Donaldson Coal Pty Limited

Abel Underground Mine

Part 3A Environmental Assessment

Application No. 05_0136

22nd September, 2006

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1 INTRODUCTION

1.1 Project Overview

Donaldson Coal Pty Ltd ('Donaldson') currently owns and operates Donaldson Open Cut Mine, located 23 kilometres north-west of Newcastle (refer Figure 1.1). This open cut mine has approval to operate until 2012 at which point the economic coal reserves will be exhausted. Donaldson proposes to develop a new underground mine (named 'Abel Underground Mine') that will access coal reserves south of the Open Cut Mine. To minimise surface disturbance, surface facilities for the Abel Underground Mine will be located within the Donaldson Open Cut Mine final void. Coal will be transported through the previously disturbed Donaldson Mine lease area to the existing Bloomfield Coal Handling and Preparation Plant (CHPP) and rail loading facility for coal processing and loading. This arrangement enables the proposed Abel Underground Mine to access a high quality coal resource while minimising the need for new facilities and land disturbance.

Figure 1.1 and Figure 1.2 show the total project area including the proposed Abel Underground Mine area, parts of the existing Donaldson Open Cut Mine that will be used for Abel surface infrastructure, and parts of the adjacent Bloomfield Colliery that will be used for the Abel Project, including the CHPP, rail loading facility and some access roads and water management structures. Underground workings and open cut areas within Bloomfield colliery that will be used for tailings disposal are also shown.

Abel Underground Mine will have a maximum production capacity of 4.5 million tonnes per annum run-of-mine (ROM) coal and an operating life of 21 years. The proposed method of extraction will be high productivity, continuous miner based bord and pillar systems, using pillar extraction techniques. This method enables flexibility in the amount of coal that is extracted from certain areas, so that subsidence can be managed and particular surface features protected. No longwall mining is proposed as part of this development application.

The underground mine area, within which coal will be extracted, extends southwards from John Renshaw Drive towards George Booth Drive. It is bounded on the eastern side by the F3 Freeway and on the western side by a geological feature in the vicinity of Buttai Creek. The proposed underground mine area is shown on Figure 1.1 and Figure 1.2.

Coal will be extracted from the Upper Donaldson and Lower Donaldson coal seams. These seams range in thickness from 1.5 to 3.3 metres and dip downwards at approximately 5 degrees towards the south of the underground mine area, so that mining will become deeper as it progresses southwards. The depth of cover to proposed mining ranges from 50 metres in the northern area immediately adjacent to John Renshaw Drive, to 450 metres at the southern boundary.

Access to the underground reserves will be from the Donaldson high wall north of John Renshaw Drive. Three roadways will be driven under John Renshaw Drive with underground mining commencing on the southern side of John Renshaw Drive and progressing southwards. ROM coal will be transported via conveyor through the high wall to a stockpile located within the existing Donaldson Open Cut void.

From this stockpile, coal will be transported to the existing Bloomfield CHPP, initially by truck but potentially later by conveyor, where it will be processed and loaded onto rail. An increase of 30% in Bloomfield CHPP's existing licenced limit of 5 million tonnes per annum ROM coal and some expansion of CHPP facilities will be required to cater for Abel coal. The ongoing operation and expansion of the Bloomfield CHPP and associated tailings disposal and rail loading facility form part of this Environmental Assessment. Additional detail on the mining method and facilities is provided in Section 2.

1.2 Project Objectives

The objectives and strategies of this proposal are to:

- Access coal resources within the Abel underground mine area using methods that have the capacity to leave coal unmined to manage subsidence impacts on identified surface features, whilst optimising resource extraction;
- Provide employment for approximately 375 employees from the lower Hunter Region;
- Maintain the market for Donaldson Coal after the Donaldson Open Cut Mine approval ceases in 2012;
- Enable ongoing operations of the Bloomfield CHPP and associated facilities;
- Follow the principles of ecologically sustainable development by utilising existing surface disturbance areas within Donaldson Open Cut Mine (with rehabilitation of remaining areas as described by the Donaldson consent) and also utilising existing coal processing and rail loading infrastructure at Bloomfield Colliery to handle Abel coal; therefore minimising surface disturbance;
- Minimise potential environmental impacts from proposed operations; and
- Conduct mining in a responsible manner, considering the existing and future environment and the community, in accordance with the principles of ecologically sustainable development.

1.3 The Applicant

The Applicant for the Abel Underground Coal Mine project is Donaldson Coal Pty Ltd ('Donaldson'). Donaldson is the applicant for all aspects of the project, including proposed alterations to and ongoing operations of Bloomfield Colliery's CHPP and associated facilities.

1.4 Part 3A Application Process – Purpose of this Document

The proposed development is for the purpose of coal mining as described in Schedule 1 Group 2 clause 5(1)(a) of State Environmental Planning Policy (Major Projects) 2005. It is therefore a Part 3A Major Project under the *Environmental Planning and Assessment Act, 1979*.

The *Environmental Planning and Assessment Amendment (Infrastructure and other Planning Reform) Act 2005*, which commenced operation on 1 August 2005, reforms the land-use planning and development assessment and approval system, particularly as it relates to major infrastructure and other significant development. An important component of this is the introduction of a separate streamlined and integrated development assessment and approvals regime for major infrastructure and other projects of significance to the State.

As stated in Fact Sheet 1 for Part 3A of the EP&A Act (August 2005), *'The focus of the new Part 3A is on ensuring the appropriate level of community consultation and environmental assessment is undertaken, based on the level of risk or community concern.'*

The draft *Steps in the Assessment and Approval of Major Projects under Part 3A Guideline* (Department of Planning, 26 July 2005) reflect the above focus of Part 3A of the EP&A Act. The Guidelines also state that *'As part of the project application, the proponent should undertake a preliminary environmental assessment based on the Preliminary Assessment Guidelines (gazetted by the Minister) and submit this information with the project application.*

The Guidelines provide a systematic process to assist proponents in identifying potential environmental issues associated with the construction or operation of the project and for allocating a ranking as to the likely environmental risks in relation to these issues. This information will provide the basis for issuing the environmental assessment requirements. The preliminary assessment will also identify upfront any likely environmental constraints on the site to assist the proponent in the formulation of the project.

On the whole the preliminary assessment is a desk top study following a walk-over the site or site components. In undertaking this preliminary assessment, proponents should consult agencies or councils regarding existing information to assist in this assessment…'

A Planning Focus meeting, to discuss the project issues with all relevant government agencies, was held on 24 November 2005. A Project Application, together with the Preliminary Assessment Report, was lodged with the Department of Planning (DOP) in December 2005. After this meeting the Minister for Planning declared the proposal to be a "project" for the purposes of Part 3A of the EP&A Act 1979.

It should be noted that at the time of submitting the Project Application no Preliminary Assessment Guidelines had been gazetted by the Minister for Planning. To ensure that the Project Application provided a systematic process for the identification of potential environmental issues associated with the

construction and operation of the Abel Underground Mine, the Project Application included an extensive environmental risk assessment for the Project. This provided a ranking of the likely project environmental risks and resulted in a numerical risk ranking for each aspect of the mine, based on the consequence and probability of any potential impacts from the mine. This risk assessment was conducted using the '*Risk Management Guidelines Companion to AS/NZS 4360:2004'*, as described in Section 5.

The risk assessment in the Project Application has also been used by Donaldson to provide further guidance in the production of this EA for the Abel Underground Project by ensuring that the 'key issues' identified in the Director-General's environmental assessment requirements have been given the appropriate level of environmental assessment in the EA. The risk assessment has since been reviewed and updated following the completion of the majority of the specialist reports and the risk rankings for the key issues for the project revised. The updated risk assessment undertaken at the completion of all technical studies concludes that with the mitigation and remediation measures proposed in this EA the project has a low risk ranking for all key issues.

This Environmental Assessment has been prepared to satisfy the Director-General's requirements issued for the project, as well as the requirements of Part 3A of the *Environmental Planning and Assessment Act, 1979*, the supporting Regulations and all relevant DOP guidelines for Part 3A that were available at the time of submission.

Once accepted as adequate by DOP, this Environmental Assessment will be publicly exhibited for at least 30 days. Following this exhibition period, DOP will produce a report on its assessment of the application for the Minister for Planning. The Minister will then approve or reject the proposal.

The project description contained within this EA varies in minor ways from the project description contained in the Project Application lodged with the Department of Planning in December 2005 and is to replace the project description contained in the Project Application of 2005.

2 PROJECT DESCRIPTION

2.1 Location and Setting

The proposed Abel Underground Mine includes the area south of John Renshaw Drive where underground mining is proposed and areas north of John Renshaw Drive that will be used for Abel surface infrastructure, including coal handling, rail loading and water and tailings management. Areas north of John Renshaw Drive are within the existing Donaldson and Bloomfield Colliery Mine Leases.

The area proposed for underground mining is within the eastern section of Exploration Lease 5497 (EL5497) and has a surface area of approximately 2750 hectares. It is bounded by John Renshaw Drive in the north, the F3 Freeway to the east and a geological feature associated with Buttai Creek to the west. The southern boundary of the proposed mine area extends to the vicinity of Seahampton Road, Stockrington.

Property and mining titles within the project area are provided in Appendix B. The majority of land in the area is owned by Donaldson, Coal and Allied and the Catholic Diocese of Maitland and Newcastle, with various private landowners to the south of John Renshaw Drive. Private landholdings are generally rural/residential in nature.

The Abel Project Area north of John Renshaw Drive consists of land within the existing Donaldson and Bloomfield mining leases that has been disturbed by mining. The nearest residential area is Ashtonfield, approximately 1.1 km north of the Bloomfield rail loop at its nearest point.

The underground area south of John Renshaw Drive consists of low undulating forested hills with patches of cleared land for rural/residential properties. There are approximately 1900 hectares of undisturbed vegetation and 900 hectares of fragmented vegetation in a farmland mosaic.

The ridgeline associated with Black Hill runs east-west through the proposed underground mine area, with tributaries of Buttai Creek, Viney Creek/Weakleys Flat Creek and Four Mile Creek draining northwards from this ridgeline. Long Gully/Blue Gum Creek drains the southern side of the ridgeline eastwards towards Pambalong Nature Reserve. Some limited clifflines and steeper gullies are located along sections of the ridge.

Existing surface items in the Abel Underground Mine area are shown on Figure 2.1 and include 110 principal residences, Black Hill Public School, Black Hill Church, a 330kV transmission line and other lower voltage transmission lines, water pipelines and roads including John Renshaw Drive, Black Hill Road, Dog Hole Road and smaller feeder roads. A list of the main surface features is provided in Section 5.

Based on detailed assessment studies, particular areas and items have been identified that require protection (to varying degrees) from mine subsidence. The mining methods proposed to be used to achieve these varied outcomes are described in Section 2.4 and provide for the protection of items such as Pambalong Nature Reserve, Principal Residences, Schedule 2 creeks, rainforest areas and other items.

2.2 Coal Resource and Reserves

The Abel Underground Mine coal resource comprises a number of coal seams. Table 1 provides a summary of the main characteristics of each seam. It is proposed to mine coal from the Upper and Lower Donaldson Seams.

Table 1 Coal Resources and Main Characteristics of Coal Seams

Coal Seam[1]	**Location of Seam**	**Expected Seam Thickness**	**Depth of Cover**	**Product**	**Total Resource***
West Borehole	Southern and eastern areas	3.5m	0-120m		Nil
Upper Donaldson Seam	Northern and central sections of mine	1.5 - 3.2m	30-250m	Semi-soft coking coal with residual high ash thermal coal	50 million tonnes
Lower Donaldson Seam	Central and southern sections of mine	1.5 – 3.3m	50-450m	Low and high ash thermal coal, with potential for semi-soft coking coal in the south-east section	99 million tonnes
Big Ben Seam	North-east and central sections of mine	1.5 - 4.0m	60-300m	Medium and high ash thermal coal	102 million tonnes
Ashtonfield Seam	North-east section of mine	1.5 - 2.2m	70-250m	Semi-soft coking coal and low ash thermal coal	5 million tonnes

* Measured + Indicated + Inferred Total *In situ* Resources of Coal Seams > 1.5 metres thick
1. Refer Planned Mining Panel Recovery

Figure 2.3, Figure 2.4 and Figure 2.5 for location of seams and cross-sections.

The Abel Underground Mine area was drilled to measured/indicated resource status by R W Miller and Company in the late 1970's with information from 43

holes being available. In 2002, an additional nine holes were drilled in the northern part of the area by Excel Holdings. A further program of twelve drill holes was implemented for the Abel Project. The objective of this current program was to verify results from previous exploration and to gain additional data on coal quality, seam gas content, strata control and groundwater. Results from this program verify the extent and nature of the mining resource.

Figure 2.3, Figure 2.4 and Figure 2.5 show drill hole locations and geological cross sections. Figure 2.6 shows cover depth to the Upper and Lower Donaldson seams. Cover depth refers to how far below the ground surface the mine seams are located.

The superimposition of a mine plan over the resource area produces an In-Situ Reserve which is then discounted for mining losses such as coal lost in the mining process, leaving of subsidence mitigation pillars and areas left unmined due to unforeseen problems. Mineable reserves for the Abel Underground Mine are shown in Table 2. The current mine plan schedules the removal of coal from the Upper and Lower Donaldson Seams only. Product market for coal from these seams is predominantly Asian and European steel and energy producers.

Table 2 Mineable Reserves

Seam	**In-Situ Resource**	**In Situ Reserve**	**Mineable Reserve***
Upper Donaldson	50 million tonnes	34 million tonnes	25-30 million tonnes
Lower Donaldson	99 million tonnes	34 million tonnes	20-25 million tonnes

** A range has been provided for mineable reserves to enable flexibility to alter mining to cater for variable surface subsidence where required.*

2.3 Previous Mining Activities

Previous mining activities in or near the proposed Abel Underground Mine include:

- the Stockrington No. 2 Colliery that mined the West Borehole Seam in the southern section of the Project Area until mine closure in the early 1980's; and
- a number of smaller mines such as Black Hill Borehole, Mountainview, Buchannan Borehole, Newburn, Buttai Borehole, Rosewood and Duckenfield and the more recent Benwerrin mine.

These former workings are shown on Figure 2.8.

Separation between the Upper and Lower Donaldson Seams and the previously mined West Borehole Seam is greater than 100 metres and therefore presents minimal mining risk in terms of potential interaction between proposed and former workings. The affect of the former West Borehole Seam workings on subsidence predictions for the Abel Underground Mine is discussed in Section 6.2.

2.4 Mining Method

2.4.1 Method

Abel Underground Mine has a maximum design production capacity of approximately 4.5 million tonnes per annum run-of-mine coal and a mine life in excess of 21 years. As discussed in Section 2.6, actual production is expected to be somewhat lower than the maximum design capacity, particularly during earlier and later years. For the purposes of environmental assessment, a maximum design production capacity has been used, except for where a range of scenarios is required, for example, for water management.

The mining method proposed is a high productivity bord and pillar system with secondary extraction, using continuous miners. The bord and pillar method with secondary extraction has the following advantages when applied to the Abel Project:

- The method can cope with an irregular shaped coal deposit which may have geological disturbances;
- Coal can be left unmined to protect identified surface features;
- Block widths and length can be varied to cater for combinations of equipment, geological problems and surface constraints; and
- The mine plan or direction of mining can be changed without lengthy production disruption.

The following describes the main steps in the bord and pillar mining method:

Formation of Main Roadways (first workings) - main roadways are created that provide access to groups of mining panels. Generally this is a 5 heading layout that creates large rectangular coal pillars.

Formation of Mining Panels (first workings) - from the main roadways, panels approximately 150m wide are developed to a logical boundary such as the limit of a conveyor, a geological anomaly, the mine boundary or a quality contour. Individual panels are separated by a 25m wide barrier pillar that is left intact.

Extraction of Mining Panels (second workings or secondary extraction) - from the panel boundary and retreating back to the main roadways, coal pillars that were formed during panel development are removed. This is known as pillar extraction or `Second Workings'. It is during this stage that any protection pillars (required

to protect surface features) are left unmined. This part of the mining process causes the roof to collapse or `goaf', which is the mechanism that creates subsidence.

Extraction of Main Roadway Pillars (second workings or secondary extraction) - as a group of mining panels is completed, if the main roadways that serviced them have no long term use, the coal pillars are removed.

2.4.2 Design for Subsidence Outcomes

The selected mining method allows for subsidence impacts to be varied by increasing or reducing the amount of coal extracted in particular areas. This will protect identified features from subsidence impacts, or reduce it to specified, manageable levels. By utilising this method, priority has been placed not on a final mine plan, but on identifying surface features that require protection and the appropriate subsidence outcomes for these features. For the purposes of this Environmental Assessment an indicative mine plan has been provided (Figure 2.8), however, this requires some flexibility to cater for changing surface and mining conditions that will occur after commencement of mining.

Four subsidence outcomes have been developed and mining methods designed to ensure these outcomes can be achieved. The four outcomes have been applied to various areas and items within the mining area that require subsidence protection, as identified by the detailed impact assessment studies. These four outcomes (shown on Figure 2.2) are:

- Zero mining impact - achieved by there being no underground mining in the area and ensuring appropriate buffers so that nearby mining also has no impact on the area or item. This has been applied to the F3 Freeway and Pambalong Nature Reserve.
- Negligible subsidence impact – being 20 mm or less of subsidence (which is considered to have negligible impact) achieved by leaving blocks or areas of coal with first workings, designed so as to provide up to 20mm of subsidence on the surface. This has been applied to Primary Residences within the mine site, Black Hill School, Church and cemetery (refer Section 7 for more detail). The Blue Gum Creek alluvium will not have first workings.
- Reduced subsidence impact to a set limit - as determined by surface features, achieved by leaving long term pillars and varying the amount of coal extracted to achieve the required surface subsidence.
- Maximum subsidence – as provided by total pillar extraction, or secondary workings, in a certain area.

Detailed Subsidence Management Plans will be prepared to ensure that mining in particular areas achieves the above outcomes. Outcomes have additional detailed commitments regarding consultation, preparation of plans and studies,

ongoing monitoring and rehabilitation as described in Section 7, which provides Donaldson's Statement of Commitments for the Project.

Protection of Schedule 2 creeklines and rainforest areas will be achieved by the application of 'Negligible Subsidence Impact' pending further studies that will be undertaken during mining. These further studies will determine whether additional subsidence can occur whilst still maintaining the integrity of these features.

Prior to further studies being undertaken, negligible subsidence outcomes will be achieved as follows:

- Schedule 2 creeks - a minimum barrier of 40 metres between the 20mm line of subsidence and the bank of the stream;
- Rainforest areas (as identified in Figure 2.2) – 20 mm of subsidence at the edge of the rainforest zone;
- Blue Gum Creek alluvium (from the confluence of Long Gully Creek with Blue Gum Creek) – 20 mm of subsidence at 40 metres from the edge of the alluvium.

To achieve the above outcomes, the mine plan requires some flexibility to adapt as conditions may change or as more information becomes available from the mining process.

Figure 2.2 shows these sensitive environmental areas and indicative mining methods. The proposed indicative mine layout is shown on Figure 2.8. This figure also shows the mining sequence from Year 1 through to Year 20.

The proposed mining method is referred to as the 'Huff Creek' layout, based on a similar operation in the United States. Figure 2.9 shows this method, with Figure 2.10 showing a plan view of a Conceptual Abel Mine Extraction Layout. This figure shows how Principal Residences and Schedule 2 creeklines will be protected from subsidence using a coal barrier system.

2.5 Mining Equipment

The mining method will require the following equipment and infrastructure:

- Surface stackout conveyor and stockpile;
- Underground conveying system that feeds onto the stackout conveyor;
- Power, water and compressed air distribution systems; and
- Diesel equipment (eg: transporters for people and material).

Mining equipment will comprise:

- Continuous miners fitted with drill rigs for the formation of underground roadways;
- Continuous miners with no rigs for secondary extraction of coal pillars;
- Shuttle cars to transport coal to the feeder breaker;
- Feeder breakers to size coal discharged from the shuttle cars to 150mm and feed coal onto the conveying system; and
- As an alternative to shuttle cars and feeder breakers, mobile chain haulage systems.

2.6 Mine Stages and Sequencing

2.6.1 Construction Stages

Three stages of construction are proposed, as follows.

i. Stage 1 Construction

This will comprise:

- Construction of the temporary bath-house and car parking area which will be separated from the operating Donaldson Mine open-cut;
- Construction of temporary workshops and offices adjacent to the new Donaldson internal access road;
- excavation of a box cut for the mine entries that is scheduled to occur as part of the open cut activity;
- a run-of-mine (ROM) stack-out conveyor with a stockpile capacity of approximately 10,000 tonne capacity located within the box cut;
- three roadways under John Renshaw Drive; and
- construction of a ventilation shaft and ventilation fans south of John Renshaw Drive.

ii. Stage 2 Construction

This will occur after the Donaldson Open Cut Mine has ceased shot firing activities (ie: explosives used to break up overburden material so that it can be removed to expose the coal seam). It includes the following construction items:

- permanent offices, bath-houses and car parking area nearer to the portals;

- permanent workshops, storage areas etc nearer to the portals; and
- a higher capacity stack-out conveyor and larger run-of-mine (ROM) stockpile in the open cut void.

iii. Stage 3 Construction

This involves the construction of a ROM coal reclaim system. It is also proposed to construct an overland conveyor from the ROM mine stockpile to the Bloomfield CHPP to replace truck haulage. This will be constructed as financial circumstances permit after the commencement of the Abel Underground Mine.

These facilities are shown on Figure 2.11.

2.6.2 Mine Stages

The mine will develop in three stages, being:

- **Stage 1**, commencing after construction of the roadways under John Renshaw Drive is completed, involves the formation of main and life-of-mine roadways (ie: roadways that are designed to remain in place for at least 20 years). This stage will last for approximately 6 months.
- **Stage 2**, lasting for approximately 1 year, is when the mine commences first workings.
- **Stage 3**, is when secondary workings or pillar extraction is introduced, together with more sets of mining equipment to increase the level of mine production.

The mine is sub-divided into three mining areas:

- The North East Area encompasses the Upper Donaldson reserves on the eastern side of the Main Headings and from John Renshaw Drive in the north to the seam split to the south;
- The North West Area encompasses the Upper Donaldson reserves on the western side of the Main Headings and from John Renshaw Drive in the north to the seam split to the south.
- The Southern Area is south of the seam split to the Abel Project area boundaries to the east and west. In this area the Lower Donaldson seam is worked.

Mine sequencing will be as follows:

- Production ramp-up for the first set of equipment will begin in the North East area;
- After approximately 1 year, production ramp-up for the second set of equipment will begin in the North West area;

- Steady state production from both North East and North West areas in the Upper Donaldson seam;
- Access roadways to the Southern Area are completed and equipment is progressively transferred from other areas;
- Steady state production from the Southern Area in the Lower Donaldson seam; then
- Production gradually decreases as reserves are consumed.

2.7 Surface Facilities and Transport

A schematic of the mining process is shown on Figure 2.7. Surface facilities will be located on the northern side of John Renshaw Drive within a section of the Donaldson Open Cut Mine where the coal has been extracted to form a final void, or box-cut. This area is shown on Figure 2.11. The surface infrastructure area will form part of the new coal mine lease and will be transferred to the Abel Underground Mine operation from the existing Donaldson Open Cut Mine.

Once coal has been brought to the surface through the mine portal under John Renshaw Drive, it will be conveyed to a run-of-mine (ROM) coal surge stockpile. This will initially be located adjacent to the mine portal but will later be re-located to a section of the Donaldson Open Cut final void screened from John Renshaw Drive. Further buffer planting associated with Donaldson Open Cut operations will enhance this screening. This area will also house the required site buildings such as administration, staff facilities, store, etc.

Coal will then be transported approximately 4 kilometres from the ROM coal stockpile to Bloomfield Coal Handling and Preparation Plant (CHPP). Coal will be transported by trucks on an internal, sealed haul road until an overland conveyor is constructed. At the Bloomfield CHPP, coal will be stored on another ROM coal stockpile prior to being processed in the washery and then stored in various stockpiles according to processed coal type. A conveyor will then transport coal from the various stockpiles to the rail loading bin, which loads the coal into waiting trains.

No public roads will be used for the haulage of coal. Employee access to the site will be via the intersection off John Renshaw Drive that is being constructed under the Donaldson open Cut Mine consent. Figure 2.11 shows the location of this intersection.

Other surface infrastructure will include:

- Mine infrastructure comprising three mine portals (providing access to the underground mine), ventilation fans, compressors and water supply pumps;
- Items within the main surface infrastructure compound, comprising power supply, car parking areas, mine offices, bath-house for mineworkers, contractors, staff and visitors, lamproom, first aid room, workshop, vehicle

garage and storage areas, fuel and hydrocarbon storage areas, lighting and potable and process water supply systems;

- Stockpile and stockpile conveyor;
- 11kV electricity supply from either a new 33kV/11kV switchyard or an existing 11kV feeder located within the area and high voltage electrical switch yards and power distribution;
- Connection to the existing Donaldson mine 380ML capacity dirty water dam;
- Connection to Hunter Water Corporation's potable water supply pipeline;
- Water pipeline connecting with the Bloomfield Coal Handling and Preparation Plant; and
- Waste water treatment and disposal – which will comprise an on-site wastewater treatment plant for bath-house and other amenities wastewater.

The only surface infrastructure required on the southern side of John Renshaw Drive will be a fan shaft and ventilation fan to provide underground mine ventilation and its associated power supply. This fan shaft and ventilation fan will be located on land owned by Donaldson, as shown on Figure 2.11. Small scale items such as monitoring boreholes and methane drainage equipment may be required for mine safety.

2.8 Coal Processing

The Bloomfield Coal Handling and Preparation Plant (CHPP) and rail loading facility will be used to process coal from the Abel Underground Mine. The CHPP and rail loading facility also handles coal from Donaldson Open Cut Mine, Bloomfield and Tasman Mines. Bloomfield's currently approved limit of 3.5 mtpa product coal (see environment protection licence number 396 *Protection of the Environment Operations Act 1997)* from the CHPP will need to be increased to cater for Abel coal and other potential sources for the Bloomfield Group. It is proposed to increase output from the CHPP to 5 mtpa product coal. This is a 30% increase in ROM coal throughput, which will increase from 5 mtpa to 6.5 mtpa ROM coal.

Some modifications to the Bloomfield CHPP infrastructure will be required to accommodate Abel Coal. These changes (shown on Figure 2.12) include:

- Increasing the ROM coal stockpile and reclaim facilities at Bloomfield to 300,000 tonnes capacity, by expanding the existing stockpile pad and in future installing a stackout conveyor with reclaim tunnel;
- Minor modifications to improve efficiencies, including the addition of a second tailings thickener within the facility;
- Modification of the coarse washery reject bin and outloading facilities as production increases;

- Expansion of clean coal gantries and stockpiles, with new gantries to be added, increasing the clean coal stockpile size to 500,000 tonnes capacity;
- Modifications to the current water management system to cater for the above mentioned additions;
- Relocation of existing service roads to cater for larger stockpile pad areas; and
- Minor upgrading of train loading facilities at Bloomfield.

These improvements, and the use of the Bloomfield CHPP (including associated facilities, stockpiles, tailings disposal and rail loop) to process 6.5 mtpa ROM coal (producing 5 million tonnes of product coal) from the proposed Abel Underground Mine and the existing Donaldson, Tasman and Bloomfield mines is part of the project for which approval is sought and is subject to this Environmental Assessment.

2.9 Coarse Reject and Tailings Disposal

During the coal washing process, waste coal material is produced in solid and more liquid (slurry) form. The solid material is termed *coarse reject*. The slurry material, a mixture of fine waste and water, is termed *tailings*.

The percentage of coarse rejects and fine tailings varies depending on the source of the coal and the mining method. Based on experience at Bloomfield CHPP and other mines, the estimated average proportions of coarse rejects and fine tailings are:

- Open Cut ROM coal 21% coarse rejects, 14% fine tailings;
- Underground coal 12% coarse rejects, 8% fine tailings.

Bloomfield CHPP coarse reject is currently mixed with overburden material and placed back into open cut pits. It is proposed to continue this process, which assists in filling voids in preparation for surface rehabilitation, including revegetation.

Since 2003, fine tailings have been pumped into the former underground workings at Bloomfield Colliery. The location of these areas is shown on Figure 2.13.

Proposed coarse reject and tailings volumes have been calculated as part of the Surface Water Assessment and Outline Management Plan provided in Appendix F. Volumes have been calculated for various production scenarios.

To June 2006 an estimated 1.2 million tonnes of fine tailings has been disposed into the Big Ben seam former workings. This is estimated to occupy about 1 million cubic metres of the estimated 4.8 million cubic metres of void space within the old underground workings. Water is recovered from the same workings at a

bore site approximately 2 km from the deposition point. This water is pumped to Lake Kennerson and subsequently used to supply make-up water to Lake Foster for use in the CHPP.

Analysis of old mine plans has enabled an estimate of current available volumes for tailings disposal to be calculated. These calculations indicate that the total volume of void space is approximately 4.8 million cubic metres. Assuming that tailings could be injected into only 50% of this volume and that approximately 1 million cubic metres has been deposited since 2003, there is an estimated 1.4 million cubic metres capacity remaining in the underground workings (being the 'Big Ben' seam).

There is also an estimated 16.8 million m^3 volume remaining on various open cut pits, including U Cut North, U Cut South, Creek Cut and S Cut (final). These pits are shown on Figure 2.13. There is therefore an estimated total capacity for coarse rejects and tailings of 18.2 million cubic metres within the existing Bloomfield operations.

Calculations have determined that for the various production scenarios modelled, there is sufficient capacity to accept all reject and tailings material over the anticipated life of all mines that contribute to the Bloomfield CHPP. A Schematic showing the proposed management of tailings and coarse reject is provided as Figure 2.14.

Rehabilitation that will occur after the emplacement of tailings in Bloomfield Colliery open cut voids is described in Section 2.13.

2.10 Water Management

The Surface Water Assessment and Water Management Plan provided in Appendix F addresses issues associated with surface water and groundwater management in the area covered by the surface facilities for the Abel Underground Mine project. The following provides an overview of the proposed water management principles and practices detailed in this study.

2.10.1 Surface Water Management Objectives

A detailed surface water management model has been developed to establish the overall performance of the water management systems associated with the existing Bloomfield CHPP, Donaldson Open Cut Mine and the proposed Abel Underground Mine. The model represents the runoff, flow, water storage and pumped transfer systems within the Four Mile Creek catchment north of John Renshaw Drive. The water balance model has been configured to allow operation of existing water storages and pumps to achieve the following objectives:

- Maintain water supply for the CHPP and dust suppression at all times;

- Achieve zero discharge to the environment from the Big Kahuna Dam;
- Minimise discharge from the Stockpile Dam; and
- Minimise discharge from Lake Foster and Lake Kennerson (with preference given to controlled discharge from Lake Kennerson).

