulation. The wastewater is collected and discharged on site via LDP 1.
- Water collection, use, and wastewater collection for the Third Entry area.
- Water management for the surface and underground infrastructure associated with the mining and coal export operations at Charbon.

The water cycles which incorporate the residential cottages, mine office/amenities, bathhouse and the Third Entry workshop area have minimal impact on the site-wide water balance. The water balance for Charbon was therefore developed including only the surrounding mine site (catchments reporting to water storages on site) and mining operations.

The water balance was setup to represent normal operation of the water cycle following the commencement of the proposed operations associated with the continued operation of the Colliery i.e. the Western Open Cut and Underground, Central Open Cut, 8 Trunk Open Cut, and the Southern Open Cut Extension, including the Western and Southern Outliers.

As the proposed extensions would occur in various stages, different demands on water supply and changes in disturbance areas would be experienced at various stages of the mine life. Therefore the water balance was modelled for the three mine life scenarios addressed in this Surface Water Assessment; namely, Years 1, 4 and 7, as represented in **Figures 5, 6** and **7** respectively.

7.3 Assumptions and Model Calibration

Limited water usage data has previously been collected on site. In particular, a limited amount of water usage and flow monitoring data was available for the period since early 2007. This data was used to estimate water transfers and some water demand rates. Additional daily transfer rates were estimated from provided pipe sizes and pump powers.

Due to the modest amount of site data available, it was necessary to make several important assumptions about site water flows. Many of the parameters in the model have therefore been estimated, and whilst the model was calibrated to match existing conditions as much as possible, further data is required to provide more certainty on the accuracy of the model.

The model was established using these estimated flow rates, water usages and transfer rates, as well as estimated infiltration rates. Adjustments were then made to assumptions used in the model to closely replicate the performance of the water management system for the period of observed data since January 2007. In addition, it was known that the site was close to running out of water in the very dry year of 2006. Minor adjustments were then made to the model to approximate the known behaviour of the system in 2006.

7.4 Inputs

7.4.1 Surface Water System

The inputs to the surface water system consist of the following:

- Runoff from the contributing catchment areas (both clean and dirty) as a direct result of rainfall events. The rainfall data used to estimate runoff in the water balance was taken from the Bureau of Meteorology (BOM) Station at Kandos Cement Works (Station No. 062017). Rainfall data was available for this station, in complete years, from 1951 to 2008. Runoff was represented by an initial loss/runoff factor, which was used to convert daily rainfall into surface runoff values when the daily rainfall exceeded the initial loss (infiltration) of rainfall. Runoff contributes to the following storages:
 - Reedy Creek Dam.
 - Mine Water Dam.
 - Rejects Emplacement Area.
 - Toe Dam.

- Third Entry Pollution Control Dam.
- Southern Open Cut Pollution Control Dam.
- Third Entry Evaporation Dam ensure identified.
- Water extracted from groundwater bores.
- Water pumped from the underground continuous miner operations to the Southern Open Cut Pollution Control Dam. It is noted that this would cease in Year 4 of the continued operations.
- Moisture content of ROM coal, estimated to be 2%.
- Pumping from Reedy Creek Dam for use in mining operations.

Table 4-1 in the Water Balance Report (GHD, 2009) provides detail on the specific data used in the site water balance.

7.4.2 Underground Water System

The inputs into the underground system consist of the following:

- Natural recharge of the active underground workings. The average expected inflow into the Western Underground workings has been estimated at 4.5 ML/yr (GeoTerra, 2009).
- Leakage of water from the Third Entry Evaporation Dam into the 5 Trunk Disused Workings Underground Storage (estimated to be 2% of the dam volume per day).
- The pumping of water from the 'Black Tanks' (which receive water from Reedy Creek Dam and water pumped from underground) into the underground workings for operation of the continuous miner.

Table 4-1 in the Water Balance Report (GHD, 2009) provides detail on the specific data used in the site water balance.

7.5 Outputs

7.5.1 Surface Water System

The outputs from the surface water system consist of the following:

- Evaporation. Evaporation data was not available from the Kandos Cement Works, from which rainfall data was used for the water balance. Evaporation data was therefore sourced from the BOM Bathurst Agricultural Station (Station No. 063005).
- Discharge via LDP 2 from the Third Entry Pollution Control Dam into Reilys Creek.

- Discharge via LDP 3 from the Southern Open Cut Pollution Control Dam into Reilys Creek.
- Leakage into the 5 Trunk Underground Storage from the Third Entry Evaporation Pond (estimated to be 2% of the dam volume per day).
- Moisture content of coal transported offsite, estimated to be 9%.
- Water used for dust suppression.
- Overflows from Reedy Creek Dam.

7.5.2 Underground Water System

The outlets from the underground water system are as follows:

- The pumping of water from the active workings to the Southern Open Cut Pollution Control Dam. Note this will cease by Year 4 of the proposed continued operations.
- Moisture content of ROM coal, estimated to be 2%.
- The pumping of water from the 5 Trunk Disused Workings to the Black Tanks, estimated to be 50kL/day.

7.6 Water Sources

The water demand for mining operations, including the continuous underground miners, dust suppression and in the CHPP is met by the following:

- Reusing water collected by the Southern Open Cut Pollution Control Dam, Third Entry Evaporation Pond, Mine Water Dam and Toe Dam. It is noted however that the Toe Dam would be replaced by the Rail Loop Pollution Control Dam during the continued operations of the Colliery.
- Extracting water from the licensed groundwater bores.
- Extracting water from Reedy Creek Dam.
- Utilising water from the 5 Trunk Disused Workings Underground Storage.

7.7 Modelling Results

7.7.1 Discharges from Site

The anticipated annual average, minimum and maximum discharges from the existing LDPs, as well as the proposed new LDPs are summarised in **Tables 11 to 14**, with a discussion on each LDP provided below the relevant table. No discharges off site would occur from LDP 1, as this LDP is for the irrigation of effluent, and hence is not discussed below.

	Average	Maximum	Minimum
Current Operation			
Number of discharges (days/yr)	0.4	6.0	0.0
ML/yr	2.5	42.0	0.0
Average discharge volume (ML/day)	2.5	7.0	0.0
Year 1			
Number of discharges (days/yr)	0.2	3.0	0.0
ML/yr	1.4	25.1	0.0
Average discharge volume (ML/day)	1.4	8.4	0.0
Year 4			
Number of discharges (days/yr)	0.1	3.0	0.0
ML/yr	1.1	24.7	0.0
Average discharge volume (ML/day)	1.1	8.2	0.0
Year 7			
Number of discharges (days/yr)	0.3	5.0	0.0
ML/yr	2.3	52.6	0.0
Average discharge volume (ML/day)	2.6	10.52	0.0

Table 11Summary of predicted discharges from LDP 2

The modelling results for LDP 2 indicate minimal discharges occurring from this licenced discharge point at present. This is consistent with data provided by the Proponent indicating minimal discharges occurring from LDP 2 in recent years. This is predicted to remain the case throughout the life of the Project, assuming average rainfall conditions. A variation to the discharge limits associated with LDP2 is therefore not requested at this time.

No discharges are expected from LDP 2 in a dry year throughout the life of the Project, with the frequency and volume of discharges increasing in a wet year. The model indicates that the average daily discharge during a discharge event in a wet year may exceed the current EPL limit of 5000kL/day between three to six times a year over the life of the mine, however it is noted that the model indicates this would only occur in extreme rainfall events. Given the limited data available for the site balance model, and that a combination of both metered and estimated data based on information such as pumping capacities was used, it is recommended a review and update of the water balance be completed when more metered data is available, in particular the predicted volume and frequency of discharges from LDP 2 and 3 verified..

The results of the water balance indicate that an average of approximately three discharge events occur from LDP 3 per year under current operational conditions, slightly above the existing EPL limit of 5000kL/day. Data provided by the Proponent, however, indicates no discharges occurring from LDP 3 over the past four years, and a variation to the EPL conditions relating to the volume of discharges from LDP3 is therefore not requested at this time. Whilst the water balance was calibrated to replicate existing conditions as much as possible using available data, this indicates that some further metered data from site on water transfer rates is required to slightly increase the accuracy of the model.

	Average	Maximum	Minimum
Current Operation			
Number of discharges (days/yr)	2.8	21.0	0.0
ML/yr	18.1	154.1	0.0
Average discharge volume (ML/day)	6.5	7.3	0.0
Year 1			
Number of discharges (days/yr)	0.8	8.0	0.0
ML/yr	6.9	110.5	0.0
Average discharge volume (ML/day)	6.9	13.8	0.0
Year 4			
Number of discharges (days/yr)	0.1	2.0	0.0
ML/yr	1.8	70.0	0.0
Average discharge volume (ML/day)	1.8	35.0	0.0
Year 7			
Number of discharges (days/yr)	0.0	1.0	0.0
ML/yr	1.0	2.3	0.0
Average discharge volume (ML/day)	1.0	2.3	0.0

Table 12 Summary of predicted discharges from LDP 3

It is noted however, that discharges from LDP 3 only occur in the water balance model in approximately 50% of years, and therefore the averages presented in Table 12 are increased by a few wet years where the predicted discharge flow is large, particularly under a wet rainfall year scenario. Further discussion on the results of the water balance is provided in the GHD report (2009).

As expected, the water balance indicates that as mining operations progress, the discharges from LDP 3 would decrease. This is due to mining in the catchment area reporting to LDP 3, namely the Southern Open Cut Extension and Southern and Western Outliers, progressively ceasing and rehabilitation of the area occurring.

	Average	Maximum	Minimum	
Year 1, 4, 7*				
Number of discharges (days/yr)	0.2	4.0	0.0	
ML/yr	1.0	24.5	0.0	
Average discharge volume (ML/day)	1.0	6.1	0.0	
*note: the inputs and outputs within the catchment of LDP4 do not change over the mine life scenarios, and				

Table 13 Summary of predicted discharges from LDP 4

therefore the discharge from LDP4 remains constant.

The water balance indicates minimal discharges from LDP 4. Water from the Pit Top Area, including the areas within the rail loop, report to this LDP. A number of dams, including the Mine Water Dam and the proposed Rail Loop Pollution Control Dam occur within the catchment of this LDP. Water is to be preferentially used from these dams in the CHPP and for mining operational proposes to minimise clean water use, and to ensure the water levels in these dams are maintained low, minimising the risk of discharge, as confirmed by the model.

	Average	Maximum	Minimum	
Year 1				
Number of discharges (days/yr)	4.6	15.0	0.0	
ML/yr	140.4	554.4	0.0	
Average discharge volume (ML/day)	30.52	36.96	0.0	
Year 4				
Number of discharges (days/yr)	4.5	14.0	0.0	
ML/yr	140.3	551.8	0.0	
Average discharge volume (ML/day)	31.17	39.4	0.0	
Year 7				
Number of discharges (days/yr)	17.1	40.0	0.0	
ML/yr	149.6	567.4	0.0	
Average discharge volume (ML/day)	8.75	14.19	0.0	

Table 14Summary of predicted discharges from LDP 5

A large natural catchment reports to the proposed LDP 5, which explains the large amount of discharges predicted to occur from this discharge point, particularly in a wet year. Importantly, it is noted that on average, the runoff reporting to LDP 5 consists of 99.9% of runoff from the natural catchment, with only the remaining 0.1% attributed to overflows from the Western Open Cut Dam. The maximum proportion of runoff attributed to overflows from the Western Open Cut to LDP 5 at any time is just 2% of the total runoff. Therefore, despite the seemingly large discharge volumes reported in Table 14, there would not be a significant increase in discharges from site as a result of mining activities to what is occurring presently.

7.7.2 Water sources and water security

Results of the water balance simulation indicate that for a low rainfall year there would be significant water stress at the site as a direct result of reduced rainfall, increased evaporation and continued water demand. During these years additional water would be required to be extracted from Reedy Creek Dam or licenced groundwater bores to meet water demands.

In addition, the introduction of the Western Open Cut into the water balance results in a reduction in water security. The operation of the Western Open Cut is dependent upon the availability of water from the 5 Trunk Disused Workings Underground Storage. When this water source becomes unavailable in Year 4, additional stress would be placed on the system as this is a significant water source. It is recommended that Charbon investigate still having access to water in the Five Trunk Disused Underground workings after mining has past through this area before Year 4.

General results from the water balance simulation regarding water sources under <u>current</u> <u>operations</u> include:

- The average annual values extracted from the various site water sources are approximately as follows:
 - **135 ML** from Reedy Creek Dam

- **2.6 ML** from Production Bores 2 and 3
- 16 ML from the 5 Trunk Disused Underground Storage to the 'Black Tanks', and which is ultimately re-used underground by the continuous miner. The volume extracted is however highly dependent on rainfall, with up to 24 ML sourced in a high rainfall year and 5.2 ML in a dry year.
- In dry years more demand is placed on Reedy Creek Dam to satisfy the requirements of the mining operations. In other years the demand on Reedy Creek is reduced with more water available due to rainfall/runoff into the Third Entry Pollution Control Dam. The model predicts the maximum volume of water extracted from Reedy Creek Dam in a year to be 150 ML, whilst the minimum is 110 ML.
- The estimated overflows from Reedy Creek Dam in the water balance model vary from nil to 1, 208 ML per year, with the annual average overflow predicted to be 112 ML. It is noted however that information from site indicates this dam does not overflow. Further verification of the water balance is therefore needed to confirm this.

The average, maximum and minimum water demands for <u>continued operation</u> of Charbon, as predicted by the water balance model, are summarised in **Table 15**.

The predicted water demands presented in Table 15 indicate that the site water demand from Reedy Creek Dam and the Groundwater Bores would increase, compared to the existing situation. On average, the demand from Reedy Creek Dam is predicted to increase by approximately 15 ML per year, with water extracted from Bores 1 and 2 to approximately double from 2.6ML to around 5.6 ML per year.

7.8 Recommendations

The GHD report (2009) includes a number of recommendations to facilitate the refinement of the water balance model for the Colliery. These are summarised below.

- Installation of more extensive flow monitoring to better understand water transfer rates and usages. This would allow either confirmation of the predictions of the water balance, or allow for further calibration of the model to better quantify water behaviours.
- The amount of recharge from the Third Entry Evaporation Dam into the 5 Trunk Disused Underground Workings in currently unknown. A review of this is required.
- Measurement of the amount of water which infiltrates from the REA to the Toe Dam (to be replaced by the Rail Loop Pollution Control Dam) is required.

Scenario Water to be extracted			d (ML/Yr)		
	Reedy Creek Dam	Groundwater Bores 1 and 2	5 Trunk Underground Storage to the Black Tanks		
Year 1					
Average	151	5.4	12.4		
Maximum	181.3	39	16		
Minimum	112.1	0	4.6		
Year 4					
Average	148	5.6	11.4		
Maximum	182	39	16		
Minimum	109	0	4.5		
Year 7					
Average	160	5.6	11.9		
Maximum	185	39	16		
Minimum	117	0	4.8		

 Table 15

 Annual Average Water Demands

- A review and update of the site water balance in 6 to 12 months time when information from the above is available.
- The model predictions indicate that the existing EPL discharge limit of 5000kL/day from LDP 3 may be exceeded during the continued operation of Charbon. It is noted however that data from site indicate that no discharges have occurred from this LDP over the last four years. It is therefore recommended that, whilst the water balance has been setup based on the best available information, the model undergo further review as described in the points above to confirm the outputs of the model, including this prediction of discharge, once more metered data is available. It is recommended that discussions be held with the relevant government agencies regarding operation of this LDP in the meantime.

8 SOIL AND WATER MANAGEMENT PLAN

A soil and water management plan (SWMP) would be prepared in accordance with regulatory requirements for the continued operation of Charbon Colliery. This SWMP would be developed in accordance with the Blue Book (Volume 1 and Volume 2E), and would address the impacts and mitigation measures discussed in Section 7 of this Surface Water Assessment.

It is recommended that the SWMP incorporate the following:

- Soil and water management principles and objectives on site, including the following:
 - Containment of dirty water runoff from open cut areas by directing this water into in-pit sumps.
 - Directing excess dirty water from the in-pit sumps into Pollution Control Dams.
 - Directing sediment-laden runoff from shaped and rehabilitated areas into designated sediment control dams.
 - Installing temporary erosion and sediment control devices as required (i.e. sediment fences, sand bag weirs) to minimise the discharge of sediment laden water from newly disturbed areas.
 - Diverting clean water runoff unaffected by the operations away from disturbed areas and off site, where possible.
 - Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments.
 - Implementing an effective revegetation and maintenance program for the site.
- Identification of sources of sedimentation and erosion
- Soil Best Management Practices to be implemented on site, including:
 - mine Planning considerations (such as minimising disturbance);
 - topsoil handling and stockpiling procedures; and
 - topsoil respreading procedures.
- Water Best Management Practice to be implemented on site, including;
 - clean water diversions;
 - dirty water capture and treatment;
 - additional sediment protection measures to be employed during the life of the Project; and
 - maintenance of sediment control structures.
- Drainage line rehabilitation
- Water monitoring procedures
- Documentation and reporting procedures

9 SURFACE WATER MONITORING PROGRAM

9.1 Introduction

It is recommended that the existing surface water monitoring program continue to be utilised for the continued operations of the Colliery. Some additional monitoring points are however recommended, given the proposed additional LDPs.

The current surface water monitoring locations have been chosen for the following purposes.

- 1. To assess whether the Site may be having any offsite impacts on the water quality flowing to receiving waters.
- 2. To identify the water quality discharging from the Pollution Control Dams (internal dirty water management system) and into the natural environment.
- 3. To assess the effectiveness of erosion and sediment control measures.

9.2 Monitoring Locations and Frequency

Charbon Colliery currently has three LDPs, namely:

- LDP 1 Sewage irrigation near Pit Top infrastructure;
- LDP 2 Discharge the Third Entry Open Cut Pollution Control Dam; and
- LDP 3 Discharge from dam at Southern Open Cut Pollution Control Dam.

The locations of these LDPs are shown in **Figures 3** and **4**. Surface water quality is monitored monthly and during discharge at LDP 2 and LDP 3. In addition, water monitoring is also undertaken both upstream and downstream of the Charbon Pit Top at locations Pit Top US and Pit Top DS respectively (**Figure 3**).

Table 16 identifies the frequency and sampling method at the existing monitoring locations. These methods are subject to change for LDP 2 and LDP 3 as they are determined by the EPL Conditions.

Two new monitoring locations are recommended, these being at the proposed new LDPs; namely one downstream of the rail loop (LDP 4), and the other downstream of the Western and Central Open Cut areas (LDP 5), as illustrated in **Figure 5**. The EPL would require varying to include these LDPs. It is anticipated that the monitoring conditions associated with these new LDPs would be similar to that for LDP 1, LDP 2 and LDP 3, as summarised in **Table 13**.
Monitoring Location	Parameter measured	Frequency (during construction and operational phase)	Sample Method
LDP 1 – Effluent irrigation near Pit Top	Volume	Daily	
LDP 2 - Discharge from the Pollution Control Dam at Third Entry	Conductivity, Oil and Grease, TSS and pH Volume	Conductivity – Continuous during discharge Volume – daily during discharge Others – Daily during discharge	Grab Sample for pollutants and estimated for the volume
LDP 3 - Discharge from the Pollution Control Dam at Southern Open Cut	Conductivity, Oil and Grease, TSS and pH Volume	Conductivity – Continuous during discharge Volume – daily during discharge Others – Daily during discharge	Grab Sample for pollutants and estimated for the volume
Pit Top Upstream*	Conductivity, Oil and Grease, TSS and pH	All – Monthly (when water is available)	Grab Sample for pollutants
Pit Top Downstream*	Conductivity, Oil and Grease, TSS and pH	All – Monthly (when water is available)	Grab Sample for pollutants
*Monitoring at these locations	is not required by the I	EPL.	

Table 16Frequency and Method of Sampling of the surface water monitoring points

9.3 Discharge Limits

The current licence conditions relating to surface water discharge from site, as specified in EPL 528, are presented in **Tables 17** and **18**. It is noted however that these are subject to change by the relevant government agency.

Guildee	e Water Quality Discharge L	
Parameter	Unit	100% Concentration Limit
LDP 2		
Total Suspended Solids	mg/L	50
рН	-	6.5-8.5
Oil and Greece	mg/L	10
LDP 3		
Total Suspended Solids	mg/L	50
рН	-	6.5-8.5
Oil and Greece	mg/L	10

 Table 17

 Surface Water Quality Discharge Limits (EPL 528)

There are no EPL conditions relating to water quality for LDP 1.

LDP	Unit	Volume Limit
1	kL/day	20
2	kL/day	5000
3	kL/day	5000

Table 18Surface Water Volume Discharge Limits (EPL 528)

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9.4 Data Recording and Reporting

Results of monitoring would be reviewed internally, and in the event where the discharge limits are exceeded, results would be reported as required to the relevant government agencies. Results of the monitoring would also be included in the AEMR and results provided to the relevant government agencies on an annual basis in accordance with licence conditions.

10 CONCLUSION

Based on the information provided in this Surface Water Assessment in relation to the implementation of recommended mitigation and control measures relating to water management within the Colliery, it is anticipated that there would be minimal impact on surface water within and downstream of the Project Site as a result of the proposed operations.

A number of first order creeks and one second order creek would be disturbed by the Project. The proposed Central Open Cut would disturb one first order creek within the catchment of Reedy Creek. The upper extent of two first order creeks would be disturbed by the Southern Open Cut Extension Area. A second order creek and a first order creek lie within the proposed area of the 8 Trunk Open Cut, within the catchment of Reilys Creek. The second order creek is very poorly defined with no defined bed and banks, and is unlikely to provide any significant riparian habitat with no vegetation other than grasses due to previous clearing of the area. This ephemeral drainage line is reflective of all drainage lines running through the proposed areas of disturbance and, as such, no significant impact on the local hydrology is anticipated. Notwithstanding this, it is recommended that any ephemeral drainage lines disturbed as part of the proposed mining operation be rehabilitated in accordance with relevant requirements.

The water balance developed for the proposed operations at the Colliery indicate that the water to be extracted from Reedy Creek Dam and the Groundwater Bores would increase compared to the existing situation to meet increasing site water demands. In average rainfall years, the demand from Reedy Creek Dam is predicted to increase by approximately 15 ML per year, with water extracted from Bores 1 and 2 to approximately double from 2.6ML to 5.6 ML per year.

The water balance also indicates that for a low rainfall year there would be significant water stress at the site as a direct result of reduced rainfall, increased evaporation and continued water demand. During these years additional water would need to be extracted from Reedy Creek Dam to meet water demands. It is predicted that between 109ML/year and 185 ML/year would need to be extracted from Reedy Creek Dam to meet water demands on site throughout years 1, 4 and 7 of operation, depending on rainfall conditions.

Two new LDPs would be required for the Project, as well as continued operation of the existing LDPs 1, 2 and 3. One LDP (LDP 4) is proposed downstream of the Pit Top and Infrastructure Area, and the other (LDP 5) is proposed downstream of the Central and Western Open Cuts.

The water balance developed for the proposed continued operations the Colliery indicates that in a wet rainfall year, between three to six discharge events greater than 5000kL/day can be expected per year from LDP 2, and up to eight from LDP 3. The existing EPL has a volumetric discharge limit of 5000kL per day from LD2 and LD3. Under average rainfall conditions, no exceedance of discharge limits is expected to occur from LDP 2, with exceedances only occurring in Year 1 of operation from LDP 3. As expected, the water balance predicts that as the mine life progresses, the discharges from LDP 3 would decrease. This is due to mining in the catchment area reporting to LDP 3, namely the Southern Open Cut, progressively ceasing and rehabilitation of the area occurring. Due to the limited amount of site data available, it was necessary to make several important assumptions about site water flows in the water balance model. Many of the parameters in the model have therefore been estimated, and whilst the model was calibrated to match existing conditions as much as possible, further flow data is required to provide more certainty on the accuracy of the model. It is recommended that the model be reviewed and updated in 6 to 12 months time, when this data becomes available, in particular to verify the predicted volume and frequency of discharges for the LDPs.

The small number of discharges recorded from the site over the last four years have all been within volumetric and quality EPL limits. This indicates the site has acceptable sediment controls in place to adequately treat water prior to discharge, ensuring that water quality limits are met. As mining operations expand into the Central, 8 Trunk and Western Open Cut Areas, three additional Pollution Control Dams would be required so that sufficient sediment controls are in place to ensure water quality limits are met. In addition, sediment basins would be constructed within the final landform to ensure the risk of offsite impacts on surface water resources are minimised as vegetation becomes established on rehabilitated areas.

11 **REFERENCES**

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APPENDICES

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(No. of pages excluding this page = 14)

- Appendix 1 Blue Book Standard Drawings
- Appendix 2 Dam Sizing Calculations

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Appendix 1

Blue Book Standard Drawings

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GSS Environmental





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Appendix 2

Dam Sizing Calculations

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Southern Outlier - Rehabilitation Phase

Southern outlier (for Type D/F Basin) Design Storm (90%ile, 5 day)	
CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume	
SETTLING ZONE VOLUME	
Disturbed Runoff Coefficient (Cv) =	0.51 Table F2 of Blue Book, assuming type C hydrologic group, and rainfall 31-40 mm
Clean Water Catch Runoff Coefficient (CCv) =	0.3
Area (A) (ha) =	13 Disturbance area
Clean Water Area (CA) (ha) =	0 No Clean water catch
Rainfall (y%ile,Xday) (R) (mm) =	37.8 Table 6.3a of Blue Book (using Lithgow, 5 day, 90%ile)
Settling Zone Volume $(m^3) = 10 \times (0.5 \text{ m}^3)$	Cv x A x R + CCv x CA x R)
Settling Zone Volume $(m^3) =$	2,506
SEDIMENT ZONE VOLUME (12 month soil loss as calculated by F	SUSLE) SUSLE
Area (A) (ha) =	13 Disturbance Area
Erosion control practive factor (P) =	0.9 Table A-2 of Blue Book, assuming track walked up and down the slope
Rainfall erosivity factor (R) =	1400 App B Blue Book.
Soil erodibility factor (K) =	0.04 Soil Lab K factor at spoil test pit 6
Slope length/gradient factor (LS) =	2.55 Table A1 Blue Book. Assumed Slope 20% with length of 20m
Cround course and measured for the form	Figure A-5 Blue Book, Assumed 0% grass cover (worst case) 1 مما دماً ممالياً مانينا بالممالياً
Sediment Zone Volume $(m^3) = A \times (R)$	x K x LS x P x C)/1.3
Sediment Zone Volume $(m^3) =$	1,285
BASIN VOLUME (Total Required Capacity) - Based on RUSLE	
Total Required Capacity $(m^3) = Settlin$	g Zone Volume + Sediment Zone Volume
Total Required Capacity $(m^3) =$	3,791

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Western Outlier - Rehabilitation Phase

Western outlier (for Type D/F Basin) Design Storm (90%ile, 5 day)	
CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume	
SETTLING ZONE VOLUME	
Disturbed Runoff Coefficient (Cv) =	0.51 Table F2 of Blue Book, assuming type C hydrologic group, and rainfall 31-40 mm
Clean Water Catch Runoff Coefficient (CCv) =	0.3
Area (A) (ha) =	14 Disturbance Area
Clean Water Area (CA) (ha) =	0 No Clean Water catch
Rainfall (y%ile,Xday) (R) (mm) =	37.8 Table 6.3a of Blue Book (using Lithgow, 5 day, 90%ile)
Settling Zone Volume $(m^3) = 10 \times (Cv \times Cv)$	A x R + CCv x CA x R)
Settling Zone Volume $(m^3) =$	2,699
SEDIMENT ZONE VOLUME (12 month soil loss as calculated by RUS	SLE)
Area (A) (ha) =	14 Disturbance Area
Erosion control practive factor (P) =	0.9 Table A-2 of Blue Book, assuming track walked up and down the slope
Rainfall erosivity factor (R) =	1400 App B Blue Book.
Soil erodibility factor (K) =	0.025 Soil Lab K factor at spoil test pit 7
Slope length/gradient factor (LS) =	2.55 Table A1 Blue Book. Assumed Slope 20% with length of 20m
	Figure A-5 blue book, Assumed U% grass cover (worst case)
Ground cover and management factor (C) =	1 and soil recently disturbed
Sediment Zone Volume $(m^3) = A \times (B \times K \times D)$	LS x P x Cl/1.3
Sadiment Zone Volume (m ³) –	QCK
	600
BASIN VOLUME (Total Required Capacity) - Based on RUSLE	
Total Required Capacity (m ³) = Settling Zo	ne Volume + Sediment Zone Volume
Total Required Capacity (m^3) =	3,564

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S Open Cut to 8 trunk open cut (for Type D/F Bas Design Storm (90%ile, 5 day)	(ui
CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume	
SETTLING ZONE VOLUME	
Disturbed Runoff Coefficient (CV) =	0.51 Table F2 of Blue Book, assuming type C hydrologic group, and rainfall 31-40 mm
uean vvaler calch runon coennient (ccv) = Area (A) (ha) =	u.s. best estimate for unicipationed, steep businaria areas 32. Catchment area below clean water diversions
Clean Water Area (CA) (ha) =	6 Area below clean water diversions
Rainfall (y%ile,Xday) (R) (mm) =	37.8 Table 6.3a of Blue Book (using Lithgow, 5 day, 90%ile)
Settling Zone Volume $(m^3) = 10 \times (C)$	v x A x R + CCv x CA x R)
Settling Zone Volume $(m^3) =$	6,849
SEDIMENT ZONE VOLUME (12 month soil loss as calculated by R	NSLE) USLE
Area (A) (ha) =	32 Disturbance Area
Erosion control practive factor (P) =	0.9 Table A-2 of Blue Book, assuming track walked up and down the slope
Rainfall erosivity factor (R) =	1400 App B Blue Book.
Soil erodibility factor (K) =	0.032 Soil Lab K factor at spoil test pit 3 and 8
Slope length/gradient factor (LS) =	2.55 Table A1 Blue Book. Assumed Slope 20% with length of 20m
	Figure A-5 Blue Book, Assumed 0% grass cover (worst case)
Ground cover and management factor (C) =	1 and soil recently disturbed
Sediment Zone Volume $(m^3) = A \times (R \times R)$	K × LS × P × C)/1.3
Sediment Zone Volume $(m^3) =$	2,531
BASIN VOLUME (Total Required Capacity) - Based on RUSLE	
Total Dominand Consists $(m^3) = c_{14}$	
	200e Volume + Seqiment 20ne Volume
Total Required Capacity (m ⁻) =	9,380

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Charbon - SEDIMENT BASIN DESIGN (BASED ON RUSLE)

8 trunk open cut -Rehabilitation phase

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INCLUDES NO CLEAN WATER DIVERSION 8 trunk open cut -Rehabilitation phase

(ni		 0.51 Table F2 of Blue Book, assuming type C hydrologic group, and rainfall 31-40 mm 0.3 Best estimate for undisturbed, steep bushland areas 32 Disturbed Area 101 Area of clean water reporting to mining area 37.8 Table 6.3a of Blue Book (using Lithgow, 5 day, 90%ile) 	v × A × R + CCv × CA × R) 17,622	 USLE) 32 Disturbance Area 0.9 Table A-2 of Blue Book, assuming track walked up and down the slope 0.400 App B Blue Book. 0.32 Soil Lab K factor at spoil test pit 3 and 8 2.55 Table A1 Blue Book, Assumed Slope 20% with length of 20m Figure A-5 Blue Book, Assumed 0% grass cover (worst case) 1 and soil recently disturbed K × LS × P × C)/1.3 2.531 	Zone Volume + Sediment Zone Volume 20,153
S Open Cut to 8 trunk open cut (for Type D/F Bas Design Storm (90%ile, 5 day)	CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume	SETTLING ZONE VOLUME Disturbed Runoff Coefficient (Cv) = Clean Water Catch Runoff Coefficient (Ccv) = Area (A) (ha) = Clean Water Area (CA) (ha) = Rainfall (y%ile,Xday) (R) (mm) =	Settling Zone Volume (m ³) = 10 × (C Settling Zone Volume (m ³) =	SEDIMENT ZONE VOLUME (12 month soil loss as calculated by R Area (A) (ha) = Area (A) (ha) = Erosion control practive factor (P) = Rainfall erosivity factor (R) = Soil erodibility factor (K) = Slope length/gradient factor (L) = Ground cover and management factor (C) = Sediment Zone Volume (m ³) = $A \times (R \times Sediment Zone Volume (m3) = A \times Sedi$	Total Required Capacity (m ³) = Settling Total Required Capacity (m ³) =

Charbon - Primary Pollution Controll Dam (Based on Type F/D Blue Book Basin)

Western Open Cut - Primary Pollution Control Dam

Western Open Cut - Primary Pollution Control Dar Design Storm (90%ile, 5 day)	5
CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume	
SETTLING ZONE VOLUME	
Disturbed Runoff Coefficient (Cv) =	0.51 Table F2 of Blue Book, assuming type C hydrologic group, and rainfall 31-40 mm
Clean Water Catch Runoff Coefficient (CCv) =	0.3 Best estimate for undisturbed, steep bushland areas Combined catch area of Areas 3 and 4, and half of western open cut (assumped to be reporting
Disturbed Area (A) (ha) =	11.5 to in-pit sump)
Clean Water Area (CA) (ha) =	22 Area of clean water reporting to dam (after clean water diversions around dam installed)
Rainfall (y%ile,Xday) (R) (mm) =	37.8 Table 6.3a of Blue Book (using Lithgow, 5 day, 90%ile)
Settling Zone Volume (m ³) = 10 x (Cv	× A × R + CCv × CA × R)
Settling Zone Volume (m ³) =	4,712
SEDIMENT ZONE VOLUME (12 month soil loss as calculated by RL	ISLE)
Area (A) (ha) =	11.5 Disturbance Area
Erosion control practive factor (P) =	1.3 Table A-2 of Blue Book, smooth and compacted
Rainfall erosivity factor (R) =	1400 App B Blue Book.
	Soil Lab K factor at spoil test pit 7 (western outlier where majority of excess topsoil is located as
Soil erodibility factor (K) =	0.025 not using skeletal soils from western open cut area)
Slope length/gradient factor (LS) =	0.36 Table A1 Blue Book. Assumed Slope 2% with length of 60m Figure A-5 Rlue Rook. Assumed 0% grass cover (worst case)
Ground cover and management factor (C) =	1 and soil recently disturbed
Sadiment Zone Volume $(m^3) = \Lambda \times (D \times)$	× 10 × 01/1 3
Sediment Zone Volume $(m^3) =$	145
BASIN VOLUME (Total Required Capacity) - Based on RUSLE	
Tatal Darwinad Fanarity (m ³) - Catalina	Zano Molumo I. Codimont Zano Molumo
Total Required Canacity (m ³) =	20ne Volume + Sediment 20ne Volume
ו הומו וצבלמוו בה המאמרוול לווו ל -	4.00/

Western Open Cut (Sth End) (for Type D/F Basin) Design Storm (90%ile, 5 day)	
CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume	
SETTLING ZONE VOLUME	
Disturbed Runoff Coefficient (Cv) = Clean Water Farb Runoff Coefficient (CCv) =	0.51 Table F2 of Blue Book, assuming type C hydrologic group, and rainfall 31-40 mm 0.3 Rest estimate for undistructed steen buckland areas
Area (A) (ha) =	6.7 Disturbance area (sth end)
Clean Water Area (CA) (ha) =	11.3 Area of clean water reporting to sth mining area
Rainfall (y%ile,Xday) (R) (mm) =	37.8 Table 6.3a of Blue Book (using Lithgow, 5 day, 90%ile)
Settling Zone Volume (m^3) = 10× (Cv × A	A × R + CCv × CA × R)
Settling Zone Volume $(m^3) =$	2,573
SEDIMENT ZONE VOLUME (12 month soil loss as calculated by RUSL	E) .
Area (A) (ha) =	6.7 Disturbance Area
Erosion control practive factor (P) =	0.9 Table A-2 of Blue Book, assuming track walked up and down the slope
Rainfall erosivity factor (R) =	1400 App B Blue Book.
Soil erodibility factor (K) =	0.025 Soil Lab K factor at spoil test pit 7 (western outlier where majority of excess topsoil is located as not us
Slope length/gradient factor (LS) =	3.23 Table A1 Blue Book. Assumed Slope 25% with length of 20m
Ground cover and management factor (C) =	I and soil recently disturbed
Sadimant Zona Valuma $(m^3) = \Lambda \times / B \times V \times 1$	
Sequence to the Volume $(m^3) = (m^3)$	
BASIN VOLUME (Total Required Capacity) - Based on RUSLE	
Total Required Capacity (m ³) = Settling Zon	ie Volume + Sediment Zone Volume 3 007

Charbon - SEDIMENT BASIN DESIGN (BASED ON RUSLE)

Western Open Cut (Sth End) - Rehabilitation Phase

Charbon - Primary Pollution Controll Dam (Based on Type F/D Blue Book B	asin)
Charbon - Primary Pollution Controll Dam (Based on Type F/D Blue	Book E
Charbon - Primary Pollution Controll Dam (Based on Type F/D	Blue
Charbon - Primary Pollution Controll Dam (Based on Typ	e F/D
Charbon - Primary Pollution Controll Dam (Based o	n Typ
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Charbon - Primary Pollution	Contro
Charbon - Primary	Pollution
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Central Open Cut - Primary Pollution Control Dam

Central Open Cut - Primary Pollution Control Dam Design Storm (90%ile, 5 day)		
CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume		
Disturbed Runoff Coefficient (CV) = Clean Water Catch Runoff Coefficient (CCV) =	0.51 Table F.2 of Blue Book, assuming type C nyarologic group, and rainfall 31-40 mm 0.3 Best estimate for undisturbed, steep bushland areas	
Disturbed Area (A) (ha) =	6 Assumed half of the total disturbance area would be reporting to in pit sump and transfered to the	e dam
Clean Water Area (CA) (ha) =	50 Area of clean water reporting to dam (worse case w/o clean water diversions)	
Rainfall (y%ile,Xday) (R) (mm) =	37.8 Table 6.3a of Blue Book (using Lithgow, 5 day, 90%ile)	
Settling Zone Volume $(m^3) = 10 \times (Cv \times A \times Cv)$: R + CCv× CA× R)	
Settling Zone Volume (m ³) =	6,827	
SEDIMENT ZONE VOLUME (12 month soil loss as calculated by RUSLE)		
Area (A) (ha) =	6 Disturbance Area	
Erosion control practive factor (P) =	1.3 Table A-2 of Blue Book, smooth and compacted	
Rainfall erosivity factor (R) =	1400 App B Blue Book.	
Soil erodibility factor (K) =	0.025 Soil Lab K factor at spoil test pit 7 (western outlier where majority of excess topsoil is located as no	ot using sk
Slope length/gradient factor (LS) =	1.01 Table A1 Blue Book. Assumed Slope 5% with length of 60m Figure A-5 Rlue Book. Assumed 0% grass cover (worst case)	
Ground cover and management factor (C) =	1 and soil recently disturbed	
Sediment Zone Volume $(m^3) = A \times (R \times K \times 15)$	x P x ()/1.3	
Sediment Zone Volume $(m^3) =$	212	
BASIN VOLUME (Total Required Capacity) - Based on RUSLE		
Total Required Capacity (m ³) = Settling Zone V	Volume + Sediment Zone Volume	
Total Required Capacity (m^3) =	<mark>62012</mark>	

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INCLUDES NO CLEAN WATER DIVERSION	
Vithout clean water diversion	
Central Open Cut Sed Basin (for Type D/F Basin) Design Storm (90%ile, 5 dav)	
CALCULATIONS BASED ON PAGE J-4 OF BLUE BOOK APP J Basin Volume = Settling Zone Volume + Sediment Zone Volume	
SETTLING ZONE VOLUME	
Disturbed Runoff Coefficient (Cv) = 0.51 Table F2 of Blue Book, assumi	ning type C hydrologic group, and rainfall 31-40 mm
Clean Water Catch Runoff Coefficient (CCv) = 0.3 Best estimate for undisturbed	ed, steep bushland areas
Disturbed Area (A) (ha) = 12 Disturbed Area	
Clean Water Area (CA) (ha) = 56 Area of clean water reporting	g to mining area
Rainfall (y%ile,Xday) (R) (mm) = 37.8 Table 6.3a of Blue Book (using	ng Lithgow, 5 day, 90%ile)
Settling Zone Volume $\{m^3\} = 10 \times \{Cv \times A \times R + CCv \times CA \times R\}$	
Settling Zone Volume $(m^3) = 8,664$	
SEDIMENT ZONE VOLUME (12 month soil loss as calculated by RUSLE)	
Area (A) (ha) = 12 Disturbed Area	
Erosion control practive factor (P) = 0.9 Table A-2 of Blue Book, assum	ming track walked up and down the slope
Rainfall erosivity factor (R) = 1400 App B Blue Book.	
Soil erodibility factor (K) = 0.041 Soil Lab K factor at spoil test p	: pit 1
Slope length/gradient factor (LS) = 3.23 Table A1 Blue Book. Assumed	d Slope 25% with length of 20m
Figure A-5 Blue Book, Assume	ned 0% grass cover (worst case)
Ground cover and management factor (C) = 1 and soil recently disturbed	
Sediment Zone Volume (m ³) = A x (R x K x LS x P x C)/1.3	
Sediment Zone Volume (m ³) = 1.540	
BASIN VOLTIME /Total Bernined Canacity) - Based on BUSI F	
Total Required Capacity (m ³) = Settling Zone Volume + Sediment Zone Volume	
Total Required Capacity $(m^3) = \frac{10,204}{10,204}$	

Charbon - SEDIMENT BASIN DESIGN (BASED ON RUSLE)

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Charbon Coal Pty Limited ABN: 71 064 237 118

Continued Operation

of the

Charbon Colliery

Groundwater Assessment

Prepared by

GeoTerra Pty Ltd

September, 2009

Specialist Consultant Studies Compendium: Part 7

Groundwater Assessment

for the

Continued Operation of the Charbon Colliery

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September, 2009

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1 BACKGROUND

1.1 Introduction

Charbon Coal Pty Limited ("the Proponent") is the management company responsible for coal mining operations at the existing Charbon Colliery, which is located in the Western Coalfield of NSW as shown in **Drawing 1**. The current and proposed layout within the Project Site is shown in **Drawing 2**.

The Project Site is defined in this report as the land contained within the current mining lease and exploration licence areas held by the Proponent (**Drawing 2**).