A schematic diagram showing the main elements described above is provided as Figure 2.15.

2.10.2 Water Management – Abel Surface Infrastructure Area

All permanent Abel Underground Mine pit top facilities will be located within the final void created by Donaldson Open Cut Mine operations. All runoff from external catchments will therefore drain away from the void and there will be no requirement for separate facilities for diversion of "clean" runoff away from the facilities. The base of the open cut will be graded to enable water to drain in a south-easterly direction. A sump with simple sedimentation and oil separation systems will be established in this vicinity. Water collected in this sump will be pumped to the 'Big Kahuna' Dam, where it will be used for dust suppression on stockpiles, haul roads and general disturbed surface areas. Excess water removed from the Abel Underground Mine will also be pumped into the Big Kahuna Dam.

An existing pipeline between Big Kahuna Dam and the Bloomfield CHPP will be upgraded to enable water to be transferred between the Big Kahuna Dam and the Bloomfield CHPP. This pipeline will primarily be used to transfer water from the Big Kahuna Dam to the Bloomfield CHPP at a rate sufficient to ensure that no overflow occurs from this dam. If necessary, this pipeline could also be used to transfer water from the Bloomfield CHPP to the Big Kahuna Dam.

The existing haul roads that will also service Abel Underground Mine have existing approved stormwater pollution control systems. All runoff from the short section of haul road connecting the Abel Underground Mine surface infrastructure area to the new sealed haul road linking Abel with the Bloomfield CHPP will drain back into the open cut void where the Abel surface workings will be located. Therefore no additional stormwater pollution control measures will be required for the haul road system proposed to transport ROM coal from the Abel Underground Mine to the Bloomfield CHPP.

If and when the conveyor is installed to convey coal from the Abel Underground Mine to the Bloomfield CHPP, standard erosion and sediment control practices will be implemented during construction of the conveyor. Permanent drainage facilities will include table drains to direct all runoff to a series of pollution control ponds at each low point on the conveyor.

The existing stormwater pollution control facilities in the vicinity of the Bloomfield CHPP comprise a series of drains that direct runoff to a number of small sediment traps which overflow to the Stockpile Dam. To cater for the proposed

expansion of stockpile areas, alterations to the water management regime will be undertaken, including modifications to existing dams and pipes, to ensure rainfall events are managed and dirty and clean water remain separated. These alterations are described in detail in Appendix F.

2.10.3 Water Balance

A water balance for the proposed Abel Underground Mine and its surface infrastructure elements, including the Bloomfield CHPP, has been completed and is provided in Appendix F. It takes into account the behaviour of the various elements of the system including runoff, water transfers, groundwater pumping, dam water levels and dam discharges to determine overall water surplus or deficit over the period of mining from the operation of the Project. The model includes water use for the proposed integrated water usage system proposed for the Tasman, Abel, Donaldson and Bloomfield mine lease areas.

Climate data and catchment runoff were incorporated into the model to determine the amount of water entering the system from rainfall and runoff. Five water storage areas were also included in the model, being Pussums Puddle, Lake Forster, Lake Kennerson, Stockpile Dam (all on the Bloomfield lease) and Big Kahuna (currently used for Donaldson Open Cut Mine).

Water requirements for each of the mine operations forming part of the model were then calculated based on two production scenarios, being 'target' production (Abel Underground Mine operating at full capacity) and 'provisional' production (reflecting a lower, more likely, extraction rate from Abel Underground Mine). The total amount of water required annually by all mines using the integrated water usage system under these two scenarios ranges from 2270 ML to 3160 ML (target production) or 210 ML to 2,680 ML (provisional production) over the life of the proposed Abel operation.

Groundwater inflows to the proposed Abel Underground workings, Donaldson Mine and Bloomfield pits were calculated to determine water make. Groundwater pumping that currently occurs at Bloomfield was also taken into consideration.

The detailed water balance results provided in Appendix F demonstrate that the following outcomes will be achieved:

- There will be adequate water available to meet all requirements for dust suppression and operation of the CHPP. Assuming tailings deposition to underground workings continues, the water balance model indicates that groundwater extraction from the Bloomfield underground workings would not exceed historic levels and would progressively decline as water from this source is substituted by groundwater inflow transferred from the Abel Underground Mine. Under these circumstances the discharge from Lake Kennerson would be significantly less than historic levels.
- Under conditions in which tailings were deposited in open cut voids, the excess water discharged from Lake Kennerson would be comparable to

2000 and 2001 rates. Under these conditions approximately 80% of the water discharged with the fine tailings would be returned for use in the CHPP. Water derived from the Abel Underground mine would also contribute to the available supply.

- Zero discharge to the environment from Big Kahuna Dam can be achieved for all mine and climate scenarios.
- Proposed minor modifications to the Stockpile Dam together with an automatic pump to transfer water to Lake Foster would allow the performance of this dam to significantly exceed the requirements set out in *Managing Urban Stormwater: Soils and Construction*. There would only be a small risk of overflow in extreme wet weather conditions. Any pollution risk would be further reduced by configuring the dam as a "first flush" capture dam.
- For all scenarios, controlled discharge volume and frequency from Lake Kennerson would be reduced significantly compared to historic conditions in the early years of the project. At the same time, the proposed operating levels for Lake Foster would ensure that any discharge at the EPA licence discharge point would primarily occur as controlled discharge from Lake Kennerson rather that overflow from Lake Foster.
- In the later stages of mining there would be an excess of water generated from the Abel Underground Mine that could not be utilised for mine purposes or the CHPP. Under the "Provisional Production" scenario this would occur from 2025 onwards and by the end of the mine life up to 2,500ML of excess water could accumulate. Excess water could be discharged to the environment via Lake Kennerson or could be retained within the Abel Underground Mine workings. The Abel Underground Mine plan indicates that up until 2015 a total of about 1,600 ML would be available for water storage in worked out areas of the mine. Additional water storage capacity would become available as mining progresses after 2015.

2.10.4 Proposed Alterations to the Existing Surface Water Management System and Operating Conditions

The existing Bloomfield CHPP and Donaldson Open Cut Mine water management facilities that form part of the Abel Underground Mine project require minimal engineering modification to cater for the proposed development. The main changes proposed are to make the Big Kahuna Dam the focal point for water management for the Donaldson Open Cut Mine and proposed Abel Underground Mine and to operate it as a 'zero discharge' dam. The existing pipeline between the Big Kahuna Dam and Bloomfield CHPP will be upgraded, as will the bypass channel around Lake Foster. This will ensure that flows in excess of 40ML/day can be released from Lake Kennerson without the risk of overflow into Lake Foster. Minor earthworks will ensure that all runoff from the enlarged stockpile area adjacent to the Bloomfield CHPP can be directed to existing dams.

A set of indicative operating parameters for the existing Bloomfield CHPP and Donaldson Open Cut Mine facilities has been determined. Compared to existing operating conditions, the main changes to existing operating conditions are to:

- hold back on pumping from the Bloomfield underground workings to minimise discharges from Lake Kennerson. In the past, pumping for groundwater level control purposes has maintained Lake Kennerson at over 80% full for extended periods. A revised target of less than 80% will be implemented for Lake Kennerson;
- Water will be transferred from the Stockpile Dam to Lake Foster;
- Water will also be transferred from Big Kahuna Dam to Lake Foster to maintain Big Kahuna at a target operating level of 75%.

2.11 Workforce and Hours of Operation

A construction workforce will be required to develop the surface infrastructure area for the proposed Abel Underground Mine. Approximately 375 employees will be required to operate Abel Underground Mine once peak production has been reached. Some of the Donaldson workforce will be able to continue working at Abel Underground Mine surface facilities. The underground workforce will be sourced where possible from the Lower Hunter Region community.

The Abel Underground mine will be set up to operate continuously 24 hours per day for up to 7 days per week, 50 weeks per year.

2.12 Interaction with Existing Mine Operations

2.12.1 Donaldson Open Cut Mine

Donaldson Open Cut Mine has consent to operate until 2012. The areas of Donaldson Mine that will be required to operate the Abel Underground Mine are included in this Application. These areas, shown on Figure 1.1, include:

- existing Donaldson private roads for coal haulage to Bloomfield CHPP and the approved access road from John Renshaw Drive for employee access;
- selected areas of current and future mining that will be used for the Abel Underground Mine surface facilities; and
- elements of the existing Donaldson water management system.

The existing Donaldson Open Cut Mine final landform and rehabilitation plans will be amended as shown on Figure 2.16 to cater for the Abel Underground Mine, which will continue operations after the closure of the Donaldson Open Cut Mine. Required amendments include retention of the Donaldson Mine final void or box-cut. The sides and floor of this void will be stabilised to provide a working area for the Abel Underground Mine surface facilities.

Donaldson currently delivers 2.5 million tonnes per annum ROM coal to the Bloomfield CHPP. This amount will decrease as Abel production increases.

2.12.2 Tasman Underground Mine

Tasman Underground Mine, to the south of George Booth Drive and the proposed Abel Underground Mine, was approved in 2004 for a maximum extraction of 960,000 tonnes per annum ROM coal. Coal from this mine will be processed at the Bloomfield CHPP and rail loading facility.

2.12.3 Other Mines and Facilities

The Bloomfield Coal Handling and Preparation Plant (CHPP) is also used, and will continue to be used, to process coal from other sources, including from the Bloomfield Group. This use has been considered in the proposed increase in capacity for the CHPP as described in Section 2.8.

Bloomfield Colliery former underground workings and open cut voids will be used for tailings and coarse reject disposal. This will assist with the filling and rehabilitation of these voids.

2.12.4 Bloomfield Coal Handling and Preparation Plant (CHPP) and Rail Loading Facility

The Bloomfield CHPP and rail loading facility will be used for the processing of coal from Abel Underground Mine. Details of proposed modifications to these facilities to cater for Abel coal are described in Section 2.8. These modifications form part of this Environmental Assessment, together with the use of the Bloomfield CHPP including associated facilities, stockpiles, tailings disposal and rail loop to process 6.5 mtpa ROM coal (producing 5 mtpa product coal) from the proposed Abel Underground Mine and the existing Donaldson, Tasman and Bloomfield mines.

2.13 Decommissioning and Rehabilitation

2.13.1 Rehabilitation of Subsidence Areas

Any rehabilitation of areas required due to subsidence will be undertaken in accordance with the Trigger Action Response Plans (TARP's) described in Section 6.2.7 and Appendix E. These TARP's will form part of the detailed Subsidence Management Plans to be prepared for the proposed underground mining area.

Rehabilitation methods for natural features may include such actions as grouting surface cracks in water courses, dam walls, roads or general areas such as grazing paddocks. This requires the topsoil to be stripped, the surface re-graded, filling of cracks with a self cementing material such as sand, cement or bentonite grout, prior to the surface being compacted and regraded and topsoil replaced.

The rehabilitation of potentially affected dams is described in Appendix E and includes such actions as draining the dam storage area and repairing the dam with an impermeable clay liner to seal any cracks, prior to re-instatement of water.

Section 6.2.7 and Table 4 of the Statement of Commitments in Section 7 provides detailed procedures for the monitoring and repair of structures, including Principal Residences, in accordance with the Mine Subsidence Board requirements. Further detail will be provided in the Subsidence Management Plans and Individual Property Subsidence Mangement Plans to be prepared.

2.13.2 Decommissioning and Rehabilitation after Completion of Mining

At the completion of mining at Donaldson Open Cut Mine in 2012, all infrastructure required for the Donaldson Mine will be removed and the land rehabilitated in accordance with the Donaldson Mine Closure Plan. The Mine Closure Plan is part of the Mine Operations Plan for the mine required as a condition of the Mining Lease. Only infrastructure required for the Abel Underground Mine will remain, being items located within the Donaldson Open Cut Mine void, the access road, haul road to Bloomfield CHPP and some water management structures.

Decommissioning of the Abel Underground Mine at the end of the extraction period will require the sealing of the underground access portals and the removal of surface infrastructure, including offices, bath house, ROM coal stockpile infrastructure, workshop, conveyors and operational water management structures. The ground surface will then be reshaped to form a stable surface with embankments at a maximum of ten degrees. Surface water management structures such as contour banks, drains and settlement ponds required to provide permanent, long-term stable water flow and storage will be constructed and open areas rock raked and ripped, in particular where roads and hardstand areas have compacted the existing ground, ripping will be up to one metre in depth. 150 mm of soil will then be spread over the site and seeded with tree seed including a cover crop to minimise soil erosion. Some roads may remain if required for future land uses, as determined by planning processes developed closer to closure time.

Figure 2.16 shows the proposed final void and landform at the conclusion of the Abel Underground Mine operation. Areas shown in green are disturbed land that will be revegetated. Undisturbed areas outside of the void are already vegetated or will be revegetated at the completion of the Donaldson Open Cut Mine.

The void at the portal will be shaped and managed in a manner consistent with the rehabilitation principles for the Donaldson Open Cut Mine. The eastern, western and southern sides of the final void will be blasted and pushed using a dozer to a maximum slope of 18 degrees. The northern side will be blasted and regraded to a maximum of 10 degrees, with a permanent vehicle access and egress ramp constructed to allow access to the pit void for ongoing monitoring and management. During highwall dozer reshaping, water management structures such as contour banks, drains and drop structures will be established to divert as much of the surrounding catchment as possible away from the final void, to limit the amount of water that accumulates in the pit. Notwithstanding this, it is expected that some water will accumulate to a maximum depth of approximately 24 metres in the deepest part of the void (below 40 metres RL.)

Material blasted from the high walls will also be used to cover any exposed coal seams and other carbonaceous material that might be left at the end of mining. Given there is no history of spontaneous combustion at the site, this approach to sealing off the exposed seams with inert overburden material is considered appropriate. Once blasting and reshaping has been completed, final rehabilitation of the disturbed void area will commence. Due to the expected standing water at the bottom of the void, a safety berm and security fence will be provided around the void to prevent unauthorised access. The berm will be designed with a trench to prevent unauthorised vehicle access to the void.

The 400 ML water management dam that is currently used for the Donaldson Open Cut Mine will continue to be used for the Abel Underground Mine. Dewatering and re-engineering of this dam to create a permanent water storage structure, as detailed in the Donaldson MOP, will therefore be delayed until closure of the Abel Underground Mine.

In accordance with relevant DPI guidelines, the Mine Operations Plan, required as a condition of the lease for the Abel Underground Mine, will include a Mine Closure Plan addressing in detail the above rehabilitation proposals. A detailed rehabilitation plan will be developed as part of the Mine Closure Plan closer to the time of closure.

It is proposed to fill former open cut areas within Bloomfield Colliery with tailings from the coal washing process. This will assist in filling and rehabilitating these areas. Rehabilitation will be undertaken in accordance with DPI guidelines which require the Bloomfield Mine Operations Plan, required as a condition of the Bloomfield mining lease, to provide details on proposed outcomes to be achieved through rehabilitation and final landform. Dewatering of these tailings areas will continue to be undertaken in accordance with current methods, which include the pumping of excess water back to the washery for settling and reuse, and the covering of dewatered areas with soil, landform shaping and seeding for tree cover.

2.13.3 Maintenance and Monitoring of Rehabilitated Areas

Maintenance of rehabilitation areas will consist of two applications of fertiliser to tree cover areas and weed and feral animal management over a five year period after mine closure. Minor remedial earthworks or soil conservation works to address any erosion or sedimentation issues will also be undertaken over this period. Monitoring programs, such as air, noise and water quality monitoring will be continued until decommissioning and rehabilitation procedures have been completed. Rehabilitation will be monitored for a period of five years after completion to ensure completion criteria have been achieved. This monitoring will include visual inspections, tree density and percentage cover and transect studies, flora and fauna surveys and water quality monitoring of runoff waters. Water quality monitoring will be undertaken to verify the long-term quality of water in the final void as well as salinity levels of any runoff waters.

3 PLANNING CONSIDERATIONS

3.1 Statutory Application Process

The proposed development is for the purpose of coal mining as described in Schedule 1 Group 2 clause 5(1)(a) of NSW State Environmental Planning Policy (Major Projects) 2005. It is therefore a Part 3A Major Project under the *Environmental Planning and Assessment Act, 1979* (EP&A Act).

The *Environmental Planning and Assessment Amendment (Infrastructure and other Planning Reform) Act 2005*, which commenced operation on 1 August 2005, reforms the land-use planning and development assessment and approval system, particularly as it relates to major infrastructure and other significant development. An important component of this is the introduction of a separate streamlined and integrated development assessment and approvals regime for major infrastructure and other projects of significance to the State. These items are now dealt with under Part 3A of the EP&A Act.

The draft *Steps in the Assessment and Approval of Major Projects under Part 3A Guideline* (Department of Planning, 26 July 2005) require the proponent to undertake a preliminary environmental assessment to be submitted to the Department of Planning as part of a Project Application. This preliminary assessment identifies upfront any likely environmental constraints on the site to assist the proponent in the formulation of the project. It also provides the basis for issuing the environmental assessment requirements by the Director-General of the Department of Planning.

Under Part 3A, a Planning Focus Meeting was convened by the Department of Planning to discuss the project with relevant Government Agencies. A Project Application with Preliminary Assessment was then prepared and lodged with the Department of Planning (DOP) on 5 December 2005. At this meeting the Department of Planning stated that the Minister for Planning has declared the development to be a "project" for the purposes of Part 3A of the EP&A Act 1979.

As a result of the Planning Focus Meeting and Project Application, the Director-General of DOP's requirements for the project were issued, together with correspondence the Department had received from various agencies on the project. These requirements, issued on 6 January, 2006, are provided in Appendix A.

This Environmental Assessment (EA) has been prepared to comply with Part 3A of the EP&A Act 1979, the supporting Regulations and all relevant DOP guidelines for Part 3A, as well as the Director-General's Environmental Assessment requirements.

After the Environmental Assessment has been lodged and accepted by the Department of Planning, the EA will be publicly exhibited for at least 30 days. An Assessment Report will then be prepared by the Department, taking into

consideration any submissions received during the exhibition period, prior to the project being approved or not approved by the NSW Minister for Planning.

3.2 Local Government Areas and Permissibility

The Abel Underground Mine project area is within Newcastle, Cessnock and Maitland local government areas (LGAs). These are shown on Figure 3.1. The majority of the underground mine and surface infrastructure area is within Cessnock LGA. The eastern extent of underground mining is within Newcastle LGA and the northern section of the Bloomfield CHPP rail loop is within Maitland LGA.

All Abel project areas within Cessnock LGA are zoned 1(a) Rural A by the Cessnock Local Environment Plan 1989, which permits underground mining and associated surface activities with consent. Within Maitland LGA, the rail loop and northern section of Bloomfield Colliery where tailings may be disposed is zoned 1(b) Secondary Rural land by the Maitland Local Environment Plan 1993, permitting coal freight and mining activities with consent. The small eastern section of the underground area within Newcastle LGA is zoned 7(b) Environmental Investigation by the Newcastle Local Environment Plan 2003, which permits underground mining activities with consent.

The Abel Underground Mine and its associated activities are therefore permissible in all applicable local government area zonings.

3.3 Relevant Legislative Requirements

3.3.1 Required Permits and Licences

The following approvals or permits are required for the proposed Abel Underground Mine:

- approval under Part 3A of the *Environmental Planning and Assessment Act 1979*;
- A Mining Lease under the *Mining Act, 1992*;
- Approval to construct the underground mine portals beneath John Renshaw Drive under the *Roads Act 1993*;
- An environment protection licence under the *Protection of the Environment Operations Act, 1997*; and
- Licence under Part 5 of the *Water Act 1912* for groundwater bores associated with the Project.

There is potential for a Part 2 licence under the *Water Act 1912* to be required for the proposed Abel Underground Mine project. Consultation with DNR is ongoing regarding the details of this licence requirement. A Part 2 licence is required for

construction or use of a work for the purpose of water conservation, irrigation, water supply, or drainage, or changing the course of a river (diversion works).

i. Development Approval

The process of seeking development approval for the Abel Underground Mine is described in Section 3.1. Approval is sought from the NSW Minister for Planning.

ii. Mining Lease

A mining lease issued under the *Mining Act 1992* entitles the leaseholder to mine the minerals specified in the lease. A Mining Lease is issued by the Department of Primary Industries (DPI) only after approval has been granted by the Department of Planning. A Mining Lease will be required prior to commencement of mining.

The mining lease, and the relevant specialist mine safety legislation will specify various conditions which must be met with regard to safety, environmental management, waste disposal and payment of tonnage-based royalties to the State. A Mining Operations Plan (MOP) will be required as a condition of the mining lease. It will be required to be prepared and approved by the Department of Primary Industries prior to the commencement of mining. The MOP is a mining plan that will include details of the mining operation, environmental management and rehabilitation. The Abel Underground Mine will be required to submit Annual Environmental Management Reviews (AEMR) documenting annual environmental performance in relation to the MOP. DPI regularly audits compliance with the MOP. A detailed Subsidence Management Plan (SMP) will also be required to be approved for the Abel Underground Mine prior to any mining occurring that could cause subsidence.

iii. Roads Approval

An approval from the Roads and Traffic Authority under the *Roads Act 1993* is sought to construct the underground mine portals beneath the road reserve of John Renshaw Drive.

iv. Environment Protection Licence

An Environment Protection Licence is required from the Department of Environment and Conservation under the *Protection of the Environment Operations Act 1997* as the proposed mine is a scheduled activity under the Act. This licence will require management within set standards and ongoing monitoring of air, water, waste and noise.

Revisions to the existing licence held for the Bloomfield Coal Handling and Preparation Plant and rail loading facility by Bloomfield Collieries will also be required.

v. Water Act Licence

A Licence under Part 5 of the *Water Act 1912* for groundwater bores associated with the Project will be required.

3.3.2 Commonwealth Legislation

i. Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the Commonwealth Minister for the Environment to approve any actions that may have significant impact on matters of national environmental significance. These matters are:

- World Heritage properties;
- National heritage places;
- Wetlands of international importance (eg: RAMSAR wetlands);
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth land and marine areas; and
- Nuclear actions (including uranium mining).

The flora and fauna study undertaken for this Environmental Assessment has considered wetlands of international importance (RAMSAR wetlands), listed migratory species and listed threatened species and populations in accordance with the Commonwealth EPBC Act 1999. The flora and fauna study concluded that there would be no significant impact on these matters resulting from works associated with the proposed development. Given this no approval is required under the EPBC Act 1999.

ii. Native Title Act 1993

The *Native Title Act 1993* is administered by the national native Title Tribunal who are responsible for maintaining a register of native title claimants and bodies to whom native title rights have been gained. These native title holders and claimants must be consulted prior to the granting of a mining lease over land to which the native title claim or right applies. All land within the Abel Underground Mine project area is freehold and therefore no claim may be made over it.

3.3.3 NSW Legislation

i. Relevant Legislation

In addition to the EP&A Act, various other NSW legislation has been referred to in the assessment of potential impacts, or will be addressed during the construction and operational phases of the project. Where relevant to the planning process the legislation has been addressed in the technical reports for each key issue. Relevant NSW legislation includes:

- *Threatened Species Conservation Act, 1995;*
- *Threatened Species Conservation Amendment Act, 2002;*
- *National Parks and Wildlife Act, 1974;*
- *Environmentally Hazardous Chemicals Act, 1985;*
- *Dangerous Goods Act, 1975;*
- *Coal Mines Regulation Act 1982;*
- *Local Government Act 1993;*
- *Roads Act 1993;*
- *Water Management Act 2000;*
- *Water Act 1912;*
- *Native Vegetation Act 2003;*
- *Dams Safety Act 1978;*
- *Protection of the Environment Operations Act 1997;*
- *Rivers and Foreshores Improvement Act 1948;*
- *Mining Act 1992;* and
- *Occupation Health and Safety Act 2000.*
- *Mine Subsidence Compensation Act 1961*
- *Heritage Act 1977*

ii. Mine Subsidence District Proclamation

The Mine Subsidence Board is responsible for administering the *Mine Subsidence Compensation Act 1961*. The Act provides for compensation or repair services where improvements are damaged by mine subsidence resulting from the extraction of coal. The Act also makes the Board responsible for reducing the risk of mine subsidence damage to properties by assessing and

controlling the types of buildings and improvements that can be erected in Mine Subsidence Districts.

The proposed Abel Underground area does not lie within a currently proclaimed Mine Subsidence District. However, discussions have been held with the Mine Subsidence Board and a District will be proclaimed over the area so that the Board is able to offer these services if required to land owners within the Abel Underground Mine area.

3.4 Relevant Policies and Guidelines

3.4.1 Policies and Guidelines Used in Project Impact Assessment

Various policies and guidelines have been referred to in the preparation of this environmental assessment. These include:

- *Guideline for Application for Subsidence Management Approvals* (Department of Primary Industries, 2003);
- *Management of Stream/Aquifer Systems in Coal Mining Developments* (DIPNR, 2006);
- *Guidelines for Fresh and Marine Water Quality* (ANZECC);
- *Managing Urban Stormwater: Soils and Construction* (Landcom);
- *NSW State Rivers and Estuaries Policy;*
- *NSW Wetlands Management Policy*;
- State Groundwater Policy documents – various (Department of Natural Resources);
- *NSW Industrial Noise Policy* (EPA, 2000);
- *Environmental Criteria for Road Traffic Noise* (Department of Environment and Conservation);
- *Environment Noise Control Manual* (Department of Environment and Conservation);
- *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Department of Environment and Conservation);
- *Draft Guidelines for Threatened Species Assessment* (Department of Environment and Conservation);
- *Draft Plan of Management – Pambalong Nature Reserve* (National Parks and Wildlife Service, 2004)
- *NSW Groundwater Dependent Ecosystem Policy* (Department of Natural Resources);

- *Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (Department of Environment and Conservation);
- *Environmental Guidelines: Assessment and Classification and Management of Liquid and Non-Liquid Wastes* (EPA, 1999);
- *Guide to Traffic Generating Development* (Roads and Traffic Authority); and
- *Road Design Guide* (Roads and Traffic Authority).

3.4.2 Planning and Land Use Policies

i. State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) that are relevant to the proposed development are:

- *SEPP (Major Projects) 2005;*
- *SEPP 33 – Hazardous and Offensive Industry; and*
- *SEPP 44 – Koala Habitat Protection.*

SEPP (Major Projects) 2005 identifies and provides the framework for major projects and the Part 3A process. The proposed Abel Underground Mine project follows the Part 3A process.

SEPP 33 Hazardous and Offensive Industry requires consideration of whether an industrial proposal is a potentially hazardous or offensive industry. This is defined as a development that *'would pose a significant risk in relation the locality: to human health, life or property; or to the biophysical environment, and includes a hazardous industry and a hazardous storage establishment' (Clause 3). A potentially offensive industry is defined as a development that 'would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment' (DOP 1994). Section 8 details management considerations* for various aspects such as waste management, fuel storage and emergency response. All hazardous materials will be managed in accordance with Donaldson's existing management procedures that have successfully operated for the Donaldson Open Cut Mine.

An Environment Protection Licence (EPL) will be obtained for the proposed development. The Department of Planning (1994) states that 'Typically, the level of offence would not be considered significant if relevant EPA licences can be obtained'. Therefore, it is considered that the project is not considered to be an offensive industry.

SEPP 44 – Koala Habitat Protection is addressed in Section 6.7. SEPP 44 requires that, for proposals on properties involving 1 hectare or more, the habitat should be evaluated for potential Koala habitat and core Koala Habitat. The flora and fauna assessment concluded that the only listed Koala feed tree species present was *Eucalyptus punctata,* which did not constitute at least 15% of the tree species present. Potential Koala habitat was therefore not present and no further investigation was required.

ii. Hunter Regional Environmental Plan

The *Hunter Regional Environment Plan 1989* (Hunter REP), prepared by the NSW Department of Planning, provides the framework for detailed local planning by local councils. Hunter REP specifies compatible land use planning for areas with coal mining potential, and stresses the importance of environmental management of mine sites. Environmental management considerations from Hunter REP have been considered in this Environmental Assessment.

iii. Draft Lower Hunter Regional Strategy

The draft *Lower Hunter Regional Strategy* (Department of Planning, 2005) has been developed *'to ensure that adequate land is available and appropriately located to sustainably accommodate the projected housing, employment and environmental needs of the Region's population over the next 25 years'.* Its aim is *'to inform future work undertaken by Government to determine infrastructure investment priorities for the Lower Hunter. Infrastructure planning will take into account this broad planning framework, including the location and types of urban centres, housing and employment lands identified in the Strategy, to ensure that future population growth is supported by essential human services and associated infrastructure.'* (Department of Planning, 2005)

The draft Strategy identifies land north of John Renshaw Drive, on which Donaldson Open Cut Mine is located, for a future inter-modal freight facility. No other land within the Abel Underground Mine project area has been identified for future housing, environmental protection or employment lands. A future inter-modal freight facility would not conflict with the continuation of the Abel Underground Mine surface infrastructure area after the closure of the Donaldson Open Cut Mine active mining program.

The draft Strategy notes (page 21) that *'access to mineral resources in the region will not be jeopardised by future urban or rural/residential development'*.