1.2 **Project Overview**

Approval is sought for the following activities.

- Mining of approximately 5.2 million tonne (Mt) of coal at a maximum rate of:
 - 700 000t per year using open cut mining methods in the Western and Southern Outlier, Southern Open Cut Extension and 8 Trunk, Central and Western Open Cuts; and
 - 900 000t per year using underground mining methods in the Western Underground;

with the maximum quantity of coal mined annually not exceeding 1.5Mtpa over a maximum of 15 years.

- Transportation of ROM coal from the proposed mining areas to the existing approved CHPP using the existing underground coal transportation infrastructure and existing and upgraded internal haul roads.
- Processing of a maximum of 1.5Mt per year ROM coal at the existing CHPP.
- Transportation of a maximum of 250 000t of ROM and product coal per year to the Proponent's customers by public road.
- Transportation of a maximum of 20 000t product coal per year to the Charbon Lime Works by private road.
- Transportation of a maximum of 1.5Mt ROM and product coal per year to the Proponent's customers by rail.
- Placement of waste rock material within proposed in-pit waste rock emplacements.
- Expand and upgrade the existing reject emplacement area to allow for placement of Project-related fine and coarse reject material.
- Construction of associated infrastructure, including:
 - three new pollution control dams;
 - the Western Underground surface facilities area;
 - new and upgraded haul roads; and
 - the 2 Trunk ROM Coal Loading Facility.

- Progressive rehabilitation to create a final landform that would generally mimic the existing landform.
- Continued use of existing site infrastructure for the life of the Project.

The locations of these activities are shown on **Drawing 2**.

In addition to the above, approval is also sought for the continued operation of those existing approved activities that would be ancillary to the operation of the proposed activities following completion of mining of the Charbon Underground and Southern Open Cut. Those activities would include, but would not be limited to, the following.

- Operation of the CHPP and train loading facility.
- Use of the offices, staff amenities, workshops, roads, Reedy Creek Dam and associated infrastructure, waste water treatment plants, underground mine infrastructure and surface water management structures and other site infrastructure.

1.3 Study Objectives

This document provides an assessment of the local and regional hydrogeology within and surrounding the Project Site.

The objective of the study is to provide an understanding of the local and regional groundwater system and to describe the potential impacts that may occur as a result of the Project.

In addition, the study will outline potential groundwater related effects on the local surface water environment and any potential effects on private bores within the local area.

The study will be used to enable assessment of the:

- potential underground and open cut groundwater inflows to the proposed workings,
- potential effect on local and regional coal measures groundwater systems,
- potential effect on local alluvial groundwater and stream systems; and
- assessment of any potential mine dewatering requirements.

The document will also outline potential groundwater management and mine water supply issues that are relevant or may be required.

1.4 **Previous Studies**

Previous groundwater studies within the Project Site have been limited to an assessment of the potential loss of recharge to spring fed dams within two privately owned properties in the south of the Project Site. The study was conducted to ascertain if the Proponent's mining activities may have impacted on private property dam water supplies (C.M. Jewell & Associates Pty Ltd, 2008).

The 2008 study did not find an association between mining operations and the level of dam water in the private dams and indicated that the low water levels were due to lack of rainfall recharge in the period preceding the investigation in November 2007. The study also noted that the open cuts in operation at the time were dry and had no observable groundwater inflow or seepage.

Regional groundwater modelling studies have been conducted for the Lower Macquarie Alluvium, downstream of Dubbo, and the Cudgegong Valley Alluvium, downstream of Lake Windamere within the region shown in **Figure 1**, although no specific groundwater modelling has previously been conducted in the vicinity of the Project Site (CSIRO, 2008).

2 **PROJECT SITE FEATURES**

2.1 **Previous Mining Activities**

The Charbon Colliery has been operating since the 1920s, initally supplying coal to the Charbon Cement Works which was located adjacent to the northern boundary of the Project Site. Following closure of the Charbon Cement Works in 1977, the Charbon Colliery was kept in production to meet regional demand for steaming coal.

In 1985, the Colliery was upgraded, including the installation of the rail loop, a Coal Handling Preparation Plant (CHPP) and an increase in the rate of production to allow the mine to produce a washed coal for export.

In 1994, Centennial Coal Company Limited purchased the Colliery from the previous operator and open cut mining began in 1996. The open cut operations were expanded into the Southern Open Cut in 2004.

The area around the various underground entries, open cut workings, surface facilities and coal handling areas within the Project Site shown in **Drawing 2** have been substantially modified by past and current coal mining activities.

Additional, abandoned underground bord and pillar coal mining operations in the vicinity of the Project Site include the decommissioned Clandulla and New South Wales Collieries which extracted coal from the Lithgow Seam under Haystack Mountain. The old workings are located immediately to the south and west of the proposed Western Underground as shown in **Drawing 2**.



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2.2 Underground Mining Operations and Associated Subsidence

Underground mining in the "8 Trunk" and "9 Trunk" Panels within the Charbon Underground (**Drawing 2**) (referred to as the SMP panels) began in 2007, with partial to full extraction predicted to generate surface subsidence ranging from 33mm to 1.32m for a depth of cover ranging between 15m and 175m. Full extraction in bord and pillar mining at Charbon can achieve up to 73% recovery of the seam section within a particular mining domain (Centennial Charbon Coal, 2006).

The maximum reported subsidence to date in areas of full extraction has been 1.14m. Maximum strain for the full extraction panels is estimated at approximately 35mm/m, averaging 20mm/m, with approximately 15mm/m for partial extraction. Subsidence as a result of partial extraction within the current Charbon Underground workings is predicted to be less than 33mm, however, there are no monitoring results to date to compare to the predictions (Centennial Coal Charbon, 2009).

No adverse subsidence-related impacts on streams, dams, groundwater systems or other surface features in the vicinity of the existing Charbon Underground have been observed.

It is proposed that mining of the Lithgow Seam within the Western Underground would be undertaken using first workings only.

The Proponent indicates that negligible subsidence, defined as less than 20mm of subsidence, is predicted over the proposed Western Underground (Seedsman Geotechnics, 2008).

2.3 Geomorphology

The Project Site is dominated by well forested, steep terrain in the east and south associated with the Great Dividing Range and Kandos State Forest, whilst the central and western areas have been extensively cleared.

Mining within the proposed 8 Trunk and Central Open Cuts would extract coal within the Lithgow Seam and the overlying Irondale Seam by excavating into the westerly-facing slopes of the Great Dividing Range. The Southern Open Cut, Western Outlier and Southern Outlier would excavate into low hills to the west of the Great Dividing Range, whilst the Western Open Cut would excavate into the east facing lower slopes of Haystack Mountain.

The proposed Western Underground would extract coal from the Lithgow Seam under Haystack Mountain and an adjoining hill, which are two connected, although isolated, outlying hills within the central western section of the Project Site.

Haystack Mountain (**Plate 1**) and its associated hill are separated from, and located to the west of the Great Dividing Range. The hills are located on the watershed between the Reedy Creek catchment, which drains to the north, and the Rileys Creek catchment, which drains to the west

The depth of extraction in the proposed underground workings would vary from zero, where the portal enters the hillside, up to approximately 215m below surface underneath the peak of Haystack Mountain.



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Plate 1: Haystack Mountain (Looking North)

2.4 Rainfall

The mean annual rainfall measured by the Bureau of Meteorology at Kandos Cement Works (Bureau of Meteorology Station No. 62017), which is located immediately to the north of the Project Site, is approximately 692mm. Kandos has a maximum rainfall usually during the summer months.

Annual average evaporation rate as measured by the Bureau of Meteorology (Bathurst Agricultural Station No 63005) is 1 490mm, giving an annual deficit of approximately 800mm (GHD, 2009).

2.5 Surface Water Hydrology

The following description of the Project Site surface water hydrology is sourced from a detailed assessment prepared for the Project (GSS Environmental 2009). Further details on the surface water hydrology within the Project Site is presented in that report, included as Part 6 of the Specialist Consultant Studies Compendium.

In summary, the Project Site is situated within the headwaters of the Cudgegong River (Reedy Creek and Rileys Creek Catchments) and the headwaters of the Nepean River (Stony Creek ad Deep Creek Catchments) as shown in **Drawing 3**.

Reedy and Rileys Creeks are located within the Macquarie and Cudgegong Regulated Rivers Water Source Area, which is within the Central West Water Management Area (DWE, 2004).
Reedy Creek flows to the northwest into Cumber Melon Creek and subsequently the Cudgegong River and Lake Windamere, whilst Rileys Creek drains in a westerly direction into Lake Windamere via Carwell Creek and the Cudgegong River. The Cudgegong River subsequently flows into the Macquarie River.

The southern most section of the Project Site is located within the headwaters of the Stony Creek catchment. Stony Creek flows into Ulumbro Creek which drains into the Capertee River, and in turn, the Nepean River. Stony Creek is located within the Hawkesbury Nepean Water Management Area.

No water management plans have been gazetted to date for the Project Site catchment areas under the *Water Management Act 2000*.

The tributaries of Reedy and Rileys Creeks within the Project Site are generally first or second order Schedule 1 streams with intermittent flow in the vicinity of the proposed open cuts. First order, Schedule 1 gullies and tributaries with intermittent flow also overly the proposed Western Underground.

For open cut mining through, or near, Schedule 1 streams, the Proponent is required to minimise impacts on watercourse stability, stream degradation, stream water quality and associated ecosystems (DIPNR, 2005).

For undermining of Schedule 1 streams, the Proponent is required to minimise, or, where necessary, remediate damage caused by subsidence on stream stability and stream channel fracturing which leads to stream flow loss. In addition, any adverse changes to stream water quality or stream ecosystems caused by subsidence should be minimised, or if required, remediated (DIPNR, 2005).

No set back zones are required for open cut or underground workings that mine in the vicinity of, or underneath, Schedule 1 streams (DIPNR, 2005).

A Controlled Activity Permit would generally be required under the *Water Management Act* 2000, however, Section 75U of the *Environmental Protection and Assessment Act,* 1979 excludes the operation of Sections 89, 90 and 91 of that Act in relation to Major Projects.

The creeks have an ephemeral flow regime with small to medium sized earthen wall dams within the valleys and on the hillslopes as shown in **Drawing 3**.

Flow characteristics of watercourses within the Project Site are likely to be variable and dependent on precipitation duration and intensity, as well as soil moisture and the effect of evapo-transpiration. Runoff and streamflow are closely related to rainfall events in the ephemeral creeks, with flows prone to rapid peaking and depletion and a tendency for no flow or low flow over extended periods.

2.6 Geology

The hill slopes and valley floors of the Project Site are covered by shallow Quaternary clay and sandy colluvial sediments, whilst thin alluvium would be present within the ephemeral creek gullies. The Quaternary unconfined and variably saturated alluvium associated with the major creek lines within the Project Site are interpreted to be less than 5m deep, comprising loams overlying silty and clayey sands with occasional potentially cleaner sand and basal gravels.

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The basement stratigraphy from higher to lower with the Project Site includes:

- Jurassic / Tertiary aged volcanic breccia, sandstone and minor basalt located on the peak of Haystack Mountain underlain by the;
- Triassic aged Narrabeen Group sandstones and claystones underlain by the;
- Permian aged Illawarra Coal Measures (shale, sandstone, conglomerate, coal and turbidites); and
- the underlying Nile Subgroup and Shoalhaven Group conglomerate, sandstone, shale and siltstones.

Drawing 4 presents a plan view of the geology within the region, whilst **Drawing 5** presents a cross section and plan of the proposed mining area showing the distribution of the Lithgow and Irondale Seams within the Project Site.

The Triassic Hawkesbury Sandstone is not present within the Project Site.

As shown in **Plate 2**, within the Project Site, the Illawarra Coal Measures include the:

- Irondale Seam;
- claystone, siltstone, tuff and sandstone of the Long Swamp Formation;
- Lidsdale Seam;
- coarse grained sandstone of the Blackmans Flat Formation, and the;
- Lithgow Seam.

Both the Irondale and Lithgow Seams are proposed to be extracted within the open cuts, with the Lidsdale Seam potentially being selectively extracted.

Only the Lithgow Seam would be extracted in the proposed Western Underground.

The stratigraphy within the Project Site is essentially flat lying with a minor dip from east-northeast to north-west as shown in **Drawing 5**, with the coal seams generally outcropping around the base of the hills.

The main structural feature in the area is the Mt Coricudgy Anticline. The strata's dip is affected by north-north-east to south-south-west trending normal faults with up to 5m of displacement, with northerly to north-west / south-east trending near vertical to vertical joints.



Plate 2: Charbon Colliery Box Cut Coal Measures (Yoo *et al*, 2001)

2.7 Local Hydrogeology

2.7.1 Introduction

Two types of aquifer systems are present in the Project Site, namely:

- thin, unconsolidated alluvium in the major valleys; and,
- shallow basement coal measures comprising a variable sequence of aquicludes (mudstones and shales), aquitards (sandstones) and low yielding aquifers (coal seams).

Neither the coal measures nor creek alluvium aquifers are listed as vulnerable aquifers under the current Aquifer Risk Assessment Report (DLWC, 1998). However, they are covered by the following.

- State Groundwater Policy (DLWC, 1997).
- Groundwater Quality Protection Policy (DLWC, 1998).
- Groundwater Dependent Ecosystem Policy (DLWC, 2002).

In general, the State policies highlight that groundwater systems, their associated groundwater quality and any groundwater dependent ecosystems (of which there are none within the Project Site) should not be significantly adversely affected by a proposed development.

The overall principle is that the groundwater resources of NSW should be managed so they can sustain the environmental, social and economic needs of the people of the State.

2.7.2 Alluvial Aquifers

Minor alluvial aquifers can occur in the highland valleys, with the aquifers typically recharged from surface water within creek lines rather than rainfall infiltration.

Alluvium along creek lines within the Project Site is interpreted to be shallow and of limited extent, with limited to no potential for use as a groundwater supply due to its potentially clay dominated low yield, limited depth, limited extent, ephemeral nature and seasonally fluctuating water levels.

Some minor baseflow drainage from intermittent, perched, groundwater seeps following elevated rainfall periods may occur, however the seeps would not be long-term features of stream flow in the area.

Salinities in the thin highland alluvial aquifers within the Cudgegong River catchment area range from fresh in coarse alluvium and weathered rock to very saline in clays and low permeability zones (CSIRO, 2008).

2.7.3 Basement Aquifers

The basement sequences within the Project Site would contain groundwater in porous rock aquifers which can have enhanced groundwater storage and flow along localised bedding plane discontinuities, or where faulting, jointing or bedding plane flexure increases the hydraulic conductivity of a formation.

The Project Site contains a local to intermediate scale highland groundwater system within the basement rocks where recharge predominantly occurs through fractures and thin permeable soils, whilst discharge occurs at breaks in slope, in drainage lines or where structural / stratigraphic conditions allow (CSIRO, 2008).

Based on regional observations and Geoterra's general knowledge of the Western Coalfields, the stratigraphically higher lithologies of the Narrabeen Group within the Project Site are not likely to have permanent or significant groundwater supply potential, although they could contain ephemeral, perched aquifers after extended rain periods.

In the Western Coalfields, the coal seams of the Illawarra Coal Measures are generally the principal aquifers.

Within the Project Site, the Irondale, Lidsdale and Lithgow Seams predominantly outcrop at the base of hills as shown in **Drawing 5**. The seams within the proposed open cut and underground workings are of limited areal extent and are likely to have limited, intermittent, rainfall recharge. As discussed in Section 4.1, within the Project Site, the regional aquifers lie between 39m and 66m below the elevation of the current and proposed workings. The regional groundwater level is beneath the proposed open cut and underground workings. As a result, the regional aquifer system would not be intercepted, or adversely affected, by the proposed open cut and underground workings.

The Irondale, Lidsdale and Lithgow Seams range from unconfined aquifers at the base of the hills where the seams outcrop to semi–confined and possibly confined aquifers with increasing depth of cover under Haystack Mountain in the area of the proposed underground workings.

No substantial, regional scale aquifers have been intercepted to date in the current and previous open cut and underground workings within the Project Site. Limited, ephemeral aquifers associated with the Irondale, Lidsdale and Lithgow Coal Seams may be present within the Project Site with low yields and low to moderate salinity. The ephemeral aquifers only contain intermittent groundwater following substantial rain periods and dry up shortly after the more substantial rainfall periods have finished. This is supported by observations at the Project Site where groundwater inflow into the Charbon Underground increases in the days following rainfall and then decreases back to low to negligible levels within one to two weeks (M Gray; pers. comm).

No groundwater seepage to streams or groundwater dependent ecosystems have been reported, however, ephemeral seeps may potentially occur following extended rain periods.

The Nile Subgroup and Shoalhaven Group outcrop on the eastern, western and southern periphery of the Project Site, although no aquifers associated with these lithologies have been intersected by previous coal mining operations, and would not be intersected by the proposed operations.

The Nile Subgroup and Shoalhaven Group provide a groundwater supply for the private groundwater bores within regional aquifers to the west of the Project Site.

2.7.4 Groundwater Seepage to the Underground and Open Cut Workings

The low groundwater yield of the coal seams and overburden within the Project Site is demonstrated by the observation that the working face within the Charbon Underground is generally dry (M Gray, pers comm).

Partial flow meter based monitoring is also conducted for water pumped into, out of and around the underground and open cut workings at the Project Site.

Assessments undertaken by GHD (2009) indicate that an average of 16ML/year of water seepage is pumped out of the 5 Trunk Disused Workings Underground Storage area, with the likely maximum and minimum volumes to be 24ML/year and 5.2ML/year respectively. It is noted that this water comprises a mixture of water that has been pumped underground for mining related purposes, seepage from the Third Entry Evaporation Dam, rainfall infiltration and goundwater inflows.

The rate of water seepage into the underground workings is highly weather dependent (GHD, 2009).

In addition, it has been previously noted (CM Jewell & Associates, 2008) that all of the current and historic open cut workings have not had any observable or continuous groundwater seepage from the open cut pit walls or floors.

2.7.5 Groundwater and Underground Related Mine Water Management

The following groundwater focussed commentary is an excerpt from a water balance study conducted for the Project Site (GHD, 2009) and described in the Surface Water Assessment for the Project, presented as Part 6 of the Specialist Consultant Studies Compendium, referred to hereafter as (GSS Environmental, 2009).

Groundwater from two production bores that were installed in 2007 during the extended drought (PB2 and PB3) supplements the surface water supply system for use in the Southern Open Cut, Charbon Underground and Coal Handling and Preparation Plant. The two bores have an annual extraction licence issued by the DWE for 30ML/year as discussed in Section 2.7.6.

The underground and open cut workings operate as a closed dirty water system where groundwater is not discharged directly to clean surface water systems, as described in the following paragraphs from a paraphrased version of GHD, (2009).

Mine water, comprising surface water pumped into the Charbon Underground, seepage of incident rainfall and limited volumes of coal seam aquifer groundwater, flows to the 5 Trunk Disused Workings Underground Storage Area from where it is pumped automatically to the surface. Approximately 1.2ML/year of this water is used as a floccculant in sediment control dams. Approximately 16ML/year of water is pumped into the Charbon Underground for dust suppression and use by the continuous miners. Mine water subsequently discharged out of the 5 Trunk Disused Workings Underground Storage is pumped into the dirty water management system via the "Black Tanks" located adjacent to the Third Entry. Excess water from the "Black Tanks" flows via an erosion control pond, which can be pumped to the Third Entry Evaporation Dam to minimise discharge through the licensed discharge point LDP2 to Rileys Creek. Alternatively, water is pumped directly to the Southern Open Cut Pollution Control Dam. Water from the Southern Open Cut Pollution Control Dam is used for dust suppression or discharge via licensed discharge point LDP3 to Rileys Creek.

The 5 Trunk Disused Workings Underground Storage Area also receives approximately 1% of the Third Entry Evaporation Dam storage capacity per day, or around 16ML/year of return seepage, with the seepage rate to the underground being highly weather dependent. The Third Entry Evaporation Dam is also used to evaporate excess dirty water.

As the underground miner is progressively extracted from the current, active underground workings, in approximately 2012, the recycled dirty water supply to the Southern Open Cut Pollution Control Dam and access to the 5 Trunk Disused Workings Underground Storage will be lost. Future modifications may be required to the existing water management system through changes to the existing piping and pumping set up or installation of bores into the Charbon Underground Workings to enable an ongoing water supply to the Project Site.

2.7.6 DWE Registered Bores and Mine Workings

Eight registered bores are located within or near the Project Site as shown in **Drawing 2**. Each of these bores are located stratigraphically below the Irondale and Lithgow seams.

Four of the bores were installed by Centennial Charbon in the north of the Project Site in early 2007 to investigate the potential for groundwater supply to the Colliery. Two bores were unsuccessful (B1 and B4), whilst two bores were completed as production bores (PB2 and PB3) as shown in **Table 1**.

No piezometer or bore construction logs were supplied by the drillers, although brief geological logs supplied by the drillers for the Centennial Charbon bores indicate a groundwater supply was sourced from the Nile Subgroup and/or Shoalhaven Group sandstones.

The Nile Subgroup and the Shoalhaven Group lie stratigraphically beneath the proposed mining operations in the Lithgow Seam. In the Centennial Charbon bores, the aquifer intersections lie between 35m and 90m below surface.

The private bores to the south of the proposed Western Underground have aquifer intersections that are most likely within the Nile Subgroup between 13m to 19m below surface, as summarised in **Table 1**.

One of the registered private bores is present in the area outside of, and to the west of the Project Site (GW23586), two private bores are located in proximity to the proposed Western Underground mining area (GW800780 and GW800781) and one bore (GW59768) is located in proximity to the proposed Western Outlier as shown in **Drawing 2**.

Bore		Co-ord	linates	Standing	Total			
	Date Installed	East	North	Water Level	Depth	Intake	Yield	Salinity
	instaneu	Easi	North	nibyi	mbyi	mbyi	(L/SEC)	(μο/τιπ)
GW23586	n/a	214750	6355151	n/a	18.2	n/a	n/a	n/a
GW59768	n/a	215820	6350030	24.30	45.7	open hole	1.38	salty
GW800780	1994	215770	6353525	n/a	25.0	13-19	2.00	fresh
GW800781	1995	216390	6353450	9.5	25.0	13-19	0.5	fresh
B1	2007	217545	6356939	20	130	35-79	1.9	n/a
PB2	2007	217311	6356234	19.95	121	45-73	6.8	2790
PB3	2007	217314	6356130	28.2	97	49-90	3.1	2860
B4	2007	217646	6356573	18	n/a	n/a	n/a	n/a
Notes: 1 n/a DWE data not supplied								
2 > swl probably deeper although post pump installation access to the PB2 / PB3 is not possible								
3 mbgl metres below ground level								

Table 1Department of Water and Energy Registered Bores

Reported yields in the private registered bores range up to 2.0L/sec from bores that are less than 46m deep within shales of the Nile Subgroup and possibly, sandstones of the Shoalhaven Group.

Standing water levels range from 9.5m and 24.3m below surface.

The available Department of Water and Energy (DWE) data indicates the private bores not installed by Centennial Charbon were drilled between 1994 and 1995.

The Centennial Charbon bores range from 97m to 130m deep, with groundwater supplies provided from between 35m and 90m below surface in sandstone with shale bands. The two Centennial Charbon production bores (PB2 and PB3) yield from 3.1L/sec-6.8L/sec from sandstone, whilst Bore 1 (B1) recorded a yield of 1.9L/sec. No drilling or pumping details for Bore 4 (B4) are available.

Production bores PB2 (80BL244069) and PB3 (80BL244070) are both licensed, with a cumulative, total extraction limit for both combined bores of 30ML/year. Bores B1 and B4 are licensed under licence number 80BL244068.

The current Centennial Charbon mine workings have an existing Water Access Licence (80BL243771) that permits groundwater extraction of up to 5ML/year.

The existing and historic open cut mines have been operated as dry workings with no observable groundwater seepage, with the exception of short periods of low flows from ephemeral perched seeps following significant rain events.

It is noted that each of the registered bores within and surrounding the Project Site access groundwater from aquifers within either the Nile Subgroup or the Shoalhaven Group. As highlighted previously, these aquifers lie stratigraphically below the Illawarra Coal Measures and have not historically, and would not in the future, be intersected by mining operations within the Project Site.

3 GROUNDWATER REGULATORY ENVIRONMENT

3.1 Introduction

Under Section 115 of the *Water Act 1912*, in areas where a Water Sharing Plan has not been gazetted, or under Section 56 of the *Water Management Act 2000* in areas where a Water Sharing Plan has been gazetted, mine workings are required to be licenced.

Extraction of groundwater via a bore or from mine workings must be licenced under the appropriate Act by the DWE for the volume of groundwater that is proposed to be extracted on an annual basis. This means that if the proposed open cut or underground coal mining activities would intersect and require dewatering of groundwater, then the workings have to be licenced under the relevant Act for an appropriate volume of annual groundwater extraction.

As indicated in Section 2.7.6, the Colliery currently holds the following groundwater licences for extraction of groundwater.

- Licence Numbers 80BL244069 and 80BL244070 Production Bores PB2 and PB3 – combined 30ML/year.
- Licence Number 80BL243771 Charbon Underground 5ML/year.

3.2 Murray Darling Basin Groundwater

Within the Project Site, the north-westerly and westerly draining catchments to the west of the Great Dividing Range watershed are covered by the Macquarie Castlereagh region of the Murray Darling Basin Groundwater Management Strategy.

The strategy was prepared by the Murray Darling Basin Commission (MDBC), and is managed in NSW by the Department of Water and Energy (DWE) under the *Water Act, 1912* and the *Water Management Act 2000*.

The Murray Darling Basin Groundwater Management Strategy was developed for the conjunctive management of unregulated surface water and groundwater systems. The draft strategy is under review, whilst a macro water sharing plan is being developed by the MDBC which involves the process of defining sustainable groundwater yield and stream-aquifer interactions within the Murray Darling Basin.

In 2008, an embargo was implemented, subject to certain exceptions, which meant that no further applications for groundwater extraction licences could be granted within the Murray Darling Basin under Part 5 of the *Water Act 1912* (NSW Govt, 2008).

This means that whilst the embargo is in place, no new allocations for groundwater extraction licences can be granted within the Rileys Creek and Reedy Creek Catchments of the Murray Darling Basin.

In accordance with the latest version of this embargo issued on 18 December 2008, the embargo does not apply to the following:

- "An application for a licence for a bore to replace some other licensed bore that the applicant has ceased to use.
- An application for a licence for a bore to produce water to satisfy a water allocation arising from the transfer of a water allocation under Section 117J [of the Act".
- Water supply where the Minister determines that a failure to supply the water would cause a prohibitively high social, economic or national security cost and the supply of the water will cause no more than minimal environmental harm to any aquifer, or its dependent ecosystems; or.
- Bores for the use of saline water where the salinity level exceeds 14,000 milligrams per litre (ppm)

Under Schedule 1 and Schedule 2 of the New South Wales Inland Groundwater Shortage Zones Order No. 1 and Order No. 2 (NSW Govt, 2008), applications for licences under Part 5 of the *Water Act 1912* within the Murray Darling Basin component of the Project Site can also continue to be made for the following purposes:

• "Monitoring and test bores for groundwater investigation and/or environmental management purposes.

- Bores on property where there is an existing licence under Part 5 of the Water Act 1912 and there is no increase in entitlement.
- A dewatering activity provided that the annual extraction does not exceed 10 megalitres per annum".

A new licence may only be granted at the Project Site where allocations are transferred from an existing licence within the same groundwater management unit, or if one or more of the other excemptions identified above applies.

If appropriate, a transfer of use may be sought from licences within the Project Site. Alternatively, an additional allocation may be sought under one of the exemptions identified above.

3.3 Sydney Basin Groundwater

The eastern and southerly draining catchments within the Project Site are covered by a Water Sharing Plan administered under the *Water Management Act 2000* within the Sydney Basin Groundwater Management Unit N603.

The easterly draining catchments contain a small component of the proposed Southwest Open Cuts as shown in **Drawing 2**.

At present, there is no embargo on new groundwater licences being granted in the Sydney Basin Groundwater Management Unit N603 for the Stony Creek and Deep Creek Catchments.

4 HYDROGEOLOGICAL INVESTIGATIONS AND ASSESSMENT

4.1 Standing Water Levels

Standing water levels in the bores drilled by Centennial Charbon ranged from 6m to 13m below ground level (mbgl) shortly after drilling, with longer term levels in Bores 1 and 4 (B1 and B4 respectively) ranging from approximately 18m to 20mbgl when Production Bores 2 and 3 (PB2 and PB3 respectively) are not operating.

As shown in **Figure 2**, when PB2 and PB3 are operating, the standing water level in Bore 1 (B1) drops by up to 12m, whilst Bore 4 (B4) drops by around 1m. PB2 and PB3 are located approximately 100m apart, whilst B4 is located approximately 450m north of PB2. B1 is located approximately 700m north of PB2 as shown in **Drawing 2**.

The reason for the greater drop in water level in B1, which is located approximately 350m further away from the production bores than B4 is not known at this stage.



Figure 2 Charbon Bore Standing Water Levels

No standing water level data in PB2 or PB3 has been available since pumps were installed in the bores as the pumps restrict access for groundwater level monitoring equipment installation inside the bores.

Based on the measured groundwater levels in surrounding local bores and the elevation of the Lithgow Seam, which is the lowermost mined seam in the Project Site, the Lithgow Seam ranges from 39m to 66m above the regional groundwater standing water level as shown in **Table 2**.

Proposed Mine	Approx. Lithgow Seam Elevation	Closest Bore and (Approximate Standing Water Level)	Approx. Elevation Difference
Central Open Cut	740m AHD	PB3 (674m AHD)	66m
Third Entry Open Cut	755m AHD	GW800781 (716m AHD)	39m
Southern Open Cut Extension	770m AHD	GW59768 (727m AHD)	54m
Southern Outlier	770m AHD	GW59768 (727m AHD)	43m
Western Outlier	778m AHD	GW59768 (727m AHD)	51m
Western Open Cut	780m AHD	GW800781 (716m AHD)	64m
Western Underground	780m AHD	GW800781 (716m AHD)	64m

Table 2Regional Groundwater and Lithgow Seam Elevation

4.2 Groundwater Flow

4.2.1 Basement Aquifers

Insufficient data is available to map groundwater flow directions within the Project Site. However, the regional groundwater flow is anticipated to reflect a combination of a west to northwest flow in sympathy with the surface topography. Locally, groundwater flow would also be modified by the dip of the local geology, with a west to east component superimposed on the topographically driven west to northwest flow direction, which reflects the dip of the coal seams.

In addition, it is noted that two potential aquifer systems exist within the Project Site, namely, coal seam aquifers associated with the Irondale, Lidsdale and Lithgow Coal Seams and aquifers associated with the Shoalhaven Group. It is noted that these aquifer systems are separated by between approximately 39m to 66m. As a result, the limited groundwater flow in the coal seam aquifers is anticipated to be hydraulically disconnected from the underlying Nile Subgroup and Shoalhaven Group regional aquifer.

4.2.2 Hydraulic Connection Between the Alluvium and Basement Aquifers

Based on the monitored depth to the regional groundwater system within the Project Site, it is anticipated that the limited, ephemeral alluvial groundwater system located along the major creek lines is hydraulically separated from, and is not connected to, the underlying Nile Subgroup or Shoalhaven Group aquifer/s.

4.3 Pump Out Tests

Two 24 hour single well pump out tests were conducted on PB2 and PB3 by Watermin Drillers Pty Ltd during February 2007 to specify criteria for submersible pumps to be fitted in the bores.

The tests were conducted on sandstone aquifers of the Nile Subgroup or Shoalhaven Group, which underlie, and are hydraulically separated from, the Lithgow Seam, which is proposed to be extracted by the Project.

No monitoring in observation bores was conducted during the tests.

The pumping test on PB3 was started with a constant pumping rate of 6.79L/sec, and then, whilst PB3 was still pumping, PB2 was started 9 hours later at 3.09L/sec. Pumping from PB3 was stopped after 24 hours whilst PB2 was still running, and PB2 was then stopped a further 9 hours later after it had been pumping for 24 hours.

As shown in **Figure 3**, PB3 exhibited linear drawdown in the first 9 hours of pumping until pumping from PB2 started. After pumping began in PB2, drawdown interference between the two bores occurred and drawdown in PB3 rapidly increased.

Whilst PB2 was pumping, it did not show a linear drawdown plot due to interference from PB3, and when PB3 was stopped, the rate of drawdown in PB2 declined.

As the drawdown tests were not conducted to satisfy the inherent assumptions relating to interpreting single well pump out tests, it is not appropriate to use the drawdown data from PB2 to determine definitively the transmissivity of the Nile Subgroup or Shoalhaven Group aquifers. However, the period from 10 minutes to 100 minutes (which is 1 log cycle of drawdown time) during test pumping of PB3 has been used to ascertain an indicative transmissivity of the sandstone formation.





Figure 3 PB2 and PB3 Pumping Test Drawdown

This assessment indicates a transmissivity for the sandstone aquifer of approximately $1.534m^2/day$. It is noted, however, that this figure is only an estimate and that further controlled tests are required to determine the transmissivity with more certainty. Using an assumed thickness of the sandstone aquifer of 28m to 41m, based on the intersected aquifer thickness in PB2 and PB3, the hydraulic conductivity of the aquifer is estimated to be between 37m/day and 55m/day. This figure is likely to be an overestimate of the actual hydraulic conductivity.

It should also be noted that the test was conducted in an open bore, and therefore both horizontal and vertical flow components are included in the interpreted estimate.

The recovery data is similarly affected by drawdown interference between PB2 and PB3 and has not been interpreted.

4.4 Groundwater Recharge

The outcropping basement rocks and alluvium are recharge sources for the regional and ephemeral groundwater systems.

Based on experience in similar areas, rainfall recharge into the basement is considered to be relatively low to negligible based on the generally low hydraulic conductivities of the strata and the high evaporation rate compared to rainfall at the Project Site.

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Using similar studies in NSW coal mines as a guide, and based on the hilly nature and short lived, high shedding capacity of rain falling on Haystack Mountain, as well as the high evaporation rate (1 490mm/year), it is assumed that 1%, or approximately 7mm/ha/year could infiltrate into the Lithgow Seams and the underlying regional groundwater system.

Using its 66.5ha area, it is assessed that the Western Underground could have an overburden recharge seepage rate into the workings of approximately 4.5ML/year for an average rainfall year. This figure may vary from 2.0ML/year to 7.5ML/year based on the maximum and minimum recorded rainfall of 303mm/year and 1 122mm/year respectively.

4.5 Groundwater Modelling and Drawdown Scenarios

Detailed groundwater modelling has not been undertaken for the proposed expansion of open cut and underground mining within the Charbon Project Site for the following reasons.

- Based on monitoring data from bores within and in the vicinity of the Project Site, the proposed open cuts and underground workings are located stratigraphically above the regional aquifer system and its piezometric surface, and would be excavated within the unsaturated zone.
- The limited subsidence (<20mm) in the vicinity of the Western Underground and limited development of overburden cracking is not anticipated to substantially increase the current rainfall recharge rate in the vicinity of Haystack Mountain.
- The proposed open cuts would not intersect the regional groundwater system, and are not anticipated to adversely affect recharge of the regional groundwater system. However, it is feasible that excavation of the open cuts could enhance recharge to the regional groundwater system, particularly if any surface water is temporarily stored, restrained or ponded in them prior to the open cuts being reshaped after mining is completed.
- The proposed Western Underground would not intersect the regional groundwater system, although it may temporarily, marginally reduce recharge to the underlying regional groundwater system whilst the workings are being operated and potentially dewatered. Once the Western Underground is completed, and if groundwater seepage accumulates in the workings and doesn't drain freely out of the down dip portal, recharge to the underlying groundwater system could increase.
- A groundwater model would not be able to be effectively developed or interpreted as the proposed open cut and underground workings would be situated in unsaturated strata.

In addition, as the current and previous open cut operations have had no quantifiable groundwater inflow, and as the proposed open cuts and underground workings will be excavated stratigraphically above the regional groundwater system, it is not anticipated that there will be any drawdown of the regional groundwater system.

As a result, no additional assessment has been made on a range of groundwater drawdown and impact scenarios.

Finally, as the Proponent proposes to backfill each of the proposed open cuts and the final landform would closely mimic the current landform, there would be no development of a pit void lake in the proposed open cuts and therefore no detailed modelling of potential groundwater volume, flow or quality impacts of an inundated final void is required.

4.6 Groundwater Chemistry

Water quality monitoring supplied by Centennial Charbon indicates that water pumped from the Charbon Underground at the Third Entry has a pH of approximately 7.9 and an electrical conductivity of approximately $1\ 000\mu$ S/cm.

In accordance with ANZECC (2000) and NHMRC (2004) guidelines and trigger levels, the groundwater quality from the Charbon Underground as well as PB2 and PB3 is not suitable for direct discharge into streams, and is marginally too saline for use as drinking water, although can be used for irrigation and livestock watering.

Limited sampling of the groundwater production bores PB2 and PB3 in 2007 indicates the groundwater from the Nile Subgroup and/or Shoalhaven Group sandstone beneath the Lithgow Seam has an electrical conductivity ranging from 2 790µs/cm to 2 860µs/cm and pH between 6.3 and 6.6 as shown in **Table 3**.

	-			•		
		Electrical				
		Conductivity	Iron	Zinc	Copper	Manganese
Bore	рН	(µ S/cm)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
		Average Gro	oundwater	Quality		
PB2	6.3	2790	22	0.29	0.1	2.4
PB3	6.6	2860	9.1	0.06	0.11	1.0
	Criteria					
ANZECC 2000 ¹	6.5 – 7.5	30-350	-	-	-	-
ANZECC 2000 ²	-	-	-	0.008	0.0014	1.9
ANZECC 2000 ³	-		10	5	5	10
ANZECC 2000 ⁴	-	3000 - 8000	-	20	0.4 - 5	-
NHMRC 2004 ⁵	6.5 – 8.5	750	0.3	3	2	0.5
Notes: 1 ANZECC 2000 default trigger for physical and chemical stressors in upland SE Aust slightly						
disturbed streams						
2 ANZECC 2000 trigger values for protection of 95% of freshwater aquatic species in slightly to						
modera	moderately disturbed systems					
3 ANZEO	3 ANZECC 2000 short term trigger values for irrigation water					
4 ANZECC 2000 livestock drinking water						
5 NHMR	5 NHMRC 2004 Australian Drinking Water Guidelines					

Table 3 Charbon Production Bore Groundwater Quality

5 POTENTIAL MINING IMPACTS ON THE LOCAL GROUNDWATER SYSTEM

This section provides a qualitative assessment of the anticipated groundwater-related impacts associated with the Project.

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5.1 Proposed Open Cuts

The proposed open cuts are not anticipated to depressurise the local basement groundwater systems as they would be excavated to the base of the Lithgow Seam, which is stratigraphically between 39m to 66m above the regional groundwater standing water level as shown in **Table 2**.

In addition, the proposed open cuts are not anticipated to depressurise the local alluvial aquifers because the subcrop of the Lithgow Seam is located at the base of the hills within the Project Site. As a result, the mining operations would occur at a higher elevation than the valley floors where the alluvial aquifers would be located, if they are present.

As the surrounding private bores extract groundwater from shale-based aquifers located in the Nile Subgroup, which is stratigraphically beneath all of the proposed workings and as the proposed workings would not adversely impact on the local basement groundwater system, the Project would not have an adverse impact on surrounding groundwater users.

Notwithstanding the above, however, it is noted that the proposed open cut may intersect temporary, perched aquifers that may generate temporary seeps at low flow rates for short periods of days to weeks after extended rain periods.

A temporary or final void lake is not anticipated to develop in any of the proposed open cuts for the following reasons.

- The proposed open cuts would be excavated to the base of the Lithgow Seam which is stratigraphically higher than the regional Nile Subgroup / Shoalhaven Group groundwater system and will be at a higher elevation than the surrounding surface water drainage lines. As a result, the proposed open cuts would be free draining to the surface water system.
- Each of the proposed open cuts would be backfilled to create a free draining final landform that would generally mimic the existing landform.

As no pit void lake would be developed in the rehabilitated proposed open cuts, there would be no potential for ponded water to act as a long term recharge source to the underlying regional groundwater system. This means there would be no potential for contamination of local or regional groundwater.

In addition, there would be no anticipated adverse effects on local stream flows or stream water quality, or minimum base flows in the Cudgegong or Capertee Rivers due to changes in groundwater related seepage flow to streams as the proposed open cuts would not be excavated into the regional groundwater system.

As the proposed workings would not be excavated into the regional groundwater system, they would therefore have no depressurisation effect on the regional groundwater system.

There would be no anticipated adverse effects on groundwater dependent ecosystems as the proposed Open Cuts would not intersect or depressurise the regional groundwater system.

5.2 Western Underground

5.2.1 Predicted Subsidence over the Western Underground

The Proponent has committed to undertake First Workings only within the Western Underground and have indicated that the proposed operation would generate surface subsidence of less than 20mm.

As a result, there would be very limited crack development, if any, over the extracted workings and no adverse effects on the underlying regional aquifers.

5.2.2 Predicted Groundwater Impacts

Bord and pillar mining in the Western Underground is not anticipated to adversely affect the regional basement groundwater levels within the Nile Subgroup or Shoalhaven Group aquifer below the underground workings, nor within the Project Site as a whole, as the proposed mining would be conducted underneath an isolated, outlying group of hills which are hydraulically separated from the remaining areas of the Project Site.

The outlying hills in Haystack Mountain over the proposed underground currently have a minor degree of rainwater recharge into the regional groundwater system, at an assumed rate of 1% of the annual rainfall, or approximately 6.92mm/ha/year due to the hilly topography and their limited surface area.

The current rate of rainfall recharge is not anticipated to be observably altered by underground mining as there is proposed to be less than 20mm of subsidence over the workings.

The less than 20mm of subsidence will mean that there will be limited to no development of subsidence cracking at surface, which means there will be no post subsidence enhanced rate of rainfall recharge into the Western Underground workings or the regional groundwater system.

The strata above the proposed Western Underground may currently contain limited extent, ephemeral, perched aquifers, and it is not anticipated there will be any significant, adverse effects on the perched groundwater system following completion of the underground mining due to the minor degree of overburden cracking that may develop above the workings.

No regional groundwater depressurisation effects are anticipated within the Project Site following underground extraction of the Lithgow Seam as the workings would be approximately 64m above the standing water level in the closest registered bore to the proposed workings and therefore stratigraphically higher than the regional groundwater system.

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Limited, post-mining hydraulic conductivity increases in the overburden above the extracted coal seam could potentially occur if significant surface cracking develops. However, as the cracking is anticipated to be very limited, if any, an increase in recharge rates due to the higher hydraulic conductivity, would be small and not significant.

Although there are two private registered bores in close proximity to the proposed Western Underground (GW800780 and GW800781) they are not anticipated to be adversely affected by any limited increase in rainfall recharge that may occur above the proposed workings, any limited reduction during dewatering of the workings that may occur whilst mining the Lithgow Seam, or by any limited increase if the workings become flooded once mining is completed.

The two private bores extract groundwater from shale and sandstone based Nile Subgroup or Shoalhaven Group lithologies with an elevation approximately 64m lower than the proposed workings.

No private bores within the Project Site would be undermined or subsided, and therefore no subsidence effects on adjacent private bore groundwater extraction or basic landholder rights are anticipated.

No adverse effects on the local alluvial groundwater levels or quality are anticipated due to subsidence over, or extraction from, the proposed underground workings, as the alluvial groundwater system is likely to be limited in extent, ephemeral and located at a lower elevation than the proposed workings.

No adverse effects on the local stream flow, minimum base flows in the Cudgegong or Capertee Rivers or water quality are anticipated due to extraction of, or the limited subsidence over, the proposed underground workings for the following reasons.

- There would be no change in rainfall recharge through the overburden into the temporary, perched aquifers that could generate limited, intermittent seeps into the surface water system following extended rainfall periods,
- The regional groundwater system is not expected to be adversely impacted by the proposed workings. As a result, groundwater flows into surface water streams and the quality of those flows would be unaffected.
- There are no known regional groundwater seeps located in the vicinity of the Western Underground and none would be likely to occur as the regional standing water level has an elevation approximately 64m lower than the Lithgow Seam within the Western Underground.

There would be no anticipated adverse effects on groundwater dependent ecosystems associated with the proposed Western Underground as there are no known groundwater dependent systems in proximity to the proposed underground workings and none are expected to occur because the Lithgow Seam in the vicinity of the proposed underground is located stratigraphically above the regional groundwater system.

6 FUTURE GROUNDWATER EXTRACTION LICENSING

The existing groundwater-related licences held by Centennial Charbon are listed in Section 2.7.6. These licences would be retained.

In addition to the existing licences, a Water Access Licence under Section 115 of the *Water Act 1912,* or subsequently Section 56 of the *Water Management Act 2000,* when the *Water Act 1912* is repealed, would be required for the Western Underground to account for the potential interception of any perched, ephemeral aquifers that may be present.

Initial assessments indicate seepage from the unsaturated overburden to the Western Underground workings would be significantly weather dependent, and could range from 2.0ML/year to 7.5ML/year, with an average of 4.5ML/year.

At present, the current Project Site groundwater allocation allows for extraction of 35ML/year, which is composed of 30ML from PB2 and PB3 (licence No.s 80BL244069 and 80BL244070) and 5ML from the existing underground with Water Access Licence 80BL243771.

Centennial Charbon would seek to obtain approval to operate the production bores and underground water access licences as a total extraction allocation, with the groundwater volumes extracted to be shared between the two licences.

If it becomes apparent from site water monitoring that the total combined, groundwater extraction allocation for the Project Site may not be sufficient, priority would be given to limiting the amount of groundwater extracted from production bores PB2 and PB3, and to replace it with water sourced from dewatering of the underground operations or dirty water storages to ensure that the total volume of groundwater extracted from both the bores and the underground workings would be less than 35ML per year.

If the total, combined 35ML/year allocation is still insufficient, Centennial Charbon would then seek to increase the Colliery's groundwater allocation through transfer of an existing allocation or application for additional allocation under one of the exemptions identified in the Groundwater Embargo described in Section 3.1.

7 GROUNDWATER MONITORING, CONTINGENCY MEASURES AND REPORTING

7.1 Introduction

The assessment has indicated that the existing and future operation of Charbon Colliery poses a low risk to groundwater systems.

Following receipt of project approval, the Proponent would develop a detailed Water Management Plan, including a Groundwater Monitoring and Response Program, that outlines the proposed monitoring procedures and verifies the impacts of the mine over its operational life.

The plan would also identify contingency measures to be implemented should outlined trigger criteria be exceeded as a result of the Project.

The program would be developed in consultation with the Department of Environment, Climate Change and Water (DECCW) and the results reported as required in the Annual Environmental Management Report.

As described in the following paragraphs, key elements of the monitoring program could include the following.

- Monitoring of surface and groundwater inflows to both the underground and open cut workings.
- Continued refinement of the site water balance, including increased metering.
- Monitoring of standing water levels within production bores or equivalent.
- Determination of sustainable yields and water quality.
- Determination of appropriate triggers and responses.

7.2 Monitoring

7.2.1 Groundwater Levels

Standing water levels in bores within and surrounding the Project Site are not currently required to be monitored.

Centennial Charbon however would undertake routine monitoring of the groundwater levels, quality and volume of groundwater pumped out of the bores and mine workings as described in the following subsections. Bores to be monitored would include the following.

- Bores B1 and B4.
- Production Bores PB2 and PB3 (if internal bore access is possible)

• Private Bores GW23586, GW59768, GW800780 and GW800781 (subject to landholder approval).

It is noted that landholder permission would be required to allow monitoring of the above private bores.

In addition, the Centennial Charbon would implement and expand the current water metering program to allow the net volume of groundwater removal from the Charbon and proposed Western Underground to be accurately established (GHD, 2009).

7.2.2 Standing Water Level

It is proposed that groundwater level monitoring would involve monthly manual standing water level measurement of all bores as shown in **Table 4**.

Monitoring Suite	Sampling Method	Frequency	Units	
B1, B4	dip meter	monthly	mbg	
PB2, PB3 ²	dip meter	monthly	mbg	
GW23586, 59768, 800780, 800781	dip meter	monthly	mbg	
Note 1: mbg = meters below ground				
Note 2: PB2 and PB3 will be monitored if suitable internal access to the bores is possible				

 Table 4

 Groundwater Level Monitoring Method and Frequency

No additional groundwater level monitoring locations are recommended as the existing, proposed suite, along with monitoring of any groundwater make within the existing and proposed open cut and underground operations is anticipated to be sufficient. **7.2.3**

7.2.4 Groundwater Quality

It is proposed that groundwater quality would be monitored within each of the bores identified in **Table 5** and would comprise both monthly field meter readings and annual laboratory analysis.

Monitoring Suite	Sampling Method	Frequency	
PB2, PB3 B1, B4	Pumped field meter readings	monthly	
PB2, PB3 B1, B4	Pumped sample for laboratory analysis	once yearly	
GW23586, 59768, 800780, 800781	Pumped field meter readings	monthly	
GW23586, 59768, 800780, 800781	Pumped sample for laboratory analysis once yearly		
Note PB2 and PB3 will be monitored if suitable internal access to the bores is possible			

 Table 5

 Groundwater Quality Monitoring Method and Frequency

Table 6 presents the parameters that would be monitored during both field meter readings and laboratory analysis, along with groundwater locations to be included in the groundwater quality monitoring suite and the frequency of monitoring.

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	Parameters	Units
Monthly Field Meter	EC, pH	µS/cm, pH
Readings		units
Annual Laboratory	(EC, pH) + TDS, Na, K, Ca, Mg, F, Cl, SO4, HCO ₃ , NO ₃ , Total	µS/cm, pH
Analysis	N, Total P, hardness, Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr	units, mg/L
	(Totals)	

 Table 6

 Groundwater Quality Monitoring Units

All bores would be purged prior to sampling until continuous monitoring of the pH and salinity indicates that the quality of water pumped from the bore has stabilised. This would require removal of at least three bore volumes of groundwater before sampling.

7.2.5 Groundwater Seepage into the Western Underground

To enable the assessment and quantification of groundwater inflow to the Western Underground workings, the volume of water pumped into and out of the Western Underground would be monitored using calibrated flow meters.

7.2.6 Rainfall

Rainfall would continue to be monitored daily at Centennial Charbon's meteorological station for the duration of the Project to enable a comparison between the quantum of annual rainfall, and the degree and duration of any groundwater seepage that may occur out of the workings.

7.2.7 Review of Monitoring Program

All results of the monitoring program would be reviewed as they are received and compared to the groundwater triggers presented in Section 7.3, with all results and interpretations subsequently reported in the AEMR.

The monitoring program would be re-assessed during preparation of each Annual Environmental Management Report and may be modified subject to agreement with the relevant government agencies once the variability of the groundwater system and effectiveness of the monitoring program is established.

7.3 Groundwater Triggers

7.3.1 Standing Water Levels

A trigger for further investigation would occur if a drop of over 10m below the rolling 12 month average in groundwater levels in any piezometer or private bore occurs over a minimum 3 month period.

Modification of the trigger level, in consultation with the DWE, may be possible as further data becomes available The trigger of a sustained 10m reduction in groundwater levels over at least 3 months excludes any effect due to pumping from a licensed extraction bore, or bores, where the groundwater level recovers once pumping ceases.

It is proposed that water level monitoring data would be plotted and interpreted when received, and if the above trigger level is exceeded or if there is a significant increase in the rate of rise or fall in aquifer water levels compared to the preceding 12 months, then an assessment by a suitably qualified specialist would be conducted. The investigation would assess if the observed groundwater level change is solely mining induced or due to a range of other potential factors, such as variation in climate, a change in pumping rate or duration in the subject or adjacent bores, or an altered rainfall / recharge relationship. The assessment would consider if potential contingency measures may need to be adopted.

7.3.2 Groundwater Quality

The following groundwater quality triggers for further investigation of potential adverse impacts on groundwater are sourced from the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 2000) for Primary Industries (Irrigation water) and are shown in **Table 7**.

Where a trigger value is exceeded, Centennial Charbon would initially undertake additional monitoring to determine whether the exceedance relates to longer-term changes in groundwater quality. This may involve increasing the frequency of monitoring for laboratory analysis to monthly or increasing the frequency of field analysis from monthly to twice monthly.

Indicator	ANZECC (2000) Trigger	General Trigger
рН	<6.0 or >8.5	>10% variation over 3 months
Conductivity	-	compared to the previous 12 months.
TDS	>13,000mg/L	1
Na	>460mg/L	
K	-	
Ca	>1000mg/L	
Mg	-	1
CI	>700mg/L	1
HC0 ₃	-	1
N0 ₃	>400mg/L	1
S0 ₄	>1000mg/	

Table 7 Groundwater Quality Trigger Criteria

7.4 Long Term Groundwater System Protection

Following closure of the mining operations, protection of the local and regional aquifer systems would be achieved through continued monitoring of the groundwater system as outlined in Section 7.2 for a period of at least one year after mining has ceased, or for a longer period as agreed with the DWE.

If during that time, any adverse effects were observed on the groundwater system that exceed the triggers outlined in Section 7.3, then the appropriate contingency measures would be implemented as outlined in Section 7.5.

7.5 Groundwater Related Contingency Measures

If mining related impacts on groundwater within a private bore is demonstrated to be greater than anticipated, Centennial Charbon would:

- assess the significance of these impacts;
- investigate measures to minimise these impacts; and,
- describe what measures would be implemented to reduce, minimise, mitigate or remediate these impacts to the satisfaction of the Department of Water and Energy.

If a non-conformance with the above trigger criteria is determined to be the result of the proposed mining operations then the landholder and DWE would be notified and a remediation strategy would be proposed and implemented, if warranted.

The following indicative contingency measures may be implemented, as appropriate.

- Sealing of surface cracks, where practicable, if they develop in the vicinity of the Western Underground and if they are determined to be adversely impacting on surface water runoff or result in increased infiltration to the strata above the Western Underground workings.
- Remedial action, including deepening of pump intakes, on private bores where a reduction in the standing water level may be attributed to the Project.

Activation of contingency procedures would be linked to the assessment of monitoring results, in light of the triggers outlined above, including both groundwater levels and groundwater quality.

7.6 Reporting

All relevant groundwater related issues and monitoring results would be included in the AEMR that would be submitted to the Department of Industry and Investment. The report would include:

• a description of all relevant monitoring and management activities during the reporting period;

- a basic statistical analysis (mean, range, variable, standard deviation) of the results for the parameters measured;
- an interpretation of water quality and standing water level changes supported with graphs or contour plots; and
- an interpretation and review of the results in relation to the trigger criteria.

The performance criteria and triggers would be reviewed after the initial 12 months of data is interpreted and every 12 months after that.

In addition, the criteria and triggers may be modified in consultation with DECCW as appropriate.

8 CONCLUSIONS

The study notes that the proposed open cuts:

- would be extracted to the base of the Lithgow Seam, which is located between 39m to 66m above the regional aquifer and standing water levels;
- would utilise an equivalent mine design and mining method to the existing open cut; and
- are equivalent in terms of their geomorphology, stratigraphy and hydrogeological conditions to the existing and previous open cuts.

As a result, it is anticipated that the proposed open cuts would not intersect any regional aquifers and that they would have limited to no perennial groundwater seepage. In addition, no temporary or final void lakes would be formed within the proposed open cuts. As a result, it is anticipated that there would be no observable adverse effects on the regional groundwater system associated with the proposed open cuts.

The proposed Western Underground is also anticipated to have no observable adverse impacts on the regional groundwater system for the following reasons.

- The proposed workings in the Lithgow Seam would be located approximately 64m above the regional aquifers and standing water level.
- The area of the proposed Western Underground is significantly smaller than the existing Charbon Underground workings. As the existing Charbon Underground workings receive low groundwater seepage volumes ranging from 0.8ML/year to 13.5ML/year (averaging 4.5ML/year) (GHD, 2009), principally following significant rainfall events, the Western Underground is also anticipated to receive insignificant inflow of groundwater.

- An initial assessment indicates the Western Underground may receive between 2.0ML/year and 7.5ML/year of groundwater inflow from unsaturated overburden seepage, with an average seepage rate of approximately 4.5ML/year.
- The proposed Western Underground is located under an isolated, hydraulically disconnected, outlying hill with a significantly smaller catchment / recharge area that the existing Charbon Underground.
- The proposed less than 20mm subsidence would not generate any significant overburden cracking, if any, and there is not anticipated to be any increase rainfall recharge or seepage into the proposed workings following extraction of the Western Underground.
- There would be limited to no depressurisation of any perched, ephemeral aquifers that may be intermittently present within the overburden.

As a result, the proposed Project is anticipated to result in no significant adverse effects on;

- local or regional aquifer groundwater levels;
- local or regional aquifer groundwater flow;
- local or regional aquifer groundwater quality;
- adjacent licensed groundwater users or basic landholder rights;
- groundwater dependent ecosystems, if present; or
- stream flow or water quality in the Cudgegong or Capertee Rivers.

As the proposed Western Underground and the proposed open cuts are anticipated to be essentially dry mines that will be excavated above the regional groundwater table, no groundwater modelling is required.

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SPECIALIST CONSULTANT STUDIES *Part 7: Groundwater Assessment* CHARBON COAL PTY LIMITED Charbon Colliery Continued Operations Report No. 753/03



Note: A colour version of this Figure is available on the Project CD

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SPECIALIST CONSULTANT STUDIES

Part 7: Groundwater Assessment

CHARBON COAL PTY LIMITED

Charbon Colliery Continued Operations Report No. 753/03



CHARBON COAL PTY LIMITED

Charbon Colliery Continued Operations Report No. 753/03






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Appendix 1

Groundwater Related Director-General's Requirements

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Table A1-1
Groundwater Related Requirements from Other Government Agencies from Relevant
Environmental Assessment Sections

Government	nment Paraphrased Requirement						
Authority	Authority						
GROUNDWATER							
Department of Water and Energy (31/10/08)	DWE requires the Environmental Assessment (EA) for the proposal demonstrate that the proposed mining operation will achieve the following:	3.0					
	 compliance with embargoes in force under Section 113A of the Water Act 1912. 						
	 No impact on adjacent licensed water users, basic landholder rights, or minimum base flows in the Cudgegong or Capertee Rivers. 	5.1 – 5.2					
	The Environmental Assessment must present a site water balance and ability to obtain licences to account for inflows and/or extractions from groundwater.	Surface water report / 2.8					
	The EA must consider a range of scenarios of groundwater drawdown and impacts.	4.5					
	The Environmental Assessment report must include demonstration that the project is consistent with the spirit and principles of the NSW State Groundwater Policy Framework Document, the NSW State Groundwater Quality Protection Policy, the NSW State Groundwater Dependent Ecosystems Policy and the NSW State Groundwater Quantity Management Policy. This must include, for the pre-, during and post-development phases of the project the following:	See below					
	 identification of surrounding groundwater users and any groundwater dependent ecosystems; 	2.7.6 / 8.0					
	 detailed explanation of potential groundwater volume, piezometric level, water table heights and the direction of flow and quality, through mine life and projections into the post-mine period; 	4.0					
	 explanation of the site water balance for the proposed extension and total site operations, including any changes to water balance inputs from rainfall runoff and/or groundwater seepage to the open cut extension; 	Surface water report / 3.0					
	 detailed description of any proposed water supply system utilising groundwater as a source, and assessment of current licensing arrangements against this; and 	2.7.5 / 6.0					
	 detailed analysis of the impacts of dewatering if required for the project, identifying the magnitude and duration of pumping, the areal extent of water level drawdown, the likely quality of extracted groundwater, alterations to site water balance, and the monitoring and reporting protocols to be adopted to meet licensing requirements. 	5.0 / 4.6 / 7.0					
	The Environmental Assessment report must include:	See below					
	 justification of the proposed final landform with regard to its impact on local and regional groundwater systems; 	4.5					
	 detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent; 	4.5					
	 the measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project. 	7.4					



Charbon Coal Pty Limited ABN: 71 064 237 118

Continued Operation

of the

Charbon Colliery

Traffic Assessment

Prepared by

FJF Group Pty Ltd

October, 2009

Specialist Consultant Studies Compendium: Part 8

Traffic Assessment

for the

Continued Operation of the Charbon Colliery

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EXECUTIVE SUMMARY

INTRODUCTION

FJF Group Pty Ltd has been engaged by Charbon Coal Pty Limited ("the Proponent) to undertake a traffic assessment for the proposed continued operation of the Charbon Colliery, including limiting transportation to 250 000t per year of product coal using the public road network (the "Project").

The traffic impact assessment considers but is not limited to:

- a description of the Project;
- an assessment of the local road network considering geometry, safety and pavement condition;
- an assessment of the potential impact of the increase in production on traffic; and
- providing recommendations as to appropriate safeguards and traffic management measures to minimise the potential Project-related impacts on traffic.

FJF Group together with the Proponent has consulted with Mid Western Regional Council and the Roads and Traffic Authority NSW during the preparation of this report. Their assistance is acknowledged.

EXISTING CONDITIONS

The existing traffic environment was established by analysis of published RTA traffic count data for the local road network and previous and new traffic counts done on Charbon Road, Angus Avenue and Jamison Road. Peak hour traffic figures are presented in the table below.

Road/Location	2010
Castlereagh Highway	234
Bylong Road	109
Cooper Drive	60
Charbon Road	69
Jamison Road	44
Angus Avenue	55

Existing Peak Hour Traffic Movements

FORECAST TRAFFIC ENVIRONMENT

Predicted peak hour traffic figures for 2017 with additional heavy vehicles generated by Charbon Colliery are presented in the Table below.

Road/Location	Forecast Non-project- related Traffic Flows		Maximum Project- related Heavy Vehicle Movements
	2017 Light Vehicles	2017 Heavy Vehicles	
Castlereagh Highway	233	32	14 ¹
Bylong Road	94	24	14 ¹
Cooper Drive	53	13	14 ¹
Charbon Road	63	12	14 ²
Jamison Road	36	12	4 ³
Angus Avenue	57	3	4 ³
Notes: Note 1 Maximum number of	Project-related hea	vy vehicles travelling	g via the Castlereagh Highway.

Forecast (2017) Peak Hour Two-Way Traffic Flows

Note 2 Maximum number of Project-related heavy vehicles travelling to either Kandos or via the Castlereagh Highway

Note 3 Maximum number of Project-related heavy vehicles travelling to Kandos

IMPACTS ON ROADS AND TRAFFIC

The proposed continuation of road transportation of product coal from Charbon Colliery on public roads would have a negligible impact on roads and intersections surrounding the Project Site. These roads and intersections would operate satisfactorily at a level of service of A - B with minimal delays and spare capacity. Project-related heavy vehicle movements would be a small proportion of total traffic on the Castlereagh Highway, including past the schools of Ilford, Capertee and Cullen Bullen, and would have a negligible impact.

It would be expected that Project-related heavy vehicle movements would have some impact on the road pavements of Bylong Road, Cooper Drive, Charbon Road, Angus Avenue and Jamison Road due to the heavy vehicles generated by Charbon Colliery.

MITIGATION OF TRAFFIC IMPACTS

Due to all roads and intersections of the study area continuing to operate at a high level of service with the proposed traffic generated by Charbon Colliery, no capacity improvements at intersections would be required.

To address anticipated impacts on road pavements on Bylong Road, Cooper Drive, Charbon Road, Angus Avenue and Jamison Road resulting from Project-related heavy vehicles, the Proponent would propose continuation of payment of Section 94 contributions to Mid Western Regional Council to fund any necessary maintenance and rehabilitation works.

As a positive impact on safety and to mitigate impacts on road users and travelling past local schools, Charbon Coal would implement a Transport Management Plan which as a framework would include the following;

- Truck driver code of conduct with disciplinary action for non-compliance.
- Hours of haulage, adherence to speed limits, truck cleanliness.

- Safety procedures for crossing narrow bridges on Charbon Road, Cooper Drive and Bylong Road.
- Limitation on use of compression brakes in built up areas.
- Emergency, accident, incident, complaint or non-compliance response and reporting.
- Road condition monitoring and reporting.
- Training requirements.
- Fatigue management procedures.
- Audit and review.

CONCLUSION

This report has taken the worst case scenario by considering traffic projections for heavy vehicle road haulage for the life of the Project, namely 7 years from 2010 to the year 2017. In summary, following implementation of the mitigation measures outlined in this report, the traffic implications of road haulage of coal from Charbon Colliery to Kandos and Mt Piper would not impact on the safety or performance of the roads and intersections of the study area.

Charbon Colliery Continued Operations Report No. 753/03

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1 INTRODUCTION

Charbon Coal Pty Limited (the "Proponent") proposes to continue the operation of the Charbon Colliery, located approximately 3km to the south of Kandos (**Figure 1**), through development of the remaining coal resources within the Project Site. It is anticipated that the proposed development would be a "Major Project" under Clause 5 of Schedule 1 of the *State Environmental Planning Policy (Major Projects) 2005.* As a result, it is anticipated that an application under Part 3A of the *Environmental Planning and Assessment Act 1979* would be prepared.

FJF Group Pty Ltd has been engaged by the Proponent to undertake a traffic impact assessment of a proposal to continue coal mining and related activities at the Charbon Colliery, including limiting transporting to 250 000t per year of product coal using the public road network (the "Project").

Appendix 1 presents the requirements of the Director General of the DoP and other relevant government agencies and where each requirement is addressed in this report.

The traffic impact assessment considers but is not limited to:

- a description of the Project;
- an assessment of the local road network considering geometry, safety and pavement condition;
- an assessment of the impact of traffic volumes generated by Charbon Coal; and
- providing recommendations as to appropriate safeguards and traffic management measures to minimise the potential Project-related impacts on traffic.

FJF Group together with the Proponent has consulted with Mid Western Regional Council and the Roads and Traffic Authority NSW during the preparation of this report. Their assistance is acknowledged.

2 PROJECT OVERVIEW

Approval is sought for the following activities.

- Mining of approximately 5.2 million tonne (Mt) of coal at a maximum rate of:
 - 700 000t per year using open cut mining methods in the Western and Southern Outlier, Southern Open Cut Extension and 8 Trunk, Central and Western Open Cuts; and
 - 900 000t per year using underground mining methods in the Western Underground;

with the maximum quantity of coal mined annually not exceeding 1.5Mtpa over a maximum of 15 years.

• Transportation of ROM coal from the proposed mining areas to the existing approved CHPP using the existing underground coal transportation infrastructure and existing and upgraded internal haul roads.

CHARBON COAL PTY LIMITED

SPECIALIST CONSULTANT STUDIES

Charbon Colliery Continued Operations Report No. 753/03 Part 8: Traffic Assessment



Note: A colour version of this figure is available on the Project CD

Part 8: Traffic Assessment



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- Processing of a maximum of 1.5Mt per year ROM coal at the existing CHPP.
- Transportation of a maximum of 250 000t of ROM and product coal per year to the Proponent's customers by public road.
- Transportation of a maximum of 20 000t product coal per year to the Charbon Lime Works by private road.
- Transportation of a maximum of 1.5Mt ROM and product coal per year to the Proponent's customers by rail.
- Placement of waste rock material within proposed in-pit waste rock emplacements.
- Expand and upgrade the existing reject emplacement area to allow for placement of Project-related fine and coarse reject material.
- Construction of associated infrastructure, including:
 - three new pollution control dams;
 - the Western Underground surface facilities area;
 - new and upgraded haul roads; and
 - the 2 Trunk ROM Coal Loading Facility.
- Progressive rehabilitation to create a final landform that would generally mimic the existing landform.
- Continued use of existing site infrastructure for the life of the Project.

The locations of these activities are shown on **Figure 2.** In addition to the above, approval is also sought for the continued operation of those existing approved activities that would be ancillary to the operation of the proposed activities following completion of mining of the Charbon Underground and Southern Open Cut. Those activities would include, but would not be limited to, the following.

- Operation of the CHPP and train loading facility.
- Use of the offices, staff amenities, workshops, roads, Reedy Creek Dam and associated infrastructure, waste water treatment plants, underground mine infrastructure and surface water management structures and other site infrastructure.

It is noted that at present, the Colliery does not have a limit of the amount of coal that may be transported by public road. The Proponent recognises that this is not consistent with current practice. As a result, the Proponent proposes to limit the amount of product coal that may be transported by public road to 250 000t per annum. Further details in relation to previous and current transportation levels are provided in Section 3.2.

3 EXISTING AND PROPOSED ROAD HAULAGE

3.1 Transportation Routes

At present, the majority of product coal is transported from site by rail, with the remainder transported by road using rigid trucks or semi-trailers. Delivery routes include the following.

CHARBON COAL PTY LIMITED *Charbon Colliery Continued Operations*



- Route 1 Coal Handling Preparation Plant (CHPP) to Cement Australia Kandos Cement Plant. The route taken is Charbon Road Bylong Road Angus Avenue Jamison Road (**Figure 3**).
- Route 2 CHPP to Mt Piper Power station. The route taken is Charbon Road -Bylong Road - Cooper Drive - Bylong Road - Castlereagh Highway - Boulder Road (**Figures 1 and 3**).
- Route 3 CHPP to Charbon Lime Works (private haul road) (Figure 2).

3.2 Previous and Current Road Haulage

Prior to construction of the existing rail loop in 1985, all coal from the Colliery was transported by road. Customers included the Charbon Cement Works (now the Charbon Lime Works), Kandos Cement Plant, Wallerawang Power Station and hospitals, factories and brickworks throughout the Central West of NSW. During the early 1980's the Colliery was transporting up to 600 000t of coal per year by public road.

Road transportation since opening of the rail loop has decreased, with up to 280 000t per year transported by public road. However, the Proponent notes that this transportation is typically sporadic, with intense periods of up to a few months duration of road transportation, followed by periods when only small amounts of coal were transported by public road. In addition, the Proponent notes that coal is routinely transported to the Kandos Cement Plant and Charbon Lime Works at rates of approximately 80 000t and 20 000t per year respectively.

3.3 Proposed Road Haulage

At present, Charbon Colliery has no limits on road haulage of product coal. However, the Proponent recognises that unlimited transportation of such materials is not consistent with current Government policy. As a result, the Proponent proposes to transport the following amounts of product coal by public road.

- Approximately 80 000t of coal per year to the Kandos Cement Plant. This would be transported principally by a single rigid truck, making multiple return journeys each day. It is noted that occasional campaigns of up to 40 heavy vehicle movements per day may be required.
- Approximately 250 000t of coal per year to the Mt Piper power station or other customers via the Castlereagh Highway. This would be transported principally by semi-trailer truck, with occasional campaigns of up to 200 heavy vehicle movements per day.

It is noted that the total amount of coal transported by public road would be 250 000t per annum. As a result, should the amount of coal transported via the Castlereagh Highway increase above 170 000t per annum, there would be a corresponding decrease in the amount of coal transported to the Kandos Cement Plant to ensure that the total amount of coal transported by public road would be less than 250 000t per year.

It is also noted that the Proponent anticipates that coal would principally be transported via the Castlereagh Highway only when issues at other coal mine operated by the Proponent or related Companies prevent them fulfilling their contractual obligations.

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Finally, approximately 20 000t of coal per year would continue to be transported to the Charbon Lime Works via private haul road. As this material is not transported via the public road network, it is not considered further in this assessment.

3.4 Proposed Hours of Road Haulage

There are currently has no restrictions on when coal may be transported from the Colliery by public road. However, the Proponent recognises that this is not consistent with current community expectations. As a result the Proponent would ensure that no heavy vehicles laden with coal are permitted to depart the Project Site before 7:00am or after 10.00pm

Coal transportation by public road would be undertaken seven days per week.

3.5 **Proposed Heavy Vehicle Movements**

A summary of the proposed maximum daily and peak hour heavy vehicle movements from Charbon Colliery is shown in **Table 1**.

Destination	Average Daily	Maximum Daily	Maximum Peak Hour		
Kandos Cement Plant	14	40	4		
Via Castlereagh Highway	80	200	14		
Via Charbon Road ² 80 200 1		14			
Note1: 1 return trip = 2 movements Note 2: Maximum heavy vehicle movements apply to transportation to both Kandos Cement Plant and via Castlereagh Highway. As a result, in the event that 200 heavy vehicle movements per day were required for transportation via the Castlereagh Highway, no coal would be transported to the Kandos Cement Plant.					
Source: Charbon Coal Pty Limited					

Table 1Proposed Heavy Vehicle Movements1

4 EXISTING TRAFFIC ENVIRONMENT

4.1 Existing and Projected Traffic Levels

Roads and Traffic Authority (RTA) traffic counts for Western Region from 1980 to 2002 (RTA, 2002) were examined to determine existing and future vehicle numbers on the Castlereagh Highway. The published RTA traffic counts are shown in **Table 2.** Figure 1 identifies the location of each of the traffic counts presented in **Table 2**.

Traffic counts for the local road network covering Bylong Road, Cooper Drive, Charbon Road, Angus Avenue and Jamison Road were obtained between 28 October 2008 and 18 November 2008 with the assistance of Mid-Western Regional Council and independent traffic counts. Summary and detailed traffic counts can be found in **Appendix 2**. **Figure 3** identifies the location of each of the traffic counts.

It is noted that transportation of product coal via the Castlereagh Highway was not undertaken during the 2008 traffic surveys undertaken for the Project.

	Table 2							
	RTA Traffic Counts							
99.267 Castlereag	h Highway	north of E	Bylong Roa	ad				
Road/Location	1980	1984	1988	1992	1996	1999	2002	
	AADT	AADT	AADT	AADT	AADT	AADT	AADT	
Castlereagh Hwy	1020	1060	1399	1643	1527	1738	1690	
99.293 Ilford Bylo	ng Road 1I	km east of	Castlerea	gh Highwa	у			
Road/Location	1980	1984	1988	1992	1996	1999	2002	
	AADT	AADT	AADT	AADT	AADT	AADT	AADT	
Bylong Road	3ylong Road 590 700 640 580 644 872 847							
Source: RTA (2002)								

Table 3 presents the proportion of heavy vehicles within the traffic counts used to convert AADT from a raw axle count to vehicles. The percentage of heavy vehicles for Castlereagh Highway was taken from RTA heavy vehicle traffic counts and advised verbally by the RTA at Bowenfels, Lithgow. The heavy vehicle percentage of 12% for the Castlereagh Highway was used for design purposes in an RTA project at Tabrabucca. Heavy vehicle counts for Bylong Road, Cooper Drive, Angus Avenue and Jamison Road were obtained from analysis of traffic count information obtained by the Proponent.

Table 3			
Percentage of Heavy Vehicles			
Road/Location	Heavy vehicle %		
Castlereagh Highway ¹	12		
Bylong Road, Cooper Drive, Angus	20		
Avenue & Jamison Road ²			
Charbon Road ² 16			
Source 1: Pers Comm (RTA, 2009)			
Source 2: Automated Traffic Counts – See Appendix 2			

Table 0

Using the published RTA traffic counts, Mid Western Council traffic counts and independent traffic counts current (2010), traffic levels were forecast using a linear regression spreadsheet (see **Appendix 3**). **Table 4** presents the projected peak hour traffic flows for the roads surrounding the Colliery.

	5	
	Road/Location	2010 ²
	Castlereagh Highway	234 ¹
	Bylong Road	109 ²
Cooper Drive		60 ²
Charbon Road		69 ²
	Jamison Road	44 ²
	Angus Avenue	55 ²
Note 1:	Peak hour volume taken as 15% of daily volume).
Note 2:	Assume growth rate of 1.2%p.a.	

Table 4
Existing Peak Hour Traffic Movements

4.2 Existing Section 94 Contributions

Existing Section 94 contributions for heavy haulage usage of local roads is currently paid to Mid Western Regional Council based on the summary of consents detailed in **Table 5**.

Issuing Authority	Approval No	Approval	Summary of transport and traffic consent
Application		date	, ,
Department of Planning Application: Applies to coal transported from Charbon Underground for domestic purposes.	-	2 Nov 1985	Condition 23. Contributions to road maintenance. The applicant shall pay council a contribution of \$0.50 (indexed annually) per tonne for non export coal exceeding 180,000t per annum transported by road haulage from the Charbon Colliery. Contributions being applied to road maintenance on Coopers Drive, Main Road 215 and Trunk Road 55.
Department of Planning Application: Applies to coal transported by public road for export purposes. Note, no transportation for such purposes.	32/92 33/92	24 June 1993	Condition 19. All export coal shall be transported by rail, except in the case of an emergency as determined by the State Rail Authority when any necessary permits to haul coal along public roads shall be first obtained from the Council. During such times which require road haulage in lieu of rail transport, the applicant shall pay council a sum equal to \$0.03 per tonne per kilometre (indexed annually to the CPI) for such haulage, to be applied to road maintenance works on Cooper Drive. Domestic coal is subject to condition 23 of the Ministers consent dated 2 Nov, 1985.
Department of Infrastructure, Planning and Natural Resources Application: Applies to coal from the Southern Open Cut transported by public road for domestic purposes.	122-3-2003	19 Dec 2003	Condition 14. The applicant shall pay \$0.035 per tonne per kilometre of local road use for domestic coal sales transported on public roads. Condition 73. The applicant shall pay council \$0.05 per tonne of coal transported on local roads to be applied for the maintenance and upgrade of Charbon Road and Cooper Drive at Charbon Village, or other roadworks agreed between the applicant and the council. Condition 15. Applicant shall make a one-off payment of \$15,000 to Council within 21 days of the date of this development consent.

 Table 5

 Summary of S94 Contribution Requirements

4.3 Existing Road Conditions

4.3.1 Introduction

The existing and proposed transportation routes include an arterial road, namely the Castlereagh Highway and sub-arterial, collector and local roads, namely Bylong Road, Cooper Drive, Charbon Road, Angus Avenue, and Jamison Road. The roads and intersections of the study area were inspected by Frank Foley of FJF Group Pty Ltd on 7 November 2008. Photos of various locations on the roads in the vicinity of Charbon Colliery are presented in **Appendix 4**.

The existing and proposed transportation routes are located in a rural area and in traffic engineering terms experiences relatively low traffic flows.

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Bylong Road, Cooper Drive and Charbon Road, are typical of rural roads where lower road design standards are accepted due to low traffic flows. Outside the township of Kandos, the road standards vary considerably with regard to carriageway width, line marking and pavement condition. Some sections of road have been upgraded while others would not meet the recommendations outlined in Table 3.2-4 of the RTA "Road Design Guide" recommendations for pavement width. The following presents a description of the existing road conditions for each Transportation Route.

4.3.2 Transportation Route 1 – CHPP to Kandos Cement Plant

4.3.2.1 Charbon Road

Charbon Road appears to be a granular type pavement with a bitumen seal with other sections of asphalt patches.

The speed limit on Charbon Road is 50 kph through the village area and 60 kph near the industrial area and leading to Charbon Colliery.

4.3.2.2 Charbon Rail Overpass Bridge

The overpass bridge over the railway line which connects Charbon to Cooper Drive is 5.05m wide from barrier to barrier and has a 5kph speed limit. There is a load limit on the bridge of 25t for rigid vehicles and 44t for articulated vehicles. The bridge is constructed of timber and appears to be in fair condition. The bridge surface is in poor condition. Refer to photos 4, 5 & 6 in **Appendix 4**.

Westbound traffic must give way to eastbound traffic crossing the bridge. Once westbound traffic has crossed the bridge, they must give way to traffic on Cooper Drive.

4.3.2.3 Charbon Road – Cooper Drive Intersection

Safe intersection sight distance (SISD) of greater than approximately 150m is achievable for traffic which have crossed the Charbon overpass bridge and are waiting to turn left or right into Cooper Drive.

There is a 50 kph speed limit along Cooper Drive for approximately 250m on both sides of the Cooper Drive - Charbon Road intersection.

Refer to photo 3 in **Appendix 4**.

4.3.2.4 Cooper Drive North of Charbon Road, Bylong Road, Angus Avenue and Jamison Road

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Cooper Drive to the north of the Charbon Road intersection appears to be a granular type pavement with a bitumen seal. A new section of road several kilometres long appears to have been recently upgraded and is in good condition.

Pavements in the township of Kandos leading to the Kandos Cement Plant, appear to be granular type pavements with a bitumen seal and also sections of asphalt. These pavements appear in good condition.

The speed limit on Cooper Drive changes from 50kph at Charbon Road to 80kph heading in the direction of Kandos, before changing back to 50kph on the outskirts of the Kandos township.

Heavy vehicles travelling to the Kandos Cement Plant turn right at Angus Ave, travel over a railway line via a level crossing, turn right into Davies Road which continues on to Jamison Road and the Kandos Cement Plant.

Refer to photo 1 and 2 in **Appendix 4**.

4.3.3 Transportation Route 2 – CHPP via Castlereagh Highway

4.3.3.1 Charbon Road, Railway Overpass and Intersection with Cooper Drive

See Section 4.3.2.1 to 4.3.2.3 for a discussion of this section of the transportation route.

4.3.3.2 Cooper Drive to the South of the Charbon Road Intersection

Cooper Drive to the south of the Charbon Road intersection appears to be sections of granular type pavement with a bitumen seal. The sealed pavement width varies, with sections that are line marked and other sections which are not.

Pavement condition is variable, with some sections in need of maintenance, while other sections appear in good condition.

There is one rail overpass bridge on Cooper Drive (**Figure 3**). The bridge has a width of 6.15m from barrier to barrier.

There is also one level rail crossing on Cooper Drive (**Figure 3**) with a stop sign. Trains passing this level crossing serve Charbon Coal and Kandos Cement with an average of eight and five services per week respectively With existing train services and low existing traffic volumes on Cooper Drive, level of service for Cooper Drive would operate A to B.

The speed limit changes from 50 kph at Charbon Road to 80 kph along Cooper Drive until the intersection of Cooper Drive and Bylong Road.

4.3.3.3 Bylong Road – Cooper Drive intersection.

The layout of the Bylong Road – Cooper Drive intersection is in the shape of an Auxiliary Right Turn lane (AUR). Sufficient room is available for vehicles to "slip" past a vehicle waiting to turn right from Bylong Road into Cooper Drive.

SISD is estimated to be approximately 200m although it is hindered by small trees.

Refer to photo 7 and 8 in Appendix 4.

4.3.3.4 Bylong Road

Bylong Road appears to be a granular type pavement with a bitumen seal and is generally in good condition.

There is one bridge on Bylong Road crossing Carwell Creek (**Figure 3**). The bridge is 5.55m wide from barrier to barrier.

The speed limit along Bylong Road is 80 kph.

4.3.3.5 Bylong Road – Castlereagh Highway intersection

The Bylong Road – Castlereagh Highway appears to be a granular type pavement with a bitumen seal. The pavement is in good condition.

The layout of the Bylong Road – Castlereagh Highway intersection is in the shape of a channelised intersection.

SISD is estimated at approximately 230m in both directions.

Refer to photo 9 and 10 in Appendix 4.

4.3.3.6 Castlereagh Highway – Boulder Road intersection

The Castlereagh Highway – Boulder Road intersection appears to be an asphalt pavement. The pavement is in good condition following a recent RTA remediation project.

The intersection is in the shape of a channelised intersection.

Refer to photo 11 and 12 in **Appendix 4**.

4.4 Accident statistics

Accident statistics for roads and intersections of the study area were provided by RTA Parkes. They are included in **Appendix 7**. Accident statistics are based on records kept by the NSW RTA and NSW Police.

Accident statistics indicate no significant road safety issues at intersections along the transportation routes, particularly relating to accidents involving heavy vehicles. It is noted that the intersection of the Castlereagh Highway and Boulder Road has been upgraded by the RTA to improve safety, ride and alignment since recorded accidents at this intersection.

5 FORECAST TRAFFIC ENVIRONMENT

5.1 Forecast Traffic Growth

Based on historic and existing traffic count figures, future highway traffic numbers have been forecast using a linear regression traffic projection presented in **Appendix 3**, for a period of 7 years from 2010. An annual growth rate of 1.2% per annum was calculated for Bylong Road. Due to the close proximity of Bylong Road to Cooper Drive, Charbon Road, Jamison Road and Angus Avenue, the growth rate of 1.2% was also adopted for these roads.