It also notes in Section 7 that *'land outside of the urban footprint as shown in Map 1 – Strategy Map will maintain existing rural zones and use rights but will not be supported for further residential zoning. This includes significant regional corridors such as the Stockton to the Watagan Range corridor, and the Wallarah Peninsula corridor. The Draft Regional Strategy establishes a framework for further investigation of rural areas to facilitate consolidation and potential expansion of national parks and the reserve estate'.* The proposed Abel Underground Mine is outside the identified urban footprint. The land is therefore

not identified for future residential sub-division that could conflict with underground mining purposes.

iv. Integrated Catchment Management Plan for the Hunter Catchment 2002

The *Hunter Catchment Blueprint* (Department of Land and Water Conservation, 2003) sets the direction for major strategic investment in natural resource management with the intention of improving the environmental, economic and social sustainability of the catchment. The first order objectives of the Blueprint are:

- *'Native vegetation, biodiversity and ecological integrity are valued, maintained and enhanced.*
- *Water bodies are managed to balance natural ecosystem requirements with community needs.*
- *Adverse impacts of salinity on ecosystem health and the community are minimised.*
- *The physical structure and vegetation of rivers, estuarine and wetland riparian zones are maintained for healthy ecosystems while achieving adequate protection from floods.*
- *Sustainable agriculture, human settlement, industry and other land uses occur while protecting Aboriginal cultural heritage, ecosystem health, soil and water.'*

This Environmental Assessment demonstrates that the project will not conflict with these priorities. Native vegetation, biodiversity, water bodies, salinity, wetlands, human settlement and Aboriginal cultural heritage have all been investigated for this Environmental Assessment.

v. Draft Thornton-Killingworth Sub-Regional Conservation and Development Strategy

This draft Strategy (Parsons Brinckerhoff, 2003) covers the interface area between the local government areas of Lake Macquarie, Newcastle, Maitland and Cessnock and includes the Abel Underground Mine project area. The draft Strategy aims to *'identify important areas of conservation, map physical constraints to development, develop a summary of constraints and factors for consideration for possible new development areas and identify strategic directions for the area.'*

The draft Strategy notes that there is potential for open cut mining around John Renshaw Drive and George Booth Drive. The Abel project proposes underground mining that will provide for much lower environmental disturbance than open cut mining. The area south of John Renshaw Drive where underground mining is proposed is identified to 'conserve rural landscape' and 'regional conservation' on the Strategic Framework plan, which is not in conflict with the Abel Underground Mine project.

vi. Hunter and Central Coast Regional Environmental Strategy

The Hunter and Central Coast Regional Environmental Strategy (HCCREMS) is a regional initiative being implemented through the collaborative efforts of fourteen Councils in the Hunter, Central and Lower North Coast of NSW. It seeks to facilitate a regional approach to ecologically sustainable development. HCCREMS' Regional Biodiversity Conservation Strategy aims to develop a strategy and implementation plan to protect the natural, biological diversity of the Lower Hunter & Central Coast in order to maintain existing ecological processes for future generations. Studies undertaken as part of the Strategy have been used in the assessment of flora and fauna for the proposed Abel Underground Mine.

3.5 Land Ownership

The majority of land within the area is owned Donaldson, Coal and Allied and the Catholic Diocese of Maitland and Newcastle, with various private landowners to the south of John Renshaw Drive. Ashtonfields owns the majority of the area on which Bloomfield Colliery is located. Property and mining titles within the project area are provided in Appendix B and shown on Figure 3.2. For privacy reasons, individual names are not provided.

4 CONSULTATION

4.1 Objectives

Consultation with government authorities and the local community has been undertaken throughout the planning phase for the proposed Abel Underground Mine. The objectives of the consultation program were to:

- Fully inform the local community about the proposal and address and include any community concerns in the Environmental Assessment process;
- Provide technical information to the local community using methods that could be clearly understood and provide a forum for open questions and dialogue; and
- Involve government authorities, including Department of Mineral Resources and Department of Planning, in the planning process to best address their key considerations in project planning.

4.2 Consultation with the Community

Community consultation has involved a variety of consultation methods including:

- the formation of an Abel Community Liaison Committee;
- letter box drops and door knocks with all land holders;
- open community information sessions chaired by an independent facilitator; and
- employment of a local person to act as community liaison officer for the project.

The Abel Community Liaison Committee was formed separately to the Donaldson Community Consultative Committee, which meets to discuss the Donaldson Open Cut Coal Mine. Both Committees have been kept informed of the Abel Underground Mine Project and have discussed the key issues.

Each landholder in the Abel Underground Mine project area who wished to discuss the proposal was spoken with and a preliminary site inspection undertaken to identify principal residences and other improvement structures. This information was used to ensure correct data on residences and structures was used in the assessment process. A letter box drop informed local residents of the first public information session that was held and contact details for project information.

The following community information sessions were held prior to submission of the Environmental Assessment:

- 2 March 2006 – 67 attendees - general overview of proposal, call for Community Liaison Committee members and community questions;
- 22 March 2006 – 37 attendees - general project discussion, community questions and subsidence presentation;
- 26 April 2006 – 33 attendees - 2nd subsidence presentation and community questions;
- 31 May 2006 – 49 attendees - Mine Subsidence Board presentation and community questions; and
- 12 July 2006 – 43 attendees – presentations on surface water, groundwater and dams, and community questions.

A meeting was also held on 22 August 2006 to discuss the proposed management of dams that occur above proposed underground mine workings.

A record of these meetings is provided in Appendix B. Minutes of the 22 August meeting were not available at the time of EA lodgement but will be posted on the project website. Records provided in Appendix B show the range of questions asked by individuals and proponent responses, as well as the presentations provided during meetings. Additional meetings are planned after lodgement of the Environmental Assessment to keep the community informed of project developments.

Donaldson has had ongoing discussions with the two largest landholders in the underground mine area, being the Catholic Diocese of Maitland and Newcastle and Coal and Allied.

Both companies own property that is located above areas that form part of the initial stages of the mine development.

The Catholic Diocese of Maitland and Newcastle intends to build a school on their land, followed by further development, pending the outcome of the draft Lower Hunter Regional Strategy. Donaldson has undertaken to ensure that the school development will not be impeded by underground mining impacts.

As further developments within both landholdings depend on the outcome of the draft Lower Hunter Regional Strategy, tentative agreements have been put in place to ensure mining operations within these holdings are complete within five years of commencement so that surface development will not be delayed by mining. Further discussions will continue when the outcome of the draft Lower Hunter Regional Strategy is known.

4.3 Government Consultation

Authority consultation for the Abel Coal Project included:

- Preliminary briefing with Department of Planning on 6 May 2005;
- Conceptual Project Development Plan meeting with DPI on 31 May 2005, and follow-up meeting later in 2005;

- Discussions with the Mayor and General Manager of Cessnock City Council during 2005;
- Discussions with the Minister of Planning in 2005;
- Two meetings with the Premier's Department during 2005;
- Planning Focus Meeting held on 24 November 2005;
- Various briefings to Department of Planning and other agencies including Department of Environment and Conservation throughout the project preparation period.

Discussions have been positive and encouraging of the main project concepts, including the use of underground extraction methods aimed at controlling subsidence and the use of existing areas of disturbance and infrastructure.

5 IDENTIFICATION OF KEY ISSUES

5.1 Risk Identification Process

The Project Application and Preliminary Assessment lodged with the Department of Planning in December 2005 identified likely environmental issues through application of a risk analysis process. An Environmental Risk Assessment was developed for the project and risk values were allocated to all proposed aspects of the mine and potential impacts.

The risk assessment (refer Appendix C), was developed using the *Risk Management Guidelines Companion to AS/NZS 4360:2004*. It provides the preliminary screening of potential environmental impacts to identify those impacts that have higher levels of risk and those impacts unlikely to result in significant risks to the environment. As such the risk assessment establishes the following:

- It provides an objective, informed basis for the identification of key issues, which are further examined in detail in the Environmental Assessment (EA).
- It provides an objective basis for the identification of issues unlikely to result in significant risks to the environment and hence issues which are not further examined in detail in the EA.
- It enables the EA to quickly focus on key issues relevant to the decision making process, rather than resulting in an EA that accords the same level of attention to key and non-key issues, with often key issues obscured.
- It enables the EA to be a briefer and more succinct document without limiting its scientific credibility.
- It provides an EA more readily understandable to and capable of being appreciated by community stakeholders.
- It ensures the EA is a decision making tool rather than a catalogue of facts regarding a project, irrespective of their relevance to decision making.
- In using a risk assessment methodology following the *Risk Management Guidelines Companion to AS/NZS 4360:2004* it establishes a transparent basis for identification of key issues.

The risk assessment has been subject to consideration by the Department of Planning and other relevant agencies as an input to the Department of Planning establishing the Director-General's requirements for the EA. This step provides a further level of confidence that the identification of key issues following the risk assessment is robust and independent.

The risk assessment process involved the following main steps:

- Establishment of the context for the risk assessment process;

- Identification of environmental risks;
- Analysis of risks; and
- Evaluation of risks to determine significant issues.

After identifying each aspect of proposed construction and operational works, an Environmental Risk Rating was applied to each aspect. This Risk Rating was based on Environmental Consequence Descriptions (Catastrophic, Major, Moderate, Minor, Insignificant) together with a 5 level probability rating for each aspect. This process provided an overall Risk Rating for each aspect, categorised as High, Medium or Low Risk.

For each project aspect, three separate scenarios were then considered:

- No controls – being a measure of 'raw' risk associated with an activity, or what may occur if no controls or mitigation measures are in place;
- Current controls – where applicable, as many aspects are already controlled as part of the environmental management of Donaldson Mine; and
- Proposed controls – which were determined by the working group to form part of the proposed development, for example, a bund, diversion, mining method or management plan.

The Environmental Risk Register (Appendix C) developed from the above process showed that many aspects of the proposed development, even with no controls, would be low or medium risk. Environmental risk associated with subsidence, if no controls were proposed, was considered generally to be a high risk. When controls are introduced, risk associated with all aspects, including subsidence, reduces to low. Low Risk is categorised as 16 to 25 in the classification system. Controlled risk associated with project aspects ranged from 17 to 24.

The Environmental Risk Assessment process was used to focus on key issues where the risk of environmental impact was considered higher. Although, after implementation of controls, all aspects were categorised as low level risk, focus was directed to those aspects that, without controls, presented a higher level of risk. This applies particularly to subsidence issues. After the completion of detailed technical studies that also included recommendations for further reduction of potential risks, the risk assessment was again reviewed and updated and the risk rankings for key issues revised where appropriate. The outcome of this risk assessment concludes that with the mitigation and remediation measures proposed in this EA the project has a low risk ranking for all key issues.

5.2 Identification of Key Issues

Key issues identified from the Risk Assessment process were identified as:

- Those items that remain as a medium risk after implementation of controls (Nil items);

- Those items that were identified as High risk prior to implementation of controls; and
- Those items where risk categorisation requires further investigation to confirm potential impact.

The Director-General's requirements for the Environmental Assessment, together with the Environmental Risk Assessment process, has identified the key issues for assessment as:

- Subsidence;
- Soil and water;
- Noise and vibration;
- Air;
- Flora and fauna;
- Heritage;
- Waste;
- Transport; and
- Visual.

Each of these key issues is assessed in detail in Section 6. After completion of the assessment studies for key issues, the risk register and risk ratings were reviewed to determine whether the risk ratings had increased or decreased as a result of detailed investigation. The risk rating allocated to a proposed activity after consideration of detailed studies and proposed management and mitigation measures is referred to as the 'residual risk'.

Section 9 describes the risk review process and the resultant residual risks allocated to activities associated with the proposed Abel Underground Mine.

5.3 Identification of Surface and Sub-surface Features

To assist in the determination of key issues, and to ensure that all items were assessed in the study of potential impact from underground mining, a catalogue of surface and sub-surface features was developed. This data was collected using the following methods:

- Consultation with the local community through meetings and visits to residential properties and businesses;
- Consultation with property stakeholders, to determine the ownership of items such as pipes, transmission lines and cables;
- Field inspections by the project team with input by specialist consultants during the course of their field studies;
- Inspection of aerial photography (new aerial photography was flown and prepared for the Abel Underground Mine project); and

- Inspection of topographic maps and other maps such as historical mine maps.

This catalogue, provided in Table 3, provided key information for the various impact assessment studies and in particular the consideration of subsidence impacts on the range of surface and sub-surface features.

Table 3 Catalogue of Surface and Sub-surface Features - Abel Underground Mine Area

Item	Description
Natural Features	
1. Rivers and creeks	Vineys Creek, Buttai Creek, Blue Gum Creek, various tributaries
2. Aquifers and springs	Determined by Groundwater Study
3. Cliffs and steep slopes	Generally in Blue Gum Creek tributaries and in quarries
4. Swamps & wetlands	Pambalong Nature Reserve
5. Threatened and protected species	Determined by Flora and Fauna study
6. Natural vegetation	Communities determined by Flora and Fauna study
Public Utilities	
7. Roads and bush tracks	John Renshaw Drive, Black Hill Road, Browns Road, Taylors Road, Stockrington Road, Seahampton Road, Doghole Road, Bluegum Close, Jacobs Lane, Cedar Hill Drive. Various private roads and bush tracks.
8. Water pipelines	2 Hunter Water Corporation lines, private Stockrington line, other domestic water pipe for residential/stock use
9. Gas line	Agility Main
10. Electricity transmission lines	Transgrid 330 kV line, Energy Australia 132 kV line, Energy Australia 66 kV line, supply to individual properties
11. Telecommunication lines	Telstra Fibre Optic Cable, Optus Fibre Optic Cable, Telstra copper services
Permanent State Survey Control Marks	Various throughout area – to be determined at SMP stage
Public Amenities	
12. Places of Worship	Black Hill Church
13. Schools	Black Hill Public School
14. Cemeteries	Black Hill church cemetery, small cemetery off John Renshaw Drive
Farmland and facilities	
15. Agricultural enterprises	Orchards, alpaca stud, cattle, goat & sheep grazing
16. Farm sheds and buildings	Various
17. Poultry sheds	Disused
18. Fences	Various
19. Farm dams	175 identified
20. Irrigation systems	Orchard system, other small systems
Industrial, Commercial and Business Establishments	
21. Workshops	On various properties

Item	Description
22. Business equipment and premises	Boral Hotmix plant, Hunter Equestrian Centre, Australian Demolition, Steggles Laboratory, Black Hill Transport.
23. Quarries	Black Hill Quarry, Stockrington Quarry
24. Undergound mining areas	Abandoned workings - various
Heritage Items	
25. Aboriginal heritage	Determined by Aboriginal heritage study
26. European heritage	Richmond Vale Railway easement (listed by Cessnock CC)
Private Property Items	
27. Principal (main) residences	110 principal residences
28. Garages / Workshops	83 identified
29. Onsite waste water systems	Various at residences
30. Water tanks	Various at residences
31. Swimming Pools	23 identified
32. Tennis courts	Various identified
33. Driveways and landscaping	Various
34. Ancillary shed / structures	Various, also outdoor horse arenas

6 ENVIRONMENTAL ASSESSMENT - KEY ISSUES

6.1 Introduction

The Part 3A application process recently introduced within the *Environmental Planning and Assessment Act 1979* enables a 2 stage assessment process. A Project Application with a preliminary assessment of all potential environmental issues is considered prior to a secondary, detailed Environmental Assessment being prepared. The Environmental Assessment focuses on key issues identified for the project. These key issues are identified through a risk assessment process and weighting system (described in Section 5) and through consideration by the Department of Planning, in consultation with other government agencies, of the Project Application documentation and other matters.

This two stage process ensures the Environmental Assessment (EA), being the second, detailed assessment, focuses on key issues and presents as a decision making tool, rather than a catalogue of facts regarding the project, irrespective of their relevance to decision making.

This section provides a brief description of each identified key issue and the methodology undertaken to investigate each key issue, together with a summary of the study outcomes with regard to their potential interactions with the proposed Abel Underground Mine. Detailed information, lists and technical data are provided in Appendices as noted.

6.2 Subsidence

6.2.1 Introduction

A detailed Mine Subsidence Impact Assessment for the Proposed Mine Layout and Extraction has been completed and is provided in **Appendix E**. The risk assessment undertaken for the Abel Underground Mine project identified that without consideration of subsidence management procedures, impacts on some surface and sub-surface features could exceed ‘safe and serviceable’ tolerance levels.

A preliminary assessment of the tolerable subsidence limits for the natural surface features indicates that the impacts can be managed by the strategies described in this section. These strategies will be implemented via the preparation of the Subsidence Management Plans.

With the implementation of the documented protection and management strategies it is expected that 'safe and serviceable' tolerance limits for the man made surface features will be met.

Levels of impact to all significant natural features and items of infrastructure are manageable and can be controlled by the preparation and implementation of Subsidence Management Plans.

The Subsidence Impact Assessment:

- provides the proposed surface and sub-surface protection strategy for the Abel Underground Mine;
- models predicted subsidence;
- identifies existing surface and sub-surface features; and
- assesses the likely impacts on these existing surface and sub-surface features within the zone of influence of the mine workings.

Sensitive surface features that may require subsidence impact control as mining progresses have also been identified.

The Mine Subsidence Impact Assessment has been prepared to predict potential subsidence and show that potential impacts can be appropriately mitigated and managed. A more detailed Subsidence Management Plan (SMP) will be prepared prior to the commencement of mining as part of the Mining Operations Plan required under the *Mining Act 1992*. SMP's are prepared for each seven years of mining.

The SMP will detail specific measures for individual land parcels and items on these parcels, such as houses, sheds, dams, fencing, pools, orchards, pipes, electricity lines and roads. These specific measures will be developed as individual property management plans, in consultation with individual landowners, agencies responsible for the management of individual areas or items and the Department of Primary Industries (DPI).

6.2.2 Surface and Sub-Surface Protection Strategies

i. Overview of Protection Strategies

The coal extraction method selected for the proposed Abel Underground Mine can vary the amount of coal extracted from a particular underground area, in order to control the amount of surface and sub-surface subsidence. This enables the protection of identified features. Varied extraction is achieved by:

- limiting mining in a particular section of a production panel to first workings only, or
- limiting the amount of coal taken in the production panels so as to leave long-term stable remnant pillars (i.e. partial pillar extraction), or
- mining to total extraction in a production panel and allowing full subsidence to develop.

A description of these alternative mining techniques which provide varying levels of subsidence impact control is provided in 6.2.2 (ii).

Other techniques or controls will also be used to prevent, mitigate or manage subsidence impacts either before or after mining. These involve actions such as strengthening structures or ground supports prior to mining, or repair works after mining.

The appropriate subsidence management options and plans for particular Abel Underground Mine surface areas will be selected based on:

- consultation with stakeholders and government authorities through the Subsidence Management Plan (SMP) process;
- monitoring of overburden behaviour and subsequent impacts during mining;
- review of the performance of the SMP; and
- revision of the plan if required after consultation and monitoring.

ii. Mining Methods to Control Subsidence

Different mining methods and sequences are proposed to be used for extracting coal from the proposed Abel Underground Mine so that subsidence can be controlled.

Donaldson Coal is proposing to mine the Upper and Lower Donaldson Seams using high productivity continuous mining machines. The mine is developed initially by forming main headings and production panels with a grid of pillars and roadways known as *first workings*. First workings generally remove 20% to 35% of the coal and do not cause significant subsidence at the surface (i.e. usually less than 20 mm). Limiting extraction in a pre-determined area to first workings only can be used to control subsidence, provided the applied loading from adjacent mining activities is considered in their design.

After first workings are completed, the pillars in the production panels are stripped on retreat to leave smaller or remnant sized pillars. The size of the remnant pillars can be designed to provide short or long-term stability, depending on the degree of subsidence development control required to protect the surface and sub-surface features. To enable a range of subsidence options to protect particular surface features across the Abel Underground Mine project site, both total extraction and partial pillar extraction are proposed.

Partial pillar extraction mining refers to pillar extraction panels that have significant sized remnant pillars remaining in the panels to control surface subsidence. The remnants are generally regular in their shape and are designed to remain stable for the long-term after mining is completed. Partial extraction panels generally remove between 40% and 60% of the coal in the panels. Subsidence can be controlled to less than 100 mm using this method.

Total extraction mining is usually when more than 70% of the coal is removed. The maximum amount of coal that can be extracted using this technique is approximately 85% of the pillars in a production panel. The remnants are designed to provide short term support to the mine roof during mining. The remnants however, are likely to reduce the subsidence that would be expected if all of the coal was removed. Maximum subsidence that occurs generally

ranges from 20% to 58% of the coal seam height mined and depends upon the mining geometry and geological conditions.

Barrier pillars are the pillars left between the production panels and main headings (which provide access to the production panels) or within the production panels themselves. These barrier pillars can be designed for subsidence control purposes. The barriers between the panels are generally required for ventilation and mining environment control (and sometimes subsidence control). Subsidence above the barriers between the panels can range between 10 mm to 1.0 metres, depending on the applied abutment loading due to adjacent mining methods (i.e. partial or total extraction), mining geometry and geological conditions.

iii. Abel Underground Mine Subsidence Protection Strategies

Each of the consultants who prepared specialist studies for this Environmental Assessment was provided with maximum subsidence predictions based on total extraction mining and asked to consider the significance of this subsidence on their particular environmental aspect, for example, archaeology, flora and fauna, groundwater and surface water. Consideration was also made of the number and type of residences and other constructed features in the area. Consideration of all these issues has led to particular protection strategies, or objectives, being developed for items such as Principal Residences (existing and future), the Black Hill School and Church (including the cemetery), other surface structures, dams, public roads, pipelines, survey marks and general surface water flow. These protection strategies are described in Section 7 which provides the Statement of Commitments by Donaldson Coal for the project.

6.2.3 Study Methodology

The Project Application prepared for the proposed Abel Underground Mine (Donaldson Coal, Dec 2005) provided a range of potential subsidence values, based on preliminary subsidence modelling across the proposed mine area. These values were provided to assist with the identification of key issues for the Environmental Assessment.

Detailed subsidence modelling has since been undertaken for the Environmental Assessment. This modelling assumed that no surface protection pillars were left in place in the underground mine. This was to determine maximum subsidence scenarios and whether additional subsidence impact controls were required.

Before subsidence predictions could be made, a geological model was developed. An assessment of massive strata within the overburden, such as conglomerate and/or sandstone units, their thickness and location above the proposed pillar panels was also undertaken as these large items can influence the amount of subsidence that can occur.

A comprehensive register of surface and sub-surface features, including natural (for example, creeklines, ecosystems, underground aquifers) and man-made

(eg: houses, dams, public infrastructure and utilities, fences, etc) features was prepared (refer Section 5.3) and considered in the Subsidence Impact Assessment.

Maximum expected and credible worst case magnitudes of surface movement of the areas above each pillar extraction panel and also over barrier pillars has been determined and is presented in Appendix E. Predictions include maximum transverse tilt, curvature, horizontal displacement and strain above the panels as well as predictions of representative transverse subsidence and associated impact parameter profiles across a group of selected pillar panels. Predictions were made using an empirically based model presented in ACARP (2003) with a reduction factor applied to allow for remnant pillars left after mining is completed.

The study outcomes include the first (i.e. subsidence after each panel is extracted) and final (i.e. after mining is completed in the study area) surface deformation predictions to 95% confidence limits. Pre and post mining surface level contours were generated based on the predicted subsidence contours, as shown on Figure 6.1.

The Subsidence Impact Assessment also included:

- a prediction of continuous and discontinuous sub-surface fracture heights above the proposed production panels, and the likelihood of surface and sub-surface aquifer adjustment;
- potential valley opening/closure and subsequent uplift movements that can occur along creek beds due to subsidence levels;
- estimates of surface crack widths and potential ponding depths above production panels and along creeks;
- estimates of creek bed slope changes after mining;
- an assessment of the likely impacts of the predicted subsidence movements on the existing natural and man-made surface and sub-surface features with damage mitigation measures that may be required, including suggested monitoring line locations to provide impact management response data; and
- a preliminary example of the design of surface protection pillars required beneath a principal residence.

The design of surface protection pillars has been done using a combination of analytical and numerical modelling techniques to assess pillar stability and surface deformations. The numerical model used is the internationally recognised LAMODEL (Heasley and Salamon, 1996). Further details on the modelling process and pillar design criteria are provided in Appendix E.

For the purpose of preparing appropriate management strategies, the potential subsidence impacts without surface protection pillars for all items, except Schedule 2 Creeks, has been assessed. This information is required for the assessment of worst-case scenarios and to determine whether it will be necessary to apply additional subsidence impact controls, based on discussions with relevant stakeholders.

Subsidence contour plans included in the Subsidence Study are also based on worst-case total extraction in each mining panel. The contours do not apply to those areas where a surface protection commitment (i.e. the Principal Residences, school, church, cemeteries and Schedule 2 creeks) has been made.

In relation to Schedule 2 Creeks the subsidence contours have been based on a mine plan that limits subsidence at the creeks to a level that the NSW Department of Natural Resources has previously indicated as likely to be acceptable in terms of long-term impact (i.e. < 45 mm at the centre of the creek). These plans therefore represent an alternate scenario based upon a greater level of extraction than is proposed for the SMP. The mine plan proposed for the SMP will limit subsidence to 20 mm at a distance of 40 m from a Schedule 2 creek bed, unless the further studies indicate that the creeks can be satisfactorily subject to greater subsidence.

6.2.4 Factors Influencing Subsidence

Various factors in the mine design, method and local environment influence subsidence. These are discussed in detail in Appendix E but include:

- the proposed mine geometry, depth of cover and extraction methods;
- the selected method of pillar extraction;
- existing underground workings on the site (eg: the abandoned Stockrington Colliery workings in the West Borehole Seam in the south-western section of the site) as increased subsidence due to pillar collapse of standing pillars in the existing workings or re-activation or consolidation of old goafed (collapsed) areas could occur;
- the geological setting, including slopes and geological structure zones (ie: faults and dykes);
- geotechnical unit properties in the roof and floor of proposed mine workings (eg: strengths and stiffnesses);
- overburden lithology and massive units (which could significantly reduce subsidence due to the size of the units above the proposed workings;
- geological structure; and
- types of surface features, and how they respond to subsidence.

6.2.5 Subsidence Predictions

Predicted maximum subsidence parameter values for 150 metre wide total extraction panels with 25 metre wide barriers were determined and are described in full in Appendix E. Figure 6.1 shows predicted post-mining subsidence contours across the Abel Underground Mine area. It should be noted that this figure does not show the proposed protection pillars for Principal Residences or other specific areas to be protected from subsidence.

Predicted subsidence is as follows:

- Credible worst-case first maximum subsidence after mining of total extraction panels ranges from 0.4 to 1.6 metres in both Upper and Lower Donaldson Seams.
- Credible worst-case final maximum subsidence after mining of total extraction panels ranges from 0.5 to 1.8 metres in both the Upper and Lower Donaldson Seams.
- Credible worst-case final subsidence above the 25 metre wide barrier pillars after the extraction of panels in the Upper Donaldson Seam ranges from 0.04 to 0.89 metres.
- Credible worst-case final subsidence above the 25 metre wide barrier pillars after the extraction of panels in the Lower Donaldson Seam ranges from 0.09 to 1.02 metres.

There could potentially be an increase in subsidence due to former underground mine workings which are located between some sections of the proposed Abel Underground Mine workings and the surface. This could be up to 600 mm for an assumed mining height of 3 metres.

6.2.6 Subsidence Impact Assessment – Types of Impacts

The following types of impacts on natural features can occur as a result of subsidence. It should be noted that these impacts are what could potentially occur where total extraction panels are planned, and that impacts would be less where lesser extraction occurs. A discussion of where these impacts could occur and mitigation measures is provided in Section 6.2.7.

i. Slope instability and erosion

This is the likelihood of sliding of blocks of conglomerate over low strength claystone beds, which has been assessed as being very unlikely to occur in the long-term in the Abel Underground Mine area. Localised instability could occur where ground slopes greater than 15° exist, if the slopes are also affected by mining-induced cracking and increased erosion rates.

ii. Ponding

Ponding may occur where low lying areas and watercourses are subject to significant differential subsidence above a total extraction panel, leading to the development of closed form depressions. Post mining subsidence contours indicate that the north-east, north-west and south-east areas of the site are unlikely to be impacted by ponding, except for some sections of the Schedule 1 creeks within the confines of the channels. A further assessment of subsidence on creeklines is provided in Section 6.2.1.

iii. Surface Cracking

Cracking occurs on the surface when there is sufficient 'bending' of the overburden as the subsidence trough develops. Maximum surface cracking widths of between 25 mm and 280 mm could occur after mining is completed. The larger cracks are predicted in the shallow northern areas where cover depths are less than 80 m and total extraction mining is proposed.

iv. Sub-Surface Cracking

Continuous sub-surface cracking refers to the extent of fracturing above a total extraction panel that would provide a direct flow-path or hydraulic connection to the workings, if a sub-surface aquifer or coal seam were intersected. The presence of coal seams or sub-surface aquifers above the workings and within the continuous fracture zone could therefore result in increased water make at seam level during extraction. It is assessed that only some shallow sections of Viney Creek could be impacted by sub-surface cracking.

Discontinuous fracturing refers to the extent above a total extraction panel where there could be a general increase in horizontal and vertical permeability within the rock mass due to bending or curvature deformation of the overburden. This type of fracturing does not provide a direct flow path or connection to the workings and is more likely to interact with surface cracks or joints. It may therefore result in an adjustment of surface and sub-surface flow paths and storage magnitudes within the rock mass, but will generally not result in a significant long-term change to the groundwater or surface run-off resource.

The likelihood of a direct connection reaching the surface is assessed to be practically impossible (i.e. less than 1% probability or not a credible scenario) for areas deeper than 100 metres. For areas where the depth ranges between 60 and 80 m and there is deep alluvium present to depths of 5 metres or more, there is a possibility (i.e. a 10 to 50% probability of occurrence) that a direct hydraulic connection to the underground workings could occur, if adverse conditions (i.e. a fault or persistent jointing) are present. The absence of adverse conditions would reduce the probability of occurrence to 1% - 5% (i.e. unlikely to very unlikely).

For areas with Schedule 1 creeks where depth is less than 200 m, it is expected that the discontinuous sub-surface fracture heights could interact with cracking or open joints on the surface. Surface waters in these areas could therefore drain into deeper cracks resulting in a drop in the ground water table initially.

Over time, the water table would be expected to recover either partially or fully as the new voids or storage spaces became saturated or in-filled with sediment.

v. Potential Scarp Development above Shallow Areas

Scarps refer to small steps in the surface that are the result of sub-vertical shear failure above the limits of total extraction and solid or partial extraction panel boundaries.

Where cover depths are less than 80 metres, which is only in the northern section of the proposed mine near John Renshaw Drive, scarp development can be managed by leaving partial extraction zones between panel edges and total extracted areas or repaired by filling cracks with self cementing materials and replacing the topsoil.

vi. "Upsidence" and Valley Bending Effects

Upsidence refers to upward buckling-type movements along creek beds that have been subsided. It is associated with a combination of mining-induced curvature or 'bending' of the surface and medium to thinly bedded sandstone with high 'locked' in horizontal stresses in the floor of a valley or man-made cutting.

Buckling of the valley floor strata following total extraction mining is considered a possibility along several of the creeks and tributaries in the Abel Underground Mine area. The magnitude of the movement will depend on a number of factors, including horizontal stress increases due to bending deformations caused by mine subsidence and whether there are relatively stiff sandstone beds immediately below the valley or creek beds.

Schedule 2 creeks on the Abel Underground Mine site are not expected to be impacted by valley closure or uplift movements due to mining effects. However, Schedule 1 creeks could be impacted by buckling or uplift of up to 206 mm, although it is considered very unlikely that this magnitude of movement will be reached.

6.2.7 Subsidence Impact Assessment

The potential subsidence impact on each identified item (Table 3) has been predicted and is discussed in Section 8 of Appendix E. For each item, predicted impacts, proposed mitigation measures and a monitoring and management strategy have been determined. These mitigation measures and monitoring and management strategies provide sufficient information to demonstrate that the predicted subsidence impact is at an acceptable level and is not significant or that any such damage can be managed or repaired so as to ensure that the impact is not significant. Further detailed investigation on individual items, in particular houses and other structures, will be undertaken as part of the SMP process prior to the commencement of mining.