Road/Location	2010 Total vehicles	2017 Total vehicles	Annual growth rate
Castlereagh Highway	234 ²	265 ²	1.9%
Bylong Road	109	118	1.2%
Cooper Drive	60	66	1.2%
Charbon Road	69	75	1.2%
Jamison Road	44	48	1.2%
Angus Avenue	55	60	1.2%
Note 1: Heavy vehicle totals generated by Charbon Colliery are not included in total vehicle numbers.			
Note 2: Peak hour volume taken as 15% of daily volume			

Table 6Forecast (2017) Peak Hour Two-Way Traffic Flows1

6 CHARBON COLLIERY TRAFFIC GENERATION

The forecast peak hour traffic flow of the roads that would be used to transport coal with the additional heavy vehicles generated by Charbon Colliery after 7 years are shown in **Table 7**.

Road/Location		Forecas project Traffic	Maximum Project- related	
		2017	2017	Heavy
		Light	Heavy	Vehicle
		vehicles	Vehicles	Movements
Castler	eagh Highway	233	32	14 ¹
Ву	long Road	94	24	14 ¹
Cooper Drive		53	13	14 ¹
Charbon Road		63	12	14 ²
Jamison Road		36	12	4 ³
Ang	gus Avenue	57	3	4 ³
Note 1: Maximum number of Project-related heavy vehicles travelling via the Castlereach Highway.				
Note 2: Maximum number of Project-related heavy vehicles travelling to either Kandos or via the Castlereagh Highway			ehicles travelling vav	
Note 3: Maximum number of Project-related heavy vehicles travelling to Kandos				

Table 7 Forecast (2017 Maximum) Peak Hour Two-Way Traffic Flows

IMPACT ON ROADS AND TRAFFIC 7

7.1 Level of service (LOS) of roads and intersections of the study area

Level of service (LOS) is the standard used to measure the performance of a road or intersection. This is defined as the qualitative assessment of the quantitative effects of factors such as speed, traffic volume, geometric features, delays and freedom of movement. The RTA provides general advice in their guide to "Traffic generating developments" on level of service for intersections and roads. This is shown in Table 9 and Table 10 respectively below;

Intersection Level of service criteria					
Level of Service	Average Delay	Give way and stop signs			
	Per Vehicle				
	(s/veh)				
A	Less than 14	Good operation			
B 15 to 28		Acceptable delays & spare capacity			
С	29 to 42	Satisfactory but accident study			
		required.			
D	43 to 56	Near capacity and accident study			
		required.			
E	57 to 70	At capacity, requires other control			
		mode.			
F Over 70 Over capacity					

		Та	ble 8	
Intersec	tion l	Leve	l of service	criteria
-				

Road Level of service criteria				
Level of	of Level of Service definition			
Service				
А	Free flow condition, high degree of freedom for drivers to select desired speed			
	and manoeuvre within traffic stream			
В	Zone of stable flow, reasonable freedom for drivers to select desired speed and			
	manoeuvre within traffic stream			
С	Zone of stable flow, restricted freedom for drivers to select desired speed and			
	manoeuvre within traffic stream			
D	Approaching unstable flow condition, severely restricted freedom for drivers to			
	select desired speed and manoeuvre within traffic stream			
E	Condition close to capacity, virtually no freedom for drivers to select desired			
	speed and manoeuvre within traffic stream. Small increases in flow will generally			
	cause operational problems.			

Table 9

With reference to **Tables 9** and **10** and existing and forecast traffic volumes, heavy vehicles generated by Charbon Colliery would have a negligible impact on traffic on the roads and intersections of the study area. These roads and intersections are shown in **Figure 3** and would operate satisfactorily at a level of service of A or B with minimal delays and spare capacity.

7.2 Impacts on Road Pavements Surrounding the Project Site

It would be expected that an increase in heavy vehicles would have an impact on road pavements on Bylong Road, Cooper Drive, Charbon Road, Angus Avenue and Jamison Road. It is acknowledged, however, that transportation of coal via public roads to the Mt. Piper Power Station is likely to be campaign based and intermittent. In addition, maintenance, rehabilitation and upgrade of these roads comes under the control of Mid Western Regional Council. Accordingly, the Proponent proposes to continue paying the current Section 94 contributions to Council for the maintenance, rehabilitation and upgrade of these roads and intersections.

7.3 Bylong Road – Castlereagh Highway intersection

It is noted that the Colliery currently has approval to transport an unlimited amount of coal via this intersection. As a result, the Project would not result in any significant impact on the intersection.

It is acknowledged, however, that the intersection was measured and analysed in accordance with Appendix A4.1 of the RTA "Road Design Guide". Calculations can be found in **Appendix 5**. To comply with the RTA "Road Design Guide" the right turn lane from the Castlereagh Highway into Bylong Road would need to be 95m long. The linemarked length is approximately 80m with additional capacity of approximately 22 m. In light of the fact that the Proponent currently has approval to transport coal via this intersection, that such transportation would continue to be campaign based and intermittent and that there has never been a traffic-related incident associated with transportation of product coal from the Colliery, the Proponent proposes no changes to this intersection.

7.4 Castlereagh Highway – School zones

It is noted that the route taken by coal haulage trucks from Charbon to Mt Piper and potentially beyond would take coal haulage trucks through Ilford, Capertee and Cullen Bullen and past schools in each village. During the morning and afternoon school zone period it would be anticipated that the Project would generate a total of seven southbound and seven northbound movements per hour. **Table 10** presents the 2010 peak hour total vehicle movements on the Castlereagh Highway and the proposed maximum Project-related peak hour movements. The traffic generated by the Project would comprise 6% in 2010 and 4.5% in 2017 of total traffic on the highway. This is considered to be such a small proportion of the total traffic that would pass the school during the school zone periods that the impacts would be negligible. In addition the Castlereagh Highway is an arterial road and is the most appropriate route for transportation of coal to Mt Piper and beyond from Charbon Colliery.

	% Project-related Traffic on Castlereagn Highway				
ſ	Year	Total vehicles (two way)	+ coal haulage vehicles generated by Charbon Colliery	Percentage increase of total vehicles	
ľ	2010	234	+8	6%	
ſ	2017	265	+8	4.5%	

Table 10 % Project-related Traffic on Castlereagh Highway

8 MITIGATION OF TRAFFIC IMPACTS

Existing and forecast vehicle numbers indicate that there would be negligible impact on roads and intersections surrounding the Project Site to the traffic generated by Charbon Colliery. Roads and intersections would be expected to operate satisfactorily with minimal delays and spare capacity. No capacity improvements at intersections would therefore be required.

To address impacts on road pavements on Bylong Road, Cooper Drive, Charbon Road, Angus Avenue and Jamison Road due to the heavy vehicles generated by Charbon Colliery, Charbon Coal would continue payment of the current Section 94 contributions to Mid Western Regional Council to fund any necessary maintenance and rehabilitation works.

As a positive impact on safety and to mitigate impacts on road users and travelling past local schools, Charbon Coal would implement a Transportation Management Plan which as a framework would include the following;

- Truck Driver's Code of Conduct with disciplinary action for non-compliance.
- Hours of haulage, adherence to speed limits, truck cleanliness.
- Procedures for crossing narrow bridges on Charbon Road, Cooper Drive and Bylong Road.
- Limitation on use of compression brakes in built up areas.

- Emergency, accident, incident, complaint or non-compliance response and reporting.
- Training requirements.
- Fatigue management procedures.
- Audit and review.

9 CONCLUSION

This report has taken the worst case scenario by considering traffic projections for heavy vehicle road haulage for the life of the Project, namely 7 years from 2010 to the year 2017. In summary, following implementation of the mitigation measures outlined in this report, the traffic implications of road haulage of coal from Charbon Colliery to Kandos Cement Plant and via the Castlereagh Highway would not impact on the safety or performance of the roads and intersections of the study area.

10 **REFERENCES**

RTA 2002, Traffic counts for Western Region from 1980 to 2002

RTA Guide to Traffic Generating Developments

APPENDICES

(No. of pages excluding this page = 55)

Appendix 1	Director General's and Environmental Assessment Requirements
Appendix 2	Traffic count summary and detailed traffic counts
Appendix 3	Traffic projection spreadsheets
Appendix 4	Photos
Appendix 5	Intersection calculations
Appendix 6	Castlereagh Highway – Boulder Road Intersection
Appendix 7	Accident Statistics

NOTE: Copies of Appendices 2 to 7 are presented on the Project CD

Charbon Colliery Continued Operations Report No. 753/03

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8 - 28

Appendix 1

8 - 29

Director General's and Environmental Assessment Requirements

(No. of pages excluding this page = 1)

Table A1 Director General's and Environmental Assessment Requirements and Where Each is Addressed

Government Authority	Paraphrased Requirement	Relevant Section		
Department of Planning (6/2/09)	Include a detailed traffic impact study.	Entire document		
Roads and Traffic Authority (29/10/08)	A traffic study is to be undertaken which includes, but is not limited to, origin-destination of vehicles. This should include staff, contractors, construction, and maintenance personnel during both the construction and operation phases of the development. The study should include vehicle types, volumes and times of peak travel and include existing, proposed, and 10 year projected figures for the Castlereagh Highway (HW18) and Bylong Valley Way (MR215).	3 and 4 (also see note below)		
	A Traffic Impact Study detailing expected vehicle types, volumes and movements for transportation. This is to include the proposed haulage routes from the mine site via public roads to local customers.	2 and 4		
	Intersection treatments and mitigation measures to cater for predicted traffic impacts. This is to include any required temporary or staged treatments and other measures such as covering of loads. The intersections and accesses are to cater for all heavy and over dimensional vehicles that will be accessing the development.	7 and 8		
	Speed and fatigue management. Employee and contractor vehicle speed on public roads, and employee and contractor driver fatigue are of significance under the conditions proposed for this development.	8		
	A Train Operations Study is to be undertaken. This study is to cover the extent of travel between the origin and destination of trains, and should take into account any existing and proposed developments in the area, as well as rail line capacity.	Not relevant.		
	Details of on-site parking provisions and on-site delivery/service areas are to be provided.	Environmental Assessment		
Note: As the traffic associated with staff, contractors and maintenance personnel will be unchanged as a result of the Project, that aspect of these requirements is not relevant to this assessment				
Appendix 2

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Traffic count summary and detailed traffic counts (Detailed Traffic Counts Are Presented on the Project CD)

(No. of pages excluding this page = 27)

FJF Group Pty Ltd

Charbon Colliery Continued Operations Report No. 753/03

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CfelT bob.white@cfeit.com (02) 9740 8600

Traffic Count Summary Report

ſ	-			38	507 437	Dav	Average	-	7	7	-	2	12	32	30	29	31	26	25	24	24	30	41	29	23	18	13	11	6	12	1	437	
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CfelT bob.white(@cfeit.com ((02) 9740 860	0				F	raffic Cou	int Sum	mary Re	port
Count Number	3823		Ref : FJ	Ŀ					000	GLE	$\left[\right]$
Street	DAVIES ROA!	D, KANDOS : B	etween JAMIS	ON ROAD & I	McDONALD ST	REET (bidire	ctional) :				
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6am - 7am	14	10	18	8	12	0	0	62	12	62	6
7am - 8am	43	33	37	35	30	6	1	178	36	194	58
8am - 9am	17	15	15	12	10	5	-	69	14	75	7
9am - 10am	12	17	22	15	15	9	2	81	16	89	13
10am - 11am	15	14	14	17	15	9	0	75	15	81	12
11am - Midday	13	22	24	24	18	10	2	101	20	113	16
Midday - 1pm	31	31	33	30	39	4	2	164	33	170	24
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2pm - 3pm	12	20	6	16	17	3	3	74	15	80	1
3pm - 4pm	24	17	24	17	19	2	9	101	20	109	16
4pm - 5pm	31	21	26	28	20	4	m	126	25	133	19
5pm - 6pm	9	15	9	10	1	9	5	38	œ	49	7
6pm - 7pm	2	8	5	10	5	0	4	30	9	34	5
7pm - 8pm	3	8	2	8	1	5	5	22	4	32	2
8pm - 9pm	2	4	-	4	2	4	1	13	3	18	e
9pm - 10pm	2	2	2	3	2	1	0	1	2	12	7
10pm - 11pm	0	4	2	2	2	2	0	10	2	12	2
11pm - Midnight	3	12	11	8	4	4	2	38	œ	44	9

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213

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270

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294

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Total

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Street DAVIES ROAD, KANDOS : Between JAMISON ROAD & MCDONALD STREET (bidirectit About 30 mts north of Angus Avenue, on Cross Roads Sign .ocation About 30 mts north of Angus Avenue, on Cross Roads Sign TON-u8 .ocation ToTAL COUNT MATRIX Start Time 12-NOV-u8 Mon TUE WED THU FN Intration 1 0 0 0 0 am -2am 0 0 0 1 1 1 am -2am 0 0 0 1 0 1 0	Count Number	3824		Ref : FJ	14					GOO	OGLE	
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	1pm - Midnight	2	2	2	2	1	4	2	6	2	15	2
01a 301 300 402 403 434 340	otal	381	366	463	432	470	404	327	2112	422	2843	406

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<u>MetroCount Traffic Executive</u> Weekly Vehicle Counts

WeeklyVehicle-119 -- English (ENA)

10:57 Tuesday, 28 October 2008 => 13:44 Tuesday, 18 November 2008 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 10 - 160 km/h. North, East, South, West (bound) [153] Bylong Valley Way 8.4klms north of Castlereagh Highway 1 - North bound, A hit first, Lane: 0 10:57 Tuesday, 28 October 2008 => 13:44 Tuesday, 18 November 2008 \\netserv\users\smulhol\MetroCount Data\15318Nov2008.EC0 (Plus) E809CDK1 MC56-6 [MC55] (c)Microcom 02/03/01 Metric (meter, kilometer, m/s, km/h, kg, tonne) Vehicles = 17377 / 17405 (99.84%) Factory default Axle sensors - Paired (Class/Speed/Count) Vehicle classification (ARX) Factory default profile All - (Headway) <u>Profile:</u> Filter time: Included classes: Speed range: Survey Duration: Separation: Identifier: Algorithm: Data type: Site: Direction: Direction: Units: In profile: Datasets: Scheme: Name: File:

<u>Weekly Veh</u>	<u>icle Counts</u>
Site:	153.0N
Description:	Bylong Valley Way 8.4klm
Filter time:	10:57 Tuesday, 28 Octobe
Schomo.	Vehicle closeification (ADV)

			1						
Site: Descriptior Filter time: Scheme: Filter:	<u>1</u>	153.0N Bylong 10:57 T(Vehicle Cls(1 2 3	Valley Wa Lesday, 2 classificati 3 4 5 6 7 8	ay 8.4klm: 8 October on (ARX) 9 10 11 1	s north o i r 2008 => 2) Dir(NE	f Castlere 13:44 Tue ESW) Sp(1	agh High ssday, 18 10,160) He	way Novembe ∋adway(>0	r 2008)
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1000-1100	*	2	46	43	41	77	73<	33.0	47.0
1100-1200	*	48	50	58	51	>86	66	51.8	61.8<
1200-1300	*	52	43	47	65	70	62	51.8	56.5
1300-1400	*	50	54	67	49	54	81	57.3	60.7
1400-1500	ĸ	70	60	85<	2 96	51	92<	77.8<	75.7<
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1800-1900	* *	32	104	70 36	23 F	47	35	42.5	42 U
1900-2000	*	17	19	23	9.0	21	22	23.5	22.8
2000-2100	*	6	18	16	21	12	16	16.0	15.3
2100-2200	*	12	6	17	32	13	19	17.5	17.0
2200-2300	*	9	11	10	17	10	5	11.0	9.8
2300-2400	*	8	4	ŝ	11	80		7.0	6.5
Totals									
0100-1900	*	*	670	753	762	669	735	701.6	702.5
0600-2200	*	*	758	858	168	774	802	802.6	791.8
0600-0090	*	*	773	873	919	792	810	820.6	808.2
0000-0000	*	*	816	914	960	821	826	862.3	842.2
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Site: Descriptior Filter time: Scheme:	2	153.0N Bylong 10:57 Tu Vehicle o	Valley Wa Jesday, 2 classificati	ay 8.4klm 8 October on (ARX)	s north o r 2008 =>	f Castlere 13:44 Tue	agh High ssday, 18	way Novembe	er 2008
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	Mon 03 Nov	Tue 04 Nov	Wed 05 Nov	udT Nov 06	Eri 07 Nov	OR Now	uns Non	Average: 1 - F	. r
Hour) 1	•
0000-0100		с ,	ΜI	m ·	01	ω,	т М	2.4	с.
0100-0200	0,	- (ы С	4	• n	~ ~	ন- বা (0.0 0.0	3.0
0300-0300	ıα	n c	יט רי	יטרי	4.0	4" 5	 	20.5	9.0
0400-0500	10	1 00	, œ	10	1 10	יי יי		1 - C	0.0
0500-0600	24	20	19	26	16	11	1	21.0	18.1
0600-0700	46	43	40	33	45	18	10	41.4	33.6
0700-0800	56	41	45	50	47	28	191	47.8	40.9
0800-0900	64	39	63	64<	68<	47	38	59.6<	54.7
0001-0060	63	40	63<	48	49	45	41	52.6	49.9
1000-1100	61	40	51	52	46	71<	47	50.0	52.6
1100-1200	68<	58<	43	43	61	65	84<	54.6	60.3
1200-1300	63	42	48	48	63	61	52	52.8	53.9
1300-1400	44	40	52	54	20	28	1 62	49.2	54.7
1500-1500	40 1 1	μ 1. C	00	505	0.5	54 V	106<	53.0	59.4
1600-1700	12	>02	76<	v 19	10	44		2.00 66 64	51.74
1700-1800	67<	47	40	52 .	76<	44	20	56.4	53.7
1800-1900	38	33	43	33	43	32	38	38.0	37.1
1900-2000	24	17	21	22	33	22	38	23.4	25.3
2000-2100	8	12	21	15	29	თ	18	17.0	16.0
2100-2200	11	11	12	21	18	თ	16	14.6	14.0
2200-2300	б и		co o	11	17	15	16	10.4	11.9
0054	2	r	5	.	Þ	1 1	- —	0	0.0
Totals									
0700-1900	678	543	639	625	719	602	662	640.8	638.3
0600-2200	767	626	733	716	844	660	744	737.2	727.1
0600-0000	781	637	749	733	867	686	764	753.4	745.3
0000-0000	825	674	792	784	902	720	784	795.4	783.0
AM Peak	1100	1100	0060	0800	0800	1000	10011		
	68	58	63	64	68	11	84		
PM Peak	1700	1600 70	1600 76	1600 61	1700	1500 62	1400		
	;	,	?	1	<i>.</i>	12	- >>+		

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Weekly Vehicle Counts

i					We	ekly V	ehicle (Counts	
Site: Descriptior Filter time: Scheme:		Bylong ' 10:57 Tu	Valley Wa lesday, 25 loccificati	ay 8.4klms 8 October	s north o r 2008 =>	f Castlere 13:44 Tu	agh High esday, 18	way Novembe	r 2008
ourenie. Filter:		Cis(123	4 5 6 7 8	9 10 11 1	2) Dir(NI	.)dS (MS∃	10,160) He	eadway(>0	<u> </u>
	Mon	Tue	Wed	nųL	Fri	Sat	Sun	Averages	
	10 Nov	11 Nov	12 Nov	13 Nov	14 Nov	15 Nov	16 Nov	1 - 5,	1 - 1
Hour DDDD-0100	¢		ç		-	01	 . r	c	c
0100-0200	n m	* 7	4 m	r (*	- ~	0 4		0 C 1 M	n.
0200-0300		• ~	. –	0 01	14	10	10	2.0	1.7
0300-0400	9	ъ	4	8	Ω.	i m		4.4	3.7
0400-0500	9	9	80	ъ С	9	4	7	6.2	5.3
0500-0600	21	11	17	21	14	10	4	16.8	14.0
0600-0700	48	41	31	47	40	20	1 2	41.4	33.4
0700-0800	51	47	59	41	53	33	17	50.2	43.0
0800-0800	80 1 80	74<	78<	76	64	53	27	74.4<	64.6
000T-0060	8 v 1	8 8 8	0 <u>5</u>	65	99	58	45	59.4	57.1
1100-1100	4 F	19	61 61	76<	75<	65<	57<	66.6 7	65.0<
1200-1300	# 0 ~ V	- L U	0.5	- C 4	/00 F	10 U	 0 C	0.10	0.00 0
1300-1400	64	48	51.5	61 61	9 6	45		64.0 64.0	61.3
1400-1500	70<	74<	47	69	<i>LL</i>	55	67	67.4	65.6
1500-1600	66	62	52	68	77	57<	81<	65.0	66.1
1600-1700	65	57	83<	79<	88	48	73	74.4<	70.4<
1700-1800	49	53	50	43	69	39	60	52.8	51.9
1800-1900	44	60	34	40	62	35	51	43.8	43.6
1900-2000	52	17	21	21	6 E	19	18	25.4	23.4
2000-2100	17	14	1:	22	22	10	29 -	17.2	17.9
0022-0012	1 4	# u 	77	7	о г Н	את		13.0	1.21
2300-2400	0 M) বা	o m	ΥΩ	11	ۍ c	 n vo	5.2	0.0 0.0
Totals									
0700-1900	744	683	663	728	884	590	667	740.4	708 4
0600-2200	849	769	738	830	1001	648	132	837 4	795 3
0600-0000	858	778	747	846	1019	629	743	849.6	807.1
0000-0000	868	810	782	883	1051	692	755	884.8	838.7
AM Peak	0800	0800	0800	1000	1000	1000	10001		
	80	74	78	76	75	65	57		
PM Peak	1400 70	1400 74	1600 83	1600 79	1200 100	1500 57	1500 81		

 Volume Value Way 8.4klms north of Castlereagh Highway
 10:57 Tuesday, 28 October 2008 => 13:44 Tuesday, 18 November 2008
 Vehicle classification (ARX)
 Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0) 649.0 721.5 735.5 767.5 - 7 н Averages 1 - 5 **Weekly Vehicle Counts** 649.0 721.5 735.5 767.5 Nov * * * * * * * * 23 Sat * * * ж. 22 Fri Nov * * * * * * * 21 Thu Nov * * * 20 Wed 19 Nov * * * * * * 153.0N Tue Nov 0 4 0800 67 * * 18 Mon Nov L100 68 676 752 766 802 600 1 Site: Description: Filter time: Scheme: Filter: 0700-1900 0600-2200 0600-0000 0000-0000 AM Peak Peak Totals Md

CHARBON COAL PTY LIMITED Charbon Colliery Continued Operations Report No. 753/03

<u>MetroCount Traffic Executive</u> <u>Daily Classes</u>

DailyClass-120 -- English (ENA)

<u>Datasets:</u>	[153] Bylong Valley Way 8.4klms north of Castlereagh Highway
Site:	1 - North bound, A hit first., Lane: 0
Direction:	10:57 Tuesday, 28 October 2008 => 13:44 Tuesday, 18 November 2008
Survey Duration:	Nnetservhusers/smulholl/MetroCount Data/15318Nov2008.EC0 (Plus)
File:	E809CDK1 MC56-6 [MC55] (c)Microcom 02/03/01
Algorithm:	Factory default
Data type:	Axle sensors - Paired (Class/Speed/Count)
<u>Profile:</u> Filter time: Included classes: Speed range: Direction: Scparation: Name: Scheme: Units: In profile:	10:57 Tuesday, 28 October 2008 => 13:44 Tuesday, 18 November 2008 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 10 - 160 km/h. North, East, South, West (bound) All - (Headway) Falcory default profile Vehicle classification (ARX) Metric (meter, kilometer, m/s, km/h, kg, tonne) Vehicles = 17377 / 17405 (99.84%)

Bylong Valley Way 8.4klms north of Castlereagh Highway 10:57 Tuesday, 28 October 2008 => 13:44 Tuesday, 18 November 2008 Vehicle classification (ARX) Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0) Total 485 816 914 960 826 896 821 867 823 0.0 0.0 0.0 0.0 0.0 0.0 0.0 10 0.0 0.0 0.0 **Daily Classes** 9.1 25 3.1 1.0 0.5 0.2 뒤 0 0.0 11.2 0.2 1.2 14 1.6 58 12.0 **1**000 80 8.80 8.80 54 6.6 79 8.8 31 3.8 89 9.7 7.3 1.2 59 6.8 1.1 о.4 О.4 0.0 8 O.9 0.1 **o** 0 0 1.4 192.3 1.2 1.5 о.6 О.б 0.0 0.0 ч г. 0 0.0 0.0 1.0 0.0 0.1 **co** | O 0.2 0.2 0.0 0.0 00.0 0.0 0 0.0 0 0.0 0.0 00.0 0.0 **9**0.0 0.0 т. 0 0.0 0.2 0.1 0.2 0.1 0.1 4 0.4 0.8 8 0 0 0 **0** 60.7 0.5 8 O.O 0.5 9 1.1 11.2 14 1.5 11 1.2 35 7.2 48 5.9 51 5.6 0.0 11.3 1.3 61 6.4 3.7 39 4.5 52 5.8 202.4 153.0N 0.0 11 2.3 26 3.2 3.3 48 5.0 79 9.6 58 7.1 68 8.3 47 5.4 343.8 2008 Average daily volume 600 73.5 676 78.0 0.0 351 72.4 703 76.9 737 76.8 656 79.9 687 83.2 680 75.9 671 81.5 October week 10 1.2 Site: Description: Filter time: Scheme: Filter: 1.2 00 6.0 0.4 0 5 0.5 1.5 28 3.4 0.4 19 2.3 d 27 Weekdays Monday, Weekend Entire Tue* (%) Mon* (%) Sat (%) **Wed** (%) **Thu** (%) **Fri** (%) Sun (%) (%) (%) (%) (%)

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DailvCl	ass-1	00												
Site: Descrip Filter ti	otion: me:		153.(Bylo 10:5	N ng Val 7 Tues	ley Wa day, 2	ay 8.4k 8 Octo	dms n ber 2(orth o 08 =>	f Castl 13:44	lereagl Tuesc	h High lay, 18	way Nover	nber 2005	~
Schem Filter:			Vehi Cls(1	cle clas 2 3 4	ssificati 5 6 7 8	on (AF 9 10	XX) 11 12)	Dir(NE	ESW)	Sp(10,	160) H	eadway	(0<)	
Monday,	3 Nov	rember	2008	4	ſ	v		α	đ	0	÷	10	∏ 01a]	
Mon	8	634	43	35	6	0	.	4	n n	75	12		825	
(%)	1.0	76.8	5.2	4.2	0.8	0.0	0.1	0.5	0.6	9.1	1.5	0.1		
Tue	٢	514	17	38	12	4	m	0	m	64	12	0	674	
(%)	1.0	76.3	2.5	5.6	1.8	0.6	0.4	0.0	0.4	9.5	1.8	0.0		
Wed	4	623	26	49	9	-1	ы	S	٢	56	14	0	792	
(%)	0.5	78.7	3°3	6.2	0.8	0.1	0.1	0.6	0.9	7.1	1.8	0.0		
Thu	12	605	27	52	6	2	e	4	ß	56	6	0	784	
(%)	1.5	77.2	3.4	6.6	1.1	0.3	0.4	0.5	0.6	7.1	1.1	0.0		
Eri	13	664	75	46	13	m .	Ч	m	4	99	14	0	902	
(%)	1.4	73.6	ю. 8	5.1	1.4	0.3	0.1	0.3	0.4	7.3	1.6	0.0		
Sat	18	600	53	26	9	2	0	ч	2	11	Ч	0	720	
(%)	2.5	83.3	7.4	3.6	0.8	0.3	0.0	0.1	0.3	1.5	0.1	0.0		
Sun	41	618	16	17	9	-	0	2	0	19	4	0	784	
(%)	5.2	78.8	9.7	2.2	0.8	0.1	0.0	0.3	0.0	2.4	0.5	0.0		
Average	vlich	mulov .	ġ											
Entire	veek													
	14	608	45	37	7	Ч	Ч	2	m	48	С	0	782	
(%)	1.8	L. TT	5.8	4.7	0.9	0.1	0.1	0.3	0.4	6.1	1.2	0.0		
Weekday	6													
	8	607	37	44	თ	1	ы	2	4	63	11	0	794	
(%)	1.0	76.4	4.7	5.5	1.1	0.1	0.1	ю . 0	0.5	7.9	1.4	0.0		
Weekend	0		č	č	,			,		1				
(%)	3.9	6U8 81.0	64 8.5	2.8	۰° ۹ 0.8	- T - T	0.0		o.o	2.0	0.3	0.0	14/	

153.0N Bylong Valley Way 8.4klms north of Castlereagh Highway 10:57 Tuesday, 28 October 2008 => 13:44 Tuesday, 18 November 2008 Vehicle classification (ARX) Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0) Total 898 810 782 883 1051 692 755 838 884 723 0.0 0.0 0.0 0.0 00.0 0.0 0.0 120 0.0 1.0 0.1 **Daily Classes 11** 1.4 16 2.0 15 2.2 0.3 0.3 1.61.1 14 1.8 18 1.7 1.4 81 10.4 66 8.1 76 7.2 15 2.0 18 2.5 91 43 4.9 72 8.1 10.8 22 56 6.7 0.0 60.7 თ 8 O.O 1.0 0.0 20 2.6 0.8 6°0 0.1 1.1 0.4 0 00.0 0.1 0.1 1.0 0.3 0.0 0.6 10.1 4 0.4 0.0 0.0 00.0 0.3 0.0 0.0 0.0 0.0 5 0.3 m 0.4 0.1 0.5 е с. О. Э 3 0.4 0.0 0.1 0.2 0.1 1.0 0.1 33 33 3.7 32 1.3 0.8 0.8 18 2.0 1.5 7.0 11 1.6 15 1.8 8 1.1 47 5.8 53 6.0 45 45 5.0 51 46 4.4 142.0 19 2.5 39 4.7 475.3 16 2.2 2008 26 3.2 26 3.3 28 3.2 52 7.5 75 9.9 30 3.4 63 8.7 3.0 4.5 39 4.7 27 Average daily volume November 601 74.2 562 71.9 553 79.9 606 80.3 643 76.7 80.2 827 78.7 669 75.7 579 80.1 653 708 72.7 DailyClass-120 **Description:** 18 2.0 1.4 9.1 1.1 16 1.5 15 31 4.1 15 1.8 12 1.4 23.2 Filter time: Scheme: week 9 Weekdavs Weekend Monday, Filter: Entire Site: **Sat** (%) Mon %

Thu (%) (%) (%) (%)

Sun (%)

(%)

(%)

%

Tue (%) **Wed** (%) 8 - 47

DailvCl	acc-1	,							Da	ilv	lass	es	
Site: Site: Descrip Filter ti Schem Filter:	ation: me: e:	2	153.0 Bylo 10:51 Vehic Cls(1)N ng Vall 7 Tues de clas 2 3 4 {	ley Wa day, 2 sificati 5 6 7 8	17 8.4 8 Octo on (AF 9 10 1	d ms n bber 2(XX) 11 12)	orth of 08 => Dir(NE	f Castl 13:44 ESW) S	ereagl Tuesc Sp(10, ⁻	h High lay, 18 160) H	way Nover eadwa)	nber 2008 (>0)
Monday,	17 No	vember 2	2008 3	4	μ.	e	٢	œ	σ	01	1	1	Total
Mon (%)	0.2	618 77.1	34 4.2	65 8.1	1.0	0.0	0.6	0.2	0.4	52 6.5	13 1.6	0.0	802
Tue* (%)	20.5	297 74.1	2.2	35 8.7	1.2	3 0.7	20.5	0.0	3 0.7	37 9.2	2.0	0.0	401
Wed* (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Thu* (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Fri* (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Sat* (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
<mark>(%)</mark>	0.0	00.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Average	daily	volume	a 1										
Entire (%)	week	618 77.1	34 4.2	65 8.1	1.0	0.0	0.6	0.2	3 0.4	52 6.5	13 1.6	00.0	802
Weekday (%)	s 2 0.2	618 77.1	34 4.2	65 8.1	8 1.0	0.0	5 0.6	0.2	3 0.4	52 6.5	13 1.6	0.0	802

<u>MetroCount Traffic Executive</u> <u>Daily Classes</u>

DailyClass-118 -- English (ENA)

<u>Datasets:</u> Site: Direction: Survey Duration: File: Identifier: Algorithm: Data type:	[155] Cooper Drive 100mtrs north of Canary St, Clandulla 1 - North bound, A hit first., Lane: 0 11:53 Tuesday, 28 October 2008 => 13:50 Tuesday, 18 November 2008 \netserv/users\smulholl\MetroCount Data\15518Nov2008.EC0 (Plus) T130H9XW MC56-L5 [MC55] (c)Microcom 19Oct04 Factory default Axle sensors - Paired (Class/Speed/Count)	
Profile: Filter time: Included classes: Speed range: Direction: Separation: Name: Scheme: Units: In profile:	11:53 Tuesday, 28 October 2008 => 13:50 Tuesday, 18 November 2008 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 10 - 160 km/h. North, East, South, West (bound) All - (Headway) Factory deault profile Vehicle classification (ARX) Metric (meter, kilometer, m/s, km/h, kg, tonne) Vehicles = 10414 / 10417 (99.97%)	

155.0N Cooper Drive 100mtrs north of Canary St, Clandulla 11:53 Tuesday, 28 October 2008 => 13:50 Tuesday, 18 November 2008 Vehicle classification (ARX) Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0) Total 0 298 550 560 517 360 506 553 438 551 0.0 0.0 0.0 0.0 0.0 0.0 50 °. 0.0 0.0 0.0 **Daily Classes** 0.0 2.3 20 3.6 1.6 1 0.4 0.6 1.4 0.5 1.411 2.0 1 œ 23 22 7.4 27 397.0 45 3.2 407.7 1.9 30 5.9 37 **o** 0 0.0 0.0 0.0 0.0 0.2 20.7 0.0 0.4 0.2 10.2 **0**00 ° °. 0.62 о.5 0.2 ¢ 0.0 0.2 0.2 0.2 0.2 -00.0 0.0 0.0 0.0 0.0 0.0 00.0 0.0 0.0 0.0 0.0 • • • • 0.0 0.4 з. 0.5 0.0 0.0 0.0 0.2 0.0 2 O.9 0.0 5 1.7 е . 0.6 0.6 1.6 0.8 1.3 0.5 1.3 5 0.0 17 5.7 37 6.7 44 7.9 25 4.5 13 2.5 с 8. 0 1.8 24 4.7 34 6.1 0.0 ө 0. 3.0 10 1.8 1.4 13 2.4 25 4.8 26 7.2 3.0 3.0 1.8 25 5.7 œ 2008 Average daily volume 233 78.2 445 80.9 447 79.8 317 88.1 414 81.8 443 80.1 368 84.0 October 0.0 79.9 421 81.4 440 DailyClass-118 0.4 а 0.5 Description: ... 1.0 1.3 о.5 1.1 0.0 1.9 10.3 0.8 week Filter time: 27 Scheme: Weekdays Weekend Monday, Filter: Entire Site: Mon* **Tue*** (%) **Wed** (%) **Thu** (%) **Sat** (%) (%) Eri (%) (%) (%) (%) (%) (%)

SPECIALIST CONSULTANT STUDIES Part 8: Traffic Assessment

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									õ	aily C	lass	es	
Site: Descrip Filter til	otion: me:		155.0 Coop 11:53	N ber Dri S Tues	ve 100 day, 2	8 Octo	ober 2	of Can 008 =>	ary St 13:50	, Clanc Tuesc	dulla Iay, 18	3 Novel	nber 20
Scrierri Filter:			Cls(1	2 3 4	5 6 7 8	01 (Ar	11 12)) Dir(N	ESW)	Sp(10,	160) H	eadwai	(0<)/
Monday,	3 Nov	rember 2	2008 3	4	ι.	ý	٢	α	σ	01	5	1	Letof
Mon	0	348	4	17	9	0	0	0	4	202	12	0	443
(%)	0.5	78.6	0.9	3.8	1.4	0.0	0.0	0.0	0.9	11.3	2.7	0.0	
Tue	4	325	9	24	თ	1	0	0	2	31	80	0	410
(%)	1.0	79.3	1.5	5.9	2.2	0.2	0.0	0.0	0.5	7.6	2.0	0.0	
Wed (%)	20.4	419 85.7	1.2	19 3.9	3 0.6	0.0	0.0	0.0	0.2	31 6.3	1.6 8	0.0	489
Thu (%)	1.0	400 79.8	12 2.4	40 8.0	1.2	0.0	0.2	10.2	3 0.6	27 5.4	1.2	0.0	501
Fri (%)	1.5 9	451 77.4	27	35 6.0	1.2	0.0	00.0	0.0	0.3	43 7.4	1.5	00.0	583
Sat (%)	1.1	410 89.3	15 3.3	23 5.0	20.4	0.0	0.0	0.0	0.0	4 0.9	0.0	0.0	459
Sun (\$)	14 3.6	319 81.8	23 5.9	17 4.4	2 0.5	0.0	0.0	0.0	2 0.5	11 2.8	20.5	0.0	390
Average	daily	volume	ØI										
Entire 1	veek												
(%)	1.1	381 81.6	13 2.8	24 5.1	0.9 4	0.0	0.0	0.0	0.2	27 5.8	1.3	0.0	467
Weekday:	ن م	000								:		,	
(%)	о.6	388 80.2	11 2.3	26 5.4	1.2	0.0	0.0	0.0	0.2	36 7.4	1.7	0.0	484
Weekend													
(8)	2.1	364 85.8	18 4.2	19 4.5	0.5	0.0	0.0	0.0	0.0	1.7	0.0	0.0	424

DailvCla	11-se	a							Da	ily C	lass	es	
Site: Site: Descript Filter tin Scheme	tion: 	2 .	155.0 Coop 11:53 Vehic	N er Driv Tueso fle class	/e 100 Jay, 28 sificatio	Mtrs n 8 Octol on (AR	orth o ber 20 X)	f Can; 08 =>	ary St, 13:50	Cland Tuesd	lulla lay, 18	Noven	1ber 2008
Monday,	ON OL	vember	2008	2 7 7		- 2 0	2		(MC-			aduway	
		~	m	4	، ا	، م	-	8	σ			12	Total
Mon (%)	1.5	374 72.1	1.9 1.9	45 8.7	1.9	0.0	0.0	0.4	0.4	56 10.8	12 2.3	0.0	519
Tue	10	395	14	43	12	0	0	0	o	41	10	0	525
(%)	1.9	75.2	2.7	8.2	2.3	0.0	0.0	0.0	0.0	7.8	1.9	0.0	
Wed	11	417	15	45	ъ	0	0	0	m	36	14	0	546
(%)	2.0	76.4	2.7	8.2	0.9	0.0	0.0	0.0	0.5	6.6	2.6	0.0	
Thu / % /	10	448 70 6	12	- 42 5	- e -	00	00	00	00	32	, 13 13		563
(2)	T.	0.61	T•7	c•1		0.0	0.0	0.0			2.2	0.0	
Eri.	13	455	21	40	۲۲ د	00	00	00		46	ი . ,	00	588
(%)	7.7	11.4	9.5	0.0		0.0	0.0	0.0	0.0	8.1	с. т	0.0	
Sat	15	337	14	13	10	0	0	0	0	18	14	0	421
(%)	9°0	80.0		3.1	2.4	0.0	0.0	0.0	0.0	4.3	с. С	0.0	
Sun	14	330	14	9	ß	0	0	0	0	13	г	0	383
(%)	3.7	86.2	3.7	1.6	1.3	0.0	0.0	0.0	0.0	3.4	0.3	0.0	
Average	daily	volume											
Entire w	eek												
(%)	11 2.2	393 77.7	14 2.8	33 6.5	1.2	0.0	0.0	00.0	0.0	34 6.7	2.0	0.0	506
Weekdays													
(%)	1.6 1	417 76.1	14 2.6	42 7.7	1.3	0.0	0.0	• • •	0.0	42 7.7	1.8	0.0	548
Weekend													
(%)	3.5	333 82.8	13 3.2	9 2.2	1.7	0.0	0.0	0.0	0.0	15 3.7	1.7	0.0	402

Count of Canary St, Clandulla 11:53 Tuesday, 28 October 2008 => 13:50 Tuesday, 18 November 2008 Vehicle classification (ARX) Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0) **Total** 510 0 248 0 0 С 510 510 0.0 0.0 0.2 0.2 ۲Ľ - 2.0 0.0 0.0 00.0 0.0 **Daily Classes** 0.0 00. **11** 12 12 1.6 0 0.0 0 0.0 0 0.0 12 2,4 12 26 10.5 0.0 ••• 0.0 0.0 0.0 35 6.9 35 6.9 0 35 6.9 **e** 0.0 0.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 о.б 0.6 0 . 9.0 0.0 0.0 80 0.0 0.0 0.0 . 4 00.0 0.0 0.0 0.0 0.0 0.4 0.4 0.0 0 ٢ 0.0 0.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0 ø 1.0 1.0 2.8 0.0 0.0 0.0 0.0 0.0 1.0 S 0.0 0.0 0.0 0.0 0.0 33 6.5 33 **4** 6.5 15 6.0 33 6.5 155.0N 21 0.0 0.0 0.0 0.0 0.0 28 5.5 28 5.5 5.5 2008 28 Average daily volume November 387 75.9 387 75.9 75.9 0.0 0.0 0.0 0.0 0.0 169 68.1 387 Description: Filter time: Scheme: Filter: 0.8 4 0.8 0.0 0.0 0.0 0.0 0.0 0.8 0.8 0 week 17 Weekdays Monday, Entire Site: Tue* (%) **Fri*** (%) Wed* (%) Thu* (%) **Sat*** (%) Sun* Mon (%) (%) (%)

CHARBON COAL PTY LIMITED Charbon Colliery Continued Operations Report No. 753/03

MetroCount Traffic Executive **Weekly Vehicle Counts**

Weekl

WeeklyVehicle-124	- English (ENA)
<u>Datasets:</u> Site: Direction: Survey Duration: File: Identifier: Algorithm: Data type:	[155] Cooper Drive 100mtrs north of Canary St, Clandulla 1 - North bound, A hit first, Lane: 0 11:53 Tuesday, 28 October 2008 => 13:50 Tuesday, 18 November 2008 \\netser\\users\smulhol\MetroCount Data\15518Nov2008.EC0 (Plus) T130H9XW MC56-L5 [MC55] (c)Microcom 19Oct04 Factory default Axle sensors - Paired (Class/Speed/Count)
<u>Profile:</u> Filter time: Included classes: Speed range: Direction: Separation: Name: Scheme: Units: In profile:	11:53 Tuesday, 28 October 2008 => 13:50 Tuesday, 18 November 2008 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 10 - 160 km/h. North, East, South, West (bound) All - (Headway) Fall corry default profile Vehicle classification (ARX) Metric (meter, kilometer, m/s, km/h, kg, tonne) Vehicles = 10414 / 10417 (99.97%)

Cito.		166 ON			Ne	ekly V	<u>ehicle (</u>	Counts	
one: Descriptio Filter time: Scheme:	ë	Cooper 11:53 Tu Vehicle	Drive 10(Jesday, 2 Jassificat)mtrs nor 8 Octobel Ion (ARX)	th of Can r 2008 =>	ary St, Cl 13:50 Tu	andulla esday, 18	Novembe	r 2008
Filter:		Cls(12:	345675	3 9 10 11 1	2) Dir(N	.)ds (∧s≘	10,160) H∈	eadway(>0	~
	Mon 27 Oct	Tue 28 Oct	Wed 29 Oct	Thu 30 Oct	Eri 31 Oct	01 Nov	02 Nov	Averages 1 - 5	1 - 7
Hour				 				,	
0000-0000	*	*	m	4	1	0	1	2.7	1.8
0100-0200	*	*	4	4	ε	4	8	3.7	4.6
0200-0300	*	×	0	5	н	m	1	1.0	1.4
0300-0400	*	*	0		S	0	4	2.7	2.8
0400-0500	*	*	ı G	м -	4	م	0	4.0	3.4
0500-0600	*	*	7	00	œ	9	2	7.7	6.2
0600-0700	*	*	41	55<	30	16	4	42.0<	29.2
0100-0800	*	*	41	41	34	25	15	38.7	31.2<
0060-0080	* :	* :	51<	32	27	27	11	36.7	29.6
0001-0060	K +	*	32	62	34<	9 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	17	31.7	30.0
10001-0001	* *	* ~	23	22	26	44	28<	23.7	28.8 20.8
1200-1200	*	ې ر	0 0	0 U	10				0.04
1300-1400	*	404	27	40	32	29	23	34.8	31.8
1400-1500	*	37	47<	41	41	29	27	41.5	37.0
1500-1600	*	42	45	46	52<	37	28	46.3	41.7<
1600-1700	*	43<	44	54<	51	29	26	48.0<	41.2
1700-1800	*	34	31	40	50	33	31 I	38.8	36.5
1800-1900	*	27	44	21	26	27	29	29.5	29.0
1900-2000	*	18	11	17	23	19	191	17.3	17.8
2000-2100	*	9	91	19	14	16	1 2	11.3	11.3
0022-0012	× •	11	- (9 T	Γ, Υ	51 F	 	12.8	12.3
2300-2400	< *	। ব	৩ ব	n w	<u>ო</u> ო	12	ی م م	9.5 9	5.2
Totals _									
0100-1900	*	*	454	419	433	405	295	423.4	397.1
0600-2200	*	*	519	526	517	471	333	506.7	467.8
0600-0000	*	*	529	538	529	497	344	516.7	480.6
0000-0000	*	*	550	560	551	517	360	538.3	500.8
AM Peak	*	*	0800	0600	0060	1100	1000		
	*	*	51	55	34	46	29		
PM Peak	*	1600	1400	1600	1500	1200	1200		
	*	43	47	54	52	41	34		

CHARBON COAL PTY LIMITED
Charbon Colliery Continued Operations
Report No. 753/03

Weekly \	/ehicl	e Coun	Its						
Site: Description:		155.0N	Drive 100	mtre nor	th of Can	10 +0 1110	official		
Filter time: Scheme:		11:53 Tu Vehicle o	uesday, 2 lassificati	8 Octobel on (ARX)	r 2008 =>	ary 34, Ch 13:50 Tue	esday, 18	Novembe	ır 2008
Filter:		Cls(1.2.3	345678	9 10 11 1	2) Dir(NE	ESW) Sp(1	10,160) He	eadway(>0	~
	Mon 03 Nov	Tue 04 Nov	Wed 05 Nov	Thu 06 Nov	Fri 07 Now	Sat 08 Nov	Sun Nov	Average: 1 - 5	
Hour							-	•	•
0000-0100	c	м (м r	т r	4	C ,	~ ~	5.8 5.8	с. С.
0200-0300		- <i>1</i>	n -	∩	∩	- 0	 n	7 C	7 - F
0300-0400	ъ С	0	5	i m	10	10		2.0	1.7
0400-0500	5	4	9	2	m	0	2	3.4	2.7
0500-0600	ი ა ,	12	5 i	10	L	99	т. М	9.4	8.0
0600-0700	36	37<		404	80 F	17	12	36.8<	30.4
0060-0080	30.5	19	26	37	43<	24	21	31.0	28.6
0900-1000	28	21	33	25	40	35<	191	29.4	28.7
1000-1100	30	29	34<	25	32	34	26	30.0	30.0
1100-1200	36<	28	29	25	36	34	39<	30.8	32.4<
1200-1300	36	24	0 0 0	26	е 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	46<	23	31.8	32.6
1400-1500	47	23	υ 10 10	24	38 85	9 r 9 r	- 05 - 65	28.6	29.9
1500-1600	34	42<	404	49~	54<	0 0 0	40<	43.8<	42.6<
1600-1700	37<	29	38	44	44	31	23	38.4	35.1
1700-1800	29	26	31	6E	40	40	27	33.0	33.1
1800-1900	20	18	16	25	28	20	18	21.4	20.7
1900-2000 2000-2100	μ	8 C	0 1.7	07	73 78 78	Π	20 1	20.2	19.1
2100-2200	0	9 9	ი თ	13	50	- 00	100	9.9	8.4
2200-2300	2	IJ	7	9	ŝ	11	101	6.0	7.3
2300-2400	2	m	5 L	9	9	9	~ ~	4.4	4.3
Totals									
0100-1900	357	309	375	375	466	381	311	376.4	367.7
0600-2200	417	380	453	467	554	426	363	454.2	437.1
0000-0000 0000-0000	426 443	388 410	465 489	479 501	565 583	443 459	375 390	464.6 485.2	467.9
and here the	0011	0000	0001	0000	0000	0000			
AM FEAK	36	37	1000 34	40	0000 43	0200 930 930	- 0011		
PM Peak	1600	1500	1500	1500	1500	1200	1500		
	5	75	2 7	0 7	ر ۲	0 7			

					We	eklv V	ehicle (Counts	
Site: Descriptior Filter time:	2	155.0N Cooper 11:53 Tu	Drive 100 lesday, 2	mtrs nor 8 Octobel	th of Can r 2008 =>	ary St, Cla 13:50 Tue	andulla esday, 18	Novembe	ır 2008
Scheme: Filter:		Vehicle o Cls(123	dassificati 45678	on (AKX) 9 10 11 1	2) Dir(NE	ESW) Sp(1	I0,160) H∈	eadway(>0	(
	Mon 10 Mon	Tue 11 Now	Wed 12 Now	Thu 13 Now	Fri 14 Now	15 Nor	Sun Nor	Average:	, , ,
Hour	ACNT OT	AON 11	AON 27	ACK CT	AON ST		-	ר ו ו	- +
0010-0000	0	9	2	4	ч	7		2.6	3.1
0100-0200	2	1	m	2	m	ъ		2.2	2.3
0200-0300	1	0	0	0	m	0		0.8	0.7
0300-0400	2	0	0	0		5	1	0.6	0.9
0400-0500	5	2	m	m	7	-	1	2.4	2.0
0500-0600	7	6	ō	12	ი	6	- 2	9.2	8.6
0600-0700	41	48<	6 C	40	51<	14		43.8<	33.4
0.80-00/0	67	87	32	0 i n	97	11	11	30.2	25.6
0060-0080	484	05	44 000	1.7	1.7	25		35.2	31.0
0001-0060	15	5 0 C	Ω Υ Υ	27 20	ν υ	3L	67	2.05	33. /
1100-1-0001	3 C K	2 C K	4 C	4 07	200	202	1.245	30.0	2.5 2.5
1200-1300	27	37	9.9	4 6	0 4 1 4	2 8	37.15	35.6	34.7
1300-1400	23	31	35	18	42	24	24	29.8	28.1
1400-1500	32	43	25	30	36	22	21	33.2	29.9
1500-1600	50<	50<	45	46	48<	22	38<	47.8	42.7
1600-1700	45	43	59<	51	45	39<	29	48.6<	44.4<
1700-1800	42	34	31	53<	37	36	29	39.4	37.4
1800-1900	29	29	28	25	34	35	27	29.0	29.6
1900-2000	14	2	21	24	20	13	15	17.2	16.3
2000-2100	12	ω ;	6	17	13	11	15	11.4	11.9
2100-2200	ω ^ι	14	14	14	11	4	10 1	12.2	10.7
2200-2300 2300-2400	مە	ο Ω	φr (r)	12	12	60	0.4	7.0 6.0	6.1
Totals									
000-1-0070	419	212	141	020	457	175	105	8 627	103 7
	104	101	101		- CU U	100			0 944
0600-0000	" U " U "	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 0 C T	040	100	000 000 000	1 0 0 0	#••••	0.001
	202	100	040	210		000		#•••••	007 007
	ATC	C7C	040	500	200	T 7 F		7.84C	500c
AM Peak	0800	0600	0800	1000	0600	1000	1 0011		
	48	48	44	40	51	36	34		
PM Peak	1500	1500	1600	1700	1500	1600	1500		
	50	50	59	53	48	39	38		

State: 155.0N Description: 155.0N Filter time: 1:33 Tuestay, 20 October 2008 => 13:07 Tuestay, 12 November 2008 Scheme: Normality (1:33 Tuestay, 22 October 2008 => 13:07 Tuestay, 12 November 2008 Scheme: Normality (1:33 Tuestay, 22 October 2008 => 13:07 Tuestay, 12 November 2008 Scheme: Normality (1:33 Tuestay, 22 October 2008 => 13:07 Tuestay, 12 November 2008 Montal Tuestay Tue Tuestay, 23 October 2008 => 13:07 Tuestay, 12 November 2008 Montal Tue						Ve	ekly V	ehicle	Counts		
Scheme: Vehicle classification (ARX) Filter: Certification (ARX) 11 Nov 1a Nov 1a Nov 21 Kev 21 Nov 22 Nov 23 Nov 1 - 5 1 - 7 11 Nov 1a Nov 1a Nov 20 Nov 21 Nov 22 Nov 23 Nov 1 - 5 1 - 7 2000-0000 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Site: Description Filter time:		155.0N Cooper 11:53 Tu	Drive 100 uesday, 2)mtrs nor 8 Octobel	th of Can r 2008 =>	ary St, Cl 13:50 Tu	andulla esday, 18	Novembe	r 2008	
Non Thu Thu <th>Scheme: Filter:</th> <th></th> <th>Vehicle (Cls(1 2 3</th> <th>classificati 3 4 5 6 7 8</th> <th>ion (ARX) 9 10 11 1</th> <th>2) Dir(NE</th> <th>.)dS (MSE</th> <th>10,160) H</th> <th>eadway(>0</th> <th>_</th> <th></th>	Scheme: Filter:		Vehicle (Cls(1 2 3	classificati 3 4 5 6 7 8	ion (ARX) 9 10 11 1	2) Dir(NE	.)dS (MSE	10,160) H	eadway(>0	_	
Montention 1 1 1 1 0000-0000 1 1 2 2 0000-0000 1 1 2 2 0000-0000 1 1 2 2 0000-0000 1 1 2 2 0000-0000 1 1 2 2 0000-0000 1 1 2 2 0000-0000 2 3 3 2 0000-0000 2 3 3 3 0000-0000 2 3 3 3 0000-0000 2 3 3 3 0000-0000 2 3 3 3 0000-0000 2 3 3 3 0000-0000 2 3 3 3 0000-0000 2 3 3 3 0000-0000 3 3 3 3 1000-1000 3 3 3 3 1000-1000 3 3 3 3 1000-1000 3 4 4 4 1000-1000 4 4 4 4 1000-1000 3 4 4		Mon 17 Nov	Tue 18 Nov	Wed 19 Nov	Thu 20 Nov	Eri 21 Nov	22 Nov	Sun 23 Nov	Averages 1 - 5	1 - 7	
0000-0000 1 4 1 1 1 0000-0000 3 1 1 1 1 0000-0000 3 3 1 1 1 0000-0000 3 3 2 1 1 0000-0000 3 3 2 1 1 0000-0000 3 3 2 1 1 0000-0000 3 3 2 1 1 0000-0000 3 3 2 1 1 0100-0000 3 3 2 1 1 0100-1000 3 3 2 3 2 0100-1000 3 3 2 3 3 3 0100-1000 3 3 3 3 3 3 0100-1000 3 3 3 3 3 3 0100-1000 3 3 3 3 3 3 1100-1100 3 3 3 3 3 3 1100-1100 3 3 3 3 3 3 1100-1100 3 4 4 4 4 4 110	Hour DODD_0100		c	*	*	*	*	*	, u ,	. u	
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3300-4000 2 0 + + 1.0 1.0 4300-7000 23 32 + + 1.0 1.0 5500-7000 23 32 + + 1.0 1.0 5500-7000 23 32 + + 1.0 1.0 5500-7000 23 32 + + 1.0 1.0 5500-7000 23 23 + + 1.0 1.0 5500-7000 23 23 + + 1.0 1.0 5500-7000 35 23 + + 1.0 1.0 5500-7000 35 23 + + 1.0 1.0 5500-7000 35 23 + + 1.0 1.0 5500-7000 32 23 + + 1.0 1.0 5500-7000 32 24 + + 32.0 32.0 5500-7000 32 + + + 110 110 5500-7000 32 + + + 110 110 5500-7000 32 + + + + 110 100 5500-70	0200-0300	+ 0	0	*	*	*	*	*	0.0	0.0	
3000-0500 3 1 * * * 2.0 2.0 9500-0500 35 32 * * * * 2.0 2.0 9500-0500 35 32 * * * 2.0 2.0 2.0 9600-0500 23 33 * * * * 2.1 2.0 2.1 9000-1000 36 23 * * * 2.1 2.1 2.1 2.1 1000-1100 36 24 * * * 2.0 2.1	0300-0400	2	0	*	*	*	*	*	1.0	1.0	
0500-0500 11 13 *** 12.0 12.0 0500-0500 27 30 *** 13.5 28.5 33.5 0500-1000 35 23 *** *** 28.5 33.5 0500-1000 35 23 *** *** 28.5 35.5 1500-1100 35 23 *** *** 37.0 32.0 1500-1100 35 23 *** *** 37.0 32.0 1500-1100 35 24 *** *** 37.0 32.0 1500-1100 35 24 *** *** 37.0 32.0 1500-1100 35 24 *** *** 37.0 32.0 1500-1200 35 *** *** 37.0 32.0 1500-1200 15 *** *** 37.0 32.0 1500-1200 15 *** *** 37.0 32.0 1500-1200 15 *** *** 37.0 32.0 1500-1200 15 *** *** 37.0 37.0 1500-1200 15 *** *** 37.0 37.0 1500-1200 16 *	0400-0500	m	Ч	*	*	*	*	*	2.0	2.0	
0000-0000 23 32 ** ** * 33.5 3	0500-0600	11	13	*	*	*	*	*	12.0	12.0	
0000-1000 23 30 ** * * 21.5 23.5 0000-1000 35 23 * * * 23.5 23.5 0000-1000 35 23 * * * 23.5 35.5 1100-1200 35 22 22 * * * 23.5 36.5 1100-1200 35 22 22 * * * 23.0 30.0 1100-1200 35 * * * * 23.5 36.5 1200-1300 32 * * * * 23.0 30.0 1300-1000 32 * * * * 23.0 30.0 1400-1000 32 * * * * 23.0 30.0 1300-1000 42 * * * * 23.0 30.0 1300-1000 17 * * * * 23.0 39.5 1300-2000 17 * * * * 17.0 17.0 1300-2000 17 * * * * 4.0 4.0 1300-2000 17 * <th>0600-0700</th> <td>35</td> <td>32</td> <td>*</td> <td>*</td> <td>*</td> <td>*</td> <td>*</td> <td>33.5</td> <td>33.5</td> <td></td>	0600-0700	35	32	*	*	*	*	*	33.5	33.5	
M00000 23 32 32 32 34 35 35 35.5 36.5 36.5 36.5 36.5 36.5 36.5 32.0<	0700-0800	27	00 00	* -	*	*	* -	* •	28.5	28.5	
0000-1100 5 24 24 24 24 24 24 25.0 30.0 1100-1200 35 24 24 27 27.0 30.0 30.0 1200-1500 22 24 26 27 27.0 22.0 22.0 1400-1500 32 22 27 27.0 32.0 30.0 1400-1500 32 29 27.0 22.0 22.0 1500-1600 59 29 29.0 59.0 50.0 1500-1000 36 29 27.0 27.0 27.0 1700-1000 17 29 26.0 36.0 30.0 1800-1000 36 29 29.0 36.0 30.0 1800-1000 17 29 26.0 29.0 36.0 1800-1000 17 29 26.0 29.0 26.0 2000-2000 17 29 29.0 29.0 20.0 2000-2000 405 29 29.0 29.0 20.0 2000-2000 405 29 29.0 29.0 20.0 2000-2000 401 29.0 29.0 29.0 20.0 2000-2000	0060-0080	23	22	* +	* +	* +	* +	* +	27.5	27.5	
100-1200 35 24 37 32 32 1400-1200 32 22 22 32 32 1400-1500 33 36 32 32 32 1400-1500 36 36 32 32 32 1500-1500 36 36 32 32 32 1500-1500 36 36 32 32 32 1500-1500 36 36 32 32 32 1500-1500 36 36 32 32 32 1500-1500 36 36 36 36 36 1500-1500 16 4 4 4 4 1500-1500 17 4 4 4 4 1500-1500 16 4 4 4 4 1500-16 36 4 4 4 4 2000-2000 16 4 4 4 4 2100-16 46 4 4 4 4 2100-16 46 4 4 4 4 2100-16 46 4 4 4 4 2100-16 46 4 4 <	0011-0060	404	> :	ĸ +	ĸ +	× +	к)		30.92	20.02	
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1300-1400 24 26 * <td< td=""><th>1200-1300</th><td>500</td><td>4 C</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td><td></td><td> </td><td></td></td<>	1200-1300	500	4 C	*	*	*	*	*		 	
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1500-1600 59. * * * * 59.0 59.0 1600-1700 42 *	1400-1500	32	*	*	*	*	*	*	32.0	32.0	
1600-1700 42 *	1500-1600	59<	*	*	*	*	*	*	59.0<	59.0<	
1700-1800 36 *	1600-1700	42	*	*	*	*	*	*	42.0	42.0	
1800-1900 29 * * * * * * 29.0 29.0 29.0 1900-2300 1 * <t< td=""><th>1700-1800</th><td>36</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td><td>36.0</td><td>36.0</td><td></td></t<>	1700-1800	36	*	*	*	*	*	*	36.0	36.0	
1900-2000 15 * * * * 15.0 15.0 2000-2100 17 * * * * * * * 17.0 2100-2200 17 * * * * * * 17.0 17.0 2200-2300 1 * * * * * 17.0 17.0 2300-2400 4 * * * * * 4.0 4.0 2000-2000 405 * * * * * 414.0 700-1900 405 * * * * * 44.0 0000-0000 510 * * * * * * * 0000-0000 510 * <t< td=""><th>1800-1900</th><td>29</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td><td>29.0</td><td>29.0</td><td></td></t<>	1800-1900	29	*	*	*	*	*	*	29.0	29.0	
2000-2100 17 * * * * * * * * * * * 17.0 17.0 17.0 2100-2200 9 * <t< td=""><th>1900-2000</th><td>15</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td><td>15.0</td><td>15.0</td><td></td></t<>	1900-2000	15	*	*	*	*	*	*	15.0	15.0	
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vehicles

No of heavy

No of light

11212

25

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ear

vehicles v 33 33 33 33 33 33 33 33 33 35 33 35 33 35 35 35

8 - 59

Traffic Volumes Charbon Colliery

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No of	heavy	vehicle										
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	%/H		5	5	5	5	2	5	5	2 2	5	5
Angus	Avenue	1.20%	54	55	55	26	22	22	58	59	59	99
No of	heavy	vehicles	11	11	11	11	1	11	12	12	12	12
No of	light	vehicles	56	57	58	58	53	09	09	61	62	ខ
	%^H		16	16	16	16	16	16	16	16	16	16
Charbon	Road	1.20%	67	68	69	69	2	7	72	73	74	75
No of	heavy	vehicles	12	12	12	12	12	13	13	13	13	13
No of	light	vehicles	47	48	48	49	50	20	51	5	52	53
	%NH		20	20	20	20	20	20	20	20	20	20
Cooper	Drive	1.20%	65	60	99	61	62	63	63	64	65	99
No of	heavy	vehicles	21	21	22	22	22	23	23	23	23	24
No of	light	vehicles	85	86	87	88	68	6	91	92	93	94
	%\H		20	20	20	20	20	20	20	20	20	20
Bylong Valley	Way	1.20%	106	107	109	110	111	113	114	115	117	118
No of	heavy	vehicles			28	28	29	30	30	31	31	32
No of	light	vehicles			205	208	212	216	221	225	229	233
	% VH				12	12	12	12	12	12	12	12
	SH18	1.90%			233	237	241	246	251	255	260	265

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Appendix 3

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Traffic Projection Spreadsheets

(No. of pages excluding this page = 3)

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Axles per Heavy Road Train 11 + B-Double 9 = average 8.5 B-Double 9 + Semi 6 = average 7.5 Semi 6 + Single unit 3 = average 4.5



Axles per Heavy Road Train 11 + B-Double 9 = average 8.5 B-Double 9 + Semi 6 = average 7.5 Semi 6 + Single unit 3 = average 4.5

Charbon Colliery Continued Report No. 753/03

Appendix 4

Photos

(No. of pages excluding this page = 2)

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SPECIALIST CONSULTANT STUDIES Part 8: Traffic Assessment



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Appendix 5

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Intersection Calculations

(No. of pages excluding this page = 1)

<u>Check right turn lane length of the intersection of Castlereagh Highway and Bylong</u> <u>Road</u>

Volume in through lane = 136 vph (use 2020 projected figure)

Turning volume Qm= 56 vph (use 2020 projected figure)

Speed = 100 kph

Right turn = 0 kph

Opposing traffic = 136 vph (use 2020 projected figure)

From Graph (figure 4.8.10 of RTA "Road Design Guide") D = 75m

```
From Graph (figure 4.8.10 of RTA "Road Design Guide") T = 48m
```

Use appendix A4 (RTA "Road Design Guide")

Gap acceptance ta = 4 tf = 2

Cp > 1000 vph

Qs = Cp/8 =1000/.8 = 1250

Utilisation ratio p=Qm/Qs=56/1250=.0448

Queue length = 1 vehicle. Adopt 20m

B = D + S = 75 + 20 = 95m

102m available, therefore ok.

Appendix 6

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Castlereagh Highway – Boulder Road intersection (Source: RTA)

(No. of pages excluding this page = 3)

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SPECIALIST CONSULTANT STUDIES Part 8: Traffic Assessment CHARBON COAL PTY LIMITED Charbon Colliery Continued Operations



CHARBON COAL PTY LIMITED

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Appendix 7

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Accident Statistics

(No. of pages excluding this page = 3)

CHARBON COAL PTY LIMITED

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Μ	R 215								
SURFACE W	STU_20	ROUTE	LGA	KEY_TU	_TYP	OTH	HER_TU_	Т	WSAC_2003_
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Wet 20	07	215	Rylstone	Car (sed	an/hatc	NUL	.L		074165735
В	oulder Re	oad	-						
SURFACE W	STU_20	ROUTE	LGA	KEY_TU	_TYP	OTH	HER_TU_	Т	WSAC_2003_
Dry 20)04	18	Lithgow Ci	t Car (sed	an/hatc	Car	(sedan/h	atch	041862837
Wet 20	004	18	Lithgow Ci	t Station w	/agon	Ligh	t truck		044939375
Dry 20	005	18	Lithgow Ci	t Light true	ĸ	4 wł	neel drive	•	051945111
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in join y			<i>,</i>					0.2	
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								4 LID	
TYPE_OF_LC) RIA_				NIAHO	VV5	AC_2003		
	95824	90 4	485027	East		vves	stern		untry non-urba
	95825	0/6 4	484906	East		vves	stern		untry non-urba
I-JUNCTION	95825	0/6 4	484906	East		vves	stern	C0	untry non-urba
ALIGNMENT	PRIMAR	Y_PE	ROAI	D_SURFA	WEATI	HER	NATURA	L_LI	SIGNALS_OP
Curved	NULL		Seale	ed	Fine		Darkness	3	Nil
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ALIGNMENT	PRIMAR	Y_PE	ROAI	D_SURFA	WEATI	HER	NATURA	L_LI	SIGNALS_OP
Straight	NULL		Seale	d	Fine		Daylight		Nil
Straight	NULL		Seale	ed	Raining	9	Daylight		Nil
Straight	NULL		Seale	ed	Fine		Daylight		Nil

8 - 76

SPEED_LIMI D 100 80 100 80	CACODE DC 02 Off 03 Off	CADESC f cway left bend f right bend into obj	FIRST_II Rollover Vehicle -	VIPA Object	NO_OF_TF 1 1	RAF NO_KILLED NULL NULL
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NO_INJURED	FATIGUE_IN	SPEEDING_I	ALCOHOL_	IN ALC	OHOL_BA	DESCRIPTIO
2	No or unknown	No or unknown	No	Nil		NULL
1	No or unknown	Yes	No	Nil		NULL
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1	No or unknown	No or unknown	No	Nil		NULL
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WSAC_20032	WSAC_20033	WSTU_20031 W	/STU_20032	TU_R	OLE_IN TU	J_TYPE
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2004	2004	044939375 W	/estern	Key tra	afficuSt	ation wagon
2005	2005	051945111 W	/estern	Key tra	afficuLiq	ght truck
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1	In ID feature	Turning right	Null	NU	LL	NULL
3	In ID feature	Turning right	Null	NU	LL	NULL
1	In ID feature	Turning right	Null	NU	LL	NULL

ERROR_FACT	OBJECT_HIT	OBJECT_H_1	OTHER_TU_A	WSTU_20033
Avoiding animal	NULL	NULL	Car (sedan/hatch)	2003
Avoiding vehicle	Drain/culvert	NULL	Car (sedan/hatch)	2007
ERROR_FACT	OBJECT_HIT	OBJECT_H_1	OTHER_TU_A	WSTU_20033
Disobey traffic con	NULL	NULL	Car (sedan/hatch)	2004
Disobey traffic con	NULL	NULL	Station wagon	2004
Disobey traffic con	NULL	NULL	Light truck	2005



Charbon Coal Pty Limited ABN: 71 064 237 118

Continued Operation

of the

Charbon Colliery

Soils Assessment

Prepared by

GSS Environmental

September, 2009

Specialist Consultant Studies Compendium: Part 9

Soils Assessment

for the

Continued Operation of the Charbon Colliery

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September, 2009

GSS Environmental

Charbon Colliery Continued Operations Report No. 753/03

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1 INTRODUCTION

1.1 Scope

Charbon Colliery currently employs both underground and open cut mining methods to produce up to 1.3 million tonnes of run-of-mine (ROM) coal annually. Charbon Colliery is located in the western coal fields of New South Wales, approximately 3km south of the township of Kandos (**Figure 1**).

An application for project approval under Part 3A of the *Environmental Planning and Assessment Act* (EP&A Act) is to be made to permit the continued operation of the colliery, including extraction of coal from five small open cuts and one underground mine (the "Project"). R. W. Corkery & Co. Pty. Limited ("RWC") was commissioned by Charbon Coal Pty Limited (the "Proponent") to prepare undertake an *Environmental Assessment* for the continued operation of the Charbon Colliery. GSS Environmental (GSSE) was commissioned by R.W. Corkery and Co Pty Ltd to undertake a soils assessment to support the application for the project approval for the Project.

1.2 **Project Overview**

Approval is sought for the following activities.

- Mining of approximately 5.2 million tonne (Mt) of coal at a maximum rate of:
 - 700 000t per year using open cut mining methods in the Western and Southern Outlier, Southern Open Cut Extension and 8 Trunk, Central and Western Open Cuts; and
 - 900 000t per year using underground mining methods in the Western Underground;

with the maximum quantity of coal mined annually not exceeding 1.5Mtpa over a maximum of 15 years.

- Transportation of ROM coal from the proposed mining areas to the existing approved CHPP using the existing underground coal transportation infrastructure and existing and upgraded internal haul roads.
- Processing of a maximum of 1.5Mt per year ROM coal at the existing CHPP.
- Transportation of a maximum of 250 000t of ROM and product coal per year to the Proponent's customers by public road.
- Transportation of a maximum of 20 000t product coal per year to the Charbon Lime Works by private road.
- Transportation of a maximum of 1.5Mt ROM and product coal per year to the Proponent's customers by rail.
- Placement of waste rock material within proposed in-pit waste rock emplacements.

CHARBON COAL PTY LIMITED

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Charbon Colliery Continued Operations Report No. 753/03



Note: A colour version of this figure is available on the Project CD

Part 9: Soils Assessment



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\\SERVER\RWC\75302\CAD\753Base_Solls 2.DWG

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- Expand and upgrade the existing reject emplacement area to allow for placement of Project-related fine and coarse reject material.
- Construction of associated infrastructure, including:
 - three new pollution control dams;
 - the Western Underground surface facilities area;
 - new and upgraded haul roads; and
 - the 2 Trunk ROM Coal Loading Facility.
- Progressive rehabilitation to create a final landform that would generally mimic the existing landform.
- Continued use of existing site infrastructure for the life of the Project.

The locations of these activities are shown on **Figure 2**.

In addition to the above, approval is also sought for the continued operation of those existing approved activities that would be ancillary to the operation of the proposed activities following completion of mining of the Charbon Underground and Southern Open Cut. Those activities would include, but would not be limited to, the following.

- Operation of the CHPP and train loading facility.
- Use of the offices, staff amenities, workshops, roads, Reedy Creek Dam and associated infrastructure, waste water treatment plants, underground mine infrastructure and surface water management structures and other site infrastructure.

As mining operations progress, soil resources would be impacted. Excavation of the open cuts and construction of surface infrastructure including haul roads, other service roads, dams and drains will result in ground disturbance requiring management to prevent downstream sedimentation of watercourses.

1.3 Assessment Objectives

The major objectives of this assessment are to:

- provide a description of the soils within the proposed areas of surface disturbance;
- provide a description of the existing and proposed soil stripping and placement procedures and the necessary erosion and sediment control structures to manage in-situ and stockpiled soil resources; and
- provide an assessment of whether the study area soils are suitable for rehabilitation purposes and what treatments, if any, are required to optimise successful rehabilitation.

This report presents the results of the survey undertaken by GSSE and the assessment of soil resources within the study area.

1.4 Study Area

The study area is located within western coal fields of NSW and incorporates all areas of proposed disturbance (**Figure 2**).

1.5 Topography and Drainage

The study area lies on the western slopes of a north-south oriented sandstone ridgeline of the Great Dividing Range. Generally, topography within the study area consists of asymmetric rolling hills with maximum elevations of approximately 800mAHD to 900mAHD and a local relief of approximately 160m to 200m. Hill slopes are steep and rocky. The study area also contains areas of low, gently sloping flat valley floors.

The areas of proposed disturbance are divided into four (4) locations, namely:

- the Central Open Cut (12ha);
- the Western Underground Surface Disturbance and Western Open Cut (6.5ha);
- the 8 Trunk Open Cut (32ha);
- the Southern Open Cut Extension (15ha);
- the Southern Outlier (13 ha); and
- the Western Outlier (9ha) (Figure 2).

The proposed Central Open Cut has slopes of approximately 25-35% and lies below steeper sections of the escarpment. The 8 Trunk Open Cut area also has similar topography, with slopes generally between 15-25%. Both these areas have northwest to southwest aspects.

The Western Open Cut similarly follows the contour with an eastern aspect and slopes of around 30%. The Southern Open Cut Extension and Southern and Western Outliers (Southwest Open Cuts) occupy the tops of three distinctive crests of around 800 m in elevation.

Four surface water catchments exist in the study area, namely the Reedy Creek, Reilys Creek, Stony Creek and Deep Creek Catchments (**Figure 3**), of which, only the first three would be disturbed by the Project. The portions of the disturbance areas within these three catchments is:

• The Central Open Cut Area and part of the Western Open Cut area are within the Reedy Creek Catchment;

- The majority of the Western Open Cut and the entire area of the proposed 8 Trunk Open Cut drains to Reilys Creek. The majority of the area (~68%) drains to large farm dams located within the major drainage lines. The remaining area drains directly into Reilys Creek; and
- A significant portion (~70%) of the Southwest Open Cuts occur within the Reilys Creek catchment area. Approximately half of this area drains into farm dams before being discharged to Reilys Creek.
- Approximately 30% of the Southwest Open Cuts occur in the upper reaches of the Stony Creek catchment, which drains south to Stony Creek.

1.6 Vegetation

The current and previous flora surveys identified 255 flora species within the Project Site, of which 43 species are exotic species. One species identified within the Project Site, namely the Capertee Stringybark (*Eucalyptus cannonii*), is listed as Vulnerable under the Schedules of the *Threatened Species Conservation Act 1995*. This species is widespread throughout the Project Site and is planted extensively and successfully during rehabilitation operations (AES/GES, 2008).

The flora survey identified nine vegetation communities within the Project Site as listed below:

- Grey Gum Stringybark Forest;
- Mountain Grey Gum Grey Gum Mountain Hickory Sheltered Forest;
- Apple Box Ribbon Gum Woodland;
- Stringybark Blakely's Red Gum Yellow Box Woodland;
- Inland Scribbly Gum Grey Gum Narrow-leaved Stringybark Woodland;
- Narrow-leaved Stringybark Sydney Peppermint Grey Gum Woodland;
- White Box Kurrajong Grey Gum Woodland;
- Yellow Box Blakely's Red Gum Woodland; and
- Cleared Land.

2 SOIL SURVEY METHODOLOGY

2.1 Introduction

A soil survey was undertaken in April 2008 by GSS Environmental to classify soil profile types within the study area. The survey was conducted in accordance with the survey methodology described in this section. The soils results are presented in **Section 3** of this report.

CHARBON COAL PTY LIMITED

SPECIALIST CONSULTANT STUDIES

Charbon Colliery Continued Operations Report No. 753/03 Part 9: Soils Assessment



2.2 Mapping

An initial soil map was developed using the following resources and techniques.

1. Southern Open Cut EIS 2003

The 2003 EIS was reviewed to appreciate the soil types present within the Southern Open Cut and understand the current topsoil stripping practices. The 2003 EIS information was used as a reference in the development of the recommendations within this report, in particular those practices which have been implemented and proven successful on the ground.

2. Aerial photographs and topographic maps

Aerial photo and topographic map interpretation was used as a remote sensing technique, allowing detailed analysis of the landscape and mapping of features related to the distribution of soils within the study area.

3. Previous soil survey results

A survey of the region (including the areas surveyed in this assessment) was undertaken by Murphy and Lawrie (1998) at a scale of 1:250,000. The survey map and report present a broad scale guide to the soil and landscape unit distribution in the Central West Region, and provides a framework for more detailed surveys. The study area was included in the survey and is generally confined to the Collingwood, Capertee and Three Sisters soil landscape units which are dominated by Red, Yellow and Brown Podzolics. The distribution of these soil landscape units are illustrated in Figure 4.

Red Podzolics within the study area generally consist of brown to reddish brown sandy loam topsoils, that are weak in structure, overlying light to medium reddish brown clays that are angular blocky and moderate to strong in structure.

Yellow Podzolics soils also feature throughout the study area. They consist of hardsetting weakly structured brown loams to sandy loams. The subsoils generally display yellowish brown or yellowish orange medium to heavy clays. The subsoils are moderately structured with coarse angular blocky rough faced peds.

Smaller portions of the study area contain bleached loams which belong to the Three Sisters soil landscape unit. Topsoils generally display dark brown sandy to fine loams. Bright yellowish-brown sandy clay loams which are weakly structured are present in the subsoils.

4. Stratified observations

Following production of a broad soil map, surface soil exposures throughout the potential disturbance areas were visually assessed to verify soil units, delineate soil unit boundaries and determine preferred locations for targeted subsurface investigations.

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2.3 Profiling

A total of nine soil profiles were assessed to enable soil profile descriptions to be made. Soil profiles were excavated by hand and also observed through use of surface exposures located in existing gullies and creek banks. Soil exposure locations were selected to provide representative profiles of the soil types encountered over the study area. Soil profile locations are shown in **Figure 2**.

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Soil layers were generally distinguished on the basis of changes in texture and/or colour. Soil colours were assessed according to the Munsell Soil Colour Charts (Macbeth, 1994). Photographs of soil profile exposures were also taken.

2.4 Field Assessment

Soil profiles within the study area were assessed generally in accordance with the soil classification procedures the Australian Soil and Land Survey Field Handbook (McDonald *et al*, 1990).

A detailed soil survey of the study area was conducted by GSSE in April 2008. The survey indicated Red, Yellow and Brown duplex soils dominate the study area. Skeletal soils were also noted. The information from these surveys was used to produce a preliminary soils map, which outlines the expected soil unit boundaries.

Soil layers at each profile site were also assessed according to a procedure devised by Elliot and Veness (1981) for the recognition of suitable topsoil material. This procedure assesses soils based on grading, texture, structure, consistence, mottling and root presence. A more detailed explanation of the Elliot and Veness procedure is presented in **Appendix 1**.

2.5 Laboratory Testing

Soil samples were collected from the exposed soil profiles and subsequently despatched to the NSW Department of Lands Soil and Water Testing Laboratory at Scone, NSW for analysis. Samples were analysed to establish the suitability of surface and near-surface soil horizons as potential growth media, and identify high value or high risk soils. Samples were analysed from the following sites (as shown on **Figure 4**).

- Site 1 Samples 1/1 & 1/2
- Site 3 Samples 3/1, 3/2 & 3/3
- Site 5 Samples 5/1 & 5/2
- Site 6 Samples 6/1 & 6/2
- Site 7 Samples 7/1
- Site 8 Samples 8/1 & 8/2

Soil horizons are signified by /1, /2 and /3 in the sample identification with the surface horizon being /1 and subsoil horizons being /2 & /3. Profile sites 2, 4, and 9 were not sampled as they displayed similar soil characteristics to previously sampled profiles sites. The soil samples were subsequently analysed for the following parameters.

- Colour
- Particle Size Analysis
- Emerson Aggregate Test
- pH
- Electrical Conductivity.

A description of the significance of each test and typical values for each soil characteristic are included in **Appendix 2**.

The laboratory test results were used in conjunction with the field assessment results to determine the depth of soil material that would be suitable for recovery and use as a growth medium during rehabilitation. The soil test results for the soil survey are provided in **Appendix 3**.

3 RESULTS

3.1 Soils Units

3.1.1 Introduction

The following soil units were identified within the study area:

- Yellow Duplex Soil
- Brown Duplex Loam Soil
- Red Uniform Clay Loam Soil
- Skeletal Soil.

The distribution of these soils is illustrated on **Figure 5**. Exposed profiles of major soil units are shown in **Plates 1** to **3**. A glossary of commonly used soils terms is presented in **Appendix 4**.

3.1.2 Yellow Duplex Soil

This soil unit is associated with two key areas, firstly the northern section of the 'central open cut' study area, and secondly the majority of the '8 Trunk Open Cut' except for the very northern tip. Yellow Duplex Soils encompasses approximately 30% of the proposed open cut footprints. The soil is characterised by dark yellow sandy and clay loams of varying depths.

A representative profile of this soil unit is presented in **Table 1**. A typical Yellow Duplex Soil profile is presented in **Plate 1**. The following provides a detailed description of each soil layer base on field observations and laboratory testing.

Topsoil

The topsoil generally consists of a coarse textured surface layer, overlying a structured clay horizon up to 10cm in depth. It is generally dark yellow to brown in colour. The structure of the fine layer is typically single grained, with the underlying horizon formed by moderate angular-blocky peds. Texture generally consists of loamy sand, with a clay content of approximately 10% and sand content of 79%.

The topsoil is structurally stable, with an Emerson rating of 8/5, indicating a low potential for dispersion. The topsoil is generally of low salinity (Electrical Conductivity (EC) of 0.13 dS/M) and slightly alkaline (pH of 7.5).

Stones were observed throughout the profile of this soil unit. The stones are generally rounded to sub-rounded and sedimentary in origin. Surface stone cover observed varied between 2% and 10%. Surface vegetation generally consisted of pasture. Root penetration throughout the topsoil is common.

Subsoil

Yellowish brown subsoils with strong consistence are moderately pedal in structure. Textures consist mainly of clay loams and medium clays, with clay content between 23% and 45%.

The subsoils are non-saline (EC of 0.03) and are very slightly alkaline (pH of 6.5). The subsoils have a low potential for dispersion, with Emerson rating of 8/3(1). Root penetration in the subsoil is low and stone content is typically between 20% and 50%.

Limiting Factors

Generally the Yellow Duplex topsoil does not display any specific management risk related to potential disturbance during stripping, and is suitable as a topdressing. The clay subsoil is texturally and structurally unsuitable for use as a final topdressing material due to high clay content and massive structure. Whilst the fine textured subsoil is unsuitable for use as a topdressing material, consideration should be given to selectively strip and conserve this material for use as an intermediate layer between the porous re-graded overburden landform and the final topdressing layer.

The Yellow Duplex topsoil is suitable for stripping to a depth of 10cm and the subsoil to a depth of 20cm below the base of the topsoil (only to be used as an intermediate layer in final rehabilitation). The topsoil is generally considered suitable as a surface cover in the establishment of vegetation.

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Table 1Yellow Duplex Soil Profile

LAYER	DEPTH (m)	DESCRIPTION
1	0.0 – 0.10	Dark brown yellow (10YR 3/3) loamy sand. Weak consistence and pedality, sub-angular blocky, earthy, 2-5mm peds. Many roots and 2-10% stone content. Clear to wavy boundary to layer 2.
2	0.10 – 0.90+	Pinkish Yellow (7.5YR 7/3) clay loam. Moderate consistence and pedality, sub-angular blocky, earthy, 20-50mm peds. Few roots and stone content approximately 20-50%.



Plate 1 Yellow Duplex Soil Profile

Note: A colour copy of this plate is available on the Project CD.

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3.1.3 Brown Duplex Loam

This soil unit is associated with the following sections of the study area.