A summary of the predicted impact, proposed monitoring and management and mitigation strategies for identified surface and subsurface items is provided as follows.

i. Watercourses – Schedule 2 Creeks

Schedule 2 creeks in the Abel Underground Mine area are very unlikely to be impacted by surface cracking or ponding due to the proposed long-term stable barrier pillars that will be left beneath them.

Schedule 2 streams (as defined by DIPNR 2005) will be managed in accordance with the DIPNR guidelines. A minimum barrier of 40 metres between the 20 millimetre line of subsidence and the bank of any Schedule 2 streams will be maintained and further studies will be undertaken, with the development of a Surface Water Subsidence Management Plan that clearly demonstrates that the above commitments can be met prior to any mining occurring which will impact on any Schedule 2 streams.

It is considered very unlikely that the catchment drainage paths will be altered.

ii. Water Courses - Schedule 1 Creeks

The Schedule 1 creeks above total extraction panels will most likely be subsided between 0.4 m and 1.6 m, depending on cover depth and mining height. This subsidence will generate 1 to 2% gradient changes along the creek beds.

Potential ponding depths of between 0.1 to 0.5 metres have been predicted for sections of these creeks above the centre of each panel. The maximum ponded volumes for these cases are generally estimated to range between 2.5 to 118 m^3. Significant ponding depths ranging between 0.4 and 1.0 m have been assessed for one of the Viney Creek and Four-mile Creek tributaries above the shallower panels in the north of the underground mining area. Actual ponding depths will also be affected by surface water percolation rates, lithology and the extent of surface cracking.

Surface crack widths between 25 mm and 240 mm (depending on the cover depth), could develop above peak tensile and compressive strain zones. Cracks occurring within the Schedule 1 drainage gullies or creek beds are only likely to impact sections where sandstone outcrops exist and could result in sub-surface re-routing of surface flows. The impacts may be self-healing as sediment accumulates over time in the cracks. It may however, be necessary to mitigate subsequent erosion impacts with grouting.

Where gully sediment deposits exist along the creeks, cracking is unlikely to impact significantly on water flows due to the self-sealing capability of sandy beds after cracks develop by on-going natural geomorphic processes.

iii. Flood Level Impacts

The 1 in 100 year Average Recurrence Interval (ARI) flood level, at the point where Blue Gum Creek enters Pambalong Nature Reserve, is 3.52 m AHD. This level represents flooding from the Hunter River only and does not represent localised flooding (i.e. from Blue Gum Creek catchment).

Based on reference to the predicted post-mining surface topography shown for the south east area, all buildings (black squares/rectangles) and proposed mining blocks are located outside or above this 1 in 100 year ARI flood level contour.

iv. Sub-Surface Aquifers

A detailed Groundwater Study (refer Section 6.3.1) has assessed the potential impact of subsidence on groundwaters (sub-surface aquifers).

The Sandgate Seam is considered to be a significant sub-surface aquifer in the overburden above the Upper and Lower Donaldson Seams. Based on the estimated height of direct hydraulic connection above the proposed workings it is considered very unlikely that the Sandgate Seam, which is approximately 160 m above the proposed workings, will be permanently impacted after mining.

The Sandgate Seam may experience depressurisation in the short term. Groundwater level recovery rates are discussed in Section 6.3.1.

v. Cliff Lines and Ridges

Cliffs have been identified along Long Gully and also within Black Hill Quarry cuttings. A cliff stability assessment has been undertaken with results indicating that cliff lines and quarry batter slopes, if subjected to the maximum predicted subsidence deformations, are likely to be impacted by an increased proportion of rock falls and superficial cracking of rock faces with widely spaced jointing. Less than 45% of the cliff lines expected to be affected by increased rock fall activity.

Most clifflines are associated with the Schedule 2 Long Gully creekline buffer and will therefore not be subjected to the subsidence impacts described above.

Rock fall management plans will be prepared for cliff lines within the Abel Underground Mine area. Appropriate rock fall hazard controls may include such items as rock fall catch ditches, barrier fencing, earth mounds and warning signs installed at appropriate locations to promote awareness that a rock fall hazards may exist.

General cliff line instability or large scale collapses of the cliff faces are not expected to occur. For cliff lines located outside of extraction limits, or where predicted strains are less than 2 mm/m, no significant damage is expected due to mining.

vi. Sensitive Ecosystems (i.e. Cool Temperate Rainforests)

Rainforest areas on the Abel Underground Mine site are closely linked with the foot slopes and gullies beneath the main clifflines at Long Gully. Subsidence in the rainforest protection zones will be limited to 20 mm of subsidence at the edge of the zone identified, unless further studies can demonstrate that there will be no significant impact on the rainforest communities within the buffer zone with greater subsidence and the mine plan can then be modified to control subsidence impacts to within the revised limits.

Cracking and ponding are unlikely to occur due to the predicted subsidence parameters and therefore the impact of these movements is expected to be low. A minor amount of rock fall damage could occur along the bases of cliff lines.

vii. Residential Buildings

Principal residences (ie the main residential building on a property) within the proposed mining area will be protected by ensuring that they are not subjected to any subsidence impact greater than which they can withstand without repair works being required. They will be protected by leaving barriers or long-term stable pillars beneath the residential structures with an appropriate angle of draw.

Residential structures can be damaged by mine subsidence from the following damage mechanisms:

- *Subsidence*: Vertical subsidence by itself does not damage a structure unless there is significant differential subsidence (ie tilt, strain and curvature) associated with it.
- *Tilt*: Tilts greater than 4 mm/m can cause damage such as sticking doors and windows, drainage patterns altered in storm water drains etc., which can be repaired/rectified up to tilts of 7 mm/m. Tilt greater than 7 mm/m generally affects the serviceability of a building, which would require re-levelling of the entire structure.
- *Curvature:* Curvature refers to 'bending' in either 'hog' or 'sag' and generally results in internal and external cracking to walls, ceilings and footings. The degree of damage for a given curvature is strongly dependent on length and height of structure and construction type (i.e. masonry or weatherboard). In general, curvature greater than 0.33 km^{-1} (radius of 3 km) can cause significant cracking to masonry walls and internal linings of timber-clad houses. Acceptable curvatures for a given structure can be estimated using the MSB Graduated Index Guidelines.
- *Strain*: Tensile or compressive strain results from hogging or sagging curvature respectively and differential horizontal displacements caused by mine subsidence. Significant damage can occur, as described for curvature, when strains exceed 2 mm/m generally, but depends upon the degree of strain transfer between the foundations and the structure.

The Abel Mine Subsidence Management Plan (SMP) will be designed so as to ensure that the impacts as described above only occur at levels that result in the Principal residence being protected before, during and after mining.

Other structures, such as equipment sheds, driveways, swimming pools, on-site effluent disposal systems, fences and in ground services will experience impacts from subsidence. There is a long history in NSW of managing such impacts through various mitigation and remediation measures that ensure that the structures remain safe and serviceable. The Mine Subsidence Board (MSB) is the government agency responsible for ensuring that this occurs and compensating landowners as required by the *Mine Subsidence Compensation Act 1961*.

In addition to this, the *Mining Act 1992* obligates Donaldson Coal to provide compensation for 'compensable loss' experienced by landowners from mining. 'Compensable loss' is defined in the *Mining Act 1992* as:

'loss caused, or likely to be caused, by:

(a) damage to the surface of land, to crops, trees, grasses or other vegetation (including fruit and vegetables) or to buildings, structures or works, being damage which has been caused by or which may arise from prospecting or mining operations, or
(b) deprivation of the possession or of the use of the surface of land or any part of the surface, or
(c) severance of land from other land of the landholder, or
(d) surface rights of way and easements, or
(e) destruction or loss of, or injury to, disturbance of or interference with, stock, or
(f) damage consequential on any matter referred to in paragraph (a)–(e),

but does not include loss that is compensable under the Mine Subsidence Compensation Act 1961 .

In the event of unforeseen damage occurring to a Principal residence or to other listed items on the land, the owner would be compensated in accordance with the above legislative requirements.

The Company commits to producing and implementing a plan of management for each Principal Residence existing at the date of approval of this project. A Principal Residence is defined as an existing building capable of being occupied as a separate domicile and used for such purpose. The plan of management will be produced and implemented as follows:

- Each Principal Residence will be individually assessed by the Mines Subsidence Board /structural engineer who will determine tolerable levels for individual subsidence parameters. Tolerable limits are those limits which will result in no mitigation works being required to the Principal Residence due to subsidence impacts from the Abel Underground Mine.
- Each Principal Residence will have a pre-mining survey to identify and record pre-existing imperfections that will not be covered by the Mines Subsidence Board.
- Such assessments will be done as and when the progression of the mining process dictates – i.e. mining may have commenced in other areas prior to the individual Principal Residence assessment being undertaken.
- Tolerable levels will be set according to such factors as dwelling construction (e.g. brick veneer, clad), type (single, double storey), size (length and width), footings (slab, strip footings, piers), surface conditions (sand, rock, clay, steep slope) etc, with reference to the MSB Graduated Guidelines (compatible with AS 2870 and the Building Code of Australia).
- The mine plan in proximity to each Principal Residence will be modified by the Company to maintain subsidence parameters within the tolerable levels determined above for each Principal Residence.
- The mine plan will be reviewed by the MSB and the DPI prior to any Subsidence Management Plan being approved under the relevant lease.

- Each Principal Residence will have a specific subsidence monitoring plan to monitor subsidence impacts before and after mining at the Principal Residence and to ensure that tolerable limits are achieved in practice.
- The Mines Subsidence Board has the responsibility to rectify any impacts to structures that may occur as a result of mining.

In cases where the owner of the Principal Residence and the Company can agree to terms which permit second workings under the Principal Residence greater than those permitted above, the Company agrees to negotiate a plan of management similar to that proposed in the section of this Statement of Commitments titled "All Other Surface Structures"..

New residences will be required to be built in accordance with the *Mine Subsidence Compensation Act 1961.*

As part of the SMP process, trigger-action response plans (TARPs) will be developed by Donaldson Coal for each Principal residence. These TARPs will be based on consultation with the owners to ensure that the Principal residence is protected and that other service infrastructure remains in a safe and serviceable condition during and after the impacts of mining.

The above methodology will involve pillar 'test' monitoring and field checks to confirm accuracy. It is considered that the modelling of overburden is conservative at this stage and further calibration of the model will be required when monitoring data above total extraction panels becomes available, prior to implementation of the model outcomes, to modify mine layouts beneath actual houses. This model calibration will occur in the north-east corner of the mine plan prior to any Principal residences being undermined.

Test monitoring survey lines will be established above a simulated site where a barrier pillar will be left within a total extraction panel that was already affected by a geological structure (so as to minimise the amount of test site coal that would be sterilised). The proposed survey lines would extend across and along the centre of the simulated house and measurements taken until full subsidence had developed.

viii. Black Hill Public School and Black Hill Church

Black Hill Public School and the church adjacent to the school will be dealt with in the same manner as a Principal Residence. The subsidence protection measures and pre- and post-mining monitoring to be undertaken for Principal residences therefore apply to the school and church. These measures will also apply to the grounds of the school, including all school buildings, structures and play spaces and to the church building and cemetery.

The grounds of a small cemetery off Lings Road, no longer used but with evidence of previous burials, will also be protected using these measures.

ix. Disused Chicken Sheds and Catholic Diocese Owned Land

Approximately fifty disused chicken sheds on the Catholic Diocese land are planned to be demolished and the land re-developed in the future. Mining will most likely occur before re-development of the site.

The property is located in a relative shallow area of the mine, where the cover depths range between 60 and 130 metres.

Due to this shallow depth, predicted subsidence and associated deformation is likely to result in significant cracking. Maximum crack widths of between 80 mm and 220 mm could occur to depths of approximately 5 to 7 metres. It is therefore expected that cracking to the surface will need to be back-filled and the site reinstated to its pre-mining condition after mining has been completed beneath this site.

The predicted maximum tilts of 27 to 46 mm/m and curvatures of 1.13 to 3.33 km-1 would also cause significant damage to the existing buildings. In view of the potential environmental hazard and damage likely to occur to the structures, it is considered that they should be demolished and removed before mining impacts occur. This will be determined in consultation with the landowners during the detailed SMP process.

There is also the possibility of surface scarp or 'step' development above the northern limits of extraction, where cover depth is less than 80 metres, to heights of between 0.1 and 0.25 metres.

Trigger-action response plans (TARPs) will be developed by Donaldson Coal based on consultation with relevant stakeholders to ensure the general public and employees working on the property are not exposed to an unsafe environment caused by mine subsidence damage.

x. Land Used for Agriculture

Orchards on the site are located above some of the proposed extraction panels. Cover depth beneath the orchards to the Upper Donaldson Seam mining ranges between 140 and 220 metres. Based on predictions, maximum surface cracks 50 to 180 mm wide could occur and some of the trees could be split.

Livestock grazing is conducted over some of the northern and south-eastern properties above in the underground mining area. Based on the predictions it is estimated that surface cracking could occur with maximum crack widths of 70 to 200 mm wide estimated. Breaking of fencing wire and loss of fence integrity may also occur due to tensile strains of 7 to 20 mm/m.

The impact of mining on the grazing of livestock would primarily require the management and repair of surface cracking and fences. Ponding is not expected to affect grazing or pasture areas. Any damage to fences or irrigation systems that may occur will be repaired.

At this stage, it is considered that the surface of the study area has adequate cross fall to 'absorb' the subsidence without creating a 'pond'. Surface cracks above total extraction areas are expected to occur, and will probably require

repair and maintenance work to control long-term degradation of the land due to erosion of surface soil into the cracks.

Further assessment of the appropriate subsidence impact levels and amelioration techniques will be addressed during the SMP process. An appropriate management and monitoring plan will then be prepared which will respond to subsidence impacts. Repairs to cracks and established trees, fences and irrigation lines would be responded to in accordance with the SMP agreement.

xi. Earth Embankment Dams

A total of 175 water supply dams exist in the underground mining area, and are located above most of the proposed pillar panels. The cover depths to the proposed panels in the UD and LD Seams range between 80 and 210 metres where the dams are located.

Farm dams are susceptible to surface cracking and tilting from mine subsidence. The impact of subsidence above a total extraction panel could result in loss of storage capacity through drainage into the surface cracks or breaching of the dam wall itself. Tilting of dams may also effectively reduce storage by lowering of the dam wall crests relative to the storage area. Some of the dams with significant storages (i.e. > 10 ML), close to Black Hill Road and other public access roads could also present a potential flooding hazard.

Based on predicted ranges of subsidence, it is considered likely that a high proportion of the dams would be subject to cracking of the dam walls and storage areas that could lead to water loss. Maximum crack widths are estimated to range from 60 to 100 mm and extend to depths of 5 to 7 metres.

It should be noted that dams like the ones in the underground mining area have been undermined and damaged by longwalls elsewhere in NSW. The dams have then been reinstated in a timely manner by the MSB and an alternative supply of water has been provided by the mine during the repair period.

Damage from subsidence (i.e. cracking and tilting) can manifest quickly after undermining, however there is usually enough time (i.e. several hours or even days) to take corrective action and manage the impact when it occurs. It will also be possible to identify which dams are likely to be impacted based on their location above the mine panels and predicted subsidence profile during the preparation of the SMP.

A Dam Monitoring and Management Strategy (DMMS) will be formulated for all dams prior to any mining occurring which will impact on the dams. The DMMS will provide for:

- The individual inspection of each dam by a qualified engineer for:
  - current water storage level;
  - current water quality (EC and pH);
  - wall orientation relative to the potential cracking;
  - wall size (length, width and thickness);

  - construction method and soil / fill materials;
  - wall status (presence of rilling / piping / erosion / vegetation cover);
  - potential for safety risk to people or animals;
  - downstream receptors, such as minor or major streams, roads, tracks or other farm infrastructure; and
  - potential outwash effects.

- Photographs of each dam will be taken prior to and after undermining, when the majority of predicted subsidence has occurred.
- Dam water levels, pH and EC will be monitored prior to and after undermining to assess the baseline and post mining dam water level and water quality in order to determine whether rehabilitation is required.
- In the event that subsidence / crack development monitoring indicates a significant potential for dam wall failure, dam water will be managed in one of the following manners:
  - pumped to an adjacent dam to lower the water level to a manageable height that reduces the risk of dam wall failure,
  - discharged to a lower dam via existing channels if the water can not be transferred, or
  - not transferred if the dam water level is sufficiently low to pose a minor risk.
- An alternate water supply will be provided to the dam owner until the dam can be reinstated.
- In the event of subsidence damage to any dams the Company shall remediate the damage and reinstate the dam in conjunction with the Mine Subsidence Board.

xii. Transgrid 330kV Towers

The cover depth beneath the towers along the easement ranges from 60 to 220 metres. The towers would be subject to transverse and longitudinal subsidence deformations (relative to the pillar panels) if they were undermined by total extraction panels. For the purposes of this assessment, it has also been assumed that the transverse and longitudinal impact parameters would be similar in magnitude.

Based on the predicted subsidence parameter profiles for the proposed pillar panels, it is assessed that the majority of towers in the underground mining area will be subject to tilts and strains that would exceed the tolerable limits of the structures.

In areas where the cover depth is less than 80 m, there is potential for 'steps' or scarps of up to 0.25 metres high to develop. At least one tower is located in a potential scarp area.

Maximum horizontal displacements to the towers may be estimated by multiplying the predicted tilts by 5.2 to 7.3. These could therefore range between 40 and 340 mm, in the same direction as the tilt.

The 330 kV tower's main function is to support the conductors as either a suspension or tension tower (i.e. the towers are subject to significant uplift or lateral loading from the conductors and wind). The key impact parameters for assessing potential subsidence impacts are tilt and strain, with tolerable impact levels, which are usually different for each tower, depending on a tower's function and dimensions. The tolerance of each tower to mining-induced tilt and strain will therefore need to be assessed by Transgrid Engineers, prior to undermining the towers.

Tolerable strain limits are usually the primary impact parameter and could range from 0.5 to 2.5 mm/m. It is also considered likely that there are tension towers or corner towers along the easement that will require specific subsidence protection.

The maximum allowable tilt of the towers also depends on several factors, one of which is the potential for roller sheaves to be installed to minimise conductor loading. Another issue is the likelihood for sudden, unmanageable tower movements due to scarp development. Normal subsidence or tilt development rates can be responded to in a timely manner if considered necessary, to ensure the towers and conductors remain in a safe and serviceable condition.

It is considered likely that tower strain protection devices will need to be installed (such as cruciform footings) above proposed production panels, before the impact of mining. Cruciform footings may also be required within 20 m of goaf edges, if the potential for strain concentration or cracking is considered a threat to the tower.

Suspension tower conductor support can usually be replaced with roller sheaves, which enables the tower to be tilted by up to 50 to 70 mm/m before further intervention work is required. This issue will be discussed with the relevant stakeholders in the process of developing an appropriate tower SMP.

Other strain-relieving techniques for minimising strains on the towers, such as installing deep slots or trenches to at least the depth of the tower footings may be available in the future, depending in part on the outcome of a current ACARP project to test the reliability of trenches to reduce strain around sensitive surface features.

Trigger-action response plans (TARPs) will be developed by Donaldson Coal in consultation with Transgrid to ensure the transmission lines and easement remains in a safe and serviceable condition during and after the impacts of mining.

Transgrid will advise Donaldson Coal of its requirements to control the long term stability of the towers and define which towers can be managed with conductor control and cruciform footings and which towers require subsidence control measures to be implemented by Donaldson Coal.

A monitoring program for providing relevant subsidence data around the towers during mining will be implemented. Agreed trigger values for the measured subsidence and strains will be determined to allow adequate response time for Transgrid maintenance crews if anomalous or unexpected subsidence behaviour occurs.

xiii. Energy Australia Powerlines

Subsidence impact parameter predictions have been made for the 132 kV electricity transmission line easement. The easement is aligned transversely across several production panels and will be subject to subsidence ranging between 0.1 and 1.1 metres.

A 66kV and numerous other domestic supply power lines are also located on the site and will be subject to similar subsidence deformations.

Horizontal displacements of 132 kV line support poles above the total extraction panels could range between 40 and 480 mm.

The maximum possible net increase or decrease in conductor length between adjacent power pole pairs, assuming that the poles are tilting towards or away from each other (and allowing for ground movements) could be up to 1.0 metres for 15 metre high power poles.

The impact of subsidence at the power poles will depend on the location of the poles and existing tolerances to differential movements above the proposed pillar panels. The key impact parameters that will need to be assessed in the SMP will be:

- tilt and tilt direction of each power pole,
- horizontal displacement and direction of movement of the power poles, and
- minimum clearance distances between the conductors and the ground after mining.

Energy Australia engineers generally consider that the top of the poles may displace up to 2 diameters horizontally before intervention or mitigation works are considered necessary. Based on a 15 metre high power pole that has a diameter of 250 mm, the maximum tolerable tilt at a power pole is in the order of 33 mm/m. Poles located in a tensile strain zones where strains exceed 5 mm/m may need to be relocated before mining.

Assuming a worst case scenario between power pole pairs located directly above the middle of two adjacent panels, the maximum possible conductor sag increase between the 12 to 15 m high poles could be up to 1.0 m after mining.

Impact management strategies would include mitigation works such as installing conductor support sheaves to allow cable tension adjustment and installation of additional poles with guy wires while repairs or relocation of existing poles are being carried out.

Trigger-action response plans (TARPs) will be developed by Donaldson Coal in consultation with relevant stakeholders to ensure the powerline network and easement remains in a safe and serviceable condition during and after the impacts of mining.

As part of the SMP, individual power pole locations will be determined and a monitoring program will be developed to measure displacement and conduct visual inspections of power poles that are located in potential impact zones.

xiv. Hunter Water Pipelines

No impact is expected along the above ground pipeline that is adjacent to John Renshaw Drive as it is located outside of a 26.5^{o} angle of draw of the proposed mining area. However, cumulative far-field horizontal displacements of up to 50 mm along a 1.3 km section of pipeline could develop due to mining.

The below-ground pipeline traverses several pillar extraction panels. The cover depth to the proposed workings along the existing route of the pipeline ranges between 60 and 220 metres and the pipeline may require mitigation works to be implemented before, during and after mining to maintain or restore it to its pre-mining shape. Maximum subsidence of 1.3 m and strain (tensile and compressive) of 12 mm/m along the pipeline are predicted.

For the majority of past cases in NSW, it has not been required to control subsidence along a buried or above ground pipeline as there are various mitigation techniques that can be applied during mining to manage the stresses induced in the pipelines due to subsidence deformations. For example, if strain magnitudes in excess of tolerable limits need to be relieved in the pipeline, this can be done by exposing the pipeline and then lifting and supporting the pipeline with sandbags, to reduce hoop and axial stress in the pipe walls back to pre-mining levels.

However, the potential for significant damage occurring during the above mitigation process is higher for older style pipelines with relatively brittle construction joints and pipe materials. It is understood that Hunter Water is in the process of replacing the existing pipeline and consultation with Hunter Water on the timing and magnitude of subsidence impact will be critical for the preparation of the SMP.

Trigger-action response plans (TARPs) will be developed by Donaldson Coal based on consultation with Hunter Water and DPI to ensure the pipelines remain in a safe and serviceable condition during and after the impacts of mining.

xv. Buried Fibre Optic Cable Easements

The Optus fibre optic cable (FOC) easement has mining cover depths ranging from 80 to 300 metres. The Telstra FOC easement is located in an easement that has mining cover depths ranging from 60 to 120 m. Potential subsidence for total extraction panels is provided in Appendix E.

The tolerance of the Optus and Telstra underground cable networks to subsidence movements is presently unknown and further details of impact management strategies will need to be discussed with the individual stakeholders as part of the detailed SMP process.

Based on predictions, it is considered that the Optus Telstra FOCs are likely to be subject to tensile strains exceeding 4 mm/m above total extraction panels, and mitigation or amelioration works may need to be considered.

One method of mitigating against mine subsidence is to temporarily remove the cables from the trenches and place them in significantly larger diameter PVC conduit before placing the cable back in the trench. The conduit will then prevent direct transfer of ground strain into the cables during undermining.

Trigger-action response plans (TARPs) will be developed by Donaldson Coal based on consultation with Optus, Telstra and the DPI to ensure the FOCs are maintained in a serviceable condition during and after the impacts of mining.

xvi. Buried Communications Lines

Telstra standard (i.e. copper wire) communications lines are located in trenches above proposed workings with depths of cover ranging from 120 to 220 metres. Based on subsidence predictions in Appendix E, repair and/or mitigation works could be required during mining to mitigate subsidence deformations on a panel by panel basis.

xvii. Roads and Drainage

John Renshaw Drive is considered to be outside of the limits of subsidence. However, monitoring of the road for vertical and far-field horizontal displacements will be undertaken by Donaldson.

Black Hill Road is located 70 to 190 metres above the proposed Upper Donaldson Seam panels. Dog Hole and Stockrington Roads in the south-east are located 180 to 200 metres above the Lower Donaldson Seam.

Proposed total extraction mining on Black Hill Road, Brown's Road, Taylor's Road and minor access roads could lead to cracking and buckling or shear failures. Damage to kerb and guttering and drainage structures beneath and adjacent to the road may also occur. Loss or increase of super elevation of roads on bends affected by tilt in excess of 20 mm/m should also be considered during consultation with the councils. Similar impacts are assessed for Dog Hole and Stockrington Roads in the south east of the mining area although the extent of impact will probably only affect 50% of these roads.

The roads in the underground mining area are flexible, granular pavements, which are amenable to repair if damaged by subsidence. Cracking, shearing and uplift of the pavement seal, as well as concrete kerbing and drainage structures, would be expected to occur in zones affected by tensile and compressive strains that exceed 2 or 3 mm/m.

Black Hill Road could be affected after mining by shallow ponding where the road crosses Four Mile Creek and Viney Creek. None of the other roads are likely to be impacted by ponding, based on the post-mining surface topography. Ponding may also have a long term impact on the strength of the pavement sub-grade and will need to be assessed further during the SMP stage.

Associated drainage structures, such as kerb and guttering, concrete lined v-drains, reinforced concrete culverts or table drains, could also be damaged by tensile and compressive strains that exceed 1 to 2 mm/m along the roads. Inspection of these features and implementation of repair works after mining impacts have occurred will be included in the SMP with the associated Council.

TARPs will be developed by Donaldson Coal based on consultation with Cessnock and/or Newcastle Councils and the DPI, to ensure roads and associated infrastructure remains in a safe and serviceable condition during and after the impacts of mining. A monitoring program will be developed to measure subsidence and strains along sections of road that will be affected, and road repair crews placed on 24-hour stand by when the section has been undermined and subsidence development or visual inspection responses have been triggered.

Damage from subsidence (i.e. cracking and tilting) can manifest quickly after undermining, however there is generally time (i.e. several hours or even days) to take corrective action and manage the impact when it occurs.

xviii. Black Hill and Stockrington Quarries

Cover depth above the proposed workings beneath the Black Hill Quarry ranges between 250 and 270 metres. Impacts may include maximum crack widths of 30 to 50 mm up to 7 metres depth (or possibly more) through the batters and haul roads. A slope stability impact assessment of the Black Hill Quarry batters indicates a high level of impact.

Although the overall function of the quarry and site infrastructure may not be impacted significantly, some post mining remedial/repair works may be required. Repairs may range from simple earthworks to batter slope stabilisation through rock bolts and meshing of the faces.

The likely areas of subsidence impact will be on the batter slopes, haulage roads and quarry buildings.

A subsidence impact and hazard assessment will be undertaken before underground mining occurs in this area. The quarry may have ceased to operate by this time and the issue of subsidence impacts in relation to alternative land use activities or rehabilitation works on the site will need to be addressed.

A similar assessment is likely for Stockrington Quarry in the south western corner of the site.

TARP's will be developed in consultation with the owners and the DPI to ensure the quarry and associated infrastructure remain in a safe and serviceable condition during and after the impacts of mining. A monitoring program for the

quarry site to measure subsidence and strains along crests of batter slopes and repairs made to cracking will be implemented.

xix. Agility Natural Gas Pipeline

The cover depth along the existing route of the buried gas pipeline in the southern eastern corner of the site ranges between 60 and 170 metres. Maximum subsidence of 1.3 m and strain (tensile and compressive) of 12 mm/m along the pipeline are predicted.

The pipeline will probably require mitigation works and possibly subsidence control measures to be implemented before, during and after mining to maintain and restore it to its pre-mining shape.

There are various mitigation techniques that can be applied during mining to manage the stresses induced in the pipelines due to subsidence deformations.

Management strategies will include monitoring of the pipeline during mining at a reasonable frequency and if the trigger level is exceeded, exposing the pipeline by removing trench backfill to reduce strain transfer from the moving ground. If necessary, the deflected pipeline may then also be lifted and supported using sand bagging techniques.

xx. Aboriginal Heritage Sites

Archaeological sites in the Abel underground area could be subject to the subsidence deformations after total extraction of the proposed mining layout. Based on the predicted worst case values, it is preliminarily assessed that the Reynolds rock and Abel 1 grinding grooves are unlikely (i.e. a 5% probability) to be cracked by the predicted tensile strains of <0.1 mm/m. It is possible (i.e. a 10 - 50% probability) that the Abel 2 grinding groove site could be cracked by a strain of 0.5 mm/m. A maximum crack width of 3 to 5 mm is predicted for the site at this location.

Splitting of the scarred tree is also a possibility, with maximum strain of 4 mm/m predicted at the tree location. It is possible that a crack width of 40 mm could occur beneath the tree resulting in the development of a split.

Preventative strain relief measures, such as installing saw cuts or trenches around the sites may be considered in consultation with relevant stakeholders.

Potential impacts on archaeological sites is assessed by the Aboriginal Heritage Assessment provided in Section 6.9.

xxi. European Heritage Sites

The disused section of the Richmond Vale Railway Line runs sub-parallel with Blue Gum Creek and the majority of the railway appears to be located above the proposed surface protection barrier for the creek. Predicted subsidence along the route is estimated to be <0.1 m with tilts < 3 mm/m and strains < 1 mm/m. It is therefore assessed that damage to the railway line is likely to be negligible.

xxii. State Survey Marks

The majority of the state survey marks in the underground area will be subject to subsidence of up to 1.0 metre and horizontal displacements of up to 200 mm if undermined by total extraction panels. Further predictions will be provided in the SMP report when the mine plan is finalised with the DPI.

Damaged survey marks will be re-instated by Donaldson Coal as required. Monitoring of level and horizontal displacement of the survey marks before and after mining effects would provide a useful database of 3-D subsidence impacts across the area.