- The central and southern parts of the 'Central Open Cut'.
- The northern tip of the '8 Trunk Open Cut'.
- The southern and western pits of the 'Southwest Open Cut'.

Brown Duplex Loam Soils encompasses some 25% of the proposed open cut footprints. The soil is characterised by brown clay and clay loams of varying depths.

A representative profile of this soil unit is presented in **Table 2**. A typical Brown Duplex Soil profile is presented in **Plate 2**. The following provides a detailed description of each soil layer based on field observations and laboratory testing.

Topsoil

Topsoil within this unit generally consists of a loamy textured surface layer approximately 20cm in depth, overlying a well structured clay subsoil. It is generally light brown to brown in colour. The structure of the upper section (approximately 5cm) of the topsoil layer consists of weak peds, with the lower topsoil section formed by moderate angular blocky peds. Texture generally consists of loam to clay loam, with clay content of approximately 23% and sand content of 70%.

The topsoil is structurally stable, with an Emerson rating of 8/3(1), indicating a low potential for dispersion. The topsoil is non-saline (EC of 0.02 dS/M) and only slightly acidic (pH of 6.1). Stones were observed throughout some profiles of this unit. The stones are generally rounded to sub-rounded. Surface stone cover varies between 2% and 10%. Surface vegetation generally consisted of grass pasture and scattered trees and shrubs. Root penetration in the surface layer is common.

Subsoil

Brownish subsoils show strong consistence and are massive in structure. Texture consists mostly of light clays, with clay content varying between 23% and 45%.

The subsoils are non-saline (EC of 0.01) and have a slightly acidic pH range of 6.4 to 6.6. Subsoils are generally stable and indicate a low to moderate potential for dispersion, with Emerson ratings between 8/3 and 3(3). Root penetration in the soil is low to moderate in the initial subsoil to none lower down the profile. Stone content is typically between 2% and 10%.

Limiting Factors

Generally the Brown Duplex Loam topsoil does not display any specific management risk related to potential disturbance during stripping with the entire top 20cm suitable for stripping and re-use as a surface topdressing in rehabilitation. The brown clay subsoil is texturally and structurally unsuitable for use as a final topdressing material due to high clay content and massive structure. Whilst this subsoil is unsuitable for use as a topdressing material, consideration should be given to selectively stripping and conserving this material for use as an intermediate layer between the porous re-graded overburden landform and the final topdressing layer.

Table 2 Brown Duplex Loam Profile

LAYER	DEPTH (m)	DESCRIPTION
1	0 – 0.05	Brown (7.5YR 5/3) loam. Weak consistence and angular blocky peds, 2-5mm in diameter. Roots common and 2%-5% weathered stones, 2-6mm in diameter. Lower boundary is sharp to layer 2.
2	0.05 – 0.20	Light brown (7.5YR 6/4) clay loam. Moderate consistence, with angular blocky peds, 5-10mm in diameter. Roots are few and weathered stones (6-20mm in diameter) occur at 2%-10%. Boundary is clear to layer 3.
3	0.20 – 0.35+	Dark reddish brown (5YR 6/6) clay. Strong consistence and massive. Root and stone content not observed.



Plate 2 Brown Duplex Loam Profile

Note: A colour copy of this plate is available on the Project CD.

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3.1.4 Red Uniform Clay Loam

This soil unit consists of reddish brown to reddish yellow uniform clay loams with little textural change down the profile. The soil unit occurs on the upper slopes and in association with the rocky knolls and ridgelines within the eastern pit of the 'Southwest Open Cuts' which adjoins the existing Southern Open Cut. The surface horizons are shallow and high in rock content.

This soil unit accounted for approximately 40% of the proposed open cut footprints. A representative profile description of this soil unit is presented in **Table 3**. **Plate 3** shows a representative profile. The following provides a detailed description of each soil layer based on field observations and laboratory testing.

Topsoil

The topsoil is approximately 12cm in depth and light reddish brown to reddish brown in colour. Textures include loams to clay loams with a weak to moderate sub-angular blocky structure. Clay content is 21%. Emerson ratings of 8/3(1) indicate that the topsoil is non-dispersive and relatively stable. The topsoil is non-saline (EC of 0.05 dS/m) and slightly acidic (pH range of 6.4). Root penetration is low while stones within the profile are less than 2% and approximately 6-20mm in diameter.

Subsoil

The subsoil is typically light brown to reddish in colour and approximately 20cm in depth. Textures include light clay loams to medium clays with a moderate to strong consistence and sub-angular blocky structure. The clay loam subsoils display structural stability (Emerson ratings of 8/3(2)), are only slightly acidic (pH of 6.2) and non-saline (EC of 0.01). The clay subsoil has approximately 30% clay content. No root penetration occurs in the subsoil layers. Stone content is generally low (10% to 20%) in the subsoils.

Limiting Factors

Generally these soils did not display any specific management risk related to potential disturbance during stripping. The surface material is suitable for stripping at a depth of 12cm and may be used as a surface topdressing in rehabilitation operations. The underlying clayey subsoil has a high clay content and massive structure, however, it can be separately stripped and conserved for use as an intermediate layer between the porous re-graded overburden landform and the final topdressing layer.

LAYER	DEPTH (m)	DESCRIPTION
1	0 – 0.12	Light reddish brown (5YR 6/4) clay loam. Moderate
		consistence and pedality, 2-5mm sub-angular peds.
		Roots are few in this layer. Stone content is 2-5%. The
		boundary is sharp to layer 2.
2	0.12 – 0.32+	Light reddish brown (5YR 6/4) medium clay loam. Strong
		consistence and pedality with 5-10mm sub-angular peds.
		Roots noted as few to none, with 10-20% stone content.

Table 3 Red Uniform Clay Loam Profile


Plate 3 Red Uniform Loam Clay

Note: A colour copy of this plate is available on the Project CD.

3.1.5 Skeletal Soil

This soil unit is characterised by shallow reddish brown stony clay soils associated with eroded steep slopes and ridgelines throughout the proposed 'Western Open Cut' on Haystack Mountain. The soil unit encompasses some 5% of the proposed open cut footprints. The description of the soil unit was based on surface observations only. No samples were taken due to high stone content.

Topsoil

The topsoil consists of a surface layer approximately 5cm to 10cm in depth. It is generally light reddish/brown with a weak structure. Peds are angular-blocky.

Stones occur over the surface of the soil unit. The stones are generally between 2mm and 50mm in diameter, are rounded to sub-rounded and sedimentary in origin. Outcropping of large boulders / rocks are prevalent. Surface stone density varies between 10% and 90%. Root penetration in the topsoil is common.

Subsoil

Where subsoil occurred instead of rock, it generally consisted of medium to heavy light reddish brown clays with a moderate angular blocky structure becoming massive below 30cm to 40cm depth.

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Limiting Factors

A significant rock content occurs throughout the soil profile. Stripping is not recommended due to high rock content.

3.2 Soil Stripping and Placement Suitability

The major Project-related land disturbance is likely to result from excavation of the open cuts and construction of surface infrastructure, including haul roads, other roads and stockpile areas. It is recommended that topsoil and subsoil be recovered from these areas of disturbance. Soil analysis results (refer **Appendix 3**) were used in conjunction with the field assessment (refer **Appendix 1**) to determine the depth or thickness of soil materials suitable for recovery. Structural and textural properties of subsoils are the most significant limiting factors in determining depth of soil suitability for re-use as topdressing materials. Recommended topsoil and subsoil stripping depths for each soil unit are provided in **Table 4**.

Soil Unit Type	Recommended Stripping Depth (cm)					
	Topsoil below surface	Subsoil below base				
	(cm)	of topsoil (cm)*				
Yellow Duplex Soil	10	20				
Brown Duplex Loam	20	20				
Red Uniform Clay Loam	12	20				
Skeletal Soil	Not recommended for stripping					
Note 1: All Subsoils should be used topdressing in rehabilitation.	as an intermediate layer betw	veen overburden and the				

 Table 4

 Recommended Topsoil and Subsoil Stripping Depths for Soil types

3.3 Erosion Potential

The brown duplex clays / subsoils found in the Southern Outlier have a moderate erosion potential, with Emerson ratings of 3(3), which indicates a slight to moderate potential for dispersion and surface hardsettingness. If the topsoil within the Southern Outlier is disturbed or removed and the subsoils are exposed, the potential for erosion may be increased. Disturbance occurring within the vicinity of a drainage line could impact on downstream water quality through an increase in sediment loads. The soils of the Southern Outlier should, therefore, be managed to ensure that the subsoils are not exposed without suitable controls being implemented, as described in Section 4.

Both Red and Yellow duplex clays / subsoils, and the Brown duplex subsoils of the Western Open Cut of the 'Southwest Open Cuts', northern tip of the '8 Trunk Open Cut' and the southern section of the 'Central Open Cut', displayed structural stability and little erosion potential, with Emerson ratings of 8/3(1), 8/5, 5 and 8/3(1) respectively.

3.4 Potential Acid Generating Material

Acid Sulphate Soils (ASS), which are the main cause of acid generation within the soil mantle, are commonly found less than five (5) metres above sea level, particularly in low-lying coastal areas such as mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes. The study area is located within the Central West region (which is located approximately 230km from the coast at > 250m AHD). There has been little history of acid generation from regolith material with this region. As a result, the potential for acid generation from topsoil and subsoil within the study area is low.

3.5 Topsoil Balance

The topsoil balance was undertaken with the following assumptions:

- Only topsoil will be used as the final surface topdressing in rehabilitation. All subsoils are assumed to be only suitable as an intermediate layer between the overburden and the final surface topdressing material;
- The open cut footprints will be completely stripped and all topsoil will be salvaged;
- A 10% handling loss has been applied;
- Rehabilitation (including topsoil respreading) will occur on the entire open cut footprints;
- Topsoil will be respread on final landforms at approximately 100mm.

The results of the Topsoil Balance shown in **Table 5** below, indicate a topsoil surplus across the entire proposed open cut footprints of 24,068m³. However, topsoil deficits are expected for individual pits or sections of pits including the Northern section of the 'Central Open Cut', the central and southern sections of '8 Trunk Open Cut', and the entire 'Western Open Cut'. These areas will require topsoil to be transported from other areas across the open cuts, which do have a surplus.

Whilst the assumption was made that subsoil was not considered in the topsoil balance, it should be noted that the assessment showed that all subsoils are suitable for use as an intermediate layer in rehabilitation. Note that extra diligence is required in implementing erosion and sedimentation controls for the subsoils from the Southern Outlier pit in the 'Southwest Open Cuts', due to its moderate susceptibility to dispersion. All subsoils may be stripped at 20cm depth below the bottom of the topsoil. Some areas may, in practice be able to be stripped further if characteristics are found to be consistent throughout the depths of the profile once stripping commences. At 20cm depth, the subsoil salvaged, and assuming 10% handling loss, has a total volume of 187,200m3. This volume is adequate to cover all the rehabilitation areas if it is re-spread as an intermediate layer on rehabilitation at 16.9cm. However, to remain on the conservative side of subsoil management, it is recommended to respread at between 10cm and 15cm depth as an intermediate layer, across all rehabilitation.

Table 5 Charbon Topsoil Balance

Open Cut Area	Pit / Section	Area (ha)	Soil Type	Stripping Depth (cm)	Volume Stripped (m³)	Volume (10% loss) (m³)	Volume Required (m³)	Shortfall/ Excess (m ³)
Central Open Cut	Northern Section	4	Yellow Duplex	10	4,000	3600	4,000	-400
(12ha)	Central & Southern Section	8	Brown Duplex	20	16,000	14400	8,000	6,400
8 Trunk Open Cut (32ha)	Northern Section	4	Brown Duplex	20	8,000	7200	4,000	3,200
	Central & Southern Section	28	Yellow Duplex	10	28,000	25200	28,000	-2,800
	Eastern Pit	33.1	Red Uniform Clay	12	39,720	35748	33,100	2,648
Southwest Open Cuts (60ha)	Western Pit	14.1	Brown Duplex	20	28,200	25380	14,100	11,280
	Southern Pit	12.8	Brown Duplex	20	25,600	23040	12,800	10,240
Western Open Cut (6.5ha)	Only Pit	6.5	Skeletal Soil	0	0	0	6,500	-6,500
				Total =	149,520	134,568	110,500	24,068

4 MANAGEMENT MEASURES

4.1 Existing Stripping Methods and Stockpiling of Topsoil at Charbon Colliery

The Erosion and Sediment Control Plan for the Southern Open Cut Area, identifies the following stripping and stockpiling methods as part of Charbon Colliery's commitment to managing soils within the survey area.

- Vehicular traffic is kept to a minimum on those soils which are to be stripped to reduce soil compaction and structural decline.
- Soil should be stripped, where possible, when it is in a slightly moist condition. Material should not be stripped in either a dry or wet condition because of the possibility of soil structural decline.
- Use of combination of a dozer and front end loader, or less preferably a scraper, to strip soil material.
- Vegetation clearing will avoid contamination of the topsoil with large quantities of green material as this promotes biological degradation (composting) of runners, roots and seeds which would otherwise be a source of regrowth when topsoil is respread.
- Timber, logs, rubbish and other vegetative matter which will interfere with respreading applications or surface stability are removed. Large rocks, road base, concrete and debris are also removed.
- Equipment operators involved in topsoil stripping are instructed on topsoil identification to maximise recovery and to avoid contamination of the target soil with subsurface material.
- Where possible soil material is used immediately in rehabilitation rather than stockpiled.
- When it is necessary to stockpile soil, the pile shall be no higher than 3m where practicable.
- Stockpiles are revegetated and fertilised as soon as possible.
- Stockpiles are located in areas protected from runoff and wind erosion.
- A good vegetative cover is maintained on stockpiles by excluding all stock and controlling weed growth.

4.2 Additional Topsoil Stripping and Handling Techniques

The following soil stripping and handling techniques are recommended to prevent excessive soil deterioration.

• Strip topsoil and subsoil to the depths stated in **Table 4**, subject to further investigation as required.

- Where practicable, place stripped material directly onto reshaped overburden and spread immediately to avoid the requirement for stockpiling.
- Strip soils by grading or pushing soil into windrows with graders or dozers for later collection by elevating scrapers, or for loading into rear dump trucks by front-end loaders. This would minimise compression effects of the heavy equipment that is often necessary for economical transport of soil material.
- Place soil transported by dump trucks directly into storage. If soil is transported by bottom dumping scrapers, it should be placed adjacent to the stockpile area and pushed to form stockpiles by other equipment (e.g. dozer) to avoid tracking over previously laid soil.
- The surface of soil stockpiles should be left in an even but roughened surface in order to promote infiltration and minimise erosion until vegetation is established and to prevent anaerobic zones forming.
- If long-term stockpiling is planned (i.e. greater than three months), seed and fertilise stockpiles as soon as possible. An annual cover crop species that produce sterile florets or seeds should be sown. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil.
- Prior to re-spreading stockpiled topsoil onto reshaped overburden (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles should be undertaken to determine if individual stockpiles require herbicide application and / or "scalping" of weed species prior to topsoil spreading.
- An inventory of available soil should be maintained to ensure adequate topsoil materials are available for planned rehabilitation activities.
- Topsoil stockpiles should be constructed so as to minimise the stockpile area in a discrete 3m high (maximum) pile. This practice is also preferable with subsoil stockpiles.
- Stockpiles should be clearly identified by a sign and a ditch or berm around the immediate stockpile area to reduce the likelihood of contamination and soil loss.
- Suitable erosion control measures such as silt fence, hay-bales and surface water diversions should be placed around the stockpile to prevent soil loss

4.3 Topsoil Respreading

Whilst the fine textured subsoil is unsuitable for use as a surface topdressing material, subsoil that is stripped to depths outlined in Table 4 (minimum of 20cm) and conserved, should be respread as an intermediate layer between the porous re-graded overburden landform and the final topdressing layer.

Where possible, suitable subsoil then topsoil should be re-spread directly onto reshaped areas. Where topsoil resources allow, topsoil should be spread to a minimum depth of 100mm. Topsoil should be spread and then sown as soon as possible, to reduce the potential for topsoil loss to wind and water erosion.

Sedimentary based overburden areas typically weather very quickly. Once disturbed (e.g. blasted, inverted and regraded with large dozers) it forms a surface that is rocky but has a significant content of weathered material and fines. The selection and placement of weathered waste rock is unnecessary in the rehabilitation process.

5 LAND CAPABILITY AND AGRICULTURAL SUITABILITY

The existing land capability for the proposed areas of disturbance at Charbon are as follows.

• Central Open Cut – Class VI.

Due to the steepness of this land and the shallow topsoil layer, this area is only suitable for grazing with judicious soil conservation measures required such as limited stocking rate, fertiliser and strategic earthworks. Patches of this land may be considered Class VII land, which is land best protected by green timber, however as a whole it is considered Class VI.

• Western Open Cut - Class VII.

Due to the skeletal soils in this area and the steep slopes this area is best protected by green timber with no grazing.

• 8 Trunk Open Cut – Class V and Class VI

Approximately 70% of the 8 Trunk Open Cut is Class VI land, with the remainder, in the vicinity of a west flowing drainage line and slopes that are less steep than elsewhere, is Class V land.

• Southwest Open Cuts – Class VI.

The land within the Southwest Open Cuts is typically steeply sloped. However, there is still adequate topsoil to make the area stable enough for some grazing.

The existing agricultural suitability for the proposed open cut mining areas at Charbon are as follows:

• Central Open Cut - Class 4.

This area is suitable for light grazing only.

• Western Open Cut - Class 5.

This area is unsuitable for agriculture or very light grazing.

• 8 Trunk Open Cut - Class 4.

This area is suitable for light grazing.

• South West Open Cuts - Class 4.

This area is suitable for light grazing.

It is noted that the Proponent would return the rehabilitated final landform to pre-mining land capability and agricultural suitability. However, to achieve this, the following will be required to be implemented.

- The final landform should generally mimic the pre-mining landform.
- Topsoil management measures recommended in this report, including stripping depths and stockpiling procedures, should be implemented.
- Topsoil should be respread on all areas undergoing rehabilitation.
- Vegetation commensurate with the pre-mining vegetation should be established.

In addition, construction of drainage works, including contour banks, in rehabilitated areas will assist in achieving pre-mining land and agricultural classes.

6 CONCLUSION

This assessment has identified an excess of topdressing material is available for use in rehabilitation, as illustrated in **Table 6**. Given the findings of this assessment, the topdressing material that is recommended to be stripped should remain viable for use as topdressing in successful rehabilitation of disturbed areas, assuming that the recommendations in this report are followed. Furthermore, if the landform is returned generally to the pre-mining topography with appropriate drainage controls, and appropriate vegetation is established, then the current land capability and agricultural suitability can be maintained over the long term following mining.

Summary of Table of Stripping and Re-Spreading Recommendations									
Open Cut Area	Pit / Section	Area (ha)	Soil Type	Topsoil Stripping Depth (cm)	Topsoil Respread Depth (cm)	Shortfall/ Excess Volume (m3)	Subsoil Stripping Depth (cm)	Subsoil Respread Depth (cm)	Comments
Central Open	Northern Section	4	Yellow Duplex	10	10	-400	20	10-15	General Management Principles as outlined in Section 4
Cut (12ha)	Central & Southern Section	8	Brown Duplex	20	10	6,400	20	10-15	General Management Principles as outlined in Section 4
8 Trunk Open Cut (32ha)	Northern Section	4	Brown Duplex	20	10	3,200	20	10-15	General Management Principles as outlined in Section 4
	Central & Southern Section	28	Yellow Duplex	10	10	-2,800	20	10-15	General Management Principles as outlined in Section 4
Southwest Open Cuts (60ha)	Eastern Pit	33.1	Red Uniform Clay	12	10	2,648	20	10-15	General Management Principles as outlined in Section 4
	Western Outlier Pit	14.1	Brown Duplex	20	10	11,280	20	10-15	General Management Principles as outlined in Section 4
	Southern Outlier Pit	12.8	Brown Duplex	20	10	10,240	20	10-15	Extra diligence required for subsoil, as moderate risk of dispersion
Western Open Cut (6.5ha)	Only Pit	6.5	Skeletal Soil	0	10	-6,500	0	10-15	General Management Principles as outlined in Section 4

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APPENDICES

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- Appendix 1 Field Assessment Procedure (Elliott and Veness)
- Appendix 2 Soil Testing Information
- Appendix 3 Soil Test Results
- Appendix 4 Glossary

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Appendix 1

Field Assessment Procedure (Elliott and Veness)

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FIELD ASSESSMENT PROCEDURE

Elliott and Veness (1981) have described the basic procedure, adopted in this survey, for the recognition of suitable topdressing materials. In this procedure, the following soils factors are analysed. They are listed in decreasing order of importance.

Structure Grade

Good permeability to water and adequate aeration are essential for the germination and establishment of plants. The ability of water to enter soil generally varies with structure grade (Charman, 1978) and depends on the proportion of coarse peds in the soil surface.

Better structured soils have higher infiltration rates and better aeration characteristics. Structureless soils without pores are considered unsuitable as topdressing materials.

Consistence - Shearing Test

The shearing test is used as a measure of the ability of soils to maintain structure grade.

Brittle soils are not considered suitable for revegetation where structure grade is weak or moderate because peds are likely to be destroyed and structure is likely to become massive following mechanical work associated with the extraction, transportation and spreading of topdressing material.

Consequently, surface sealing and reduced infiltration of water may occur which will restrict the establishment of plants.

Consistence - Disruptive Test

The force to disrupt peds, when assessed on soil in a moderately moist state, is an indicator of solidity and the method of ped formation. Deflocculated soils are hard when dry and slake when wet, whereas flocculated soils produce crumbly peds in both the wet and dry state. The deflocculated soils are not suitable for revegetation and may be identified by a strong force required to break aggregates.

Mottling

The presence of mottling within the soil may indicate reducing conditions and poor soil aeration. These factors are common in soil with low permeabilities; however, some soils are mottled due to other reasons, including proximity to high water-tables or inheritance of mottles from previous conditions. Reducing soils and poorly aerated soils are unsuitable for revegetation purposes.

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Macrostructure

Refers to the combination or arrangement of the larger aggregates or peds in the soil. Where these peds are larger than 10 cm (smaller dimension) in the subsoil, soils are likely to either slake or be hardsetting and prone to surface sealing. Such soils are undesirable as topdressing materials.

Texture

Sandy soils are poorly suited to plant growth because they are extremely erodible and have low water holding capacities. For these reasons soils with textures equal to or coarser than sandy loams are considered unsuitable as topdressing materials for climates of relatively unreliable rainfall, such as the Hunter Valley.

Root Density and Root Pattern

Root abundance and root branching is a reliable indicator of the capability for propagation and stockpiling.

Field Exposure Indicators

The extent of colonisation of vegetation on exposed materials as well as the surface behavior and condition after exposure is a reliable field indicator for suitability for topdressing purposes. These layers may alternate with other layers which are unsuitable. Unsuitable materials may be included in the topdressing mixture if they are less than 15cm thick and comprise less than 30 per cent of the total volume of soil material to be used for topdressing. Where unsuitable soil materials are more than 15 cm thick they should be selectively discarded.

Appendix 2

Soil Testing Information

(No. of pages excluding this page = 3)

TEST SIGNIFICANCE AND TYPICAL VALUES

Particle Size Analysis

Particle size analysis measures the size of the soil particles in terms of grainsize fractions, and expresses the proportions of these fractions as a percentage of the sample. The grainsize fractions are:

clay	(<0.002 mm)
silt	(0.002 to 0.02 mm)
fine sand	(0.02 to 0.2 mm)
medium and coarse sand	(0.2 to 2 mm)

Particles greater than 2 mm, that is gravel and coarser material, are not included in the analysis.

Emerson Aggregate Test

Emerson aggregate test measures the susceptibility to dispersion of the soil in water. Dispersion describes the tendency for the clay fraction of a soil to go into colloidal suspension in water. The test indicates the credibility and structural stability of the soil and its susceptibility to surface sealing under irrigation and rainfall. Soils are divided into eight classes on the basis of the coherence of soil aggregates in water. The eight classes and their properties are:

Class 1	-	very dispersible soils with a high tunnel erosion susceptibility.
Class 2	-	moderately dispersible soils with some degree of tunnel erosion susceptibility.
Class 3	-	slightly or non-dispersible soils which are generally stable and suitable for soil conservation earthworks.
Class 4-6	-	more highly aggregated materials which are less likely to hold water. Special compactive efforts are required in the construction of earthworks.
Class 7-8	-	highly aggregated materials exhibiting low dispersion characteristics.

The following subdivisions within Emerson classes may be applied:

- (1) slight milkiness, immediately adjacent to the aggregate
- (2) obvious milkiness, less than 50% of the aggregate affected
- (3) obvious milkiness, more than 50% of the aggregate affected
- (4) total dispersion, leaving only sand grains.

Salinity

Salinity is measured as electrical conductivity on a 1:5 soil:water suspension to give EC (1:5). The effects of salinity levels expressed as EC at 25° (dS/cm), on plants are:

0 to 1	very low salinity, effects on plants mostly negligible.
1 to 2	low salinity, only yields of very sensitive crops are restricted.
greater than 2	saline soils, yields of many crops restricted.

pН

The pH is a measure of acidity and alkalinity. For 1:5 soil:water suspensions, soils having pH values less than 4.5 are regarded as strongly acid, 4.5 to 5.0 moderately acidic, and values greater than 7.0 are regarded as alkaline. Most plants grow best in slightly acidic soils.

LABORATORY TEST METHODS

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Particle Size Analysis

Determination by sieving and hydrometer of percentage, by weight, of particle size classes: Gravel >2mm, Coarse Sand 0.2-2 mm, Fine Sand 0.02-0.2 mm, Silt 0.002-0.2 mm and Clay <0.002 mm SCS Standard method. Reference - Bond, R, Craze B, Rayment G, and Higginson (in press 1990) Australia Soil and Land Survey Laboratory Handbook, Inkata Press, Melbourne.

Emerson Aggregate Test

An eight class classification of soil aggregate coherence (slaking and dispersion) in water. SCS Standard Method closely related to Australian Standard AS1289. The degree of dispersion is included in brackets for class 2 and 3 aggregates. Reference - Bond R., Craze, B., Rayment, G., Higginson, F.R., (in press 1990). Australian Soil and Land survey Laboratory Handbook, Inkata Press, Melbourne.

EC

Electrical Conductivity determined on a 1:5 soil:water suspension. Prepared from the fine earth fraction of the sample. Reference - Bond R, Craze B, Rayment G, Higginson FR (in press 1990) Australian Soil and Land Survey Handbook. Inkata Press, Melbourne.

pН

Determined on a 1:5 soil:water suspension. Soil refers to the fine earth fraction of the sample. Reference - Bond, R., Craze, B., Rayment, G., Higginson, F.R. (in press 1990). Australian Soil and Land Survey Handbook. Inkata Press, Melbourne.

Appendix 3

Soil Testing Results

(No. of pages excluding this page = 5)



Land Administration & Management Property & Spatial Information

Soil Conservation Service

SOIL TEST REPORT

Page 1 of 3

Scone Research Centre

REPORT NO:	SCO08/179R1
REPORT TO:	Clayton Richards GSS Environmental PO Box 907 Hamilton NSW 2303
REPORT ON:	Twelve soil samples RWC7-08-01 Charbon Water & Soil Assessment
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	7 May 2008
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL

fren.

G Holman (Technical Officer)



Report No: SCO08/179R1 Client Reference: Clayton Richar GSS Fnvironm

Clayton Richards GSS Environmental PO Box 907 Hamilton NSW 2303

	_		_		_									_
	our	Moist	10YR2/2	7.5YR5/6	7.5YR3/3	7.5YR3/3	5YR4/6	5YR4/4	5YR4/6	7.5YR4/4	7.5YR4/4	7.5YR3/4	7.5YR3/3	7.5YR4/6
172		Dry	10YR3/3	7.5YR7/3	7.5YR5/3	7.5YR6/4	5YR6/6	5YR6/4	5YR6/4	7.5YR7/3	7.5YR6/3	7.5YR6/4	7.5YR5/3	7.5YR6/3
9402	CAAD	Hq	7.5	6.5	6.2	6.4	6.6	6.4	6.2	6.3	6.4	4.6	6.3	6.3
	CIA4	EC (dS/m)	0.13	0.03	0.02	0.01	0.01	0.05	0.01	0.01	<0.01	0.07	0.02	0.01
0/ 400	7/96/J	EAT	8/5	8/3(1)	8/3(1)	8/3(1)	3(1)	8/3(1)	8/3(2)	8/3(2)	3(3)	5	8/3(1)	3(1)
)	gravel	17	10	4	1	<1	2	<1	1	1	12	5	<1
<i>107</i>	nalysis (%	c sand	31	11	23	18	12	10	5	7	5	11	27	23
; ;	icle Size A	f sand	31	33	43	41	29	50	48	27	28	17	35	33
	r/B/1 Part	silt	12	20	12	17	14	17	17	31	29	18	16	15
		clay	6	26	18	23	45	21	30	34	37	42	17	20
	Method	Sample Id	Charbon 1/1	Charbon 1/2	Charbon 3/1	Charbon 3/2	Charbon 3/3	Charbon 5/2	Charbon 5/3	Charbon 6/1	Charbon 6/2	Charbon 7/1	Charbon 8/1	Charbon 8/2
	Lab No		-	2	3	4	5	6	7	8	6	10	11	1

9 - 45

CACKED.

Page 2 of 3

Report No: Client Reference:

Hamilton NSW 2303 PO Box 907

SCO08/179R1 Clayton Richards GSS Environmental

					and the second			
Lab No	Method	P7C/1]	Particle Siz	ze Analysis	- mechani	cal dispersi	ion (%)	C6A/2
	Sample Id	clay	silt	vf sand	cf sand	c sand	gravel	OC (%)
	Charbon 1/1	2	6	24	10	38	17	11.4
63	Charbon 1/2	24	19	23	10	14	10	0.38
e.	Charbon 3/1	15	10	28	13	30	4	2.06
4	Charbon 3/2	22	15	27	12	23	1	0.89
N	Charbon 3/3	38	16	22	10	14	<1	0.36
9	Charbon 5/2	15	20	35	16	12	2	1.32
7	Charbon 5/3	24	21	32	16	7	<1	0.60
\$	Charbon 6/1	28	32	21	6	6	1	1.21
6	Charbon 6/2	31	29	23	6	7	1	0.95
10	Charbon 7/1	36	19	13	7	13	12	1.07
11	Charbon 8/1	13	15	25	10	32	5	2.45
12	Charbon 8/2	26	17	20	6	28	<1	0.80

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END OF TEST REPORT

Page 3 of 3



Land Administration & Management Property & Sputial Information

> Soli Conservation Service Scone Research Centre 709 Gundy Road PO Box 283 Scone NSW 2337 Telephona: (02) 6545 1666 Facsimile: (02) 6545 2520 www.lands.nsw.gov.au

16 May 2008

PO Box 907

Clayton Richards

GSS Environmental

Hamilton NSW 2303

SC008/179R1

Dear Clayton Richards

......

Analysis of twelve soll samples - Charbon Water & Soil Assessment

The analysis of twelve samples (RWC7-08-01 Charbon Water & Soil Assessment) has been completed (Soil test report SCO08/179R1).

The soil erodibility factor (K factor) has been determined using the particle size analysis-mechanical dispersion (P7C/1) and organic carbon (OC) (as described by Rosewell 1993). The surface soil structure was assumed to be medium and the profile permeability was assumed to be slow.

Lab No	Sample Id	K factor	Rating
11	Charbon 1/1	na	-
2	Charbon 1/2	0.041	High
3	Charbon 3/1	0.032	Moderate
4	Charbon 3/2	0.037	Moderate
5	Charbon 3/3	0.030	Moderate
66	Charbon 5/2	0.049	High
7	Charbon 5/3	0.047	High
8	Charbon 6/1	0.041	High
9	Charbon 6/2	0.040	High
10	Charbon 7/1	0.025	Moderate
11	Charbon 8/1	0.032	Moderate
12	Charbon 8/2	0.032	Moderate

Page 1 of 2



Due to the high concentration of organic carbon (OC) the soll erodibility factor (K factor) could not be determined for the Charbon 1/1 sample

9 - 48

This interpretation was based on the samples supplied being representative, and literature guidelines. If you have any queries, please contact me on (02) 6545 1666.

Yours sincerely

SR Young Laboratory Manager Scone Research Centre

References

Rosewell CJ (1993) Soiloss – A program to assist in the selection of management practices to reduce erosion. Department of Conservation and Land Management.

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Appendix 4

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Glossary

(No. of pages excluding this page = 3)

A Horizon

The original top layer of mineral soil divided into A_1 (typically from 5 to 30 cm thick; generally referred to as topsoil

Alluvial Soils

Soils developed from recently deposited alluvium, normally characterise little or no modification of the deposited material by soil forming processes, particularly with respect to soil horizon development.

Brown Clays

Soil determined by high clay contents. Typically, moderately deep to very deep soils with uniform colour and texture profiles, weak horizonation mostly related to structure differentiation.

Consistence

Comprises the attributes of the soil material that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation or rupture.

Electrical Conductivity

The property of the conduction of electricity through water extract of soil. Used to determine the soluble salts in the extract, and hence soil stability. (Soil Landscapes of Singleton 1991)

Emmerson's Aggregate Test (EAT)

A classification of soil based on soil aggregate coherence when immersed water. Classifies soils into eight classes and assists in identifying whether soils will slake, swell or disperse (Soil Landscapes of Singleton, 1991)

Gravel

The >2 mm materials that occur on the surface and in the A_1 horizon and include hard, coarse fragments.

Lithosols

Stony or gravelly soils lacking horizon and structure development. They are usually shallow and contain a large proportion of fragmented rock. Textures usually range from sands to clay loams.

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Loam

A medium, textured soil of approximate composition 10 - 25% clay, 25 - 50% silt and ${<}50\%$ sand.

Mottling

The presence of more than one soil colour in the same soil horizon, not including different nodule or cutan colours.

Particle Size Analysis (PSA)

The determination of the of the amount of the different size fractions in a soil sample such as clay, silt, fine sand, coarse sand and gravel. (Soil Landscapes of Singleton 1991)

Pedality

Refers to the relative proportion of peds in the soil (as strongly pedal, weakly pedal or non-pedal).

pН

A measure of the acidity or alkalinity of a soil.

Solodic Soils

Strong texture differentiation with a very abrupt wavy boundary between A and B horizons, a well-developed bleached A2 horizon and a medium to coarse blocky clay B horizon.

Soloths

Similar to a solodic soil but acidic throughout the profile. Tends to be a more typical soil of the humid regions where the exchangeable cations in the B Horizon of the solodised soils have been leached out.

Podzolics

Podzolic soils are acidic throughout and have a clear boundary between the topsoil and subsoil. The topsoils are loams with a brownish grey colour. The lower part of the topsoil has a pale light colour and may be bleached with a nearly white, light grey colour.

Ped

An individual, natural soil aggregate. (Soil Landscapes of Singleton 1991)

Sodicity

A measure of exchangeable sodium in the soil. High levels adversely affect soil stability, plant growth and/or land use.

Soil mantle

The upper layer of the Earth's mantle, between consolidated bedrock and the surface, that contains the soil. Also known as the regolith.



ABN: 71 064 237 118

Continued Operation

of the

Charbon Colliery

Subsidence Assessment

Prepared by

Seedsman Geotechnics Pty Limited

October, 2009

Specialist Consultant Studies Compendium: Part 10

NOTE: This report was not commissioned and has not been reviewed by R.W. Corkery & Co. Pty Limited. Enquiries in relation to this report should be directed to the author.

CHARBON COAL PTY LIMITED

Charbon Colliery Continued Operations Report No. 753/03

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SEEDSMAN GEOTECHNICS PTY LTD

ACN 082 109 082

285 Cordeaux Road, Mt Kembla NSW 2526 Telephone 0417279556 Facsimile 0242712220

Friday, 02 October 2009

REF: Charbon-13

Mr G Watson Mine Manager Charbon Colliery PO Box 84 Kandos NSW 2848

Dear Grant,

Re: Western underground Mine

You have forwarded a proposed mine plan for the Haystack Mountain area seeking comments related to subsidence impacts. The plan calls for first workings with 6m wide roadways and a pillar height of approximately 3.0m. The maximum depth of cover is 220m and the minimum depth is 15m.

It is understood that a constraint of negligible subsidence has been applied to the mining.

Inspection of the plan indicates that the following general guidelines have been used:

- 15m to 80m depth pillars on 16m centres
- 80m to 200m depth pillars on 26m centres
- 200m to 220m depth pillars on 26m and 30m centres

The 16m pillars are to be formed on retreat by quartering pillars formed at 32m centres.

The pillar dimensions have been based on initial advice from us.

Pillar Stability

Table 1 presents the details of the calculation of the stability of the pillars using the University of NSW "normal" and "squat" pillar strength equations and full tributary area loading. Only the calculations for the maximum depth for each pillar size are shown – at lesser depths there will be greater stability. Table 2 presents the relationship between the factors of safety and the probability of failure in the UNSW methodology. It can be seen that the factors of safety that apply to the plan are indicating probability of failures better than 1:100,000 and in most cases

Page 1 of 3

SPECIALIST CONSULTANT STUDIES Part 10: Subsidence Assessment



better than 1,000,000. It is noted that these probabilities are not actual annual exceedance probabilities, but for convenience will be considered as such.

10 - 2

Table 1 Calculation of pillar stability

DEPTH	80 m	200 m	220 m
ROCK DENSITY	2.50	2.50	2.50
PILLAR WIDTH	10.00	20.00	24.00
PILLAR LENGTH	10.00	20.00	24.00
ROADWAY WIDTH	6.00	6.00	6.00
SEAM THICKNESS	3.00	3.00	3.00
CENTRES	16.00	26.00	30.00
WIDTH/HEIGHT	3.33	6.67	8.00
INITIAL STRESS	1.96	4.90	5.39
TIB. AREA STRESS	5.02	8.28	8.42
% EXTRACTION	61	41	36
PILLAR STRENGTH	11.06	16.53	20.07
FACTOR OF SAFETY	2.20	2.00	2.38

Table 2 Probability of failure versus factor of safety

8 in 10	0.87
5 in 10	1.00
1 in 10	1.22
5 in 100	1.30
2 in 100	1.38
lin 100	1.44
1 in 1 000	1.63
1 in 10 000	1.79
1 in 100 000	1.95
1 in 1 000 000	2.11

We note that in civil engineering construction (major surface infrastructure) a value of 1:1,000,000 is conventionally used. There is a question as to what should be the probability of failure to apply to pillar design in the situation at Charbon where there are no man-made structures or intensive surface uses.

The probability of failure should be consistent with other potential changes in the landscape. We are not aware of any examination of this issue in the technical literature.

We note that for the last say 3 million years (late Pliocene and Pleistocene), the geologic record suggests that there have been glacial and interglacial cycles of 40,000 to 100,000 years. These cycles could be expected to have major impacts on the landscape. We assess that this time frame is a suitable basis for an assessment of environmental risk. On this basis, we assess that a probability of failure of 1:100,000 is appropriate for pillar design; this equates to a factor of safety of 1.95. Table 1 indicates that the lowest factor of safety that applies in the layout is 2.0, and that values in excess of 2.11 apply to the vast majority of the proposed layout.

Charbon-13, 02/10/09

Page 2 of 3

10 - 3

SJ

It is assessed that the proposed layout provides adequate levels of stability.

Surface subsidence

Given the calculated pillar stresses (less than 8.5 MPa), and based on our knowledge of the roof and floor materials and the subsidence above other similar layouts, the associated surface subsidence above the pillars will be less than 20mm. This degree of surface subsidence will not be resolvable from background movements and survey error using standard terrestrial survey techniques. Any changes in tilts and strains will be insignificant and not be measureable with standard survey techniques.

There is a risk of the collapse of the roof of the bords at very low depths of cover, bearing in mind the likely presence of a weathered zone and associated soils. Without detailed knowledge of the overburden, it may be appropriate to limit the minimum depth of 25m if such surface impacts are not acceptable.

Yours truly

W. Judame

Ross Seedsman

Charbon-13, 02/10/09

Page 3 of 3

Charbon Colliery Continued Operations Report No. 753/03

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10 - 4


Charbon Coal Pty Limited ABN: 71 064 237 118

Continued Operation

of the

Charbon Colliery

Site Water Balance

Prepared by

GHD

November, 2009

Specialist Consultant Studies Compendium: Part 11

NOTE: This report was not commissioned and has not been reviewed by R.W. Corkery & Co. Pty Limited. Enquiries in relation to this report should be directed to the author.

CHARBON COAL PTY LIMITED

Charbon Colliery Continued Operations Report No. 753/03

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CLIENTS PEOPLE PERFORMANCE

Charbon Coal Pty Ltd

Charbon Colliery Water Balance November 2009

Revision 1



INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT



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- A Goldsim Representation of Existing Operations
- B Goldsim Representation of Proposed Extensions Year 1 and Year 4 Scenarios
- C Goldsim Representation of Proposed Extensions Year 7 Scenario
- D Water Balance Results



Glossary

Aquifer	Underground water storage within either disturbed or undisturbed strata.
Average Recurrence Interval	A statistical estimate of the average period in years between the occurrence of a flood of a given size or larger, eg. floods with a discharge as big as, or larger than, the 100-year ARI flood event will occur on average once every 100 years. ARI is equal to the reciprocal of annual flood risk, e.g. an AFR of 1/100 has an ARI of 100 years.
Bord and pillar	A mining system whereby coal is extracted leaving "pillars" of untouched coal to support the strata above.
Clean catchment areas	Catchments in which there are no exposed surfaces containing coal or mined carbonaceous material.
Clean water	Waters on the premises that have not come into physical contact with coal, or mined carbonaceous material.
Coal Handling Preparation Plant	A place where coal is washed, screened and prepared for market.
Design rainfall event	A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year or 1% probability flood).
Dewatering	Transfer of water from underground workings to other storages.
Dirty catchment areas	Catchments in which coal mined carbonaceous materials are present or areas where the topsoil has been disturbed.
Dirty water	Water on the premises that has come into physical contact with coal, mined carbonaceous materials or otherwise contains elevated sediment load.
Fractures	Cracks within the strata either natural or resulting from underground works.
Groundwater	Water held in strata that is not overlying the strata of the coal seam, or within the coal seam.
Infiltration	Natural flow of surface water through ground surfaces as a result of rainfall events.
Interburden	The strata between coal seams.
Licensed Discharge Point	A location where Charbon Coal has a license to discharge water.
Net extraction	Difference between water transferred to, and from, the underground water storage.
Overburden	The strata between the recoverable topsoil and the upper coal seam.