6.2.8 Proposed Surface and Sub-Surface Monitoring Program

i. Surface Monitoring Program

Given the proposed subsidence control methodology for the Abel Mine, and the surface topography and surface infrastructure above the proposed pillar panels, a subsidence and strain monitoring program will be implemented to review the predictions and angle of draw to significant impact parameters, and to provide adequate information to calibrate LAMODEL and refining the subsidence prediction.

Trialling of proposed strain-relieving techniques, such as saw cuts in rock outcrops and trenches that could be used around archaeological sites, may also be carried out in non-sensitive areas.

Opportunities also exist to test the shallow areas for scarp development above total extraction panels and trial protection pillar designs for both flat and steeply sloping sites.

ii. Sub-Surface Monitoring Program

It is expected that Donaldson Coal will initially be required to measure the maximum height of continuous (i.e. the A Horizon) and discontinuous fracturing (i.e. the B Horizon) above the sections of panels that are located at least 3 cover depths away from the Schedule 2 Creeks and where the cover depth ranges between 60 and 100 m. The data will allow a comparison/validation of measured values with the conceptual model outcomes of expected surface and groundwater level impacts and empirical model predictions.

It is considered that any proposed monitoring and testing program would probably only be required for the first few panels, should measurements confirm the predicted values. The potential interaction with the overlying Sandgate Seam would also be required to be assessed.

Other management tools, such as groundwater monitoring wells and underground pumping records will provide information for assessing impacts on groundwater of subsequent pillar panels. These monitoring programs are described in the relevant sections of this report.

6.2.9 Conclusion

A preliminary assessment of the tolerable subsidence limits for the natural surface features indicates that the impacts can be managed by the strategies described in this section. These strategies will be implemented via the preparation of the Subsidence Management Plans.

With the implementation of the protection and management strategies described above it is expected that 'safe and serviceable' tolerance limits for the man made surface features will be met.

Levels of impact to all significant natural features and items of infrastructure are manageable and can be controlled by the preparation and implementation of Subsidence Management Plans.

6.3 Surface Water and Soils

6.3.1 Overview

The assessment of potential impact on surface waters from the proposed Abel Underground Mine includes consideration of catchments, watercourses and any wetland areas above the underground mining area. Potential impact includes physical alteration to these items as well as changes to water quality. Through adoption of the relevant guidelines and performance criteria, this assessment has concluded that potential impacts on watercourses associated with underground mining will be eliminated or adequately controlled so as to ensure that there is no significant impact on the environment. In particular, there will be negligible change to the overall catchment topography and negligible surface disturbance within the underground mine area.

Subsidence impacts on Schedule 1 streams are assessed to be within acceptable levels, and ongoing monitoring will ensure that impacts are identified so that they can be remediated as soon as practicable to prevent any potential downstream impacts. Studies have concluded that there will be no significant impact from subsidence on Schedule 2 Streams and any impacts on features such as Blue Gum Creek and Pambalong Nature Reserve will not be significant.

A description of the water management system for the surface infrastructure area, including use or removal of water in association with the underground workings and the use of water by the Bloomfield Coal Handling and Preparation Plant and rail loading facility is provided in Section 2.10.

Soils of the Abel Underground Mine site were described in the Project Application lodged for the Project in December 2005. Soil impacts are only considered to be potentially associated with changes to the landform due to subsidence, or disturbance for surface infrastructure construction. Management of potential soil erosion due to subsidence and surface disturbance is addressed in Section 8.13. Soil management associated with the construction

of surface facilities will follow existing Donaldson Coal soil management protocols as part of their Environmental Management System.

6.3.2 Objectives and Performance Criteria – Watercourses

Minimisation of watercourse impact within the underground mine area was a key element in the selection of the mining design and method. The guidelines *Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region* (DIPNR Version 1, April 2005,) have been used to provide direction on identifying the significance of watercourses, appropriate mining methods to prevent impact to watercourses and suitable methods for monitoring and management of the identified watercourses.

The categorisation of watercourses into Schedule 1, 2 or 3 Streams and differing performance criteria relative to the Stream Schedule, as provided by the Guidelines, have been applied to this proposal. These watercourse categories are:

- *Schedule 1 Streams* are first and second order watercourses and are usually intermittent. They are categorised as the least significant streams and performance criteria are based on providing stable stream lengths with minimal incision or erosion;
- *Schedule 2 Streams* are primarily third and higher order streams, which drain into primary catchment river systems. The performance criteria is based on having minimal adverse impact on stream stability or water quality, including the application of buffers; and
- *Schedule 3 Streams* are major rivers and connected alluvial groundwaters. They are the most significant schedule and performance criteria is based on a precautionary approach to provide zero mining induced ground movements or fracturing, including the application of buffers. No Schedule 3 streams are located above the underground mine area.

For Schedule 2 Streams (i.e. Blue Gum, Long Gully, Viney and Buttai Creeks), the primary outcome required by the Guideline (DIPNR, 2005) is that '*geomorphic integrity of the stream will be* maintained*, the ecosystem habitat values of the stream will be protected and no significant alteration of the water quality will occur in the stream.'* In relation to Schedule 2 Streams, the guideline also states:

> *'Barrier Zones*
>
> *The range of stream systems which fall under Schedule 2 streams of this guideline is large. In certain cases, underground mining operations should provide a minimum barrier between the 20 millimetre of subsidence and the bank of Schedule 2 streams. Open cut operations should provide a barrier of 150 metres between an agreed point on the highwall and Schedule 2 stream system. The imposition of a barrier will be considered where inadequate pre-mining assessment or highly significant risk of long term damage are identified*.'

The guideline also states that it is expected the mining industry *'develop and utilise innovative mechanisms to protect surface and groundwater resources and the geomorphic framework in which they exist'.*

Any watercourse remedial work required will be designed and undertaken in accordance with the *Rehabilitation Manual for Australian Streams* (Land and Water Resources Research and Development Corporation, 2000).

Water quality impacts have been assessed for aquatic ecosystems in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000). Select reaches of Long Gully, Blue Gum Creek and Pambalong Nature Reserve are considered to be *high conservation/ecological value* as described in the ANZECC Guidelines. The water quality objective for ecosystems of high conservation/ecological value is to ensure that there is *'no detectable change (beyond natural variability) in the levels of the physical and chemical stressors'* except *'where there is considerable biological assessment data showing that such changes will not affect biological diversity in the system'*. The remaining watercourses within the underground mine area are considered to be *Slightly to moderately disturbed ecosystems* as described in the ANZECC Guidelines, and a less conservative approach can be adopted for water quality criteria based on a low risk of impact to the ecosystems, however, maintenance of biodiversity is to remain a management goal.

The predicted impacts on the Pambalong Nature Reserve have been assessed against the desired outcomes of the Draft Plan of Management for Pambalong Nature Reserve (DEC, 2004). The most relevant desired outcomes from the plan are those for soil and water conservation, which are:

- '*There is no evidence of increased sediment loads into the reserve from soil erosion in the upper catchment.*
- *There is no reduction in the water quality and health of watercourses in the reserve.*

- *Natural flow regimes are maintained where possible and there is an increased knowledge and understanding of hydrological processes affecting the site.'*

Any remedial actions required to control erosion within the watercourses will be undertaken in accordance with the guidelines contained in the *Managing Urban Stormwater: Soil & Construction* (Landcom, 2004) handbook.

The protection of watercourses is consistent with the principles of the NSW *State Rivers & Estuaries Policy* (NSW Water Resources Council, 1993) and in particular Pambalong Nature Reserve will be protected in accordance with the goals and principles of the NSW *Wetlands Management Policy* (DLWC, 1996) which is a component policy of the Rivers & Estuaries Policy. The most relevant principle of the Wetlands Management Policy is that '*Appropriate water regimes and water quality needed to maintain or restore the ecological sustainability of wetlands will be provided through the implementation of water management plans'*.

6.3.3 Existing Surface Water Environment

i. Surface Water Catchments and Watercourses

The Abel Underground Mine area is located within the lower section of the Hunter River catchment and consists of low undulating forested hills with patches of cleared land for rural/residential properties. A ridgeline associated with Black Hill runs east-west through the proposed underground mine area, with tributaries of Buttai Creek, Viney Creek, Weakleys Flat Creek and Four Mile Creek draining northwards from this ridgeline. Long Gully & Blue Gum Creek drain the southern side of the ridgeline eastwards towards Pambalong Nature Reserve. There are several distinct sub-catchment areas within the underground mine area. These are described as follows and shown on Figure 6.2.

The Weakleys Flat Creek (and Viney Creek) sub-catchment area drains northward into Woodberry Swamp prior to entering the Hunter River. The sub-catchment is approximately 935 hectares, which represents about 34 percent of the total underground mine area. A large portion of the sub-catchment area is cleared land that previously supported chicken production. The watercourses in this sub-catchment area are ephemeral.

The Buttai Creek sub-catchment area drains north/westward into Wallis Creek prior to entering the Hunter River. The sub-catchment is approximately 425 hectares, which represents about 15 percent of the total underground mine area. The watercourses in this sub-catchment area are ephemeral.

The Four Mile Creek sub-catchment area drains northward into more significant reaches of Four Mile Creek prior to entering the Hunter River. The sub-catchment is approximately 343 hectares, which represents about 12 percent of the total underground mine area. The watercourses in this area are ephemeral and there are numerous farm dams of various sizes located on the watercourses.

The Minmi Creek sub-catchment drains eastward into the Hexham Swamp prior to entering the Hunter River. The sub-catchment is approximately 47 hectares, which represents about 2 percent of the total underground mine area. The area contains one unnamed ephemeral tributary of Minmi Creek.

The Blue Gum Creek (and Long Gully) sub-catchment area drains eastward into the Pambalong Nature Reserve and Hexham Swamp prior to entering the Hunter River. The sub-catchment is approximately 992 hectares, which represents about 36 percent of the total underground mine area. The watercourses in this area are generally ephemeral, however Blue Gum Creek would be expected to have at least a small base flow for the majority of the year, including some minor seepage from the near surface alluvium. Blue Gum Creek has ponded areas that would be expected to remain wet, even in very dry conditions. Blue Gum Creek has a significant catchment area upstream of the underground mine area, with the catchment extending to the slopes of Mount Sugarloaf to the west. The total catchment area of Blue Gum Creek (including off-site areas) is approximately 2,080 hectares.

Pambalong Nature Reserve is located immediately downstream of the underground mine area and is largely dependant on freshwater flows from Blue Gum Creek. Pambalong Nature Reserve is a freshwater wetland consisting of a series of small swamps. It is at the western edge of a chain of wetland reserves, including Hexham Nature Reserve and Kooragang Nature Reserve, that form the Hunter Estuary wetlands. A Draft Plan of Management for Pambalong Nature Reserve was produced by DEC (NPWS) in June 2004.

ii. Surface Water Quality

Surface water quality data has been collected from the main watercourses in each of the sub-catchment areas identified within the underground mine area, except in the Buttai Creek sub-catchment where samples could not be collected due to a lack of flow during sampling.

Donaldson conducts a regular surface water monitoring program of the three main creeks (Scotch Dairy Creek, Weakley's Flat Creek and Four Mile Creek) that traverse the existing Donaldson Mine property. These creeks are sampled above and below the existing open cut mine site on a monthly basis for a suite of parameters. A baseline survey of these creeks was undertaken in 1997 and routine monitoring has been undertaken since June 2000.

The location of the water quality sampling is shown on Figure 6.3.

Analytes measured in the laboratory include pH, Electrical Conductivity (EC), Total Dissolved Solids, Total Suspended Solids (TSS), Chloride, Sulfates, Alkalinity (Bicarbonate), Alkalinity (Carbonate), Calcium, Magnesium, Sodium and Potassium. Data for the main watercourses within the Abel underground mine area is presented in Table 4 for selected analytes. This data has been sourced from sampling undertaken as part of the Abel Project and routine sampling undertaken by Donaldson Mine.

Table 4 Background Surface Water Quality Data

Sample Site	Date	PH	EC uS/cm	Total Suspended Solids Mg/L
Weakley's Flat Creek (EM6)	Min	4.0	145	1
	Avg (2000 to 2005)	7.0	630	17
	Max	8.3	3,480	252
Four Mile Creek (EM1)	Min	4.8	85	1
	Avg (2000 to 2005)	7.0	388	34
	Max	7.9	895	269
Viney Creek	4/4/2006	6.7	355	13
Buttai Creek*	TBA	-	-	-
Long Gully*	TBA	-	-	-
Blue Gum Creek (U/S)	4/4/2006	6.9	275	266
Blue Gum Creek (D/S)	4/4/2006	6.9	860	20
Default Trigger Levels**	ANZECC 2001	6.5-8.0	125-2200	6-50 (NTU)

* Samples could not be taken as there was no flow in the watercourse

** Default Trigger values taken from ANZECC Chapter 3 – Aquatic Ecosystems, and used here as a guide to typical water quality, not as a strict limit.

Water quality data has been compared to the lower and upper limits of the default trigger values outlined for lowland rivers in south-east Australia (ANZECC 2000, Ch 3 – Aquatic Ecosystems). For Weakleys Flat Creek and Four Mile Creek substantial background data is available due to the long term monitoring undertaken by Donaldson. The average water quality data for these watercourses is within the range outlined by ANZECC, however, there is a wide range of variability in the water quality measured over time, including some exceedances of the upper limits outlined by ANZECC. For example, the maximum recorded values for pH, EC and TSS within Weakleys Flat Creek are all above the upper limits of the default trigger value range. The one-off water quality samples obtained for Viney Creek and Blue Gum Creek are within the range outlined by ANZECC, with the one exception being TSS measured for Blue Gum Creek Upstream which is well above the upper limits outlined by ANZECC. Water quality samples have not been collected from Long Gully and Buttai Creek as there were no flows in the watercourses at the time of sampling.

The generally good water quality is a reflection of the relatively undisturbed catchments, however, the variability in the data suggests that a longer term monitoring period will need to be implemented in order to more fully describe the background water quality.

The long term data collected by Donaldson and the data collected during the full suite analysis was also used to assess the source of the water within the watercourses. Based on the relative composition of the major ions the following interpretation has been made:

- The Blue Gum Creek Upstream sample appears to be predominantly surface runoff;

- The Blue Gum Creek Downstream and Viney Creek samples appear to be mostly surface runoff, but with some proportion of groundwater baseflow;
- The Weakleys Flat Creek has been sustained by groundwater baseflows over recent dry years; and
- The Four Mile Creek appears to be mostly surface runoff, but with some proportion of groundwater baseflow.

In all cases above, the groundwater is probably from the near surface zone (ie: alluvium/colluvium and/or weathered bed rock) and is not connected with deeper regional groundwater.

iii. Watercourse Characteristics

In early 2006 a watercourse survey was undertaken to collect typical data for the watercourses throughout the Abel Underground Mine area. Information was collected on the following characteristics:

- Bed material type (grain size/depth etc);
- Notable stream features (exposed rock, bed controls, etc);
- Channel geometry;
- Existing erosion;
- General vegetation communities; and
- Flow & Ponding conditions.

A summary of the observations made during the watercourse survey for each sub-catchment area is presented as follows.

a. Weakleys Flat Creek (and Viney Creek) sub-catchment

Weakleys Flat Creek and Viney Creek were observed to have bed and bank material predominantly consisting of soil and gravel, with occasional outcropping sandstone. The channel widths generally ranged from 1.5 to 3 metres wide, and the channel height ranged from 0.5 to 1.5 metres. There was no flow in the creeks during the survey, but small ponds were observed.

b. Buttai Creek sub-catchment

Buttai Creek was observed to have bed material ranging from sand, gravel, soil, boulders and mud, and the bank materials predominantly consisted of soil. The channel width generally ranges from 1 to 3 metres wide, and the channel height ranges from 1 to 2 metres. There was no flow in Buttai Creek during the survey, but ponds were observed.

c. Four Mile Creek sub-catchment

The watercourses within this sub-catchment area were observed to have channel bed and bank material that predominately consisted of soils, with

varying amounts of sand, gravel and boulders. The occasional sandstone outcrop was observed within the channel. The channel width generally ranges from 1 to 4 metres wide, and the channel height ranges from 0.3 m to 2 metres. There was no flow in the creek during the survey, but there were several ponds observed up to depth of approximately 0.4 m. The upper reaches of the watercourses have a high concentration of farm dams.

d. Blue Gum Creek (and Long Gully) sub-catchment

Blue Gum Creek was observed to generally have bed material of soft mud and discontinuous ponds and soil bank material. The majority of Blue Gum Creek is located within an alluvial soil deposit. The channel width generally ranges from 2 to 6 metres, and the channel height ranges from 1.25 m to 2.5 metres. The water in ponds generally appeared to be fairly turbid. The smaller tributaries of Blue Gum Creek were observed to have soil and gravel bed and banks, with boulders and outcropping rock occurring in some locations. The tributaries generally have channels up to 3 m wide and 2 m high, and in some of the lower areas the bank heights are negligible where channels flow over broad alluvial areas. The tributaries generally had no flow, and few ponds. The upper tributaries of Long Gully were observed to have bed materials with more gravel, boulders and outcropping rock, with increased bed width and bank height compared to other tributaries in the sub-catchment. There appear to be unnaturally large gravel deposits within the Long Gully tributaries, possibly a consequence of previous sediment-laden discharge from the quarries within the catchment. There were no flows observed in Long Gully, but ponds were present.

e. Minmi Creek sub-catchment

The Minmi Creek sub-catchment was not inspected during the survey due to access difficulties. The tributary of Minmi Creek is expected to have characteristics within the range of those observed within the Blue Gum Creek sub-catchment.

Photos taken of the main watercourses within each of the sub-catchment areas are presented as part of the Subsidence Impact Assessment in Appendix E.

Baseline data will continue to be collected until the commencement of mining to provide a detailed description of watercourse conditions. This baseline data will form part of the Watercourse Subsidence Management Plan (WSMP), described in Section 8.4.

iv. Key Surface Water Features

All watercourses within the underground mine area have been categorised as Schedule 1 or 2 Streams in accordance with the *Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region* (DIPNR, 2005). No Schedule 3 Streams are present in the underground mine area. The significance of Schedule 1, 2 and 3 Streams has been previously described in Section 6.3.2.

Scheduled Streams within the underground mine area are shown on Figure 6.2. Schedule 2 Streams incorporate lengths of Long Gully, Blue Gum Creek, Viney Creek and Buttai Creek, and therefore these watercourses are considered to be the more significant watercourses within the underground mine area.

Rainforest communities identified as part of the Flora and Fauna investigation (Section 6.7) are associated with riparian vegetation within and adjacent to watercourses, primarily within the Long Gully and Blue Gum Creek sub-catchment. The adjoining watercourse reaches are considered to be relatively significant as the rainforest communities are largely dependant on them. .

In addition to watercourses within the underground mine area, Pambalong Nature Reserve is also considered to have high significance. Although Pambalong Nature Reserve is located outside of the underground mine area and not within the Application Area, it is dependant on surface flows from Blue Gum Creek and changes in the flow condition of Blue Gum Creek could potentially impact the Pambalong Nature Reserve ecosystem. Subsequently, the sub-catchment area including Blue Gum Creek and Long Gully is considered to be the most significant within the underground mine area. In particular, the lower reach of Blue Gum Creek, immediately upstream of Pambalong Nature Reserve and within the alluvial soil landscape unit (i.e Wyong Soil Landscape), is considered the most significant of the Schedule 2 Streams within the underground mine area.

6.3.4 Mitigation Measures and Monitoring

i. Overview

Given the guidelines provided by DIPNR, 2005 and the fact that mining operations do not approach the first Schedule 2 Stream for approximately 2 years into the mine schedule, Donaldson is committing to:

- a minimum barrier of 40m between the 20 millimetre line of subsidence and the bank of any Schedule 2 Streams

unless

- further studies, to be undertaken prior to any mining occurring which could potentially directly impact on a Schedule 2 Stream, demonstrate that the DIPNR 2005 guideline can be met without such a barrier.

Given that the mine plan for the Abel Underground Mine will be subject to further refinement as part of the SMP process, this Environmental Assessment, and associated specialist reports, has been based upon a mine plan which results in a predicted 45mm of vertical subsidence at the centre of the affected Schedule 2 Streams. Initial discussions with the Department of Natural Resources have indicated that this is acceptable given the stream characteristics and the predicted subsidence impacts. However, prior to any such mine plan being implemented the above mentioned further studies will have to be undertaken to confirm that the mine plan results in impacts to the Schedule 2 Streams which comply with the second limb of DIPNR guideline,

"*Management of stream/aquifer systems in coal mining developments*" in relation to mining under Schedule 2 streams.

The following outlines in detail the proposed management of Schedule 1 and 2 Streams, the Pambalong Alluvium and the identified Rainforest Communities.

ii. Schedule 1 Streams

Schedule 1 Streams will be managed via the implementation of mitigation and remediation works where needed to ensure that:

- stream stability is maintained where subsidence occurs;
- stream fractures are minimised;
- stream channels are maintained with minimal incision from bed grade change stream bed grade change minimised to provide stable stream length.

Where any stream stability controls are required they will be designed in accordance with the *Rehabilitation Manual for Australian Streams* (Land and Water Resources Research and Development Corporation, 2000) and will be provided primarily by vegetation.

iii. Schedule 2 Streams

Schedule 2 Streams will be managed so as to ensure that:

- they maintain pre-mining course, and maintain bed channel gradients which do not initiate erosion;
- streams should maintain pool riffle sequences where they pre-existed, or should have pool riffle sequences installed where appropriate;
- connectivity to underground workings should be avoided;
- flow loss to fracture zones should be limited to flow loads to groundwater similar to pre-mining levels;
- geomorphic integrity of the stream will be maintained;
- the ecosystem habitat values of the stream will be protected; and
- no significant alteration of the water quality will occur in the stream.

The above commitments for Schedule 2 streams will be achieved by:

(a) the provision of a minimum barrier of 40m between the 20 millimetre line of subsidence and the bank of any Schedule 2 streams; unless

(b) the carrying out of further detailed studies and the development of a Watercourse Subsidence Management Plan for the Abel Underground Mine clearly demonstrates that the above commitments can be met prior to any mining occurring which will impact on any Schedule 2 streams.

iv. Pambalong Alluvium

For the lower reach of Blue Gum Creek (from the confluence of Long Gully and Blue Gum Creek downstream), a buffer will be provided which provides for no more than 20mm of subsidence at 40m from the edge of the alluvium. Within the buffer zone no significant subsidence will occur.

v. Rainforest Communities

For reaches of watercourses on which a rainforest community is identified, a buffer which provides for no more than 20mm of subsidence at 40 m from the edge of the community will be adopted.

vi. Watercourse Subsidence Management Plan

A Watercourse Subsidence Management Plan (WSMP) will be prepared as a component of the overall Subsidence Management Plan (SMP). This Plan will provide the mechanism to minimise impacts on Schedule 1 and 2 Streams within the underground mine area, with the aim of preventing impacts to significant downstream watercourses. An outline of the WSMP and incorporated monitoring is provided Section 8.5. Where it is proposed not to leave a barrier around a Schedule 2 Stream a detailed assessment will be undertaken for the watercourse (in addition to the WSMP) and provided to DNR addressing the proposed impacts on it. An outline of the detailed monitoring to be undertaken is provided Section 8.5

6.3.5 Predicted Surface Water Impacts

As there will be minimal surface infrastructure above the underground workings, any impacts on watercourses and catchments caused by proposed surface works will be negligible. In general the only potential impacts on surface waters within the proposed Abel Underground Mine area are those impacts associated with the surface expression of subsidence.

For the watercourses within the underground mine area, the subsidence assessment in Section 7.1 contains a detailed discussion of the predicted surface expression of subsidence. A brief discussion of the predicted outcomes is contained below, and should be assessed in conjunction with Section 7.1.

The predicted impacts on **Schedule 1** Streams include the following:

- Minimal changes to bed slope are expected with the majority of slope increases expected to be less than 1% to a maximum of 2%. Changes in slope will be minor and localised, and are not expected to have any significant impact on erosion of watercourses;
- There potentially could be increased ponding, with predicted ponding depths up to a maximum of 0.5 metres for Schedule 1 Streams. The exception to this is a tributary of Viney Creek which has predicted ponding depths up to 1.0 metres. The sites of the predicted ponding

within this tributary of Viney Creek would be subject to detailed monitoring and remedial action to reduce erosion if necessary;

- There will be minimal changes to overall topography with no re-direction of any surface flow paths;
- Surface cracking will generally be less than 150 mm in width, with a maximum of 360 mm in two watercourses, based on worst case scenarios. The cracks are predicted to extend to maximum depths of 2 to 5 metres, however, there is potential for deeper cracks to occur where adverse conditions exist (such as faulting). The majority of watercourses within the underground mine area contain bed material consisting of variable amounts of soil, sand and gravel. These cracks are expected to be self healing as mobile bed material is deposited within the cracks. In locations where sediment outcrops exist and there is limited bed load, the cracks may not self heal, and remediation may be required. Localised erosion and downstream sediment transport may occur as a result of the larger cracks, and erosion and sedimentation controls will be implemented as soon as practical to prevent downstream impacts.
- For the watercourses within the underground mine area, no significant loss of surface waters is expected, as discussed in the Groundwater Impact Assessment. The shallow depths of the predicted surface cracks means that any surface water entering the cracks is expected to enter the near surface material (alluvium/colluvium and weathered bedrock) and re-emerge downstream within the same watercourse. There is greater potential for cracking to cause hydraulic connection to the deeper regional groundwater where the depth of cover is shallower. This is the case for Weakleys Flat Creek and Four Mile Creek watercourses at the northern extent of the underground mine area. Accordingly, the mine plan will include partial extraction to reduce the amount of goaf collapse underneath these watercourses where there is less than 80 m depth of cover. Remediation of any impacts in these watercourses can also be undertaken if impacts do occur.
- The risk of increased acidity due to leaching of surface waters through subsidence-induced cracks is considered minimal. Due to the small amount of surface cracking over the catchment areas, the amount of surface water flowing through subsurface rock and re-emerging downstream is expected to be minor in relation to the overall catchment runoff. Also, stream bed lithologies within the area do not appear to present a significant risk of acid-forming potential. Nevertheless, this will be further assessed in detail, and monitoring will include the detection of any changes in the pH of flow.
- The identification of specific potential high-risk areas will be undertaken following the completion of baseline surveys under the WSMP to collect further information, including the identification of watercourse reaches with significant sandstone bedrock and the watercourse conditions at the predicted ponding locations. Similarly, monitoring within the WSMP will focus on the early detection of impacts at these locations, so that remedial actions can be implemented as soon as practical. In most cases, it is expected that remedial actions will be implemented after subsidence in any adjoining panels is complete, however, short term

controls will be immediately implemented where required. With the implementation of the WSMP to detect and remediate any surface changes, the level of impact on the Schedule 1 Streams is not expected to be significant.

The direct impacts on Schedule 2 Streams, including changes to bed slope, ponding and cracking, will be negligible as these streams, as defined by DIPNR (2005) will be managed so as to ensure that:

- they maintain pre-mining course, and maintain bed channel gradients which do not initiate erosion;
- they maintain pool riffle sequences where they pre-existed, or have pool riffle sequences installed where appropriate;
- they maintain connectivity to underground workings, and flow loss to fracture zones in similar levels to pre-mining;
- they maintain geomorphic integrity of the stream;
- the ecosystem habitat values of the stream are protected; and
- no significant alteration of the water quality occurs in the stream.

The above commitments for Schedule 2 streams will be achieved by:

- the provision of no more than 20 millimetres of subsidence within a minimum barrier of 40m from the bank of any Schedule 2 stream; or
- the carrying out of further detailed studies and the development of a Surface Water Management Plan for the Abel Underground Mine which clearly demonstrates that the above commitments can be met prior to any mining occurring which will impact on any Schedule 2 streams.

For the lower reach of Blue Gum Creek (from the confluence of Long Gully and Blue Gum Creek downstream), a buffer will be provided which provides for no more than 20mm of subsidence at 40m from the edge of the alluvium will be adopted, and within the buffer zone no significant subsidence will occur.

Any change in water quality within the upper reaches of the Schedule 2 Streams where flow from a Schedule 1 Stream enters will be minimised as a result of the minimal impacts to Schedule 1 Streams.

Similarly, any change to the flow regime in Schedule 2 Streams as a result of changes to the flow regime in Schedule 1 Streams will be minimised as there is predicted to be negligible water loss from the surface water catchment. More than 50 percent of the total Blue Gum Creek catchment is located outside the underground mine area, and will be unaffected.

There is no predicted impact on Pambalong Nature Reserve as a result of the underground mining, and indirect impacts are also expected to be negligible. The protection of the Blue Gum Creek sub-catchment ensures that any surface expression impacts occurring on the Schedule 1 Streams are unlikely to cause any significant change to the water quality and flow regime entering the

Pambalong Nature Reserve. Monitoring to be undertaken will contribute towards the desired outcomes of the Draft Plan of Management (DEC, 2004) and will be beneficial to the future management of Pambalong Nature Reserve.

6.3.6 Conclusion

Through adoption of the relevant guidelines and performance criteria, potential impacts on watercourses associated with underground mining will be eliminated or adequately controlled in accordance with relevant guidelines. In particular, there will be negligible change to the overall catchment topography and negligible surface disturbance within the underground mine area.

Subsidence impacts on Schedule 1 Streams are assessed to be within acceptable levels, and monitoring under the WSMP will detect any actual impacts so that they can be remediated as soon as practicable to prevent downstream impacts. Subsidence impacts on Schedule 2 Streams and significant features such as Blue Gum Creek and Pambalong Nature Reserve will be negligible as DIPNR guidelines for stream impact will be followed, together with further studies to determine appropriate subsidence impacts.

6.3.7 Cumulative Impacts on Surface Water

The existing mining operations at Donaldson Coal mine to the north of John Renshaw Drive have the potential to impact on Weakleys Flat Creek and Four Mile Creek. The Donaldson Coal Mine Annual Environmental Management Review (AEMR) for 2004-2005 suggests that Donaldson is not impacting upon chemical or physical conditions, and that for biological monitoring there is no obvious deterioration in water quality in the downstream sites, which could be directly attributed to intermediate mining activity of Donaldson.

The Surface Water Assessment & Outline Water Management Plan (Appendix F) addresses the potential impacts upon Four Mile Creek associated with the proposed surface infrastructure activities and existing Bloomfield operations to the north of John Renshaw Drive. The document contains an outline Water Management Plan that will provide increased protection to Four Mile Creek.

The approved Tasman mine project is located on land to the south west of the Abel underground mine area, and has the potential to impact on Blue Gum Creek. The EIS (August 2002) for the Tasman mine project predicted that, for the Blue Gum Creek catchment, "*any impact on the overall surface water quality from the catchment is expected to be imperceptible*", and that there will be "*no adverse water quality impacts or water quantity changes*" to Pambalong Nature Reserve.

When the impacts of the underground mining are considered in conjunction with the impacts of surrounding activities, the potential cumulative impacts are predicted to be insignificant. In the event that cumulative impacts do occur, the Integrated Monitoring Network to be established (incorporating the monitoring for the sites of Donaldson, Bloomfield, Tasman and Abel) will enable a

coordinated response to the impact. This Integrated Monitoring Network is described in Section 8.15.

6.4 Groundwater

6.4.1 Study Objectives

A groundwater investigation has been undertaken for the proposed Abel Underground Mine and is provided as Appendix G. A Peer Review of the groundwater study was also completed and is provided in Appendix G(E). The Peer Review found that the data and methods used were consistent with best practice approaches and that the arguments and conclusions were robust and appropriate.

The groundwater investigations aimed to:

- Assess and describe the existing groundwater environment in the vicinity of the proposed Abel Underground Mine;
- Identify potential risks to the environment from the proposal;
- Evaluate the potential impacts of the proposal on the regional and local groundwater resources, incorporating any necessary management and mitigation strategies; and
- Assess any residual post-project impacts and any ongoing management requirements.

The study has been undertaken with reference to the following relevant policies:

- NSW State Rivers and Estuaries Policy;
- NSW Wetlands Management Policy;
- NSW Groundwater Policy Framework Document – General;
- NSW Groundwater Quantity Management Policy;
- NSW Groundwater Quality Protection Policy; and
- NSW Groundwater Dependent Ecosystem Policy.

The following relevant best practice guidelines have been referenced:

- *Groundwater Flow Modelling Guideline* (Middlemis, 2001);
- *Independent Inquiry into the Hunter River System* (Healthy Rivers Commission, 2002);
- *Guidelines for Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region* (DIPNR, 2005); and

- *Groundwater Monitoring Guidelines for Mine Sites within the Hunter Region* (DIPNR, 2003).

6.4.2 Study Methodology

A series of piezometers were installed across the proposed Abel Underground Mine area to enable separate sampling, testing and monitoring of the principal coal seams and the overburden and interburden sediments, both within the shallow northern part of the deposit, and downdip at the southern end. Some bores were also installed along the strike to the east. A number of shallow piezometers were also installed around the Pambalong Nature Reserve. The location of these piezometers and bores is shown on Figure 6.5. Piezometer design and testing details are provided in Appendix G.

A hydraulic testing program was carried out on the standpipe piezometers, comprising either slug tests or short duration pumping tests, to determine aquifer permeabilities. Water samples were also collected from each piezometer during hydraulic testing. The samples were submitted to a NATA-registered laboratory for comprehensive analysis of physical properties and the major inorganic parameters.

The specific investigations carried out for the Abel Underground Mine project were supplemented by relevant parts of earlier studies carried out for the Donaldson Open Cut Coal Mine. Ongoing monitoring of groundwater levels and groundwater and surface water quality have provided additional information.

A limited test program was also carried out on existing bores on the Bloomfield project site.

The hydrogeological investigations (including modelling) have also been undertaken with reference to the *Guidelines for Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region* (DNR, 2005), with the model developed in accordance with the best practice guidelines on groundwater flow modelling (MDBC, 2001).

6.4.3 Existing Hydrogeological Environment

i. Introduction

A detailed description of the existing hydrogeological environment that interacts with or influences groundwater is provided in Appendix G. This includes:

- Climate – rainfall and evapotranspiration;
- Geology;
- Hydrogeology;
- Recharge and Discharge;
- Groundwater Quality; and

- Groundwater and Surface Water Interaction.

ii. Hydrogeology

In the Abel Underground Mine area, permeability was found to be generally highest in the coal seams and areas of significant fracturing or faulting. However, overall the coal measures were found to be poorly permeable. The interbedded sandstones and siltstones are of lower permeability and offer very limited intergranular porosity and little secondary permeability and storage in joints.

Groundwater was also found to occur in the alluvial overburden, which comprises mainly swamp, floodplain and estuarine sediments. There is considered to be limited hydraulic connectivity between the alluvium and the coal measures.

iii. Recharge and Discharge

Groundwater flow within the coal measures is controlled by the regional topography, with recharge occurring in areas of elevated terrain and then slow movement down-dip or along strike to areas of lower topography. There is considered to be a component of lateral flow in the coal measures out of the project area over the southern and eastern boundaries. This flow is believed to be limited due to the substantial overburden cover (up to several hundred metres).

Groundwater level contours for the Donaldson Seam show an overall pattern of flow to the east, south and west from a central ridge which extends southwards from the Donaldson Open Cut Mine. The flow pattern is largely independent of the local topography. The contours also show the influence of dewatering in the Donaldson Open Cut Mine area with a prominent cone of depression located to the north of John Renshaw Drive.

A similar flow pattern is apparent for the rest of the coal measures. Groundwater levels are about 5 to 10 metres higher in the overburden above the Donaldson Seam. There is a consistent pattern of lower pressure heads with depth.

Groundwater levels in the near surface material, which includes alluvium/colluvium and weathered bedrock, show a much closer relationship to the local topography. While groundwater levels in the deeper coal measures are not influenced by local topography, the surficial groundwater levels are locally influenced.

Groundwater flow within the deeper coal measures is therefore believed to be more regionally controlled, whereas flow within the near-surface material is subject to local topographic influences.

The alluvium around Hexham Swamp and the wetlands of Pambalong Nature Reserve is believed to be in hydraulic continuity with the swamp, but there is believed to be negligible hydraulic connection between the swamps and the deeper groundwater.

Rainfall recharge occurs to the coal seams where they outcrop and to the alluvial aquifers. The alluvial aquifers are likely to be in hydraulic continuity with Hexham Swamp in the east and Wallis Creek to the west of the Abel Underground Mine area. During periods of high stream flow, surface water courses are likely to contribute to this alluvial aquifer recharge. However, stream flows from rainfall runoff are reported to be short-lived after rainfall events.

The coal seams, where covered by overburden, are recharged mainly by flow along the bedding from elevated areas where the beds are exposed in outcrop, with minimal downward percolation through the overburden. After reaching the water table, flow is predominantly down-gradient along the more permeable horizons, but also with a component of continuing downward flow to recharge underlying coal seam aquifers.

Rainfall recharge rates within the hard rock outcrop area are believed to be relatively low (below 10 mm/yr). However, where alluvial deposits occur, recharge rates may be as high as 100mm/yr.

Groundwater discharge occurs through evaporation, seepage and spring flow where the water table intersects the land surface, and through baseflow contributions to creeks, rivers and Hexham Swamp, including discharge to the alluvium where it occurs. There is almost no existing groundwater abstraction in the Abel Underground Mine area other than for coal mine dewatering at Donaldson Open Cut Mine and Bloomfield Colliery.

iv. Groundwater Quality

The quality of groundwater sampled from within the Abel Underground Mine area is variable, with total dissolved solids (TDS) ranging from less than 518 mg/L to 13,000 mg/L. The highest salinities are reported from the surficial groundwater (ie the weathered Permian/alluvium-colluvium). The lowest reported salinity of 518 mg/L was from the Donaldson Seam.

The salinities reported from the Donaldson Open Cut Mine area are also variable. They represent a broad spectrum of lithologies, including the coal seams (Donaldson Seam and others above and below) and various levels within the coal measures overburden. Salinities ranged from 770 to 16,000 mg/L TDS. pH is close to neutral.

v. Groundwater and Surface Water Interaction

There is believed to be limited interaction between the surface drainage system and the deeper groundwater within the coal measures. The limited occurrences of localised surficial groundwater on the other hand are believed to be in reasonable hydraulic connection with the high level streams, and there is expected to be some interchange of water between the creek-beds and the shallow weathered bedrock beneath. These localised occurrences of surficial groundwater do not represent a significant or regionally extensive aquifer system, and should be considered to be an integral part of the surface water flow system.

6.4.4 Groundwater Impact Assessment

A numerical groundwater flow model based on the MODFLOW package has been used to assess potential groundwater impacts from the proposed Abel Underground Mine. A detailed description of the modelling is provided in Appendix G.

The model area included the proposed Abel Underground Mine, Donaldson Open Cut Mine and part of the Bloomfield Colliery operation, and extends to the north and west as far as the outcrop line of the Lower Donaldson seam, which is represented in the model using a no-flow boundary. The southern model boundary was set approximately 1.8 km south of the Abel Underground Mine area.

Figure 6.6 shows existing and predicted groundwater levels for the Abel Underground Mine site, as generated by the groundwater model.

i. Surficial Groundwater and Surface Water

Under present (pre-mining) conditions there was found to be a clear lack of hydraulic connection between the surface and near surface water resources, shown by large differences in groundwater levels. The near surface groundwater levels are strongly influenced by local topography, whereas the deeper groundwater in the coal measures is responding to regional influences of recharge and discharge.

The modelling also indicated minimal impacts from the mining operation on either the near surface groundwater or surface flow in the creek system overlying the mine area.

The subsidence studies (Appendix E) indicate that continuous cracking is likely to result in hydraulic connection for a distance of between 29 and 66 metres above the proposed Abel Underground Mine workings. In the area of shallow cover depth in the northern part of the Abel Underground Mine area, the subsidence study predicted that direct hydraulic connection may extend to the surface. However, elsewhere throughout the Abel Underground Mine area, the depth of cover is such that direct hydraulic connection with the surface is not expected to occur.

The area of potential direct hydraulic connection to the surface does not contain any regionally significant alluvium.

As shown by the predictive modelling, there is potential for leakage of groundwater from higher levels in the Permian coal measures above the predicted zone of continuous cracking, but this would occur by natural leakage through the relatively low permeability strata, and not by the creation of a direct fracture-induced pathway.

ii. Pambalong Nature Reserve

The prevailing groundwater levels in the coal measures beneath Pambalong Nature Reserve indicate that there is negligible hydraulic connection between the Donaldson Seam aquifer and the surface wetland. The depth of cover above the Upper Donaldson seam in this vicinity is around 150 metres. The Pambalong Nature Reserve has been excluded from the proposed Abel Underground Mine area. Further, it is not proposed to mine by total extraction methods beneath the Blue Gum Creek alluvial valley that extends south-westwards from Pambalong Nature Reserve. The closest proposed area of total extraction mining to Pambalong Nature Reserve is approximately 300 metres laterally from the north-western margin of the wetland. This is beyond the buffer zone required by the DNR Guideline for mining near streams and alluvial aquifers (DNR, 2005). As a result, negligible subsidence impacts are predicted to occur beneath the Pambalong Nature Reserve.

The Subsidence Assessment has predicted that the maximum extent of continuous sub-surface fracturing above the Donaldson seam at the closest point to Pambalong Nature Reserve would be around 50 metres, or a credible worst case height of around 120 m above the seam level in the event of adverse conditions. On this basis, it is not expected that the sub-surface cracking will allow direct hydraulic interconnection between the workings and the surface or any near-surface groundwater in the vicinity of Pambalong Nature Reserve. This is supported by the groundwater model predictions.

iii. Groundwater Quality

It is expected that the quality of groundwater inflows to the proposed Abel Underground Mine will initially be similar to the current groundwater inflow to the Donaldson Open Cut Mine, with total dissolved solids (TDS) around 1500-2000 mg/L and pH around 7. Over time, a gradual increase in salinity may occur, to an eventual salinity of around 3000-4000 mg/L TDS. Following completion of the project and recovery of groundwater levels, groundwater levels will remain below ground level in the vicinity of the mine portal, and there is not expected to be any ongoing discharge of mine water. In the event that there is any reduction in groundwater baseflow contribution to the surface streams within the predicted subsidence impact areas, the impact on water quality in the streams would be beneficial, as the groundwater quality is commonly poorer than the quality of surface runoff.

iv. Proposed Tailings Disposal

The current practice of tailings disposal and recovery of water, as well as the sump pumping from the open cuts, in particular S Cut, is maintaining a groundwater "sink" within the Bloomfield lease. Thus groundwater currently flows generally towards the lease, and there is believed to be no off-site discharge of tailings leachate or other contaminated groundwater.

It is proposed to process proposed Abel Underground Mine coal through the Bloomfield CHPP, as well as continued processing of coal from other sources. The expansion of the CHPP to accommodate the additional throughput will require additional water supply, which will be partly derived from groundwater

inflows to Abel, but will require continued pumping from the Bloomfield bore and from the open cut sumps. Hence it is anticipated that the groundwater "sink" will be maintained, and groundwater will continue to flow inwards towards the Bloomfield lease.

6.4.5 Groundwater Monitoring and Management

The monitoring program currently operating at Donaldson Mine will be continued and expanded to include the proposed Abel Underground Mine and existing Tasman Underground Mine and Bloomfield CHPP areas, as an integrated monitoring system covering all four sites. This will also be integrated with the surface water monitoring program. The Integrated Monitoring System is described in Section 8.15.

The groundwater monitoring program will include:

- Monthly measurement of water levels in a representative network of piezometers;
- Quarterly sampling of all standpipe piezometers, for laboratory analysis of electrical conductivity (EC), total dissolved solids (TDS) and pH;
- Annual collection of water samples from all standpipe piezometers for laboratory analysis of a broader suite of parameters:
  - Physical properties (EC, TDS and pH);
  - Major cations and anions;
  - Nutrients; and
  - Dissolved metals.
- Weekly measurement of the volume of mine water pumped from the underground workings, with separate inflow rates monitored if two or more separate mining areas are active at any time;
- Weekly measurement on site of the electrical conductivity (EC), total dissolved solids (TDS) and pH of the mine water pumped from the underground workings.

The following response plan will be implemented in the event of significant unforeseen variances from the predicted inflow rates and/or groundwater level impacts:

- Additional sampling and/or water level measurements to confirm the variance from expected behaviour; and
- Immediate referral to a hydrogeologist for assessment of the significance of the variance from expected behaviour. The review hydrogeologist would be requested to recommend an appropriate remedial action plan or amendment to the mining or water management approach.

At the end of the second year of underground mining, a comprehensive review will be undertaken of the performance of the groundwater system. This would include re-running the groundwater model in transient calibration mode, to verify that the actual inflow rates and groundwater level impacts are in accordance with the model predictions. If necessary, further adjustment would be made to the model at that time, and new forward predictions of mine inflows and water level impacts would be undertaken.

The groundwater model used for the simulation of impacts from the proposed Abel Underground Mine has been limited to the Donaldson seams and the coal measures stratigraphically overlying them. Thus the model does not extend north of the sub-crop line of the Lower Donaldson Seam, and does not include all of the Bloomfield mining operation. This limitation was considered adequate for the purpose of predicting impacts from the Abel project.

The model does include the existing Donaldson Open Cut Mine, however that operation has been simulated in a simplified fashion, rather than detailed simulation of the westward advance of the open cut with progressive backfilling.

There is currently a groundwater depression centred on the deepest part of current mining in the open cuts near the southern boundary of the Bloomfield lease, and a lesser depression centred on the water recovery bore into the former underground Big Ben workings which are the current depository for tailings from the CHPP. Hence the Bloomfield operation constitutes a regional groundwater sink.

It is proposed, as part of an ongoing groundwater management program, to expand the current groundwater model to include deeper layers and an expanded area that will incorporate the Bloomfield operations and areas of possible groundwater impact around Bloomfield to develop a regional model suitable for performance monitoring of the cumulative effects of the four adjacent mining operations. It is proposed to calibrate this expanded model with ongoing monitoring data from Bloomfield, and more detailed simulation of the Donaldson mining and backfilling.

6.4.6 Conclusion

The groundwater investigations carried out for the proposed Abel Underground Mine have led to the following principal conclusions:

- Groundwater is present in most lithologies in the area, but significant permeability is generally only present in association with fracturing and cleat development in the principal coal seams in the Permian coal measures. Lesser permeability may be present locally in interburden siltstones, mudstones and sandstones, and in the surficial alluvium / colluvium.
- Groundwater quality is variable, with salinity ranging from around 500 to more than 13000 mg/L total dissolved solids (TDS). pH is generally close to neutral.

- Groundwater levels in the Permian coal measures including the Donaldson Coal Seams generally fall to the east and west from a central ridge extending south from the Donaldson mine area, and range from around 35 mAHD near the central northern end of the project area to around 10-15 mAHD along the eastern boundary, and around 15-20m at the north-western corner. The groundwater levels in the Permian coal measures are unrelated to the local topography, and are frequently artesian (ie: above ground level) in low-lying areas.

- Surficial groundwater levels in the alluvium / colluvium, probably including the thin upper highly weathered zone of the Permian coal measures are strongly controlled by the local topography, and appear to be unrelated to the groundwater in the underlying less weathered Permian coal measures. Thus the surficial groundwater water levels are above the Permian groundwater levels in elevated locations and below the Permian levels in low-lying areas.

- The dewatering operations at the Donaldson Open Cut Mine have caused a noticeable cone of drawdown in groundwater levels, ranging up to more than 30m (ie to around –15 mAHD) along the southern margin of the open cut. The cone of drawdown has extended only a short distance into the north-eastern part of the proposed Abel Underground Mine area.

- The Donaldson Open Cut Mine dewatering appears to have had negligible impact on groundwater levels in the alluvium/colluvium, or in the Permian coal measures lithologies that are stratigraphically above the zones that have been directly intersected by the open cut.

- A less pronounced cone of depression has developed around the Bloomfield mining operations, most of which are situated north of the Donaldson Seam subcrop line. Near the southern boundary of the Bloomfield lease, mine dewatering appears to have resulted in drawdown in groundwater levels to around –30 mAHD.

- Dewatering will be required as part of the proposed mine developments. Modest groundwater inflows are predicted to the Abel Underground Mine, based on the most likely set of assumed hydraulic parameters. The total groundwater inflow rate is predicted to increase steadily through the project life, reaching a maximum of 3 ML/day by the 20 year mark.

- Sensitivity modelling suggests that the maximum inflow rates could be between about 1.5 and 4.5 ML/day.

- Initial average water quality of groundwater inflows to the Abel underground mine is expected to be similar to that currently entering the Donaldson open cut, with TDS around 1500-2000 mg/L and pH around 7. Over time, a steady increase in salinity may occur, to an eventual salinity of around 3000-4000 mg/L TDS.

- The dewatering associated with the proposed Abel Underground Mine is predicted to locally impact groundwater levels in the Donaldson Seam and the immediately overlying coal measures sediments. Drawdowns to below –100 mAHD are predicted for the sediments above the centre of mining activity as it progresses through the lease.

- There is believed to be negligible hydraulic interconnection between the Donaldson seams and the Hexham Swamp / Pambalong Nature Reserve. Limited connection was simulated in the groundwater modelling to assess a possible worst case condition. Drawdowns of just 10 cm at the completion of extraction, and a maximum of 12 cm two years after completion, and then recovery back to pre-mining levels, were predicted by the groundwater model for the alluvium adjacent to Pambalong Nature Reserve, and less beneath the main Hexham Swamp region to the east of the F3 freeway. In practice, no impact is expected.
- Recovery of groundwater levels after completion of mining have been assessed by 60 years of post-mining simulations. Pressure heads in the Donaldson Seam are predicted to recover to 80% of the pre-mining levels within 6 years after cessation of mining. Undisturbed overburden groundwater levels show a much slower rate of recovery due to their lower permeability, and also show an apparent incomplete recovery.
- Localised changes to the relative proportions of surface flow and surficial groundwater baseflow may occur as a result of subsidence effects. However, these two components should properly be considered as component parts of the surface water system, and are predicted to remain unconnected to the deeper groundwater.
- No adverse impacts on surface water quality are expected.
- No existing groundwater supplies are expected to be impacted.
- No adverse impacts are expected on any groundwater dependent ecosystems (GDEs).

6.5 Noise and Vibration

6.5.1 Overview and Objectives

A noise impact assessment has been undertaken for the proposed Abel Underground Mine and the use of the Bloomfield CHPP and associated facilities and is provided in Appendix H. The following provides a summary of this study.

The Environmental Risk Assessment undertaken for the Abel project assigned a low environmental risk rating to risks associated with an increase in noise from construction or operation of the proposed Abel Underground Mine, including the cumulative impact associated with the operation of various mines in the local area. Environmental risk is greatly reduced by the nature of underground mining, where there is no noise associated with the removal of overburden as there is for open cut mines. Noise will also be reduced by placing permanent surface facilities within the Donaldson Open Cut Mine final void.

The objective of the noise impact assessment was to identify the potential impacts of noise from the proposed Abel Coal Mine, including construction and operation of the mine, coal handling and processing at the existing Bloomfield Coal Handling and Preparation Plant and associated rail and road traffic movements.

The noise assessment was prepared with reference to Australian Standard *AS 1055:1997 Description and Measurement of Environmental Noise Parts 1, 2 and 3* and in accordance with the Department of Environment and Conservation's (DEC) *NSW Industrial Noise Policy* (INP). Where issues relating to noise are not addressed in the INP, such as sleep disturbance, rail traffic noise and construction noise goals, reference has been made to the *NSW Environmental Noise Control Manual* (ENCM).

The INP provides a framework and process for deriving noise criteria for consents and licences to regulate premises that are scheduled under the *Protection of the Environment Operations Act, 1997*. The assessment criteria are outlined as follows:

- **Intrusiveness**: The intrusiveness criterion means that the equivalent continuous noise level (LAeq) of the source should not be more than five decibels above the measured background level (LA90).
- **Amenity**: This assessment is based on noise criteria relevant to industrial-type specific to land use and associated activities and does not include road, rail or community noise. The acceptable recommended LAeq from industrial noise sources range between a minimum of 35 to 70 dBA and a maximum between 40 and 75 dBA.
- **Sleep disturbance**: To avoid sleep disturbance the ENCM recommends that the LA1 (1minute) noise level of the source should not exceed the background noise level (LA90) by more than 15 dBA when measured outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).
- **Rail Noise**: The Main Northern Rail line provides access to the subject site. Train movements on the Bloomfield rail loop have been assessed as on-site, industrial noise sources as part of this investigation.
- **Construction Noise**: The project specific construction noise goals outlined below will apply to the construction period of the proposed Abel Coal Mine infrastructure:
  - 4 weeks and under – background LA90 plus 20 dBA
  - 4 weeks to 26 weeks – background LA90 plus 10 dBA
  - Greater than 26 weeks – background LA90 plus 5 dBA

6.5.2 Project Specific Noise Criteria

The following project specific criteria have been adopted for this noise impact assessment study.

i. Operational Noise Design Criteria

If the criteria outlined in the INP are achieved it is unlikely that most people likely to be affected by the proposed project would consider the noise levels excessive.

ii. Sleep Disturbance Noise Goals

The sleep disturbance noise goals for all the relevant residential areas affected by the proposed Able Goal Mine will not exceed 53 dBA per continuous noise level minute (LA1).

iii. Rail Traffic Noise Goals

ARTC operates the Main Northern Railway and noise emissions are regulated via ARTC EPL 3142 which does not nominate specific noise limits but notes an objective to progressively reduce noise levels to appropriate goals. ARTC's guideline on Noise Assessment Criteria states that noise emissions must aim for 60 dBA at night and a maximum of 85 dBA during the day.

iv. Construction Noise Goals

The goals for construction noise will be those outlined in Assessing Construction Noise in Appendix H.

6.5.3 Existing Acoustical and Meteorological Environment

A conservative measure of ambient noise was based on data collected prior to commencement of Donaldson Open Cut Mine and quarterly monitoring since suggests that ambient levels have risen since 2000. The influence of the Bloomfield operation on background noise measurements was insignificant and no correlation could be established.

Wind needs to be considered as it has the potential to increase noise levels. Based on seasonal wind records, wind is a feature of this site, in particular from the southern sector in the evening and night and from the north western sector at night.

Temperature inversion is not a feature of the area as the occurrence of inversion does not exceed the threshold of occurring for approximately 30% of the total night-time during winter.

6.5.4 Noise Controls

The following noise controls have been incorporated into the noise model:

- Partial enclosure and noise screening of drives and conveyors of the Bloomfield CHPP to screen residences to the north of the site;
- Orientation of the ventilation shaft on the southern side of John Renshaw Drive towards the north-west, away from residential receivers and angling the output parallel to the ground; and
- The sound power level of the front end loader to be used near the portal not to exceed 113 dBA.

6.5.5 Operational Noise Modelling

A computer model was used to predict noise emissions from operation of the proposed Abel Underground Mine. The model used a three dimensional digital terrain map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

Other assumptions made in modelling the proposed operation include the following:

- All acoustically significant plant and equipment operates simultaneously.
- Mobile noise sources, such as haulage trucks, were modelled at typical locations and assumed to operate in repetitive cycles.
- All noise control measures described in Section 6.5.4 are implemented.
- The Bloomfield CHPP modifications are completed.

6.5.6 Operational Noise Modelling Results and Discussion

Operational noise levels from the proposed Abel Underground Mine are shown in Table 5 and are predicted to meet the project specific noise criteria at all receiver locations under prevailing weather conditions with the exception of Location K where an exceedence of 1 dBA during the night-time is predicted during a prevailing north west wind. Location K is a residence on the former chicken farm land now owned by the Catholic Diocese of Newcastle and Maitland and has an existing agreement between the owner and Donaldson.

Table 5 Predicted Abel Coal Mine Noise Levels

Location	**Period**	**Predicted Noise Level LAeq (15 minute) (dBA)**			**Project Specific Noise Criteria (LAeq)**
		Calm	**NW Wind**	**SE Wind**	
A Weekdays Beresfield	Day	<30dBA	n/a	n/a	50dBA
	Evening	<30dBA	n/a	<30dBA	48dBA
	Night	<30dBA	<30dBA	<30dBA	41dBA
B Yarrum Rd Beresfield	Day	<30dBA	n/a	n/a	50dBA
	Evening	<30dBA	n/a	<30dBA	48dBA
	Night	<30dBA	<30dBA	<30dBA	41dBA
C Phoenix Rd Black Hill	Day	<30dBA	n/a	n/a	43dBA
	Evening	<30dBA	n/a	<30dBA	44dBA
	Night	<30dBA	<30dBA	<30dBA	38dBA
D Black Hill School	Day	<30dBA	n/a	n/a	41dBA
	Evening	<30dBA	n/a	30dBA	40dBA
	Night	<30dBA	30dBA	<30dBA	36dBA
E Brown Rd Black Hill	Day	<30dBA	n/a	n/a	41dBA
	Evening	<30dBA	n/a	<30dBA	40dBA
	Night	<30dBA	30dBA	<30dBA	36dBA
F Black Hill Rd	Day	<30dBA	n/a	n/a	41dBA

Location	Period	Predicted Noise Level LAeq (15 minute) (dBA)			Project Specific Noise Criteria (LAeq)
		Calm	NW Wind	SE Wind	
Black Hill	Evening	<30dBA	n/a	<30dBA	40dBA
	Night	<30dBA	33dBA	<30dBA	36dBA
G Buchanan Rd Buchanan	Day	<30dBA	n/a	n/a	43dBA
	Evening	<30dBA	n/a	<30dBA	41dBA
	Night	<30dBA	<30dBA	<30dBA	36dBA
H Mt Vincent Rd Louth Park	Day	<30dBA	n/a	n/a	43dBA
	Evening	<30dBA	n/a	<30dBA	41dBA
	Night	<30dBA	<30dBA	<30dBA	36dBA
I Lord Howe Dv, Ashtonfield	Day	<30dBA	n/a	n/a	44dBA
	Evening	<30dBA	n/a	36dBA	46dBA
	Night	<30dBA	31dBA	36dBA	38dBA
J Kilarney St Avalon Estate	Day	<30dBA	n/a	n/a	49dBA
	Evening	<30dBA	n/a	<30dBA	47dBA
	Night	<30dBA	33dBA	<30dBA	40dBA
K Catholic Diocese (Former Bartter) K1, K2, K3	Day	<30dBA	n/a	n/a	41dBA
	Evening	<30dBA	n/a	<30dBA	40dBA
	Night	<30dBA	**37dBA**	<30dBA	36dBA
L Kilshanny Ave, Ashtonfield	Day	33dBA	n/a	n/a	46dBA
	Evening	33dBA	n/a	40dBA	46dBA
	Night	33dBA	35dBA	40dBA	40dBA

n/a: the meteorological condition is not relevant during this period

Since the operational scenario modelled is likely to represent an acoustically worst-case scenario, actual operational noise levels from the proposed Abel Underground Mine and the use of the Bloomfield CHPP are likely to be less than those predicted.

The predicted LAmax noise levels from operation of the Abel Underground Mine, shown in Table 6, meet the sleep disturbance criteria at all locations with the exception of Location K. At the location K external LAmax noise levels of up to 52 dBA may occur during the night-period that correlates to noise levels that are acceptable for inside dwellings. There is an existing agreement between the owner and Donaldson in relation noise at location K.

Table 6 Predicted Maximum Noise Levels at Night - Adverse Weather

Location	Period	Predicted Noise Level LAmax (dBA)		Sleep Disturbance Criteria (LAeq)
		NW Wind	SE Wind	
E Browns Road	Night	41dBA	39dBA	46dBA
F Black Hill Road	Night	42dBA	44dBA	46dBA
I Lord Howe Dr., Ashtonfield	Night	37dBA	43dBA	48dBA
J Kilarney Street, Avalon Estate	Night	40dBA	38dBA	50dBA
K Catholic Diocese (Former Bartter) K1, K2, K3	Night	**52dBA**	37dBA	46dBA
L Kilshanny Ave Ashtonfield	Night	38dBA	46dBA	53dBA

i. Rail Noise

The Bloomfield CHPP and rail loading facility utilise the Main Northern Railway Line. An average of 3 to 6 trains per day will use the Bloomfield rail loop.

The increase in rail traffic is predicted to increase the existing daytime LAeq (15hour) rail noise level by approximately 0.2 dBA and the existing night-time LAeq (9hour) rail noise level by approximately 0.1 dBA. These increases are considered to be negligible and would not be discernible by receivers near the rail line.

The Australian Rail Track Corporation (ARTC) operates the Hunter Valley Coal Rail Network in NSW. Noise emissions from the railway are regulated by an Environment Protection Licence (EPL) that requires noise to be controlled by the implementation of noise limits and the management of noise via pollution Reduction Programs. Trains using the Bloomfield Rail Loading Facility form part of this network and will comply with the EPL requirements.

6.5.7 Construction Noise Assessment

Construction noise modelling was carried out using the same model as for the operational scenario. Noise predictions were provided for calm atmospheric conditions as construction is only permitted between 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm. It was assumed that construction at the site would exceed 26 weeks and it is predicted that construction activities associated with the proposed Abel Underground Mine will comply with construction noise criteria at surrounding receivers. Predicted maximum construction noise levels at night in adverse weather are shown in Table 7.