Recharge	Inflow of water from surrounding strata into underground workings through infiltration. This can be as a result of rainfall events or from surrounding aquifers.
Reject	The by-product resulting from the processing of coal, including rock and coal material that is out of sale specifications.
Sediment-laden water	Water that has a high level of suspended solids.
Steady state condition	A condition in which the system has achieved equilibrium.
Strata	Geological layers below the ground surface.
Surface Water	Water that is derived from precipitation and may be stored in dams, rivers, creeks and drainage lines.
Tailings	Fine reject material produced as a result of the coal processing process.
Temporary storage	Volume of storage available within a dam between the permanent water level and the overflow level.
Underground water	The water held in the goaf (voids) within the overlying strata of the coal seam, or within the coal seam, or within the active underground workings.



Abbreviations

AHD	Australian Height Datum
ARI	Average Recurrence Interval
СНРР	Coal Handling Preparation Plant
DWE	Department of Water and Energy
EIS	Environmental Impact Statement
kL	Kilolitres
LDP	Licensed Discharge Point
m	Metres
MB	Monitoring bore
ML	Megalitres
REA	Reject Emplacement Area
ROM	Run of Mine
т	Tonnes



1. Introduction

1.1 Commission

GHD Pty Ltd was commissioned by Charbon Coal Pty Ltd to prepare a surface and ground water balance for the Charbon Colliery.

1.2 Scope of Work

The scope of work for the study has included:

- Confirmation of the site water surface water and groundwater management systems.
- Establishment of a mathematical model to represent the water movement on the site for both surface waters and groundwater flows.
- Establishment of design flow rates for water transfers in consultation with Charbon Colliery staff.
- Application of the mathematical model to quantify the water budget for the existing operations at the Charbon Colliery.
- Verification of the model operation and water availability and security for the current operations.
- Modification to the mathematical model to represent the future mine operations when incorporating the Western Underground and Western Open Cut.
- Verification of the predicted water availability and security for the future mine operations including the Western Underground and Western Open Cut.

1.3 Methodology

The methodology adopted for the assessment closely followed the scope of works with:

- A series of meetings with site staff and ongoing liaison to confirm the water cycle operation at site for the existing conditions and planned with the extension to additional open cut areas and the Western Underground operations.
- Establishment of a mathematical model to replicate the surface water and groundwater movement at the site for the existing operations.
- Verification of the model performance against available information.
- Modification of the model to represent the proposed modifications to the site water cycle when incorporating the additional open cut areas and the Western Underground.
- Assessment of the water security for the proposed operations when the additional open cut areas, the Western Underground and Western Open Cut are operational.



2. Charbon Colliery

2.1 Location

The Charbon Colliery is operated by Centennial Coal Company Pty Ltd through a company called Charbon Coal Pty Ltd. The colliery is located approximately 4 km south of Kandos and approximately 1km south of Charbon. Figure 2.1 provides a locality map for the Charbon Colliery and proposed new coal extraction areas.

2.2 Site Operations

2.2.1 Overview

Mining associated operations at the Charbon Colliery include:

- Underground mining.
- Open cut mining.
- Coal processing and washing at the Coal Handling and Preparation Plant (CHPP).
- Coal stockpiling adjacent to the CHPP and rail loop.
- Loading of coal for export from site by rail and road.
- Mechanical maintenance activities undertaken near the Administration area and at a workshop near the Third Entry area.
- Office and administrative activities.
- Reject emplacement.

Figure 2.2 provides the location of these facilities.

In addition, the Charbon Colliery owns 14 residential cottages located at Charbon and potable water is supplied to those dwellings.

2.2.2 Coal Mining Operations

The colliery operates both open cut and underground mining operations at the site. The Run of Mine (ROM) production at Charbon is approximately 1.3 Mta with approximately 76% of this becoming product or saleable coal. The approved maximum extraction rate is 1.5 Mta.

Approximately 60% of the product coal is currently sourced from the underground operations. The majority of the product coal is transported from the site by rail – a smaller amount of product is trucked to the Kandos Cement Works, Charbon Lime Works and other domestic customers.



The main coal mining operations at Charbon consist, are shown schematically in Figure 2.3, of:

- Underground extraction of coal from the Lithgow Seam.
- Open Cut extraction of coal from surface outcrop coal seams including the Lithgow and Irondale Seams.
- Transporting the coal to near the CHPP, by conveyors, where it is processed and prepared for transportation off site.
- Rejects from the CHPP are retained on site in a Reject Emplacement Area (REA).



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2.2.3 Water Management Associated with Mining Operations

There are many water movements associated with the coal mining operations at the Charbon Colliery. The main water movements at the Charbon site are shown schematically in Figure 2.4 and consist of:

- Rain will fall on the vegetated and revegetated areas of the topographic catchment and a portion of the surface runoff will be harvested in dams. Surface runoff from vegetated areas is termed clean water runoff. The main water harvesting dam is the Reedy Creek Dam which has a capacity of approximately 220 ML. Some additional water is harvested in smaller on site dams which are indicated in Figure 2.4 by "On site water storage".
- During rainfall events there may be runoff from disturbed areas of the site. This is termed "dirty runoff" and is directed to dirty water storages. Overflows from the dirty water storages pass, after sedimentation and sediment trapping, through licensed discharge points (LDPs) and then can be trapped by other site water storages.
- Water from the dirty water storages is used on site for dust suppression.
- Water from the on site storages is used within the CHPP with water from the CHPP going into:
 - The coal stockpile for coal to be transported off site.
 - The REA with rejects.
 - Excess flow is returned to the on site water storages.
- Water from the REA seeps through the REA and finds its way back into site water storages.
- Stored site water is used within the underground operations by the continuous miner and for dust suppression. Some of this water is returned to the CHPP as ROM moisture.
- Water finds its way into the underground workings through overburden fractures and is pumped from underground into on-site storages where some can seep back into the old underground workings.
- Water that seeps into the underground workings is extracted and pumped to the surface water storages.
- An option exists for the extraction of water from the underlying regional groundwater source, using the existing bores, for water to be extracted and used on site.

2.2.4 Other Water Management Activities

In addition, there is a potable water supply to the site operations and wastewater collection and treatment. It has not been included within the site analysis, as modelled, and is discussed, in overview, in Section 3.2.1.



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2.3 Site Mining

2.3.1 Historical Mining Activities

The Charbon Colliery commenced operations in the 1920s and initially supplied coal to the Charbon Cement Works. The colliery was retained as an operational facility, to satisfy a local demand for steaming coal, after closure of the Charbon Cement Works in 1977.

The colliery was upgraded in 1985 to include the rail loop, Coal Handling Preparation Plant (CHPP) and the production rate was increased to produce a washed coal for export.

Open cut mining commenced at the site in 1996.

Historical underground bord and pillar mining has previously been undertaken in the vicinity of the Western Underground area.

2.3.2 Existing Mining Activities

Current mining operations include extraction of ROM by bord and pillar methods within the existing Charbon Underground in the 8 Trunk and 9 Trunk panels. This extraction commenced in 2007.

In addition, up to 600,000T/a is retrieved from open cut mining toward the south of the site, in the existing Southern Open Cut.

ROM coal from the above operations is transported to the CHPP via surface and underground conveyor. A proportion of the ROM coal is transported directly off-site but the majority of the ROM coal is processed by the CHPP where it is separated and product coal is stockpiled prior to transportation away from the site by rail and road.

Rejects are disposed on site at the REA. Fine rejects are pumped to the REA as a slurry with the coarser fractions transported by truck for placement.

2.3.3 Future Activities

The future coal extraction (GeoTerra 2009) and associated works will include the additional underground and open cut mining within the following proposed areas:

- The Southern Open Cuts, including the Southern Open Cut Extension and the Southern and Western Outliers.
- The 8 Trunk Open Cut.
- The Central Open Cut.
- The Western Underground and Open Cut.

Additional site operations will include a continuation of the existing Charbon Underground, operation of the CHPP, coal stockpiling, reject emplacement, mechanical maintenance, administrative functions and rehabilitation of the ground surface as mining disturbance ends in localised areas.



2.4 Site Geology and Hydrogeology

Mining to date has been within the Lithgow Seam and Irondale Seam, and where economically viable the Lidsale Seam. The proposed underground mining operations under Haystack Mountain will be within the Lithgow Seam and open cut mining will be within the Lithgow and Irondale Seams.

The basement stratigraphy, from higher to lower, is reported as being (GeoTerra 2009):

- Jurassic / Tertiary aged volcanic breccia, sandstone and basalt located on the peak of Haystack Mountain.
- Triassic aged Narrabeen Group sandstones and claystones.
- Permian aged Illawarra Coal measures including the Irondale, Lidsdale and Lithgow Seams.
- Underlying Shoalhaven Group conglomerate, sandstone shale and siltstones.

The same report indicates that there are two types of aquifer system present at the site. They are:

- Thin, unconsolidated alluvium in the major valleys.
- Shallow basement coal measure comprising a sequence of aquicludes, aquitards and low yielding aquifers.

Neither of the coal measures or creek alluvium aquifers are reportedly listed as vulnerable aquifers under the current Aquifer Risk Assessment Report.

The regional aquifers are located below the proposed workings. The Lithgow Seam is located approximately 40 to 60 m above the regional groundwater elevation at nearby bore sites.

The existing and past workings have been generally dry workings with minimal groundwater inflow.

2.5 Site Hydrology

The Charbon Colliery mining lease operations extend along the western edge of the Great Dividing Range. Due to smaller ridges extending from the main range to the west, the mining lease boundary extends into four local catchments: Reedy Creek, Rileys Creek, Stony Creek and Deep Creek.

Reedy Creek and Rileys Creek are part of the Macquarie-Bogan River Catchment whilst Stony Creek and Deep Creek form part of the Hawkesbury-Nepean Catchment. The catchments are shown on Figure 2.2.

Reedy Creek Catchment

Reedy Creek catchment is the northernmost catchment and contains the following site features: CHPP, ROM stockpiles, REA, Mine Washery Dam, Pit Top Services Area, coal loading infrastructure, rail loop, the proposed Central Open Cut and portions of the proposed Western Open Cut. Reedy Creek flows into Reedy Creek Dam. Overflows from the Reedy Creek Dam enter Cumber Melon Creek which drains into the Cudgegong River, then Lake Windamere situated to the north-west of the site.



Rileys Creek Catchment

Rileys Creek catchment lies to the south of Reedy Creek catchment and is comprised of the following site features: Southern Open Cut, 8 Trunk Open Cut, Southern Open Cut Extension, Western Outlier, Third Entry Area, Black Tanks and existing Underground workings. This catchment contains numerous farm dams that contain local minor flows. Rileys Creek drains into Carwell Creek, to the west, which drains into Lake Windamere.

Stony Creek Catchment

Stony Creek is located on the western side of the ridgeline, which runs along the eastern border of the site, and drains to the south of the mining lease. Of the Charbon Colliery site features, only portions of the proposed Southern Open Cut Extension and portions of the Southern and Western Outliers lie within the Stony Creek catchment. Stony Creek drains into Ulumbra Creek which flows south east into the Capertee River that drains into the Hawkesbury-Nepean River system.

Deep Creek Catchment

Deep Creek catchment is located on the eastern side of the Great Dividing Range. No site features of the mine are located within the Deep Creek catchment. Deep Creek flows to Capertee River to the south.



3. Water Management

3.1 Site Water Management Overview

The site has separable water cycles. They are:

- Supply of potable water, wastewater collection, treatment and an irrigation system from the residential cottages, mine office/amenities and bathhouse. The potable water is obtained from The Mid-Western Council reticulation, the wastewater is collected, treated and is discharged on site.
- Water collection, use, wastewater collection and septic treatment for the Third Entry area. Water is collected from the roof areas, held in tanks and used for toilet flushing. Wastewater is treated using a septic system at this location.
- Surface and underground infrastructure associated with the mining and coal export operations.

A schematic of the water cycles for the existing operations is provided in Figure 3.1 for the potable and wastewater systems and in Figure 3.2 for the surface and underground systems associated with the existing mining activities.

3.2 Potable and Wastewater Systems

3.2.1 Residential Cottages, Office Amenities and Bathhouse

Charbon village consists of 14 dwellings which are owned by Charbon Coal Pty Ltd. The water for these dwellings, the bathhouse and office amenities is sourced from the Mid Western Council reticulated supply system that services Rylstone and Kandos.

Wastewater from these sources is treated at the wastewater collection system and then applied to the sewer irrigation area. Discharges from this area pass through LDP1.

These components of the site water use and disposal have not been modelled in this analysis.

3.2.2 Third Entry Workshop Area

Water for the Third Entry Workshop is sourced from rainwater tanks that collect water from the roofs and store that water for use. After usage the water is transferred to a wastewater collection system which treats the water in a septic system.

These components of the site water use and disposal have not been modelled in this analysis.

3.3 Mine Water Cycles and Operations

The primary objectives of water management at Charbon Colliery are to separate clean and dirty water on the site and effectively manage water for use for mining activities through collection, treatment and reuse.





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The separation of clean and dirty water on the site is achieved by a series of diversion banks that redirect clean water from disturbed land areas and sedimentation dams that retain water for onsite re-use or discharge via licensed discharge points.

Groundwater inflow into the underground active workings has been historically minimal with the workings being classified as a relatively dry mine when compared to many other underground coal mines. Some recharge is received in the active workings following rainfall events but the volume is not considered significant. Water make does however accumulate in the 5 Trunk Disused Workings and is being used as a source of water for mining operations in the past few years.

Water demand for mining operations including the continuous underground miners, dust suppression and CHPP is met by:

- Reusing water collected by the Southern Open Cut Dam, Erosion Pond, Washery Dam and Toe Dam.
- Extracting water from licensed groundwater bores.
- Extracting water from Reedy Creek Dam.
- Utilising water from the 5 Trunk Disused Workings Underground Storage.

3.3.1 Surface Water System

Surface water consists of runoff that contributes to any of the site's surface water storages. The surface water storages, provided in Figure 3.3, are:

- Reedy Creek Dam.
- Mine Washery Dam.
- Rejects Emplacement Area.
- Toe Dam.
- Erosion Pond.
- Southern Open Cut Dam.
- Third Entry Evaporation Pond.
- Header Tank.

Inputs

The inputs into the surface water system consist of:

- Runoff from the contributing catchment areas (both clean and dirty) as a direct result of rainfall events.
- Water extracted from groundwater bores.
- Water pumped from the underground continuous miner operations to the open cut dam.
- Moisture content of Run of Mine (ROM) Coal.
- Pumping from Reedy Creek Dam.



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Outputs

The outputs from the surface water system are:

- Evaporation.
- LDP2 from the Erosion Pond into Rileys Creek.
- LDP3 from the Southern Open Cut Dam into Rileys Creek.
- Reedy Creek Dam spillway historically there has been few spills during the current Colliery ownership.
- Leakage into the 5 Trunk Underground Storage from the Third Entry Evaporation Pond.
- Moisture content of coal transported off site.

3.3.2 Underground Water System

The mining at Charbon Colliery interacts with the Lithgow and Irondale Seams. Both seams are located above the regional aquifer and therefore groundwater inflow into the workings is minimal. The seams are intermittently recharged following extended rainfall periods but become dry a few days to weeks after rainfall.

The underground water storages that most affects the water balance of the site is the 5 Trunk Disused Workings Underground Storage. The 5 Trunk Disused Workings Underground Storage is an area of old workings that regularly fills with water. The inflow of water into this storage is sourced as leakage from the Third Entry Evaporation Pond which is perched above the 5 Trunk Disused Workings, and rainfall on the overlying catchment.

Inputs

The inputs into the underground water system consist of:

- Natural recharge of the active underground workings.
- Leakage of water from the Third Entry Evaporation Dam into the 5 Trunk Disused Workings Underground Storage.
- The pumping of water from the Black Tanks into the underground workings for operation of the continuous miner.

Outputs

The outlets from the underground water system are:

- The pumping of water from the active workings to the Southern Open Cut Dam.
- Moisture content of ROM coal.
- The pumping of water from the 5 Trunk Disused Workings to the Black Tanks.



3.4 Existing Colliery Operations Water Cycle

The water cycles for the existing site operations are shown in Figure 3.3.

3.4.1 Surface Features

Reedy Creek Dam

The main source of water for operation of the colliery is Reedy Creek Dam which has a capacity of approximately 220 ML. Overflows from Reedy Creek Dam pass downstream of the site into Cumber Melon Creek. Charbon Colliery has a licence for water extraction from Reedy Creek Dam. Water pumped from Reedy Creek Dam to the Mine Washery Dam is metered to determine the volumetric water transfer. Water from the operations returns to the dam via overflows from the Mine Washery Dam into Reedy Creek. Water can also be pumped directly from Reedy Creek Dam to the Header Tank.

Mine Washery Dam

The Mine Washery Dam receives water from Reedy Creek Dam and excess water from the CHPP. Water is pumped from the Mine Washery Dam to the CHPP and a large header tank.

Header Tanks

Water for the Header Tank is sourced from the Mine Washery Dam and Reedy Creek Dam. Water pumped from Reedy Creek Dam directly to the header tank provides an increased security of the supply system on site. Water can gravitate from the large header tank to a smaller header tank to provide increased supply reliability.

CHPP

The CHPP is also supplied with water from the Mine Washery Dam and Toe Dam. A further water input to the CHPP is the in-situ moisture content of the ROM coal. Water leaves the CHPP in the rejects, placed in the REA, and in the export coal. Any excess water at the CHPP discharges back to the Mine Washery Dam.

Toe Dam

The Toe Dam is located immediately downstream of the REA. The Toe Dam receives seepage water from the REA. It is also believed, based on site knowledge and visual observations of vegetation types located downstream of the Toe Dam, that a significant proportion of water that infiltrates through the REA finds it way downstream of the Toe Dam, as underground seepage.

Groundwater Bores

Water can be pumped into the Toe Dam from two nearby bores. These bores are licenced with a licence entitlement of 30 ML/a. We are advised that these two bores were constructed in or early 2007 as a result of the water shortage experienced during the last drought.



Black Tanks

Water that is discharged into the underground workings for dust suppression and for the continuous miners is passed through the "black tanks". The two Black Tanks are each approximately 26kL capacity and receive pumped water from underground from the 5 Trunk Disused Workings area and also water from the Header Tank. Sourcing water from the Black Tanks (and therefore water from the 5 Trunk Disused Workings) was not available until early 2007.

Erosion Pond

The Erosion Pond is located nearby the Third Entry Workshop Area and collects runoff from the local disturbed dirty water catchment. The Erosion Pond receives excess flows from the Black Tanks. Water is regularly pumped from the Erosion Pond to the nearby Third Entry Evaporation Dam to minimise discharge through the licensed discharge point, LDP2, to Rileys Creek. LDP2 is located at the spillway from the Erosion Pond.

Third Entry Evaporation Dam

As the name indicates, the Third Entry Evaporation Dam is located nearby the Third Entry area. This dam is used to evaporate excess water. The dam also permits water to seep into the 5 Trunk Disused Workings Underground Storage. The dam receives water from the local catchment and pumping from the Erosion Pond.

Southern Open Cut Dam

The Southern Open Cut Dam is located nearby the Southern Open Cut. The Southern Open Cut Dam receives runoff from the local catchment and excess water from the current underground workings. The dam supplies water for dust suppression for mining activities. Overflows from the dam are discharged through LDP3.

3.4.2 Underground Features

5 Trunk Disused Workings

The 5 Trunk Disused Workings Underground Storage receives inflow water from the Third Entry Evaporation Dam. The site information indicates that the rate of seepage into the underground at this location is very much weather dependent. This storage is an area of underground workings with water partially filling the mining void.

Current Underground Mining Activities

Current underground mining activities are located just south of the Southern Open Cut. Water for the underground mining activities is supplied by the Black Tanks. The underground workings are relatively dry and receive some water inflow in the days following rainfall. Excess water from the active underground mining area is pumped to the Southern Open Cut Dam.



3.5 Western Open Cut, Western Underground and Southern Open Cut Extensions Water Cycle

The proposed extensions to mining activities at Charbon include the Western Underground, Western Open Cut and additional open cut mining in the southern area including the Southern Open Cut Extension, Western Outlier and Southern Outlier.

It is anticipated that the Western Underground and Open Cut water cycle operation will be relatively similar to the rest of the Charbon Colliery. It is planned that water will be provided to the Western Underground and Open Cut operations from the header tank with the water being used for dust suppression and the spray onto the continuous miner during its operation. Based on provided advice it is not expected that there will be a significant amount of water seep into these workings. Advice received from groundwater consultants (GeoTerra) is that annual inflow is anticipated to be around 4.5 ML.

When the Western Underground and Open Cut commences operation it is planned that one of the continuous miners and associated support equipment, currently operating in the existing underground workings, will be transferred to the Western Open Cut.

The anticipated changes to the site water cycle for this operation are shown in Figure 3.4.

3.5.1 Western Extension

Western Open Cut Dam

The Western Open Cut Dam would collect water from its natural catchment as well as the disturbed catchment created by the Western Open Cut and also receive excess water from the Western Underground.

Water from the dam will be used for dust suppression. If insufficient water is available in the Western Open Cut Dam for dust suppression, water will pumped from the Header Tank.

Western Open Cut

The Western Open Cut operations would be scheduled to take place over the first few years of the proposed extensions and subsequently rehabilitated in the following years. The open cut would require water for dust suppression which would be sourced from the Western Open Cut Dam.

Western Underground Mining

The Header Tank will supply water for the Western Underground mining activities. The underground workings are expected to be relatively dry, with an expected annual inflow into the workings of 4.5ML (Geoterra, 2009). In the event there is excess water in the Western Underground Workings, water will be pumped to the Western Open Cut Dam.

New Licensed Discharge Point (LDP5)

A proposed new licensed discharge point will be located downstream of the Western Open Cut Dam near the railway heading to Kandos. For this report this has been named LDP5.



3.5.2 Southern Open Cut Extensions

The open cut extensions in the south consist of the Southern Open Cut Extension, Western Outlier and Southern Outlier. The progressive mining of these three locations will require dust suppression that will be sourced from the Southern Open Cut Dam. Dirty water will be generated by the disturbed areas that will be diverted along a series of banks and channels to the Southern Open Cut Dam.

3.6 Future Operations in Existing Mining Area

3.6.1 Rail Loop Dam

Due to changes being made to the REA, the Toe Dam will be relocated to inside the rail loop. The Toe Dam will therefore be replaced by the Rail Loop Dam that has a greater capacity and collects runoff from a catchment area encompassing the CHPP and stockpile area.

New Licensed Discharge Point (LDP4)

A proposed new licensed discharge point will be located at the spillway from the Rail Loop Dam. For this report this has been named LDP4. Water discharging from LDP4 will flow into Reedy Creek.

3.6.2 Existing Underground Mining Area

At the commencement of underground mining operations in the western area, one of the continuous miners and associated support equipment will be relocated from the current operations to the Western Underground. Water demand for these operations will therefore be reduced. The remaining miner will continue to operate in older sections of the mine for the life of the project.

3.6.3 Central Open Cut

The Central Open Cut will be located in the Reedy Creek catchment in the northern portion of the site. Mining of this area is not expected to commence until 2016 and will require dust suppression which will be sourced from the pollution control dams.

3.6.4 8 Trunk Open Cut

The 8 Trunk Open Cut will be located in the Rileys Creek catchment near the centre of the mining lease. Mining of this area is not expected to commence until 2014 and will require dust suppression that will be sourced from the pollution control dams.



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4. Data

4.1 Extent of Water Balance Model

The water cycles which incorporates the residential cottages/main office amenities/bathhouse and the Third Entry workshop area have minimal impact on the site-wide water balance. The application of effluent at the two irrigation areas is considered to have minimal to no effect on the balance of the mine site as a whole as the runoff from these areas due to irrigation is minimal. Consequently, the water balance for Charbon Colliery has been developed including only the surrounding mine site and mining operations.

Staff of Charbon Colliery provided descriptions of the water cycles and water transfer system on the site.

4.2 Data Available from Charbon Colliery

A limited amount of water usage and flow monitoring data was available for the period since early 2007. This data was used to estimate water transfers and some water demand rates. Additional daily transfers rates were estimated from provided pipe sizes and pump powers.

4.2.1 Feature Capacities and Transfer Rates

Data and site operational information has been made available for this assessment. The data items listed in Table 4.1 has been derived from that data as follows:

- Dam storage capacities were provided.
- Areas of water storages were derived from site photographs.
- Catchment areas were derived from topographic maps.
- Maximum water transfer rates were derived from provided pipe sizes, pump capacities and estimated pumping heads.
- Moisture contents of coal and rejects was provided.
- Bore transfer rates were provided.
- Dust suppression, continuous miner and CHPP water usage rates were provided.
- Underground water usage and coal production data for the period 28 August to 2 December 2008 was supplied.



Table 4-1Supplied and Derived Data

Parameter	Annual Value	Daily Value
Reedy Creek Dam capacity		220 ML
Reedy Creek Dam surface area		45,630 m ²
Reedy Creek Dam catchment area		1022 ha
Mine Washery Dam capacity		50 ML
Mine Washery Dam surface area		8,430m ²
Header Tank capacity		250 kL
Small Header Tank capacity		50 kL
Toe Dam capacity		4 ML
Proposed Rail Loop Dam (replaces Toe Dam)		15ML
Toe Dam surface area		1,760 m ²
Third Entry Evaporation Dam capacity		8 ML
Third Entry Evaporation Dam catchment area		150 ha
Erosion Pond capacity		35 ML
Erosion Pond catchment area		41 ha
Active Underground Workings Catchment area		29 ha
Southern Open Cut Dam capacity		46 ML
Southern Open Cut Dam catchment area		100 ha
Proposed Rail Loop Dam surface area		3670 m ²
Proposed Rail Loop Dam catchment area		25.3 ha
Proposed Central Open Cut Dam capacity		7ML
Proposed Central Open Cut Dam surface area		5000 m ²
Proposed Central Open Cut Dam catchment area		12.4 ha
Proposed 8 Trunk Open Cut catchment area		32 ha
CHPP Water Demand	138 ML/a	600 kL/d
ROM production rate 1.3 Mta		5,652T/d
ROM moisture content		2% (113 kL/d)
Export coal recovery rate		76% of ROM
Export coal moisture content		9% (397 kL/d)



Parameter	Annual Value	Daily Value
Coarse reject/tailings rate		10% of ROM
Moisture content of coarse tailings		20% (158kL/d)
Fine rejects/tailings rate		14% of ROM
Moisture content of fine rejects/tailings		28% (158kL/d)
Reject Emplacement Area		31,565 m ²
Tailings infiltration rate		0.0075 m/d
Open Cut Areas Initial Loss		7.5mm
Pasture/Grassed Areas Initial Loss		25mm
Densely Vegetated Areas Initial Loss		60mm
Rock Emplacement Areas Initial Loss		70mm
Rehabilitation Areas Initial Loss		70mm
Reject Emplacement infiltration passing to Toe Dam		30% of infiltration
Tailings infiltration passing to Reedy Creek Dam		30% of infiltration
Continuous Miner water usage for 2 miners. When operation of the Western Open Cut commences this demand will be half at each location		50 kL/d when non operational 112 kL/d when operational
Dust suppression water usage at Southern Open Cut	90 ML/a	500 kL/d when operational, 0kl/day when non operational
Transfer capacity from Bore 1 and 2 to Toe Dam		1 ML/d
Combined extraction licence for Bores 1 and 2		30 ML/a
Maximum Transfer rate from Reedy Creek Dam to Mine Washery Dam		1,830 kL/d
Maximum Transfer rate from Mine Washery Dam to CHPP/Header Tank		814 kL/d
Maximum Transfer rate from Toe Dam to CHPP		600 kL/d
Maximum Transfer rate from 5 Trunk Disused Underground Storage to Black Tanks		300 kL/d
Transfer rate from Erosion Pond to Third Entry Evaporation Dam		50 kL/d when operational, 0kl/day when non operational



Parameter	Annual Value	Daily Value
Mine operations	Coal produced typically on 5 days/week.	
	3 week shut down at Christmas with only maintenance undertaken.	
	1 week shut down at Easter with only maintenance undertaken.	
	2 week shut down in October with only maintenance undertaken.	
Mine Workings Water Access Licence	5 ML/a	5 ML/a
Leakage rate from Third Entry Evaporation Dam to the 5 Trunk Disused Workings Underground Storage		2% of dam volume/d
5 Trunk Disused Workings Underground Storage Capacity		400kL



4.2.2 Precedences on Water Transfer

Operational precedences adopted for the analysis for water transfers are detailed in Table 4.2.

 Table 4-2
 Operational Precedence for Water Transfer

Feature	Comments
Mine Washery Dam	Maintained at 60% capacity when possible. Receives all overflows from CHPP. Received water from Reedy Creek Dam when capacity less than 60% and water available in Reedy Creek Dam.
CHPP	Received water from Toe Dam as higher priority than water from Mine Washery Dam while Toe Dam storage exceeds 25% capacity.
Toe Dam	Water from the REA always seeps into the Toe Dam. Receives water from bores when less than 25% of capacity in Toe Dam and less than 20% capacity in Reedy Creek Dam. Will be replaced by the Rail Loop Dam which will operate under the same rules.
Black Tanks	 Maintained full Discharge to (in reducing priority): Underground / Continuous Miner and Dust Control. Erosion Pond.
Header Tank	 Maintained full Flow from (in reducing priority): Reedy Creek. Mine Washery Dam. Black Tanks. Flow to (in reducing priority): Black Tanks. Mine Washery Dam.
Erosion Pond	For Years 1, 4 and 7, if not enough water is available for dust suppression from the Southern Open Cut Dam or the Central Open Cut Dam water is then obtained from the Erosion Pond.


4.3 Sourced Data

4.3.1 Topography

The 1:25,000 scale topographic map for Ilford (8832-2-S) provided topographic information for the Charbon Colliery site.

4.3.2 Rainfall

Rainfall data for the Charbon Colliery site analysis was adopted as being the same as that for the Kandos Cement Works site operated by the Bureau of Meteorology (Station No. 062017). Data for this site was available, in complete years, from 1951 to 2008.

The data was checked for consistency and a summary of the annual rainfall is given in Figure 4.1. This figure demonstrated the variability in the annual rainfall. The year 2006 was a particularly dry with there only being 304 mm of rainfall recorded. One year, 1982, had less recorded rainfall. If the colliery had been operating at the same production rate in 1982 then one would have expected a similar site water shortage to that experienced in 2006. Rainfall statistics were:

- Minimum annual rainfall 303 mm in 1982.
- Average annual rainfall 692 mm.
- Median annual rainfall 696 mm.
- Maximum annual rainfall 1,122 mm in 1973.



Figure 4-1 Annual Rainfalls at Kandos Cement Works Site



The monthly rainfall statistics were also determined for the period of record. Selected statistics are shown in Figure 4.2. The average monthly rainfalls were observed to vary from a low of approximately 43 mm in April to a high of approximately 77 mm in January. Figure 4.2 shows a significant variation in the maximum recorded monthly rainfalls with the maximum monthly value being approximately 330 mm in February to a lowest maximum monthly value of approximately 160 mm in June.



Figure 4-2 Monthly rainfall statistics

An analysis of the rainfall data was undertaken to enable an understanding of the likely rainfall patterns at the site. For various intervals of daily rainfall, the average number of days per year which fall within each interval are presented in Figure 4.3. The figure also presents the cumulative days per year as a percentage against the same rainfall intervals.



Figure 4-3 Number of rain days of various magnitudes



As presented in Figure 4.3, the average number of non rainfall days per year is approximately 275. which is greater than 75% of days in a year. Of the remaining 25% of days in the year, 14% receive less than 5mm of rainfall. Figure 4.4 presents the same statistics as Figure 4.3, excluding days without recorded rainfall. This enables a more detailed view of the data.



Figure 4-4 Daily Rainfall Magnitudes

As presented in Figure 4.4, the amount of rain falling on any one day decreases for rainfall greater than 5mm. On average, approximately 11% of days in the year (or 40 days) receive greater than 5mm of rain with 2.5% of days in the year (or 9 days) receiving greater than 20mm of rain.

4.3.3 Evaporation Data

Daily evaporation data was not available for the site. Information for Bathurst Agricultural Station (Station no. 063005) was adopted for this study.

Figure 4.3 provides a representation of the average monthly evaporation. Adopted evaporation rates were adjusted for the change in site conditions from a measuring site to the site dams.





Figure 4-5 Average monthly evaporation rates

The average annual evaporation rate was approximately 1,490 mm as compared to the annual average rainfall of approximately 690 mm giving an annual deficit (difference between annual rainfall and annual evaporation) of approximately 800 mm.



5. Modelling Representation

5.1 Goldsim

The model used to represent the colliery water balance was Goldsim Version 9.60 (Goldsim Technology 2007). This software is a graphical, object oriented system simulation software for completing either static or dynamic systems. It is like a "visual spreadsheet" that allows one to visually create and manipulate data and equations.

Simulation, in this context, is defined as a process of creating a model of an existing or proposed system (such as a mine water management system) in order to identify and understand the factors that control the system performance or predict (forecast) the future behaviour of the system.

A model representation of the existing mining operation related water cycles was created using Goldsim and the results verified, as best as practical, for the drought period of 2006 and early 2007 when Reedy Creek Dam was very low.

Once the model operation was verified as representing the site conditions at that time, it was modified to include the future operations and the two bores where switched on to permit water supply to the Washery Dam. These bores were not operational in 2006.

5.2 Water Cycle Modelling

All the water balance modelling was completed using:

- Daily time steps were used for the analysis daily rainfall data was the shortest period data available.
- The small header tank and the associated pump was not incorporated into the analysis for simplicity.
- Runoff from catchments was represented by an initial loss/runoff factor this was used to convert daily rainfalls into surface runoff values when the daily rainfall has exceeded the initial loss of rainfall (infiltration which is subsequently transpired by vegetation). This approach was adopted and calibrated to typical surface runoff values for the site soil conditions in preference to undertaking water balances to quantify the surface runoff from each catchment.

5.2.1 Model Structure

The model was configured to represent the water cycles using a series of rules data. The model was created as a series of elements each containing preset rules and data, that were linked to represent the water transfer around the water cycles.

The overall structure of the model is shown in Appendix A, for the existing configuration, and Appendices B and C for stages within the future operations where the water cycle has changed.



5.2.2 Model Data

The data shown in Table 4.1 was incorporated into the model operational rules.

The water transfer rates shown in Table 4.2 were entered as maximum values that could occur on any single day.

When the model determined that the required daily water transfer rate, for any of the transfer elements, was less that the maximum specified daily value for that element, the model adopted the reduced transfer volume. For example, for the transfer from Reedy Creek to the Mine Washery Dam was set at 1,830 kl/d but when the model determined a reduce transfer volume was appropriate, on any day, the reduced value was adopted. Hence the transfer volume summaries, in Figures 6.1 to 6.4, show an annualised transfer volume less than the maximum potential value which is the product of the number of days of operation times the maximum daily transfer value.

5.2.3 Model Operational Rules

The rules identified in Table 4.2 were specified within the model to determine the priorities adopted within the model for water transfers.

5.3 Goldsim Representation

5.3.1 Existing Operations

The normal operation of the water cycle, associated with coal production, shown in Figure 3.3 was modelled in Goldsim. To undertake the modelling the following simplifications were incorporated:

- Transfer rates were modelled using daily time steps. In reality, transfer rates are determined during the day on an "as needs basis" and may operate over periods smaller than a day.
- The small header tank was excluded from the model.
- The daily coal production rate was determined from the achieved yearly production rate of 1.3 million tonnes per annum. In reality the daily production rate would vary. The approved production rate is 1.5 million tonnes per annum.
- The moisture content of the ROM, Product and Reject Coal was assumed to be static percentages of the daily production. In reality these values would vary daily.
- The pumping rates to the underground miner were assumed as 50kL and 112kL per day on non operational and operational days, which were average values determined from a 3 month period of data supplied by Charbon staff. In reality the demand for the underground miner varies daily.
- The demand of the CHPP was assumed to be 600kL per operational day. In reality this value varies daily.
- Dust suppression rates were determined as 500kL per day, as indicated as an average value by Charbon staff. In reality the dust suppression rates would vary daily.



 Operating rules/precedences were established within the model in accordance with advice from Charbon staff. In reality the same decisions may not be made by staff due to influences outside the model.

There was limited data available for the following segments of the model. The values for these portions of the model were therefore adjusted to replicate anecdotal site information:

- Infiltration from the Reject Emplacement Area.
- Proportion of Reject Emplacement infiltration that flowed to the Toe Dam.
- Proportion of Reject Emplacement infiltration that flowed to the Reedy Creek Dam.
- Rate of leakage from Third Entry Evaporation Dam into the 5 Trunk Disused Workings Underground Storage.

The Goldsim representation of the existing site water balance is shown in Appendix A.

5.3.2 Proposed Operations Including Open Cut Extensions and Western Underground

The Goldsim model was modified to represent the proposed normal operation of the water cycle at the site following the commencement of operation of the Western Underground, Western Open Cut, Southwest Open Cuts, 8 Trunk Open Cut and Central Open Cut.

Changes to the model were to incorporate additional elements to represent the future works shown diagrammatically in Figure 3.4 and identified in Sections 3.5 and 3.6.

We understand that it is unlikely that the Western Underground and Open Cut will yield a significant amount of water within the mined coal seam. Hence, the assumed water usage rates per tonne of production from the Western Underground and Open Cut area has been set at the same as for the existing mining operation. The same assumptions made for the existing operations were applied to the Western Underground and Open Cut scenario.

As the proposed mining operation extensions will occur in various stages, different demands on water supply and changes in disturbance areas will be experienced at various stages of the mine life. Therefore, the water balances for the extensions have been modelled for three scenarios of the proposed mining operations: Year 1, Year 4 and Year 7. These stages of mine life are represented in Figures 5.1, 5.2 and 5.3.

Year 1 Scenario

The following amendments were made to the existing scenario to represent the proposed extension:

- The Toe Dam was relocated to within the rail loop (renamed Rail Loop Dam) with a greater capacity of 15ML that would collect runoff from a catchment area.
- The catchment contributing to the Southern Open Cut Dam was modified to represent predicted disturbance areas, areas awaiting revegetation and natural vegetation.
- Transfers from the Header Tank to the Western Underground and Open Cut Operations were introduced.



- The Western Open Cut Dam was added to the model with a capacity of 4.8ML that would collect runoff from the Western Underground and Open Cut catchment and store water for transfer between the Header Tank, Western Underground Operations and Dust Suppression.
- An allowance or 200kL per day for Dust Suppression in the Western Open Cut Operations.
- Demand of 25kL and 56kL per non-operational and operational day respectively for the Western Underground Operations.
- Reduction of the demand in the existing Underground Operations from 50kL and 112kL to 25kL and 56kL per non-operational and operational day respectively.
- Infiltration from the overhead catchment into the Western Underground Workings at 4.5ML per year as indicated by correspondence from GeoTerra.

Year 4 Scenario

The following amendments were made to the Year 1 scenario to represent the proposed Year 4 scenario:

- The catchment contributing to the Southern Open Cut Dam was modified to represent predicted disturbance areas, areas awaiting revegetation and natural vegetation.
- The Western Open Cut disturbed catchment was reduced to resemble revegetation of an area naturally flowing to the south.
- Pumping from the existing underground mining operations to the Southern Open Cut Dam ceased.

Year 7 Scenario

The following amendments were made to the Year 4 scenario to represent the proposed Year 7 scenario:

- The catchment contributing to the Southern Open Cut Dam was modified to represent predicted disturbance areas, areas awaiting revegetation and natural vegetation.
- The additional areas affected by the Central Open Cut and the 8 Trunk Open Cut were incorporated into the model to represent predicted open cut areas, rock emplacement areas and areas awaiting revegetation.
- The series of dams collecting runoff from the Central Open Cut was represented in the model as a single pollution control dam with 7ML capacity, which is equal to the total capacity of the series of dams.
- Runoff from areas affected by the 8 Trunk Open Cut were collected in an in-pit sump and subsequently pumped to the Erosion Pond.
- Dust suppression from the Southern Open Cut Dam was decreased to 250kl/operational day and dust suppression from the Central Open Cut Dam commenced at 250kl/operational day.



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6. Modelling Results

6.1 Existing Operations

Initially the model was established using the estimated flow rates, water usages and estimated infiltration rates. Adjustments were required to these initial values to closely replicate the system performance for the period of observed data since January 2007. It was known that the site was close to running out of water in the very dry year of 2006. Appendix D provides detailed numerical results for the existing conditions.

Minor adjustments were required to some model parameters to approximate the behaviour in 2006. The adopted parameters are those given in Tables 4.1 and 4.2. A significant assumption within the modelling is the amount of infiltration at the REA that finds its way into the Toe Dam for reuse.

The modelled minimum volume within Reedy Creek Dam in 2007 were sensitive to the infiltration rate at the REA, changing the rate from 3mm to 5mm per day from the REA resulted in a 17ML increase in the minimum volume obtained in Reedy Creek Dam in February 2007.

The proportion of the Reject Emplacement infiltration that contributes to Reedy Creek Dam and the Toe Dam is difficult to quantify as these are subsurface flows. The proportions assigned to them were determined so that reasonable responses were output by the model. For example, the proportion flowing into the Toe Dam was determined such that over flows from the dam do not occur frequently yet the volumes contributing to the dam were consistent with observations at the site.

Assumptions have also been made when modelling the leakage from the Third Entry Evaporation Dam to the 5 Trunk Disused Workings Underground Storage and the capacity of the underground storage. The leakage rate from the Third Entry Evaporation Dam has an affect on whether the demand for the Underground Mine is sourced from the underground storage or Reedy Creek Dam. The capacity of the 5 Trunk Disused Workings Underground Storage has been assumed because the capacity at the time of this study could not be accurately determined.

Anecdotal information from site indicated that overflows from LDP3, the Third Entry Evaporation Dam and Reedy Creek Dam in recent years have been minimal. To reflect these conditions in the model, catchments were divided into various land use areas which had different initial loss values. The initial loss values for each land use were adjusted to reflect the anecdotal site conditions.