Table 7 Predicted Maximum Construction Noise Levels at Night - Adverse Weather

Location	Period	Predicted Noise Level LA10 (dBA) Calm	Construction Noise Criteria (LA10)
D Black Hill School	Day	<30dBA	<41dBA
E Browns Road Black Hill	Day	30dBA	41dBA
F Black Hill Road Black Hill	Day	37dBA	41dBA
K Catholic Diocese (Former Bartter) K1, K2, K3	Day	36dBA	41dBA

6.5.8 Cumulative Noise Assessment

The results (refer Table 8) show that the cumulative impact of mining and surface operations in the area surrounding the Abel Underground Mine, including the addition of trains on the Main Northern Railway Line, will comply with the relevant amenity criteria set in accordance with the INP.

6.5.9 Noise Management and Monitoring

Existing noise management procedures that apply to the Donaldson Open Cut Mine will apply to the Abel surface operation and the Bloomfield CHPP. These include:

- the use of reversing quackers to reduce night-time noise;
- noise monitoring consisting of operator attended and unattended noise measurements at four locations relevant to the mining operations at the time of monitoring, together with a log of operational activities to identify any significant generated noise sources; and
- daily contact with neighbours of the mine when blasts are occurring to keep them informed of actions on site.

Noise monitoring that will be undertaken as part of the integrated Monitoring Network (refer Section 8.22) will consist of eleven existing monitoring locations representative of the surrounding noise environment for the nearest potentially affected residential areas, which have been previously established to monitor the Donaldson Open Cut Mine.

Table 8 Predicted Cumulative Impact – Abel Underground Mine Project including Bloomfield CHPP

Location	Period	Intrusive Predicted Noise Level LAeq (15 minute) (dBA)				Cumulative Amenity Level LAeq (period)		Amenity Criteria (LAeq)
		Project Abel		Donaldson Coal				
		Calm	Adverse	Calm	Adverse	Calm	Adverse	
D Black Hill School	Day	<30dBA	n/a	34dBA	42dBA	32dBA	39dBA	55dBA
	Evening	<30dBA	<30dbA	34dBA	40dBA	32dBA	37dBA	45dBA
	Night	<30dBA	30dBA	32dBA	36dBA	31dBA	33dBA	39dBA
E Browns Road Black Hill	Day	<30dBA	n/a	<30dBA	43dBA	30dBA	40dBA	55dBA
	Evening	<30dBA	<30dBA	<30dBA	<40dBA	30dBA	37dBA	45dBA
	Night	<30dBA	30dBA	<30dBA	<36dBA	30dBA	34dBA	39dBA
F Black Hill Road Black Hill	Day	<30dBA	n/a	<30dBA	43dBA	30dBA	40dBA	55dBA
	Evening	<30dBA	<30dBA	<30dBA	<40dBA	30dBA	37dBA	45dBA
	Night	<30dBA	33dBA	<30dBA	<36dBA	30dBA	35dBA	39dBA
I Lord Howe Dr Ashtonfield	Day	<30dBA	n/a	<30dBA	<46dBA	30dBA	43dBA	55dBA
	Evening	<30dBA	36dBA	<30dBA	<44dBA	30dBA	42dBA	45dBA
	Night	<30dBA	36dBA	<30dBA	<38dBA	30dBA	38dBA	40dBA
K Catholic Diocese Land. K1,K2,K3	Day	<30dBA	n/a	41dBA	44dBA	38dBA	41dBA	55dBA
	Evening	<30dBA	<30dBA	41dBA	43dBA	38dBA	40dBA	45dBA
	Night	<30dBA	37dBA	36dBA	38dBA	34dBA	38dBA	39dBA
L Kilshanny Ave Ashtonfield	Day	33dBA	n/a	<30dBA	<46dBA	31dBA	43dBA	55dBA
	Evening	33dBA	40dBA	<30dBA	<44dBA	31dBA	42dBA	45dBA
	Night	33dBA	40dBA	<30dBA	<38dBA	31dBA	39dBA	40dBA

6.6 Air Quality and Greenhouse Gas Emissions

6.6.1 Overview

The Environmental Risk Assessment undertaken for the proposed Abel Underground Mine and associated surface facilities, including the Bloomfield CHPP, assigned a low environmental risk rating to risks associated with reducing air quality. Environmental risk is greatly reduced by the nature of underground mining, where particulate matter and dust is only generated by surface activities and not by the removal of overburden as is the case on an open cut mine. It is also reduced for the Abel Underground Mine by the minimal need to clear new areas by using existing disturbed areas and infrastructure.

Appendix I provides an Air Quality Assessment for the Abel Underground Mine. The report provides:

- air quality assessment criteria;
- a description of the existing air quality and meteorological conditions;
- air quality assessment and modelling methodologies;
- an assessment of potential air quality impacts;
- quantification of potential greenhouse gases from the project; and
- mitigation measures to prevent, reduce, manage, and monitor potential air quality impacts.

The air quality assessment concludes that as the mine is an underground operation, emissions will be minor compared with an open cut mine of a similar production level. Air quality emissions from proposed surface facilities and the Bloomfield CHPP operation and below determined criteria.

Model predictions of the dispersion of dust emissions from the mine indicate that no residences are likely to experience any exceedances of the Department of Environment and Conservation (DEC)'s long-term assessment criteria for particulate matter (PM_{10}), total suspended solids (TSP) or dust (insoluble solids) deposition.

The DEC's 24-hour average PM_{10} assessment criterion of 50 $\mu g/m^3$ is currently exceeded in the local area from time to time, particularly at times when bushfire smoke affects air quality. This situation will continue, however, emissions from the mine are not predicted to significantly affect the number of exceedances.

Mitigation measures that will be applied to control dust from the proposed Abel Underground Mine and the Bloomfield CHPP are:

- Stockpiles at the mine portal will be below ground level;

- The main ROM and product coal stockpiles will be fitted with water sprays;
- Conveyors will be enclosed on three sides;
- Monitoring of meteorological conditions, dust deposition and concentration levels will be continued – with enhanced analysis enabled by the use of the integrated monitoring network that will monitor and share data from Tasman Underground Mine in the south to Bloomfield CHPP in the north;
- Regular analysis and reporting of the monitoring results will be undertaken to identify any problems should these arise; and
- Vegetation will be maintained around the mine surface facilities to mitigate visual impacts and reduce off-site transport of dust.

6.6.2 Air Quality Assessment Criteria

The overall approach to the assessment followed the A*pproved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Department of Environment and Conservation, 2005). It is based on the use of an air dispersion model, which has been used with estimated emissions and local meteorological data to predict dust concentration and deposition levels arising from the proposal.

After making appropriate allowances for existing levels of dust the predicted values have been compared with the assessment criteria published by the NSW Department of Environment and Conservation (DEC). The modelling assessment is a level 2 assessment as defined by the DEC's assessment procedures.

The project will result in the liberation of a number of classes of particulate matter (PM) described as:

- total suspended particulate matter (TSP);
- particulate matter with equivalent aerodynamic diameters 10 μm or less (PM_{10}); and
- particles with equivalent aerodynamic diameters of 2.5 μm and less ($PM_{2.5}$)

The above emissions would occur primarily as fugitive dust from the surface facilities and in the mine ventilation air.

There would also be emissions from vehicles and underground equipment. These emissions include carbon monoxide (CO) and minor quantities of sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). In practice these gaseous emissions will be minor and at levels that will not give rise to environmental impacts. For this reason these pollutants were not considered further in the air quality assessment.

Air quality goals relevant to the study are provided in Table 9. These goals relate to the total dust burden in the air and not just the dust from the project. The assessment criteria are designed to protect human health.

Table 9 Air quality standards/goals for particulate matter concentrations (Source: DEC, 2005)

Pollutant	Standard / goal	Averaging period	Agency
Total suspended particulate matter (TSP)	90 μg/m^3	Annual mean	National Health and Medical Research Council (NSW DEC, 2005)
Particulate matter < 10 μm (PM_{10})	50 μg/m^3	24-hour maximum	NSW DEC (2005) (assessment criteria)
	30 μg/m^3	Annual mean	NSW DEC (2005) (long-term reporting goal)
	50 μg/m^3	(24-hour average, 5 exceedances permitted per year)	National Environment Protection Measure (NEPC, 1998)

μg/m^3 – micrograms per cubic metre
μm - micrometre

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces and possibly vegetation/crops. Table 10 shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. The criteria for dust fallout levels are set to protect against nuisance impacts (DEC, 2005).

Table 10 DEC criteria for dust (insoluble solids) fallout

Pollutant	Averaging period	Max. increase in deposited dust level	Max. total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

6.6.3 Existing Air Quality

Monitoring programs to characterise the meteorological conditions and existing air quality have been in place since late 1999 as part of the Donaldson Open Cut Mine Air Quality Management Plan (AQMP). Data analysed in this report is from May 2000. Figure 8.2 shows the locations of the meteorological station and air quality monitors that will continue to be used for the Abel Underground Mine as part of the Integrated Monitoring Network. The air quality monitoring plan comprises eleven dust deposition gauges, one TSP monitor and one PM_{10} monitor. In addition, the DEC's PM_{10} monitor at Beresfield provides information on regional PM_{10} concentrations.

Overall, dust deposition levels appear to be at satisfactory levels and an increment of up to 2 g/m^2/month in the annual average dust (insoluble solids) deposition levels would be acceptable under DEC's assessment procedures.

As with dust deposition, PM_{10} and TSP concentrations are currently satisfactory, but emission sources of PM_{10} that might affect air quality in the Beresfield area should be carefully controlled to ensure that the area continues to comply with the DEC annual and 24-hour criteria of PM_{10}. The proposed Abel Underground Mine is unlikely to contribute significantly to the PM_{10} burden in the Beresfield area.

6.6.4 Air Quality Modelling

Guidelines for the assessment of air pollution sources using dispersion models (DEC, 2005) specify how assessments based on the use of air dispersion models should be undertaken. The approach taken in this assessment follows as closely as possible the approaches suggested by the guidelines.

The model used for the air quality assessment was the US EPA ISCST3 model. Modelling is described in detail in Appendix I.

6.6.5 Estimates of Dust Emissions

The emissions from the major dust sources associated with the Abel project have been calculated (refer Appendix I) and are summarised below:

- The mine ventilation system 47,304 kg/year
- Loading coal to the raw coal stockpile 2,250 kg/year
- Wind erosion from stockpile at Abel 13,140 kg/year
- Wind erosion from stockpiles at Bloomfield 172,747 kg/year
- Dust loss from the conveyor system 4,818 kg/year

or

- Dust from trucking coal to Bloomfield 148,000 kg/year
- Transferring raw coal to trucks 2,250 kg/year
- Loading coal to the Bloomfield CHPP stockpile 2,250 kg/year
- Emissions from the Bloomfield CHPP 19,500 kg/year
- Loading coal to trains at Bloomfield 2,250 kg/year

- Total (with conveyor) 264,259 kg/year

- Total (with trucking) 409,691 kg/year

6.6.6 Air Quality Impact Assessment

Air quality modelling provided contours around the mine that show the location of predicted concentration and deposition levels. These contour plans are provided in Appendix I.

The most affected residence is located approximately 1 km to the southeast of the surface facilities. This residence is located on land scheduled for future re-development and is currently rented pending demolition. This residence is predicted to experience worst-case increases as follows:

- 24-hour average PM_{10} concentrations - increase of approximately 20 μg/m3, which is less than the DEC's 50 μg/m3 assessment criterion. 24-hour average PM_{10} concentrations could still exceed the assessment criterion on days when the background-level of PM_{10} is above 30 μg/m3 at a time when emissions from the Abel project were at the highest level. This will happen from time to time particularly when air quality is affected by bushfire smoke.
- annual average PM_{10} concentrations – increase of approximately 5 $\mu g/m^3$ which is less than the DEC's 30 $\mu g/m^3$ annual average assessment criterion. Annual average PM_{10} concentrations would need to exceed 25 $\mu g/m^3$ before the criterion would be exceeded. Annual average PM_{10} concentrations at Blackhill have never exceeded 25 $\mu g/m^3$ since monitoring commenced in May 2000. The current annual average PM_{10} concentration at Blackhill is currently at approximately 15 $\mu g/m^3$. Based on this analysis it is unlikely that the annual average PM_{10} assessment criterion would be exceeded at the most affected residence.
- annual average TSP concentrations – increase of approximately 8 $\mu g/m^3$ which is less than the DEC's 90 $\mu g/m^3$ annual average assessment criterion. Annual average TSP concentrations would need to exceed 82 $\mu g/m^3$ before the criterion would be exceeded. The annual average TSP concentration data from Blackhill has never exceeded 50 $\mu g/m^3$ since the monitoring program commenced in May 2000. It is unlikely that the annual average TSP assessment criterion would be exceeded at the most affected residence.
- annual average dust (insoluble solids) deposition level – increase of approximately 0.7 $\mu g/m^3$ which is less than the DEC's annual average increment of 2 g/m^2/month that has been determined as an acceptable increase.

Coal will be transported to the Bloomfield CHPP via truck using an internal sealed haul road. While there is additional dust generated by the trucking option the off-site impacts are not changed significantly and air quality assessment criteria would still be met at all residences. Sealing of the road considerably reduces dust emissions for the project.

6.6.7 Greenhouse Gas Emissions

Greenhouse gas inventories are calculated according to a number of different methods. The procedures specified under the United Nations Framework Convention on Climate Change (the Kyoto Protocol) is the most common method of calculating greenhouse gas emissions. This is also appropriate for this project where the product coal will be shipped to and used by Kyoto signatory countries.

The protocol identifies greenhouse gases as follows:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6).

Carbon dioxide and N_2O are formed and released during the combustion of gaseous, liquid and solid fuels. The most significant gases associated with the Abel Underground Mine project are CO_2 and N_2O, which will be liberated when fuels are burnt in diesel power equipment and in the generation of the electrical energy that will be used by the project.

In keeping with the Kyoto Protocol global accounting methodology, off-site greenhouse gas emissions from the generation of energy from coal extracted from the Abel project are not included in this assessment. This will be accounted for in the country where it is used for energy. This prevents double-counting of greenhouse gas emissions when determining global levels.

Inventories of greenhouse gas emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (potentials) and emission factors take into account the global warming potentials of the gases created during combustion.

The global warming potentials assumed in the Australian Greenhouse Office (AGO) (2005) emission factors are as follows:

- CO_2 – 1
- CH_4 – 21
- N_2O – 310
- NO_2 – not included.

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to in terms of CO_2-equivalent emissions. The emission factors published by the Australian Greenhouse Office (AGO) (2005)

have been used to convert fuel usage and electricity consumption into CO2-equivalent emissions.

The project will liberate greenhouse gases as a result of the combustion of diesel to power mining equipment, the use of electrical energy and as a result of methane in the mine ventilation air. A substantial fraction of the emission is due to the methane emissions in the mine ventilation air. However, it should be noted that the *Australian Greenhouse Office Factors and Methods Workbook* indicates that methane production from NSW open cut mines is just over 4 times the amount produced from non-gassy underground mines (Table 6 AGO, 2004)

The estimated annual emission of CO_2-equivalent is in the range 5,807 tonnes/year to 709,560 tonnes/year depending on production. These can be compared with the estimated total CO_2-equivalent emissions for Australia in 2003 of 550 Mt calculated using the Kyoto protocol calculation methods (Australian Greenhouse Office (2005) - web site).

Coal produced by the Abel Underground Mine is for the export coal market, primarily in East Asia. Its end use and the greenhouse emissions from end users varies according to the type of use (eg. power generation, concrete or steel manufacture) and the technologies employed in user plants, the environmental regulatory regime in the destination country and the nature of international obligations accepted in the destination country.

6.7 Flora and Fauna

6.7.1 Introduction

The Environmental Risk Rating allocated to potential flora and fauna impacts (refer Section 5.2) is low due to the nature of underground mining, which does not require land clearing. The design of surface facilities and use of existing facilities also enables land clearing to be minimised. With subsidence controls as described in Section 8.3, the impact on any change in landform on flora and fauna is also expected to be low. Surface infrastructure will predominantly be located in existing areas of disturbance within the Donaldson and Bloomfield open cut mines, minimising the need for land clearing.

Appendix J provides detailed flora and fauna listings, community descriptions and the 7-part test undertaken in accordance with the requirements of the NSW *Threatened Species Conservation Amendment Act 2002*. Appendix D contains details of flora and fauna management and monitoring plans that will be implemented during construction and operation of the Abel Underground Mine.

The Preliminary Assessment (Donaldson Coal, 2005) undertaken to identify potential environmental impacts determined that a flora and fauna assessment be undertaken for the following areas:

- Surface facility areas where native vegetation may be disturbed, being the conveyor route and expansion areas for stockpiles associated with the Bloomfield coal handling and Preparation Plant (CHPP);
- The underground mine area south of John Renshaw Drive, where the surface could potentially be subjected to subsidence impact; and
- Pambalong Nature Reserve, which is outside of but downstream of the mine area.

The requirements of the following legislation were considered in the preparation of this assessment:

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *NSW Threatened Species Conservation Act 1995* (TSC Act);
- *NSW Threatened Species Conservation Amendment Act 2002*;
- *NSW National Parks and Wildlife Act 1974* (NP&W Act);
- *NSW Environmental Planning and Assessment Act 1979* (EP&A Act); and
- SEPP 44 Koala Habitat Assessment.

The methods used to investigate flora and fauna are consistent with the *Draft Guidelines for Threatened Species Assessment* (Department of Environment and Conservation and Department of Primary Industries, July 2005).

Under the environmental assessment provisions of the EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance are subject to an assessment and approval process. Action includes any project, development, activity, or series of activities. The Act identifies seven matters of national environmental significance, listed as follows, with the potentially relevant items highlighted in bold and addressed by this assessment. The relevant assessments conclude that the items are not significant and therefore approval under the EPBC Act is not required.

1. World Heritage properties;

2. National heritage places;

3. Wetlands of international importance (Ramsar wetlands);

4. Threatened species and ecological communities;

5. Migratory species;

6. Commonwealth marine areas; and

7. Nuclear actions (including uranium mining).

6.7.2 Surface Facility Areas

The flora and fauna investigation area for proposed surface facilities included the pit top area for the Abel Underground Mine which will generally be located within the Donaldson Open Cut Mine void, the road and conveyor route to Bloomfield CHPP and areas designated for potential stockpile expansion around the CHPP. The area between the proposed Abel pit top and the Bloomfield CHPP consists of forest fragmented by several roads, easements and tracks including the coal haul road from Donaldson open cut pit to the Bloomfield CHPP, a Hunter Water pipeline, access road to the administration offices and workshop and the newly constructed haul road from John Renshaw Drive. The areas designated for potential stockpile expansion around the Bloomfield CHPP consist of forested patches segmented by a number of roads and tracks.

The route for the proposed coal conveyor and the location of coal stockpile expansion areas were selected following preliminary flora and fauna investigations, with the aim of maximising the use of existing clearing and disturbed areas and minimising any impact on threatened species and endangered communities.

i. Methodology

Ground searches were conducted throughout the investigation area in order to collate a full floristic content list and to determine the extent and types of vegetation communities present. Vegetation communities were classified according to the regional model (NPWS, 2000), commonly referred to as LHCCREMS (Lower Hunter and Central Coast Regional Environmental Management Strategy).

The community classification was arrived at through the acquisition of ground-truthed data describing the floristic content of the vegetation at a number of locations in the investigation area. Community boundaries were determined through a combination of aerial photograph interpretation and on-the-ground mapping using a hand-held GPS.

The fauna investigation used the following methods:

- Terrestrial mammal trapping using Elliott A, Elliott B and cage traps;
- Arboreal mammal trapping using Elliott B traps placed on platforms on tree trunks at 2 – 4m above the ground;
- Hair tubes placed on tree trunks;
- Harp trapping for insectivorous bats;
- Large forest owl call playback;
- Spotlighting;
- Watching of habitat hollows at dusk;
- Targeted and opportunistic amphibian and reptile searches; and

- Targeted and opportunistic bird survey.

Appendix J lists species found throughout the study area.

ii. Methodology - Threatened Species Assessment

The first stage of the threatened species assessment was to extract records from the Atlas of NSW Wildlife database for threatened flora and fauna species reported within a 5km radius of the investigation area. This list is provided in Appendix J, together with a table showing the likelihood of these threatened fauna species using the investigation area.

Threatened fauna profiles were then developed, indicating the habitat requirements of these species, to be considered in later tests of significance and impact. Profiles for fauna determined as having a 'Possible' likelihood of using the investigation area were developed and are provided in Appendix J. These species are:

- Speckled Warbler (*Chthonicola sagittatus*);
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*);
- Brown Treecreeper (*Climacteris picumnus victoriae*);
- Regent Honeyeater (*Xanthomyza phrygia*);
- Black-chinned Honeyeater (*Melithreptis gularis*);
- Swift Parrot (*Lathamus discolor*);
- Masked Owl (*Tyto novaehollandiae*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*);
- Eastern Free-tail Bat (*Mormopterus sp*.);
- Little Bent-wing Bat (*Miniopterus australis*);
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*);
- Large-footed Myotis (*Myotis adversus*); and
- Greater Broad-nosed Bat (*Scoteanax rueppellii*).

A threatened flora profile for *Tetratheca juncea*, listed as Vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, is also provided in Appendix J.

iii. Field Survey Results

a. Flora

No threatened species of flora under the TSC Act 1995 or the EPBC Act 1999 were found in the investigation area. One rare species, (ROTAP, Briggs & Leigh 1995) *Grevillea montana*, was relatively widespread. Appendix J lists the 156 flora species present.

b. Vegetation Communities

Floristic and structural data was assessed from 135 locations resulting in 6 vegetation communities being mapped across the investigation area, the details of which can be seen in Appendix J. Two of these communities, MU17 and MU19, are listed as endangered ecological communities in the schedules of the NSW TSC Act.

Table 11 Vegetation communities present across the investigation area

Map Unit	Description	Area (ha)
MU5	Alluvial Tall Moist Forest	8
MU12	Hunter Valley Moist Forest	5
MU17	Lower Hunter Spotted Gum – Ironbark Forest	138
MU18	Central Hunter Ironbark – Spotted Gum - Grey Box Forest	1
MU19	Hunter Lowlands Redgum Forest	4
MU30	Coastal Plains Smooth-barked Apple Woodland	28

Detailed descriptions of these vegetation communities is provided in Appendix J.

c. Fauna

Table 12 details the trapping effort and Figure 6.8 shows the location of transects used in this investigation.

Table 12 Trapping effort for the investigation

Method	Effort/ transect (trap nights)	Total effort (trap nights)
Elliot A small mammal trap terrestrial	60	660
Elliot B medium mammal terrestrial	8	88
Elliot B medium mammal arboreal	12	132
Cage trap terrestrial	12	132
Harp trap	4	44
Hair tubes arboreal	16	176

Appendix J contains detailed capture and observation data as well as historical data from the permanent annual monitoring quadrats established on the Donaldson property. The 38 species of bird recorded in the investigation area are also listed in Appendix J.

Table 13 shows the eight species of insectivorous bat and one marsupial recorded as present in the investigation area and listed as threatened species.

Table 13 Threatened fauna found in the investigation area

Common Name	Scientific Name
Little Bent-wing Bat	*Miniopterus australis*
Common Bent-wing Bat	*Miniopterus schreibersii*
East Coast Freetail Bat	*Mormopterus norfolkensis*
Large-footed Myotis	*Myotis adversus*
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*
Greater Broad-nose Bat	*Scotorepens rueppellii*
Eastern Cave Bat	*Vespadelus troughtoni*
Little Forest Bat	*Vespadelus vulturnus*
Squirrel Glider	*Petaurus norfolcensis*

iv. SEPP 44 Koala Habitat Protection

SEPP 44 requires that, for proposals on properties involving 1 hectare or more, the habitat should be evaluated for potential Koala habitat and core Koala Habitat. Potential Koala habitat is defined as areas of native vegetation where the trees listed in Schedule 2 (of SEPP 44) 'constitute at least 15% of the total number of trees in the upper and lower strata of the tree component'. Should potential Koala habitat be found, further investigation for the existence of core Koala habitat should be undertaken and if this habitat is found to be present then a detailed Plan of Management should be prepared for the Koala colony in the area. Schedule 2 feed trees are listed in Table 14.

Table 14 SEPP 44 Schedule 2 Feed Tree Species

Scientific Name	Common Name
Eucalyptus tereticornis	Redgum
Eucalyptus microcorys	Tallowwood
Eucalyptus punctata	Grey Gum
Eucalyptus viminalis	Ribbon or Manna Gum
Eucalyptus camaldulensis	River Red Gum
Eucalyptus haemastoma	Broad-leaved Scribbly Gum
Eucalyptus signata	Scribbly Gum
Eucalyptus albens	White Box
Eucalyptus populnea	Bimble Box or Poplar Box
Eucalyptus robusta	Swamp Mahogany

The only listed feed tree species present was *Eucalyptus punctata* which did not constitute at least 15% of the tree species present. Potential Koala habitat was therefore not present and no further investigation was required.

v. *NSW Threatened Species Conservation Act 1995 and Commonwealth EPBC Act 1999*

In order to assess the significance of threatened species considered as likely or actually being present in an area and to assess the impact of any proposed disturbance on these species, a 7-part test is applied. This test is provided for in the NSW Threatened Species Conservation Act 1995 as amended by the NSW Threatened Species Conservation Amendment Act 2002. A 7-part test (Appendix J) has been applied to those species listed previously, as well as for the Lower Hunter Spotted Gum – Ironbark Forest listed in Table 11.

Consideration of wetlands of international importance (RAMSAR wetlands), listed migratory species and listed threatened species and populations in accordance with the Commonwealth EPBC Act 1999 is provided in Appendix J.

The results of the tests of significance for both the NSW *Threatened Species Conservation Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* show that there would be no significant impact on any threatened species or endangered ecological communities resulting from the works associated with the construction of the coal conveyor or the expansion of the coal stockpile areas at the Bloomfield CHPP.

6.7.3 Underground Mine Area

This area consists of the land potentially subject to subsidence impacts over the underground mine, being approximately 1900 hectares of relatively undisturbed vegetation and 900 hectares of fragmented vegetation in a farmland mosaic. The topography consists of a complex system of ridges (elevation around 300 metres) and steep gullies which drain across alluvial flats ultimately into the Hexham floodplain. Subsidence will be varied over the mine area.. due to factors such as depth of workings, geological conditions, surface features and slope. Therefore, not all surface areas will be subject to the same degree of subsidence, with some experiencing no change.

i. *Methodology*

The investigation for this area was directed at classifying the various ecosystems extant across the area based on the vegetation, floristic content and structure. Habitat surrogates were used to develop a list of species of threatened flora and fauna that were considered likely to occur. Particular attention was given to the likelihood of species being present that were listed as rare or threatened from a local, State and Commonwealth perspective.

The vegetation communities present across the underground mining area were first assessed by ground-truthing. Summary data describing the composition and structure of the vegetation was collected at points across the area and this data was used to direct more detailed sampling of the variation found to be present. The summary data was obtained by driving all available tracks and by walking into areas not accessible by track. Detailed sampling was in the form of standard 20mx20m floristic plots in which all species present were recorded using the

modified Braun-Blanquet 6-point scale of cover-abundance. The data from these floristic plots was analysed against data from the wider region using PATN (Belbin 1989) in order to assess what groupings were present. The floristic content of the various groupings was then assessed against the vegetation communities detailed in the regional vegetation model as prepared by NPWS (2000).

Finally the ground-truthed data and the community classification data was combined and, using an extrapolation process in a GIS, a map of the vegetation communities extant over the area subject to potential subsidence impacts was prepared.

The available published data on the ecological requirements of species from a range of sources was used to determine which species of fauna were likely to be present in the vegetation communities mapped for the area.

ii. Results and Discussion

a. Vegetation Communities

370 ground-truth data points and 31 detailed floristic plots were used to determine the vegetation communities extant across the Abel surface area. Analysis of the detailed floristic plots using PATN (Belbin 1989) showed 7 separate communities to be present (See Appendix J for detailed dendrogram). Table 15 lists the communities and their present area. Two listed and one preliminarily listed endangered ecological communities were found to be present.

Table 15 Vegetation Communities Mapped across the Underground Mine Area

Map Unit	Description	Area (ha)
MU1a	**Sub-tropical Rainforest	27
MU5	Alluvial Tall Moist Forest	153
MU12	Hunter Valley Moist Forest	174
MU15	Coastal Foothills Spotted Gum – Ironbark Forest	593
MU17	*Lower Hunter Spotted Gum – Ironbark Forest	643
MU18	Central Hunter Spotted Gum – Ironbark Forest	20
MU19	*Hunter Lowlands Redgum Forest	6
MU30	Coastal Plains Smooth-barked Apple Woodland	108

*Endangered ecological community, **Preliminarily listed endangered ecological community.

A detailed description of each vegetation community listed above is provided in Appendix J.

The most significant vegetation community present was the Sub-tropical Rainforest found in the Long Gully network and an unnamed gully to the south (refer Figure 6.7).

b. Groundwater Dependant Ecosystems

Even during a long dry period a base flow of water was present along the rainforest gullies and it is evident that the rainforest is dependant on both the base flow and the surrounding topography to create a suitable habitat and microclimate. This suggests that the subsurface structure allows the retention of rainfall in a perched water table separate from the deep groundwater. This is also supported by local accounts of clean water flow down Long Gully, appearing and continuing for some time, following the 1989 earthquake.

c. Flora

Only one threatened flora species, *Tetratheca juncea*, was reported from the Atlas of NSW Wildlife database for an area within 5 kilometres of the boundary of EL5497, an area larger than the proposed Abel Underground Mine area.

Over 350 species of flora were identified during the field assessment. The full list can be found in Appendix J. Table 16 lists the significant species found during this investigation and Figure 6.7 shows the location of these species in the investigation area.

Table 16 Significant plant species found across the investigation area.

Species	**Status**	**Description**	**Habitat**
Arthropteris palisotii	E	A climbing fern	One plant found in the Long Gully Sub-tropical Rainforest
Tetratheca juncea	V, C	A small wiry generally leafless plant with pink flowers	Restricted to the Smooth-barked Apple (MU30) vegetation
Eucalyptus fergusonii	R (2RC-)	An ironbark	MU15 and MU12
Callistemon shiressii	R (3RC-)	A small paper bark tree with small cream 'bottle brush' flowers	Moist gullies (MU5) and rises (MU12)

KEY: C = vulnerable Commonwealth EPBC Act, E = endangered NSW TSC Act, V = vulnerable NSW TSC Act, R = rare ROTAP (Briggs & Leigh 1995), 2RC- = geographic range <100k Rare Conserved but numbers unknown, 3RC- as for 2RC- but geographic range >100k.

d. Fauna

The results of a database search of the Atlas of NSW Wildlife for an area within 5 kilometres of the boundary of EL5497, are shown in Table 17.