To achieve a representation of the reported few overflows it was necessary to set the rainfall – runoff parameters, specifically the rainfall required to create runoff at relatively large but realistic values. To achieve this, while providing an appropriate representation of the catchments, the land uses were divided into different land uses to reflect the different stages in the site life. In addition, soil storage capacities for the different land uses.





Results of the performance verification runs for the year 2006 and early 2007 showed that:

- The low rainfall produced little surface runoff into the Reedy Creek Dam during the year.
- The low rainfall reduced the amount of infiltration from the Third Entry Evaporation Dam into the underground workings as its storage was below average for 2006.
- If in place at the time, modelling showed that storage in the 5 Trunk Disused Workings was below average for 2006 as the recharge rate had been set to be a function of the volume of water stored within the Third Entry Evaporation Dam. This caused a larger proportion of the water for the underground workings for that year to be drawn from Reedy Creek Dam via the Header Tank.
- The amount of seepage from the REA was also reduced as the evaporation from the REA was relatively greater than the total of the rainfall onto the REA plus the tailings moisture to the REA.
- For the year 2006, an amount of 136ML was predicted to have been extracted from Reedy Creek Dam, a total of 18ML was predicted to have been extracted from Bores 1 and 2, if they had been in place at that time, and 5.2ML of water was predicted to have been extracted from the underground workings in the area of 5 Trunk Disused Workings Underground Storage if in place at the time. The amount of water extracted from Bores 1 and 2 can readily be adjusted, water demand transferred to another location, by a minor adjustment to the operating protocols for the water pumping.
- For the year 2007, 17.2ML was extracted from Bores 1 and 2, if they had been in place at the time. Nearly all pumping from the bores occurred in the first 6 weeks of 2007 before the dam was recharged by heavy rainfall in February. Groundwater bores are activated as a last resort when levels are low in Reedy Creek Dam and the Toe Dam.
- Following the 2006 dry period, Reedy Creek Dam refilled to full capacity in June 2007 by very heavy rainfall.

Predicted extraction and water transfer rates for this mode of operation are given in Figure 6.1. The figure provides mean predicted values for each water transfer over the simulation period together with the respective minimum and maximum values in brackets to give an indication of the range of likely values. Where there are no values in brackets, there was not a range as the transfer rate was static across all years.

General results from the simulations included:

- The estimated annual water usage at the CHPP is approximately 134 ML.
- In average rainfall years there is a water deficit (difference between rainfall and evaporation) of approximately 800 mm on water storages at the site and this represents an annual demand of around 70ML on the surface water resources at the Charbon Colliery site to satisfy the water evaporation demand from the water storages.
- The average annual values predicted to have been extracted from water sources was:
 - An amount of 135 ML from Reedy Creek Dam.
 - A total of 2.6ML from Bores 1 and 2.
 - An amount of 16ML from the underground workings in the area of 5 Trunk Disused Workings Underground Storage.



- The yearly sourcing of water from the 5 Trunk Disused Underground Storage to the Black Tanks (and ultimately the Continuous Miner) is dependent on rainfall. In a high rainfall year up to 24ML is expected to be sourced from the 5 Trunk Disused Underground Storage whilst in a dry year this value is only 5.2ML.
- The average number of days in which there are discharge events from LDP2 is 0.5, ranging from no discharges in a dry year through to 6 days in a wet year.
- The average number of days in which there are discharge events from LDP3 is 3, ranging from 0 discharges in a dry year through to 21 days in a wet year.
- In dry years more demand is placed on Reedy Creek Dam to satisfy the requirements of the mining operations. In other years the demand on Reedy Creek Dam is subsidised by the runoff into the Third Entry Evaporation Dam. The maximum volume of water pumped from Reedy Creek Dam in a year is 150ML whilst the minimum is 110ML.
- The estimated overflows from Reedy Creek Dam vary from 0 to 1,208ML per annum. The average annual flows from the dam are estimated to be 112ML.
- Annually, between 10 and 20% of the water pumped from Reedy Creek Dam is pumped directly to the Header Tank. The remaining demand from Reedy Creek Dam is pumped to the Mine Washery Dam.

Only the extraction from Bores 1 and 2 is likely to affect the regional groundwater regime. The extraction from the workings is not expected to impact the regional groundwater regime as the workings are above the regional groundwater phreatic surface as discussed earlier in Section 3 of this report.

Examination of the rainfall statistics shown in Figure 4.3 indicate that there are relatively few days with significant, greater than 20 mm, rainfall at site. The relatively small number of days of significant rainfall supports the anecdotal information from site that indicates few overflows from the structures. Hence, there is validation in the adoption of relatively high loss values for the rainfall and runoff modelling.

Figures 6.2 and 6.3 show the pattern of discharge from LDP3 and Reedy Creek Dam for the existing conditions. As shown in these graphs, although the average discharges are not close to zero, the average discharges from these points are boosted up by a few larger discharge events. For both discharge points in approximately 50% of all years there is no discharge shown by the model.





Annual LDP3 Discharges

Figure 6-2 Predicted LDP3 discharge frequency and discharge volumes

Annual Number of Discharge Overflow Volume (ML) Events Year (1-58)

Annual Reedy Creek Dam Overflows

Discharge Volume
LDP Discharge Events

Figure 6-3 Predicted Reedy Creek Dam overflow frequency and overflow volumes



Figures 6.2 and 6.3 indicate that based on the available information there would be approximately half the analysed years when there would not be any discharge from LDP3 or overflow from Reedy Creek Dam. In approximately 10 years there was predicted to be significant discharges.

6.2 Operations Including the Proposed Underground and Open Cut Extensions

As detailed in Section 5.3.2, water balance modelling was completed for three scenarios representing Year 1, Year 4 and Year 7 of the proposed extension to operations at Charbon Colliery. The modifications made to each of the models to represent each of the scenarios are also detailed in Section 5.3.2. Each of the scenarios was modelled using the 58 years of available daily rainfall data from 1951 through to 2008.

Predicted extraction and water transfer rates for Years 1, 4 and 7 modes of operation are given in Figures 6.4, 6.5 and 6.6. The detailed results showing the maximum, minimum and mean transfer rates for processes are shown in Appendix D.

When comparing the flow values given in Appendix D, and determining the maximum demands then it is necessary to consider that the maximum water extraction from Reedy Creek Dam, for example, will most probably occur in a wet year while the maximum extraction from the Bores will occur in a dry year. Hence it is not appropriate, when determining the maximum value, to simply arithmetically add the maximum values in Appendix D.

A summary of results not visible in Figures 6.4 to 6.6 has been provided in Table 6.1 below. To compare the performance of the water cycle in a dry year, results for the year 2006 and 2007 have been included in the table.



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Table 6-1	Additional	Annual	Demands
	Additional	Amaa	Demanas

2006	Year 1	Year 4	Year 7
Total extraction from Reedy Creek Dam	119ML	117ML	117ML
Total extraction from Groundwater Bores 1 and 2	31ML	32ML	31ML
Extraction from 5 Trunk Disused Underground Storage	5ML	5ML	5ML
2007	Year 1	Year 4	Year 7
Total extraction from Groundwater Bores 1 and 2	17ML	17ML	317ML
Average over all years	Year 1	Year 4	Year 7
Total extraction from Reedy Creek Dam	151ML/yr	148ML/yr	160ML/yr
Total extraction from Groundwater Bores 1 and 2	5.5ML/yr	5.5ML/yr	5.5ML/yr
Discharge events from LDP2	0.2d/yr	0d/yr	0.3d/yr
Discharge events from LDP3	0.8d/yr	0.1d/yr	0d/yr
Discharge events from LDP4	0.2d/yr	0.2d/yr	0.2d/yr
Discharge events from LDP5	4.6d/yr	4.5d/yr	17d/yr

Some notable results were that:

- For a situation of the year 2006 rainfall being repeated with the Western Open Cut operational, it is predicted that the volume of water pumped from Reedy Creek Dam would decrease from the existing levels by between 15ML/yr and 20ML/yr. Under the same conditions, the volume of water pumped from the groundwater bores would increase from 18 to 31ML/yr.
- The predicted water pumped from the existing operations to the proposed Western Operations will place a significant demand on the existing water system since the Western Operations are likely to be relatively dry. Based on the estimated dust suppression demand of 45 ML/a there is likely to be a demand of 40 – 50MLML/a required to be pumped to the proposed Western Operations.
- The Western Operations places an additional pressure on water demand from Reedy Creek Dam. This pressure is somewhat offset by a reduced demand of the existing underground mining operations and the addition of the Rail Loop Dam. The greater capacity of the Rail Loop dam enables more water to be used from this source rather than the Washery Dam, which is topped up from Reedy Creek Dam. In an average year there is an increase in pumping from Reedy Creek Dam of approximately 15ML to 25ML compared to the existing operations. During a dry year nearly 30ML extra is pumped from Reedy Creek Dam. This may be significant to mining operations if consecutive dry years are experienced which may lead to the emptying of Reedy Creek Dam.



- The discharges from LDP 3 is predicted to decrease with each consecutive phase of the extensions. The cause of this is the increase in disturbance areas followed by progressive rehabilitation of the Southern Open Cut Extensions. Rock emplacement areas and rehabilitated areas generate lower rates of runoff. As more area is rehabilitated in the Southern Open Cut Extension less runoff contributes to the Southern Open Cut Dam, decreasing the discharge volumes and frequency.
- Annually for all proposed scenarios, between 15 and 35% of the water pumped from Reedy Creek Dam is pumped directly to the Header Tank, with over 80% of this water being transferred to the Western Operations and the remaining transfers from the Header Tank being pumped to the Black Tanks. The remaining demand from Reedy Creek Dam is pumped to the Washery Dam.
- There is a considerable interaction of several parameters within the Goldsim model and this, together with the changed site operations, makes the evaluation of results given in Appendix D complex. For examples, the reduced runoff to the Southern Open Cut Dam is a result of an increased amount of the catchment being rehabilitated or ready for rehabilitation while the number of discharges from LDP5 increases for Year 1 to Year 7 as a result of the discharged predicted to occur from the Central Open Cut Dam. Similarly the runoff from the Western Open Cut Disturbed Catchment is predicted to be approximately the same in the Year 1 and Year 4 configuration but reduced in the Year 7 configuration as a result of completed revegetation. Revegetation typically uses a significantly increased amount of soil moisture during the first 15 to 20 years of regrowth and this reduces the soil moisture values.



6.3 **Qualifications on Predictions**

Predicted water transfers are based upon a mix of data. Typical data sources for model construction and verification included:

- Relatively reliable data
 - Monitored flows to the continuous miner for a period.
 - Monitored rainfall from nearby Kandos.
 - Monitored evaporation from Bathurst.
 - Surface catchment areas were based on topographic maps.
 - Product coal moisture content.
 - Reject moisture content.
 - CHPP water usage.
- Less reliable data
 - Estimates of underground catchment areas.
 - Capacity of underground storages.
 - Estimates of many water transfer rates based upon pipe diameter, pipe material and power of pump motors.
 - Infiltration rate in the Reject Emplacement.
 - Proportion of overflow from Toe Dam that reaches Reedy Creek Dam.
 - Proportion of discharge from Reject Emplacement infiltration that reaches Reedy Creek.
 - Rate of leakage from Third Entry Evaporation Dam to 5 Trunk Disused Workings Underground Storage.
 - Site infiltration rates for normal and revegetated catchment areas.
 - The capacity of the Rail Loop Dam is to be confirmed.
 - Estimates of demands for the Western Underground and Open Cut operations have been scaled from the existing operations. When the disturbed area is better defined there may be an opportunity to refine the estimated demand for dust suppression.

As a result of the number of items listed within the "less reliable data" category there is likely to be a significant risk that the provided estimates may be inaccurate. It is suggested that the individual predictions given above should be considered reliable to +/-30% to +/- 50% until more site data is gathered to allow refinement of the data sources and hence the model predictions to be confirmed as reliable.



6.4 Recommendations

To facilitate refinement of the operation of the water cycle model for the Charbon Colliery site, the following are recommended:

- Improved flow monitoring be established at the site. It is recommended that this include the installation of "clamp on" meters being installed at sites shown in Figure 6.7. Routine and ongoing monitoring of the flows at these sites would either confirm the predictions within this report or allow calibration of the model to better quantify the water behaviour. Installation of hour run metering could be installed as an alternate metering form provided that the flow transfer rates are quantified. The monitoring should be continued until at least 6 months of continuous data is available for the updating and calibration of the water balance model.
- A review be undertaken to allow calibration of the flow from the 5 Trunk Disused Workings Underground Storage to the Black Tanks be completed to develop a predictive calibration of the likely leakage from the Third Entry Evaporation Dam into the 5 Trunk Disused Workings Underground Storage to be established as a function of site rainfall. This would be used in future site predictions. The amount of recharge through this location is currently unknown.
- There is an unknown amount of water that infiltrates from the surface of the Reject Emplacement Area (REA) into the Toe Dam. This could be measured at the pipe that drains the base of the rejects however the reliability of this measurement is unknown as there could be lower level seepage.
- Updating and recalibration of the predictive model should be undertaken when the above data becomes available to increase confidence in the modelling results and to facilitate improved site management. A period of continuous data of not less than 6 months should be available for the updating and calibration of the water balance model.

During the preparation of this study there have been some licensing issues identified. These, along with recommendations for addressing the issues, include:

- The model predictions indicate that the existing licensed extraction limits have been exceeded and are likely to be exceeded in the future. It is recommended that discussions be held with regulators to resolve the licensing issues.
- The model predictions indicate that the existing licensed extraction limits may not be sufficient for current and future mining operations. It is recommended that all licence limits and conditions be reviewed, in association with regulators based on the results of the model.



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7. Summary

GHD was commissioned by Charbon Coal Pty Ltd to prepare a surface water and groundwater balance for the Charbon Colliery.

Preparation of the plan has required: confirmation of the site water surface water and groundwater management systems, establishment of a mathematical model to represent the water movement on the site, application of the model to quantify the water budget for the existing operations and future operations.

Due to the modest amount of site data available to verify the flow estimates it was necessary to make several important assumptions about the site water flows. The most significant assumptions have been the amount of infiltration at the REA that finds its way into the Toe Dam for reuse. The validity of the assumptions requires confirmation when more site data is available for model verification.

Results of the performance verification runs for the low rainfall year of 2006 confirmed that for the low rainfall year there would have been a significant water stress at the site as a direct result of reduced rainfall, increased evaporation and the continued water demand. This has been anecdotally confirmed during meetings at site. For 2006, an amount of 136ML was predicted to have been extracted from Reedy Creek Dam, a total of 18ML was predicted to have been extracted from Bores 1 and 2 and 5ML of water was predicted to have been extracted from the underground workings in the area of 5 Trunk Disused Workings Underground Storage.

General results from the simulations of existing operations included a prediction of average extractions of approximately 135ML from Reedy Creek Dam, approximately 2.6ML from Bores 1 and 2 and approximately 16ML from the underground workings in the area of 5 Trunk Disused Workings Underground Storage.

Only the extraction from Bores 1 and 2 is likely to affect the regional groundwater regime. The extraction from the workings is not expected to impact the regional groundwater regime as the workings are above the regional groundwater phreatic surface.

When including the proposed extensions in the site operations there is a predicted reduction in water security. For a repeat of the 2006 rainfall with the proposed extensions operational, it is predicted that between 116ML and 120ML would be extracted from Reedy Creek Dam, approximately 30ML would be extracted from Bores 1 and 2 and 5ML of water would be extracted from the underground workings in the area of 5 Trunk Disused Workings Underground Storage.

For a year of average rainfall the predicted extractions would be approximately 150ML to 160ML from Reedy Creek Dam, approximately 5.5ML from Bores 1 and 2 and approximately 12ML from the underground workings in the area of 5 Trunk Disused Workings Underground Storage.

For the Year 7 configuration it was predicted that an annual volume of approximately 14 ML would drain into the Central Open Cut storages with an average annual overflow of approximately 10 ML. The overflow volume would be reduced if this water was used, in part, for



dust suppression. The overflow will pass through LDP5. An average annual yield of approximately 11ML is predicted from the 8 Trunk system.

The projected operations of the mine when the proposed extensions are operational is dependent upon the ongoing water availability from the 5 Trunk Disused Workings Underground Storage and the 8 Trunk system. Site planning will need to address the matter of whether these sources of water are maintained or whether they are abandoned. A final decision on this matter should be made prior to the updating of the water balance model when site monitoring data is available. If, or when, the underground sources of leakage water become unavailable there will be an additional stress placed on the water cycle as this is currently a significant water source.



8. References

GeoTerra Pty Ltd 2009, Continued Operation of the Charbon Colliery Groundwater Assessment, (Draft).

Goldsim Technology Group LLC 2007, Goldsim Users Guide, Volumes 1 and 2.

GSS Environmental 2009, Continued Operation of the Charbon Colliery Surface Water Assessment (Draft).



Appendix A Goldsim Representation of Existing Operations

GOLDSIM MODEL LAYOUT

EXISTING OPERATIONS - BROAD SCALE VIEW



GOLDSIM MODEL LAYOUT

EXISTING OPERATIONS - DETAILED VIEW











Appendix B Goldsim Representation of Proposed Extensions – Year 1 and Year 4 Scenarios

GOLDSIM MODEL LAYOUT

PROPOSED OPERATIONS - YEAR 1 AND YEAR 4 - BROAD SCALE VIEW



Results
GOLDSIM MODEL LAYOUT

PROPOSED OPERATIONS - YEAR 1 AND YEAR 4 - DETAILED VIEW





Western_Ops_ROM_Moisture

UG_Ext_ROM_Moisture OC_Ext_ROM_Moisture



Appendix C Goldsim Representation of Proposed Extensions – Year 7 Scenario

GOLDSIM MODEL LAYOUT

PROPOSED OPERATIONS - YEAR 7 - BROAD SCALE VIEW





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Results

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GOLDSIM MODEL LAYOUT

PROPOSED OPERATIONS - YEAR 7 - DETAILED VIEW



EightTrunkOC_Cat_OC

EightTrunkOC_Runoff_OC



Appendix D Water Balance Results

	Total Pumpin from Reedy Ck Dam	Pumping from Reedy Ck Dam to Header Tank	Pumping Reedy Ck Dam to Washery	Reedy Ck Dam Catchment Runoff	Overflow from Reedy Ck Dam	Pumping Washery to Header Tank	Pumping Wash Dam to CHPP	Washery Dam Overflow	Recycle from CHPP to Washery Dam	Pumping Header to BlackTanks	Pumping from GW Bores	Pumping UG Storage to Black Tanks	Pumping Black Tanks to UG Miner	Leakage To UG Storage	Overflow from Toe /Rail Loop Dam	Pumping UG to Southern OC Dam	Dust Suppression From Southern OC	Runoff to Southern OC Dam	Runoff to Third Entry Dam	Above ground leakage to existing UG Workings	l Overflow from Tailings Dam	Infiltration from Tailings Dam	Toe/Rail Loop Dam To CHPP	Pumping Black Tanks to Erosion Pond	Pumping Erosion Pond to Third Entry Evap Dam	Runoff to Erosion Dam	Existing UG Operations ROM Moisture Content	
Units	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	ML/yr	
Current Ope	rations	15.0	110.0	040.7	111.6	0.5	112.0	0.0	2.2	16.2	2.6	15.7	22.4	15.0	0.0	11.4	06.0	102.2	57	4.4	1.0	64.2	20.5	0.0	10.0	17.0	25.2	
Max	134.0	15.6	128.1	242.7	1208.4	0.5	110.0	0.0	2.2	26.8	2.0	24.0	32.1	24.8	0.0	11.4 44.4	00.3 112.0	217.7	5.7 109.0	4.4	1.2	04.3 74.5	20.5	0.0	10.0	69.4	25.3	
Min	110.3	7.8	92.2	0.0	0.0	0.2	87.0	0.0	2.2	8.1	0.0	5.2	32.1	5.2	0.0	7.1	21.5	21.3	0.0	0.0	0.0	55.1	15.0	0.0	1.2	0.0	25.2	
2006	136.1	25.8	110.2	1.3	0.0	1.0	101.4	0.0	2.2	26.8	18.0	5.2	32.1	5.2	0.0	7.1	21.5	21.3	0.0	0.0	0.0	55.1	32.4	0.0	1.2	0.1	25.2	
2007	115.0	13.1	101.9	298.8	15.7	0.5	98.4	0.0	2.2	13.6	17.2	13.8	32.1	13.9	0.0	10.6	92.0	141.2	0.0	3.5	0.0	63.9	35.4	0.0	7.8	24.2	25.2	
Proposed O	perations Ye	ar 1																										
Mean	151.2	42.6	108.5	251.1	110.0	1.3	102.7	0.0	2.2	3.3	5.4	12.4	16.1	13.6	1.0	10.3	67.3	71.3	5.7	4.4	1.2	64.3	31.6	0.0	6.9	17.8	10.1	
Max	181.3	57.6	124.6	1345.8	1260.8	2.2	117.6	0.0	2.2	9.3	38.8	16.1	16.1	24.8	24.5	43.3	111.5	160.1	109.0	37.4	22.1	74.5	55.8	0.0	11.2	69.4	10.2	
2006	112.1	21.5	01.0 81.5	0.0	0.0	0.0	70.0	0.0	2.2	0.0	0.0	4.0	16.0	4.5	0.0	5.9	14.5	14.5	0.0	0.0	0.0	55.1	17.4	0.0	0.7	0.0	10.1	
2000	128.7	21.5	107.7	118.6	13.4	0.6	85.2	0.0	2.2	0.4	16.6	12.9	16.0	13.7	0.0	9.5	78.0	97.5	0.0	3.5	0.0	63.9	48.6	0.0	7.4	24.2	10.1	
Proposed O	erations Ye	ar 4																										
Mean	148.4	44.3	108.4	250.9	108.7	1.4	102.5	0.0	2.2	4.3	5.6	11.4	16.1	12.5	1.0	0.0	46.1	51.1	5.7	4.4	1.2	64.3	31.7	0.0	5.5	17.8	10.1	
Max	181.5	59.5	124.7	1343.2	1256.1	2.2	117.6	0.0	2.2	10.6	38.8	16.0	16.1	24.5	24.5	0.0	97.0	140.8	109.0	37.4	22.1	74.5	55.8	0.0	11.2	69.4	10.2	
Min	109.0	23.1	79.3	0.0	0.0	0.6	78.0	0.0	2.2	0.1	0.0	4.5	16.0	4.5	0.0	0.0	9.5	11.0	0.0	0.0	0.0	55.1	17.4	0.0	0.7	0.0	10.1	
2006	116.8	36.3	79.3	0.5	0.0	1.6	90.0	0.0	2.2	7.1	31.8	4.5	16.0	4.5	0.0	0.0	9.5	11.0	0.0	0.0	0.0	55.1	43.8	0.0	0.7	0.1	10.1	
2007 Proposed Or	IZ0.4	23.1 ar 7	109.0	110.0	10.9	0.7	05.2	0.0	2.2	0.9	10.0	12.5	10.0	13.0	0.0	0.0	50.5	00.1	0.0	5.5	0.0	05.5	40.0	0.0	0.5	24.2	10.1	
Mean	160.3	ai /	108.5	260.4	111.3	17	102.5	0.0	22	3.8	5.6	11 0	16.1	13.0	1.0	0.0	10.1	03	57	4.4	12	64.3	31.8	0.0	62	17.8	10.1	
Max	185.3	61.3	124.6	1359.7	1266.4	2.3	117.6	0.0	2.2	9.7	38.8	16.1	16.1	24.5	24.5	0.0	33.5	51.2	109.0	37.4	22.1	74.5	55.8	0.0	11.2	69.4	10.1	
Min	117.3	31.4	79.2	0.0	0.0	0.6	78.0	0.0	2.2	0.0	0.0	4.8	16.0	4.7	0.0	0.0	0.5	0.0	0.0	0.0	0.0	55.1	17.4	0.0	1.0	0.0	10.1	
2006	117.3	38.2	79.2	0.5	0.0	1.5	90.6	0.0	2.2	6.8	31.2	4.8	16.0	4.7	0.0	0.0	0.5	0.0	0.0	0.0	0.0	55.1	43.2	0.0	1.0	0.1	10.1	
2007	141.6	32.6	109.6	118.9	18.2	0.6	85.2	0.0	2.2	0.8	16.6	12.5	16.0	13.2	0.0	0.0	13.8	11.8	0.0	3.5	0.0	63.9	48.6	0.0	6.7	24.2	10.1	
	LDP2 Discharge	Number of LDP2 Discharges	LDP3 Discharge	Number of LDP3 Discharges	Moisture Content of Total Product Coal	Moisture Content of Coarse Tailings	Moisture Content of FineTailings	Pumping from Header to Western UG Extension	Pumping from Header to Western Operations	Pumping from Header Tank to Western OC Dam	Moisture Content of ROM from Western UG	Moisture Content of ROM from Western OC	Western Open Cut Dam Overflow	Western Oper Cut Disturbed Catchment Runoff	Western OC Dust Suppression	Pumping from Western UG to WesternOC Dam	Leakage to Western UG	Natural Runofi to Western OC Dam - Diverted around dam	Dust Suppression from Erosion Pond	LDP4 Discharge	Number of LDP4 Discharges	LDP5 Discharge	Number of LDP5 Discharges	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment)	Central OC Runoff	Dust Suppression from Central OC Dam	Overflow From Central OC Dam	8 Trunk OC Runoff
Units	LDP2 Discharge ML/yr	Number of LDP2 Discharges days/yr	LDP3 Discharge ML/yr	Number of LDP3 Discharges days/yr	Moisture Content of Total Product Coal ML/yr	Moisture Content of Coarse Tailings ML/yr	Moisture Content of FineTailings ML/yr	Pumping from Header to Western UG Extension ML/yr	Pumping from Header to Western Operations ML/yr	Pumping from Header Tank to Western OC Dam ML/yr	Moisture Content of ROM from Western UG ML/yr	Moisture Content of ROM from Western OC ML/yr	Western Open Cut Dam Overflow ML/yr	Western Oper Cut Disturbec Catchment Runoff ML/yr	Western OC Dust Suppression ML/yr	Pumping from Western UG to WesternOC Dam ML/yr	Leakage to Western UG ML/yr	Natural Runofi to Western OC Dam - Diverted around dam ML/yr	Dust Suppression from Erosion Pond ML/yr	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope	LDP2 Discharge ML/yr rations	Number of LDP2 Discharges days/yr	LDP3 Discharge ML/yr	Number of LDP3 Discharges days/yr	Moisture Content of Total Product Coal ML/yr	Moisture Content of Coarse Tailings ML/yr	Moisture Content of FineTailings ML/yr	Pumping from Header to Western UG Extension ML/yr	Pumping from Header to Western Operations ML/yr	Pumping from Header Tank to Western OC Dam ML/yr	Moisture Content of ROM from Western UG ML/yr	Moisture Content of ROM from Western OC ML/yr	Western Open Cut Dam Overflow ML/yr	Western Oper Cut Disturbed Catchment Runoff ML/yr	Western OC Dust Suppression ML/yr	Pumping from Western UG to WesternOC Dam ML/yr	Leakage to Western UG ML/yr	Natural Runofi to Western OC Dam - Diverted around dam ML/yr	Dust Suppression from Erosion Pond ML/yr	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean	LDP2 Discharge ML/yr rations 2.5	Number of LDP2 Discharges days/yr	LDP3 Discharge ML/yr 18.1	Number of LDP3 Discharges days/yr	Moisture Content of Total Product Coal ML/yr 86.5	Moisture Content of Coarse Tailings ML/yr	Moisture Content of FineTailings ML/yr	Pumping from Header to Western UG Extension ML/yr	Pumping from Header to Western Operations ML/yr	Pumping from Header Tank to Western OC Dam ML/yr	Moisture Content of ROM from Western UG ML/yr	Moisture Content of ROM from Western OC ML/yr	Western Open Cut Dam Overflow ML/yr	Western Oper Cut Disturbed Catchment Runoff ML/yr	Western OC Dust Suppression ML/yr	Pumping from Western UG to WesternOC Dam ML/yr	Leakage to Western UG ML/yr	Natural Runof to Western OC Dam - Diverted around dam ML/yr	Dust Suppression from Erosion Pond ML/yr	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Min	LDP2 Discharge ML/yr rations 2.5 42.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0	Number of LDP3 Discharges days/yr 2.8 21.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3	Moisture Content of FineTailings ML/yr 35.4 35.6 35.3	Pumping from Header to Western UG Extension ML/yr	Pumping from Header to Western Operations ML/yr	Pumping from Header Tank to Western OC Dam ML/yr	Moisture Content of ROM from Western UG ML/yr	Moisture Content of ROM from Western OC ML/yr	Western Open Cut Dam Overflow ML/yr	Western Oper Cut Disturbec Catchment Runoff ML/yr	Western OC Dust Suppression ML/yr	Pumping from Western UG to WesternOC Dam ML/yr	Leakage to Western UG ML/yr	Natural Runof to Western OC Dam - Diverted around dam ML/yr	Dust Suppression from Erosion Pond ML/yr	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Min 2006	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3	Pumping from Header to Western UG Extension ML/yr	Pumping from Header to Western Operations ML/yr	Pumping from Header Tank to Western OC Dam ML/yr	Moisture Content of ROM from Western UG ML/yr	Moisture Content of ROM from Western OC ML/yr	Western Open Cut Dam Overflow ML/yr	Western Oper Cut Disturbec Catchment Runoff ML/yr	Western OC Dust Suppression ML/yr	Pumping from Western UG to WesternOC Dam ML/yr	Leakage to Western UG ML/yr	Natural Runof to Western OC Dam - Diverted around dam ML/yr	Dust Suppression from Erosion Pond ML/yr	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Min 2006 2007	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 2.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr	Pumping from Header to Western Operations ML/yr	Pumping from Header Tank to Western OC Dam ML/yr	Moisture Content of ROM from Western UG ML/yr	Moisture Content of ROM from Western OC ML/yr	Western Open Cut Dam Overflow ML/yr	Western Oper Cut Disturbec Catchment Runoff ML/yr	Western OC Dust Suppression ML/yr	Pumping from Western UG to WesternOC Dam ML/yr	Leakage to Western UG ML/yr	Natural Runof to Western OC Dam - Diverted around dam ML/yr	Dust Suppression from Erosion Pond ML/yr	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Min 2006 2007 Proposed O	LDP2 Discharge ML/yr ations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 Derations Ye	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 ar 1	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 2.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.6 35.3 35.3	Pumping from Header to Western UG Extension ML/yr	Pumping from Header to Western Operations ML/yr	Pumping from Header Tank to Western OC Dam ML/yr	Moisture Content of ROM from Western UG ML/yr	Moisture Content of ROM from Western OC ML/yr	Western Open Cut Dam Overflow ML/yr	Western Oper Cut Disturbec Catchment Runoff ML/yr	Western OC Dust Suppression ML/yr	Pumping from Western UG to WesternOC Dam ML/yr	Leakage to Western UG ML/yr	Natural Runof to Western OC Dam - Diverted around dam ML/yr	Dust Suppression from Erosion Pond ML/yr	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Min 2006 2007 Proposed O Mean	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 perations Ye 1.4	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 2.0 0.8	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3 35.3 35.4	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1	Pumping from Header to Western Operations ML/yr 40.8	Pumping from Header Tank to Western OC Dam ML/yr 26.4	Moisture Content of ROM from Western UG ML/yr 7.6	Moisture Content of ROM from Western OC ML/yr 7.6	Western Open Cut Dam Overflow ML/yr 0.3	Western Oper Cut Disturbed Catchment Runoff ML/yr 9.6	Western OC Dust Suppression ML/yr 44.7	Pumping from Western UG to WesternOC Dam ML/yr 13.0	Leakage to Western UG ML/yr 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0	Dust Suppression from Erosion Pond ML/yr 7.0	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr 140.4	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WCC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Min 2006 2007 Proposed O Mean Max	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges 0.4 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 2.0 0.8 8.0 0.8 8.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.5 87.0	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.4 35.4 35.4 35.4	Pumping from Header to Western UG Extension ML/yr 16.1	Pumping from Header to Western Operations ML/yr 40.8 50.7	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6	Western Oper Cut Disturbed Catchment ML/yr 9.6 19.4	Western OC Dust Suppression ML/yr 44.7 45.0	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2	Dust Suppression from Erosion Pond ML/yr 7.0 25.0	LDP4 Discharge ML/yr	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr 140.4 554.4	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WCC Dam natural catchment) ML/yr	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max 2006 2007 Proposed O Mean Max Min 2006	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 ar 1 0.2 3.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 0.0 0.8 8.0 0.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.1 16.0	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 26.4	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0	Western Oper Cut Disturbed Catchment ML/yr 9.6 19.4 2.4	Western OC Dust Suppression ML/yr 44.7 45.0 44.6	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0	LDP4 Discharge ML/yr 1.0 24.5 0.0	Number of LDP4 Discharges days/yr	LDP5 Discharge ML/yr 140.4 554.4 0.0	Number of LDP5 Discharges days/yr	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr 121.1 473.5 0.0	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Min 2006 2007 Proposed Op Mean Max Min 2006 2007	LDP2 Discharge ML/yr 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 ar 1 0.2 3.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 0.0 0.8 8.0 0.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.4 35.4 35.6 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.4 35.6 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 16.2 35.4	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0	Western Oper Cut Disturbed Catchment Runoff ML/yr 9.6 19.4 2.4 2.4 13.4	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 0.0 0.0 0.0 4.5	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 1911	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Min 2006 2007 Proposed Op Mean Max Min 2006 2007 Proposed Op	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 22.4	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0	Western Oper Cut Disturbed Catchment Runoff ML/yr 9.6 19.4 2.4 2.4 2.4 13.4	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 0.0 0.0 4.5	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Min 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean	LDP2 Discharge ML/yr ations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0 1.8	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 2.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.3 86.4 86.5 86.2 86.5 86.2 86.5 86.2 86.2 86.3	Moisture Content of Coarse Tailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0 16.1	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8 41.5	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 16.2 35.4 22.4 27.3	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0 0.0 0.2	Western Oper Cut Disturbed Catchment Runoff ML/yr 9.6 19.4 2.4 2.4 13.4 8.6	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6 44.6 44.7	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0 19.0	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 0.0 4.5 10.0	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0 0.0 1.0	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0 0.0 0.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1 140.3	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0 4.5	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2 121.1	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff
Units Current Ope Mean Max Min 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean Max	LDP2 Discharge ML/yr ations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0 1.8 70.0	Number of LDP3 Discharges days/yr 2.8 21.0 0.0 0.0 2.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.5 87.0 86.2 86.3 86.4 86.5 87.0	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0 16.0 16.1 16.1	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8 32.1 21.8 41.5 51.3	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 16.2 35.4 22.4 27.3 35.6	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0 0.0 0.2 4.1	Western Oper Cut Disturbed Catchment Runoff ML/yr 9.6 19.4 2.4 2.4 13.4 8.6 17.4	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6 44.6 44.7 45.0	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0 19.0 74.2	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 0.0 4.5 10.0 28.0	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0 1.0 24.5	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0 0.2 4.0 0.2 4.0 0.2 4.0 0.2 4.0 0.2 4.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1 140.3 551.8	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0 4.5 14.0	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2 121.1 473.5	Central OC Runoff	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff
Units Current Ope Mean Max Min 2006 2007 Proposed O Mean Max Min Max Max Min	LDP2 Discharge ML/yr ations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0 0.0 1.8 70.0 0.0	Number of LDP3 Discharges 2.8 21.0 0.0 2.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0 16.1 16.1 16.1	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8 32.1 21.8 41.5 51.3 22.8	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 22.4 27.3 35.6 17.4	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0 0.0 0.0 0.2 4.1 0.0	Western Oper Cut Disturbed Catchment Runoff ML/yr 9.6 19.4 2.4 2.4 13.4 8.6 17.4 2.1	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6 44.6 44.6 44.6 44.6	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0 19.0 74.2 0.0 0.1	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 0.0 4.5 10.0 28.0 0.0	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0 0.0 1.0 24.5 0.0	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1 140.3 551.8 0.0	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0 4.5 14.0 0.0	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2 121.1 473.5 0.0	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Min 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean Max Min 2006	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges 0.4 6.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0 0.0 1.8 70.0 0.0 0.0 0.0	Number of LDP3 Discharges 2.8 21.0 0.0 0.0 2.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0 16.0 16.1 16.1	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8 41.5 51.3 22.8 30.8 30.8	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 22.4 27.3 35.6 17.4 35.6 17.4 35.6	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Western Oper Cut Disturbed Catchment ML/yr 9.6 19.4 2.4 2.4 2.4 13.4 8.6 17.4 2.1 2.1 2.1 2.1	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6 44.6 44.6 44.6 44.6 44	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0 19.0 74.2 0.0 0.1 26.0	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 0.0 0.0 4.5 10.0 28.0 0.0 0.0 0.0 0.0 7	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0 1.0 24.5 0.0 0.0 0.0 0.0 0.0	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1 140.3 551.8 0.0 0.8 0.8 191.1	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0 4.5 14.0 0.0 1.0 7.0	LDP5 Natural Catchment Runoff (excluding WCC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2 121.1 473.5 0.0 0.7 165.2	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Min 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 ar 1 0.2 3.0 0.0 0.0 ar 1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0 1.8 70.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP3 Discharges days/yr 2.8 21.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.6 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0 16.0 16.0 16.0	Pumping from Header to Westerm Operations ML/yr 40.8 50.7 21.8 32.1 21.8 32.1 21.8 41.5 51.3 22.8 30.8 22.8	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 22.4 27.3 35.6 17.4 35.6 23.6	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Western Oper Cut Disturbed Catchment ML/yr 9.6 19.4 2.4 2.4 2.4 13.4 13.4 8.6 17.4 2.1 2.1 2.1 2.1	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6 44.6 44.6 44.6 44.6 44	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0 74.2 0.0 0.1 26.0	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 0.0 0.0 28.0 0.0 0.0 28.0 0.0 0 0.0 7	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0 1.0 24.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1 140.3 551.8 0.0 0.8 191.1	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0 4.5 14.0 0.0 1.0 7.0	LDP5 Natural Catchment Runoff (excluding WCC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2 121.1 473.5 0.0 0.7 165.2	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max Nin 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges days/yr 0.4 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0 1.8 70.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP3 Discharges 2.8 21.0 0.0 2.0 0.8 8.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0 16.0 16.0 16.0	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8 41.5 51.3 22.8 30.8 22.8 49.6	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 22.4 27.3 35.6 17.4 35.6 23.6 23.6	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Western Oper Cut Disturbed Catchment ML/yr 9.6 19.4 2.4 2.4 13.4 8.6 17.4 2.1 2.1 2.1 12.1	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6 44.6 44.6 44.6 44.6 44	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0 19.0 74.2 0.0 0.1 26.0	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 25.0 0.0 0.0 4.5 10.0 28.0 0.0 0 7 7 18.2	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0 1.0 24.5 0.0 0.0 0.0 0.0 0.0 1.0 24.5	Number of LDP4 Discharges days/yr 0.2 4.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1 140.3 551.8 0.0 0.8 191.1	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0 4.5 14.0 0.0 1.0 7.0 1.0 7.0	LDP5 Natural Catchment Runoff (excluding WCC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2 121.1 473.5 0.0 0.7 165.2	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
Units Current Ope Mean Max 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean Max Min 2006 2007 Proposed O Mean Max	LDP2 Discharge ML/yr rations 2.5 42.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Number of LDP2 Discharges 0.4 6.0 0.0	LDP3 Discharge ML/yr 18.1 154.1 0.0 0.0 8.3 6.9 110.5 0.0 0.0 0.0 0.0 1.8 70.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Number of LDP3 Discharges days/yr 2.8 21.0 0.0	Moisture Content of Total Product Coal ML/yr 86.5 87.0 86.2 86.2 86.2 86.2 86.2 86.2 86.2 86.2	Moisture Content of Coarse Tailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Moisture Content of FineTailings ML/yr 35.4 35.3 35.3 35.3 35.3 35.3 35.3 35.3	Pumping from Header to Western UG Extension ML/yr 16.1 16.1 16.0 16.0 16.0 16.0 16.0 16.0	Pumping from Header to Western Operations ML/yr 40.8 50.7 21.8 32.1 21.8 41.5 51.3 22.8 30.8 22.8 49.6 53.9	Pumping from Header Tank to Western OC Dam ML/yr 26.4 35.4 16.2 35.4 16.2 35.4 22.4 27.3 35.6 17.4 35.6 23.6 23.6	Moisture Content of ROM from Western UG ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Moisture Content of ROM from Western OC ML/yr 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Western Open Cut Dam Overflow ML/yr 0.3 6.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Western Oper Cut Disturbed Catchment ML/yr 9.6 19.4 2.4 13.4 8.6 17.4 2.1 2.1 12.1 12.1 0.1 3.2	Western OC Dust Suppression ML/yr 44.7 45.0 44.6 44.6 44.6 44.6 44.6 44.6 44.6 44	Pumping from Western UG to WesternOC Dam ML/yr 13.0 13.0 13.0 13.0 13.0 13.0 13.0 13.0	Leakage to Western UG ML/yr 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5 4.5	Natural Runof to Western OC Dam - Diverted around dam ML/yr 19.0 74.2 0.0 0.1 26.0 19.0 74.2 0.0 0.1 25.9 19.0 74.2	Dust Suppression from Erosion Pond ML/yr 7.0 25.0 0.0 25.0 0.0 0.0 4.5 10.0 28.0 0.0 0 0 7 7 18.2 37.0	LDP4 Discharge ML/yr 1.0 24.5 0.0 0.0 0.0 0.0 24.5 0.0 0.0 0.0 0.0 0.0 1.0 24.5	Number of LDP4 Discharges days/yr 0.2 4.0 0.2 4.0	LDP5 Discharge ML/yr 140.4 554.4 0.0 0.8 191.1 140.3 551.8 0.0 0.8 191.1 149.6 567.4	Number of LDP5 Discharges days/yr 4.6 15.0 0.0 1.0 7.0 4.5 14.0 0.0 0.0 1.0 7.0 1.0 7.0 1.0 7.0	LDP5 Natural Catchment Runoff (excluding WOC Dam natural catchment) ML/yr 121.1 473.5 0.0 0.7 165.2 121.1 473.5 0.0 0.7 165.2 120.9 472.7	Central OC Runoff ML/yr	Dust Suppression from Central OC Dam ML/yr	Overflow From Central OC Dam ML/yr	8 Trunk OC Runoff ML/yr
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