Table 17 Threatened Fauna Species recorded within 5km Radius of EL5497

Family	Species	Common Name	Status
Frogs			
Hylidae	*Litoria aurea*	*Green and Golden Bell Frog	E1
Birds			
Acanthizidae	*Pyrrholaemus sagittatus*	Speckled Warbler	V
Accipitridae	*Hamirostra melanosternon*	Black-breasted Buzzard	V
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V
Anatidae	*Stictonetta naevosa*	*Freckled Duck	V
Anseranatidae	*Anseranas semipalmata*	*Magpie Goose	E1
Ardeidae	*Botaurus poiciloptilus*	*Australasian Bittern	V
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V
Ciconiidae	*Ephippiorhynchus asiaticus*	*Black-necked Stork	V
Climacteridae	*Climacteris picumnus*	Brown Treecreeper	V
Columbidae	*Ptilinopus magnificus*	Wompoo Fruit-Dove	V
Haematopodidae	*Haematopus longirostris*	*Pied Oystercatcher	V
Jacanidae	*Irediparra gallinacea*	*Comb-crested Jacana	V
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subsp.)	V
Meliphagidae	*Xanthomyza phrygia*	Regent Honeyeater	V
Petroicidae	*Melanodryas cucullata*	Hooded Robin	V
Psittacidae	*Lathamus discolor*	Swift Parrot	E1
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V
Rostratulidae	*Rostratula benghalensis australis*	*Painted Snipe (Australian subspecies)	E1
Strigidae	*Ninox connivens*	Barking Owl	V
Tytonidae	*Tyto novaehollandiae*	Masked Owl	E1
Marsupials			
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V
Phascolarctidae	*Phascolarctos cinereus*	Koala	V
Megachiropteran Bats			
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V
Microchiropteran Bats			
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V
Molossidae	*Mormopterus norfolkensis*	Eastern Freetail-bat	V
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V
Vespertilionidae	*Miniopterus australis*	Little Bentwing-bat	V
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bent-wing Bat	V
Vespertilionidae	*Myotis adversus*	Large-footed Myotis	V
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V

E1-Engangered, V-Vulnerable as per Schedule 2 of the *Threatened Species Assessment Act 1995.* * Species dependant on the Pambalong Nature Reserve or similar habitat.

During the field investigation a family of Powerful Owls (*Ninox strenua*), including adults and fledged young, were found in the rainforest gully at the southern part of the investigation area and a Sooty Owl (*Ninox tenebricosa*) was found in the Long Gully rainforest. A full list of fauna species considered likely to be present in the various habitat types across the area is provided in Appendix J.

iii. Impact Assessment

Vegetation in the areas of dry forest on ridges and slopes would not be impacted by surface subsidence. The populations of *Tetratheca juncea* would not be placed at risk by changes in ground level and there would be no impact on the fauna of the area.

Subsidence impacts that could be detrimental to the rainforest gullies include cracking of the bedrock structures in the gully floor resulting in downward diversion of the ground water, collapse and sliding of rock structures at the edges of the rainforest resulting in physical damage to the forest and invasion of open and disturbed areas by Lantana. To minimise these potential impacts, subsidence in the Schedule 2 creeks, around where the rainforest has developed will be limited by minimising disturbance of the creekline and reducing the risk of rock fall from the associated clifflines. The Statement of Commitments (Section 7) provides a commitment to protect Schedule 2 creeks and clifflines. The majority of rainforest areas are located adjacent to these creeks and clifflines and therefore will be protected in the same manner.

6.7.4 Pambalong Nature Reserve

The Pambalong Nature Reserve (refer Figure 6.9) is a wetland reserve approximately 35 hectares in area located on the western side of the F3 freeway, 2km north of Minmi. This reserve receives the runoff from major catchments on the east of the Black Hill range, as well as from Blue Gum Creek which carries runoff from Sugarloaf Range to the south. Overflow from the swamp subsequently drains east across the Hexham floodplain.

The Pambalong Nature Reserve Draft Plan of Management (DEC 2004) describes the reserve as being an important habitat for Latham's Snipe, a migratory bird protected under the JAMBA and CAMBA agreements which are agreements between the Commonwealth of Australia and the Japanese and Chinese governments for the protection and conservation of migratory birds. Appendix J lists 60 species of bird recorded at the reserve by various bird observers over the period 2001 – 2006. This list contains three species listed as vulnerable in the NSW TSC Act:

- *Irediparra gallinacea* (Comb-crested Jacana);
- *Stictonetta naevosa* (Freckled Duck); and
- *Anseranas semipalmata* (Magpie Goose).

Keith and Scott (2005) note that the reserve contains two endangered ecological communities:

- Swamp Oak Floodplain Forest; and
- Freshwater Wetlands on Coastal Floodplains.

Alteration to the Natural Flow Regimes of Rivers, Streams, Floodplains & Wetlands is a key threatening process listed in the schedules of the NSW TSC Act. The mine plan has excluded Pambalong Swamp and included a buffer area around it where mining will be excluded. Any potential impact could only arise from an alteration to the water flow into the reserve. Any potential impact could only arise from an alteration to the water flow into the reserve.

The Subsidence Impact Assessment (refer Section 6.2.7) notes that the subsidence in the Schedule 2 creeks will be kept to a level where the integrity of the creek bed is protected. Consequently it is expected that loss of water flowing into the reserve as a result of the underground mining will be very unlikely.

6.7.5 Conclusion

The ecological investigation has found that there would be no impact on threatened species or endangered ecological communities resulting from the construction and operation of the Abel Underground Mine and the use and expansion of the Bloomfield CHPP.

6.8 European Heritage

A review of European heritage registers identified that an elevated corridor of land in the south-eastern section of the proposed Abel Underground area, near Pambalong Nature Reserve, associated with the former Richmond Vale Railway, is listed by Cessnock City Council. The listing is in Schedule 3 'Items of the Environmental Heritage' as part of Cessnock City Council's Local Environmental Plan 1989. The listing is for *'all earthworks, structures and ancillary equipment along the Richmond Vale Railway formation including a corridor of land 100 metres wide centred on the railway trackbed centreline.'* (Cessnock City Council, 2006).

The subsidence impact assessment (Appendix E) identifies the railway corridor and notes that the majority of the railway corridor appears to be located above the proposed surface protection barrier for Blue Gum Creek, a Schedule 2 creek that has a subsidence management commitment. Potential damage from subsidence of the railway corridor, in consideration of tilts and strains, is considered by the subsidence impact assessment to be negligible.

6.9 Aboriginal Heritage

6.9.1 Introduction

The proposed Abel Underground Mine has been subject to an Aboriginal Heritage Assessment by South East Archaeology with reference to the draft Department of Environment and Conservation (NSW) (DEC) *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*, as specified in the Director-General of the Department of Planning's Environmental Assessment Requirements. This assessment has also involved reference to the DEC *Interim Community Consultation Requirements for Applicants* policy and the DEC *Aboriginal Heritage Standards and Guidelines Kit.* A detailed Aboriginal heritage assessment report is presented in Appendix K and summarised as follows.

6.9.2 Study Objectives and Scope

The objectives of this assessment were to:

- Identify important Aboriginal heritage issues and the relevant performance criteria;
- Outline the methodology and results of impact modelling;
- Analyse whether or not the impacts meet the relevant performance criteria; and
- Identify management and mitigation measures and any residual impacts after their implementation.

The heritage assessment involved:

- Research into the environmental, cultural, historical and archaeological background of the heritage investigation areas;
- Searches of the DEC Aboriginal Heritage Information Management System (AHIMS) and other relevant heritage registers such as the State Heritage Register, Register of the National Estate, National Heritage List and Commonwealth Heritage List, along with the Maitland, Cessnock and Newcastle Local Environmental Plans and the Hunter Regional Environmental Plan;
- Development of a predictive model of Aboriginal site location for the heritage investigation areas;
- Field survey of areas to be disturbed by surface infrastructure;
- Reconnaissance inspection of the underground lease area in order to refine the predictive model;
- Consultation with the local Aboriginal community; and

- Preparation of a report outlining the results of the investigation.

6.9.3 Aboriginal Heritage Evidence

The names and locations of Aboriginal heritage evidence within the investigation area are marked on Figure 6.10 as best can be determined from the available evidence. This is based on information about previous recordings contained in archaeological reports, the DEC AHIMS register and DEC site records, along with information recorded during field inspections by South East Archaeology.

Approximately 38 Aboriginal heritage sites are present within the heritage investigation areas, including approximately 17 within the area north of John Renshaw Drive and approximately 21 within the underground lease area south of John Renshaw Drive. The identified sites comprise approximately 33 stone artefact occurrences (ie. open artefact scatters and 'isolated artefacts'), four grinding groove sites (including one with an associated artefact scatter) and one scarred tree. Apart from one grinding groove site, the remainder of the sites within the northern investigation area are artefact occurrences. The southern investigation area hosts three grinding groove sites and a single scarred tree, with the remaining evidence comprising artefact occurrences. No Aboriginal heritage sites are listed within the investigation area on other heritage registers or planning instruments.

At least two places that may be of traditional or historical cultural significance to Aboriginal people, but do not necessarily host physical remains, occur within the southern investigation area. These comprise an Aboriginal pathway along Black Hill Spur that probably extended from Hexham Swamp to Mount Sugarloaf and a ceremonial site known as 'the Doghole' in the vicinity of Stockrington and Long Gully.

Although the investigation area north of John Renshaw Drive, which is mainly contained within the active mine leases of Donaldson and Bloomfield mines, has been comprehensively sampled, inspections within the southern investigation area, where underground mining will occur, have been confined to general reconnaissance and limited direct sampling in order to refine a predictive model of Aboriginal site location. More detailed inspection of the underground lease area is proposed as a staged process in advance of underground mining.

6.9.4 Predictive Model

A predictive model of Aboriginal site location has been constructed and refined through a reconnaissance inspection of the southern investigation area. The predictive model indicates that stone artefact evidence is likely to occur in a widespread distribution of variable density across virtually all landform units within the investigation area. Other types of heritage evidence are known to occur or have some potential to occur within the southern investigation area, particularly ceremonial sites, cultural sites of significance, grinding grooves, lithic quarries, rock shelters, shell middens and scarred trees.

The significance of Aboriginal heritage evidence, including scientific, cultural, educational, historic and aesthetic values, can be assessed against a range of criteria commonly used in Aboriginal heritage management. Scientific value involves assessment of the potential usefulness of the heritage evidence to address further research questions (research potential), the representativeness of the evidence, the nature of the evidence and its state of preservation. Cultural significance refers to the contemporary, historic or traditional value placed upon the evidence by the local Aboriginal community. The significance of Aboriginal heritage sites recorded within the investigation areas will be assessed prior to any impacts occurring, as specified in the Aboriginal Heritage Management Plan. Further consultation with the Aboriginal community will be undertaken to establish the level of cultural significance of the identified evidence. This will assist in determining the specific management strategies that can be implemented for individual heritage sites.

6.9.5 Consultation

Consultation has been undertaken and is ongoing with the local Aboriginal community, with reference to the DEC *Interim Community Consultation Requirements for Applicants* policy. This has involved a formal consultation procedure with various government agencies and Aboriginal groups, along with media advertisements, to seek initial registrations of interest in the project. Field inspection of the northern investigation area and reconnaissance inspection of the southern investigation area has been undertaken with representatives of the Mindaribba and Awabakal Local Aboriginal Land Councils. All registered stakeholders were forwarded a detailed statement of the project methodology for comment and were invited to attend an inspection of the area. Copies of the draft report were forwarded to Aboriginal stakeholders and their comments sought and addressed.

The *National Parks and Wildlife Act 1974* (NP&W Act) provides the primary basis for the legal protection and management of Aboriginal heritage sites within NSW. The Act provides various controls for the protection, management and destruction of Aboriginal objects. Under the Part 3A Major Project amendments to the *Environmental Planning and Assessment Act 1979* (EP&A Act), subsequent to approval being granted, Section 90 Consent under the NP&W Act may not be required to impact Aboriginal objects. However, a detailed Statement of Commitments is provided in relation to this project and outlines proposed heritage management and mitigation measures to ensure that there is no significant impact on Aboriginal heritage sites and that appropriate consultation occurs in relation to them.

6.9.6 Potential Impacts

Impacts of the proposal on Aboriginal heritage may occur in two distinct ways: directly through construction, maintenance or use of surface facilities, and indirectly, through mining induced subsidence.

Proposed surface impacts will largely be confined to narrow corridors or areas within the northern investigation area. Most impacts will be confined to the existing approved open cut mine limit or existing areas of ground disturbance in which the potential for heritage evidence is negligible. However, where impacts do occur to ground in which there are identified stone artefacts or potential for stone artefacts to occur (ie. less disturbed land), mitigation measures will be implemented to reduce potential impacts. Mitigation measures will also be implemented to reduce the risk of potential impacts to the single grinding groove site or any further grinding groove sites that may be identified along Four Mile Creek.

Impacts from underground mining in the area south of John Renshaw Drive are limited to mining induced subsidence which could affect two forms of heritage evidence, rock shelters and grinding groove sites, through cracking and/or rock fall. The potential impact of subsidence on other site types is assessed as generally low. Mitigation measures will be implemented to ensure that there is no significant impact to these forms of heritage evidence.

6.9.7 Management and Mitigation Measures

Management and mitigation measures proposed to minimise the potential impacts of Project Abel on Aboriginal heritage are outlined as follows. The key measures include:

- An Aboriginal Heritage Management Plan will be implemented in consultation with the relevant Aboriginal stakeholders to specify the policies and actions required to mitigate and manage the potential impacts of the proposal on Aboriginal heritage. The plan includes procedures for ongoing Aboriginal consultation and involvement, maintenance of an Aboriginal site database, management of recorded sites within the investigation area, further archaeological investigation prior to undermining, identification and management of previously unrecorded sites (including skeletal remains) and a programme of monitoring. The plan will be regularly verified to establish that it is functioning as designed (ie. policies adhered to and actions implemented) to the standard required;
- Continued use of surface infrastructure and construction of new surface infrastructure will be assessed against the location of identified Aboriginal heritage evidence and where impacts may occur, mitigation measures will be implemented as specified in the Aboriginal Heritage Management Plan. Donaldson will seek to *minimise* impacts to identified and potential Aboriginal heritage evidence within the northern investigation area and to conserve identified evidence where impacts are not required to occur for operational reasons. Donaldson will seek to *mitigate* impacts to identified and potential Aboriginal heritage evidence within the northern investigation area where impacts must occur for operational reasons;
- Staged systematic archaeological survey of each section proposed to be undermined in the southern investigation area will occur with the participation of the Aboriginal stakeholders prior to any underground

mining in that section. The survey will sample the geographic extent of each section. The nature, level of integrity, potential impacts and scientific and cultural significance of any evidence identified will be assessed in consultation with the Aboriginal stakeholders and mitigation measures implemented as per the Aboriginal Heritage Management Plan;

- Where site types susceptible to subsidence impacts (grinding grooves and rock shelters) are identified within the southern investigation area, an assessment of the potential impacts of subsidence will be undertaken by an appropriately qualified expert. Where it is determined that subsidence may impact a grinding groove or rock shelter site (including shelters with 'Potential Archaeological Deposits') mitigation measures will be designed and implemented to ensure that there is no significant impact to that site;
- An integrated monitoring network for Aboriginal heritage across the Abel, Tasman, Donaldson and Bloomfield sites will be established, including continuation of the existing programme of monitoring in the Donaldson Bushland Conservation Areas, monitoring before and after undermining for a sample of Aboriginal sites within the southern investigation area for which it is not anticipated that subsidence related impacts will occur, monitoring before and after undermining for all Aboriginal sites for which it is inferred that undermining may result in impacts in order to ensure the adequacy of conservation measures around those sites, and documentation of the results of all monitoring in an annual report; and
- Donaldson will continue to consult with and involve the registered Aboriginal stakeholders, particularly the Local Aboriginal Land Councils, in the ongoing management of the heritage resources within the investigation area as per the Aboriginal Heritage Management Plan.

After implementation of these management and mitigation measures, it is concluded that the risk of any significant impact to Aboriginal heritage from Project Abel is low.

6.10 Waste

Waste was identified as a key issue by the Department of Planning Director-General's requirements. The main waste product to be produced by the proposed Abel Underground Mine is tailings and coarse reject, which will be produced when the run-of-mine coal is processed at the Bloomfield Coal Handling and Preparation Plant (CHPP). A detailed description and assessment of the disposal methods for these items is provided in Section 2.9 and Appendix F. This assessment calculated that for the 2 production scenarios developed, coarse reject/tailings will be in the vicinity of 24.2 million cubic metres or 15.4 million cubic metres. For both these scenarios there is sufficient capacity to accept all reject and tailings material over the anticipated life of all four mines (Tasman, Donaldson, Abel and Bloomfield) that contribute to the Bloomfield CHPP.

Coarse reject and tailings will be disposed to various Bloomfield Colliery areas including pumping underground into the Big Ben seam and into the remaining open cut pits, including U Cut North, U Cut South, Creek Cut and S Cut (final). Disposal of coarse reject and tailings into these open cut areas will assist with

rehabilitation and final landform of these areas, as described in the Bloomfield Colliery Mining Operations Plan.

Other wastes that will be produced by the Abel Underground Mine and associated surface facilities, including the Bloomfield CHPOP, include general mine waste such as broken or superseded equipment, packaging, used oils and general office and employee waste. There will also be wastewater produced by the bathhouse and other amenities. The management of wastewaters is described in Appendix F. General waste management will be in accordance with existing Donaldson and Bloomfield procedures. Existing Donaldson procedures will be expanded to include the Abel operations. Waste management is further described in Section 8.11.

6.11 Traffic and Transport

A Traffic and Transport Assessment prepared by Connell Wagner is provided in Appendix L. The Abel Underground Mine will have minimal impact on the local road network as no coal will be hauled on public roads. The existing Bloomfield Coal Handling and Preparation Plant (CHPP) that will be used for the processing is accessed via existing private haul roads within the Donaldson open cut mine and Bloomfield colliery areas. A conveyor system will be constructed to convey coal from the mine portal north of John Renshaw Drive to the Bloomfield CHPP when economically viable to do so. The existing rail loading facility will also be used, so no trucks will be used to haul coal to the Port of Newcastle. Given these factors, traffic and transport was allocated a low environmental risk rating by the risk assessment undertaken for the project.

The traffic and transport assessment for the proposal determined employee and general delivery numbers for the mine and access requirements, and assessed the impact of this on the road network, as well as road safety and efficiency/performance of the intersections proposed to be used.

Operation of the Abel Mine is expected to generate a maximum of 560 vehicular trips per day on to the existing road network. This trip generation will be via the Donaldson Access intersection on John Renshaw Drive, approximately 2km west of the F3 Freeway / Weakleys Drive roundabout. This intersection is due to be completed by the end of June 2006 and is designed to be a high standard channelised t-intersection with long deceleration and acceleration facilities for traffic entering and leaving the Donaldson Mine access.

The impact of the 560 additional trips on key roads in the Beresfield / Thornton area has been assessed as negligible, with increases below 1% on most roads representing less than one year of natural growth rates which are currently in the order of 6%. The exception to this is John Renshaw Drive east of the access intersection where a 6.9% increase in traffic can be expected before the increase is dissipated to other roads with higher base volumes. The increase on John Renshaw Drive is unlikely to have any noticeable impact on the capacity and road safety of that section of road or the operation of the roundabout intersection at the northern end of the F3 Freeway.

Consideration of the future operating performance of the Donaldson/Abel Mine access intersection has been undertaken with the following inputs:

- Continued natural traffic growth on John Renshaw Drive at 3%p.a.
- Continuation of Donaldson Mine operations until 2011.
- Road haulage of coal from the Tasman Mine commencing in 2006 and continuing until 2017.
- Abel Mine operational as early as 2007 and continuing to 2017 and beyond.
- Inclusion of some traffic from the Ashtonfield site (as per earlier NTPE Traffic Study) after 2012 but before 2017.

The results derived from a series of operating scenarios confirm that the through traffic movements and overall intersection performance would be satisfactory to 2017 and beyond. This analysis has not considered any major functional change to the status of John Renshaw Drive within the National Highway and State Road networks.

Delays arising for traffic entering and exiting the access intersection have been calculated and these are generally satisfactory, with LoS B or LoS C for most turning movement scenarios. The exceptions are potentially significant delays for right turns out of the access intersection, heading west on John Renshaw Drive. These calculated delays can be reduced by re-direction of potential traffic from the futuristic Ashtonfield development to a dedicated access facility elsewhere on John Renshaw Drive.

As a result of these analyses it is concluded that the future operation of the proposed Abel Mine is unlikely to have an adverse impact on the existing road network or the key access intersection to the internal site infrastructure and surface facilities. The access to the proposed mine from John Renshaw Drive would perform adequately under all operating scenarios for at least ten years after a possible mine opening next year, that is up to 2017.

6.12 Visual Aspects

A visual impact assessment has been undertaken for the Abel Underground Mine project and is provided as Appendix M. Due to the nature of underground mining, and the minimal disturbance of the surface due to the use of existing surface facilities, the environmental risk rating for visual disturbance allocated by the Preliminary Assessment was low.

The visual impact assessment provides details of all proposed surface facilities, including the ventilation shaft south of John Renshaw Drive, surface facilities and ancillary items north of John Renshaw Drive, the internal haul road and overland conveyor system, and proposed changes to the Bloomfield Coal Handling and Preparation Plant (CHPP). It also provides details of the existing visual amenity of the area and surrounds, and identifies all potential viewpoints, including Black Hill ridge and Ashtonfield.

The visual impact assessment notes that the nature of underground mining is such that any visual impacts are generally associated with obtaining access into the mine, with surface transport systems and with the coal processing infrastructure, rather than with the mine itself. In the case of the Abel Underground Mine, a significant portion of the required surface infrastructure is already present on the Donaldson Mine Lease, and any additional infrastructure and works can easily be accommodated on land already disturbed by the Donaldson Open Cut Mine. Further, the siting of additional infrastructure required for the Abel Mine is such that it would either not be visible from surrounding areas at all, or would only be perceptible as a modification to the existing mining infrastructure.

The mitigation of visual impacts associated with existing mining operations as a part of the Abel Underground Mine would contribute towards an improvement of existing visual impacts from the Bloomfield Coal Handling and Processing Plant.

Overall, the proposal to mine coal underground would not noticeably alter the visual environment of either the underground mining area or of surface study area within the existing Donaldson Mine Lease. The visual impacts of the proposed works, as assessed by the detailed visual impact assessment, confirmed that the environmental risk rating is low.

6.13 Cumulative Impacts

The proposed Abel Underground Mine will interact with the nearby Tasman Underground Mine, Donaldson Open Cut Mine, Bloomfield Mine and Bloomfield Coal Handling and Preparation Plant (CHPP) and rail loading facility. The Abel Underground Mine will utilise existing areas of disturbance within Donaldson Open Cut Mine to house surface infrastructure. Existing haul roads within Donaldson Open Cut Mine will also be used. The intersection north off John Renshaw Drive will be shared between Abel Underground and Donaldson Open Cut Mine employees and Tasman Mine haul trucks.

Consent for Donaldson Open Cut Mine expires in 2012 and potential impacts are associated with the operation of both Abel Underground Mine and Donaldson Open Cut Mine together. These include aspects such as air quality, noise and water management. These potential cumulative impacts have been examined in detail by each of these studies. These studies note that no criteria will be exceeded even when both mines are operating, except for a 1 dBA noise exceedance predicted to occur at night-time during a prevailing north west wind at one residential location. This residence has an existing agreement between the owner and Donaldson.

Tasman and Abel Underground Mines will both utilise the Bloomfield CHPP and rail loading facility. Impacts associated with the combined use of this facility by these and any other mines have been assessed and this continued use and expansion of the Bloomfield CHPP is part of the project being assessed by this EA. In particular the Water Management Study (Appendix F) has designed a detailed water management scheme that integrates all current and future operations north of John Renshaw Drive to ensure water quality and quantity goals can be met.

An Integrated Monitoring Network (refer Section 8.15) has been developed to reduce duplication of monitoring on the existing Tasman and Donaldson Mines, proposed Abel Underground Mine and at the Bloomfield CHPP. The Integrated Monitoring Network will also enable data sharing and introduce new monitoring points that may have previously been located between sites. This Integrated Monitoring Network is a key aspect of the proposed Abel Underground Mine proposal as it enables a more detailed 'picture' of the sub-regional environment to be gained and reporting to address issues across the whole sub-region from Mount Sugarloaf to Ashtonfield, rather than focussing on individual mine site issues. This Integrated Monitoring Network will better monitor cumulative impacts from the four mine sites.

7 STATEMENT OF COMMITMENTS

The Director-General's requirements for the Abel Underground Mine project require that the Part 3A Environmental Assessment for the project include a Statement of Commitments which details the measures proposed by Donaldson Coal Pty Ltd ('**the Company'**) for environmental mitigation, management and monitoring of the proposed project. The Director-General specified the requirement for a Statement of Commitments in the Environmental Assessment Requirements for the project in accordance with Section 75F(6) of the *Environmental Planning and Assessment Act 1979*.

If approval is granted under Part 3A of the *Environmental Planning and Assessment Act 1979* the Company will commit to the following controls for construction and operation of the proposed Abel Underground Mine.

0. General	The Applicant shall carry out the development generally in accordance with the: (a) Abel Underground Mine Part 3A Environmental Assessment. If there is any inconsistency between the conditions of this Statement of Commitments and a document listed above the conditions of this Statement of Commitments shall prevail to the extent of the inconsistency.
1. Production	1.1 No more than 4.5 million tonnes of ROM coal a year will be mined from the Abel Underground Mine. 1.2 No more than 6.5 million tonnes of ROM coal a year will be processed at the Bloomfield CHPP. 1.3 No more than 5.0 million tonnes per annum of product coal will be transported on the Bloomfield Rail Loop.
2. Hours of Operation	2.1 The Abel Underground Mine will operate 24 hours per day, seven days per week. 2.2 The Bloomfield CHPP will operate 24 hours per day, seven days per week. 2.3 The Bloomfield Rail Loop will operate 24 hours per day, seven days per week.
3. Noise	**3.1 Construction Activities** The following noise control measures will be implemented prior to commencement of construction of the Abel Underground Mine or the upgrade of the Bloomfield CHPP;

	(a) Maintain all machinery and equipment in working order; (b) No construction activities at the Abel pit top will take place on Sundays or Public Holidays; (c) Where possible locate noisy site equipment behind structures that act as barriers or at the greatest distance from noise sensitive areas; (d) Orient equipment so that noise emissions are directed away from noise sensitive areas; **3.2 Noise Control Measures** (a) The following noise control measures will be implemented prior to the mining of coal from the Abel Underground Mine: • orientation of the ventilation fan towards the north-west, away from residential receivers and angle the output parallel to the ground. • The sound power level of the front end loader to be used near the portal should not exceed 113 dBA and will be fitted with a noise sensitive reversing alarm. (b) The following noise control measures will be implemented prior to the Bloomfield CHPP receiving any ROM coal from the Abel Underground Mine: • Noise mitigation works including partial enclosure and noise screening of drives and conveyors of the Bloomfield CHPP to screen residences to the north of the site. **3.3 Monitoring** Within 6 months of this approval being granted a Noise Monitoring Program shall be prepared and implemented for the Abel Underground Mine and the Bloomfield CHPP, to the satisfaction of the Director-General. The Noise Monitoring Program shall include a combination of real-time and supplementary attended monitoring measures, and a noise monitoring protocol for evaluating compliance with the noise environmental assessment. This plan will be integrated with the monitoring plans for the Tasman, Donaldson and Bloomfield Mines to provide a single integrated Noise Monitoring Program for all 4 mines. **3.4 Continuous Improvement** The Company shall: (a) report on these investigations and the implementation of any new noise mitigation measures on site in the AEMR, to the satisfaction of the Director-General.

	The operator of the Bloomfield CHPP shall: (b) investigate ways to reduce the noise generated by the Bloomfield CHPP, including maximum noise levels which may result in sleep disturbance; (c) implement all reasonable and feasible best practice noise mitigation measures on the site; and (d) report on these investigations and the implementation of any new noise mitigation measures on site in the AEMR, to the satisfaction of the Director-General.
4. Air Quality	**4.1 Construction** The following actions shall be adopted in relation to dust control on the site during construction of the proposed Abel Underground Mine and the modifications to the Bloomfield CHPP: • Minimise the area to be disturbed; • Progressively rehabilitate disturbed areas as soon as practicable; • Restrict vehicle movements to specified routes; • Provide speed limited signage around the mine site; • Dust suppression using water sprays; • Commence landscaping as soon as practicable; • Install dust gauges to monitor dust deposition levels at sensitive receptors. A minimum of 11locations are proposed. **4.2 Air Quality Control Measures** (a) The following actions would be adopted in relation to dust control on the site during operation of the proposed Abel Underground Mine and the operation of the Bloomfield CHPP: • All mobile equipment will be maintained in good working order to limit exhaust fumes. • Regular watering of all roads; • Use water sprays periodically on open stockpile areas and regular visual inspection will be undertaken and water sprays activated as required. (b) Dust emissions generated by the Abel Underground Mine and the Bloomfield CHPP will not exceed any statutory limits. (c) Dust control on site is to be aimed at prevention of air pollution and prevention of the degradation of local amenity. (d) Dust controls on the site will comply with all relevant NSW DEC guidelines and any applicable Environment Protection

	Licence issued under the POEO Act 1997. (e) Regular inspections for excessive visible dust generation will be undertaken and appropriate controls will be implemented when such events occur. This will include ceasing operations during high wind conditions if necessary to ensure effective dust control. **4.4 Monitoring** (a) Within 6 months of the grant of this approval a Air Quality Monitoring Program shall be prepared and implemented for the Abel Underground Mine and the Bloomfield CHPP, to the satisfaction of the Director-General. The Air Quality Monitoring Program shall include a combination of real-time and supplementary attended monitoring measures (including real-time air quality monitoring for 24-hour average PM10 and the recording of required meteorological monitoring data) and an air quality monitoring protocol for evaluating compliance with the air quality environmental assessment. This plan will be integrated with the existing monitoring plans for the Tasman, Donaldson and Bloomfield Mines to provide a single integrated Air Monitoring Program for all 4 mines. (b) Within 6 months of this approval, the Company shall ensure that there is a suitable meteorological station operating in the vicinity of the development in accordance with the requirements in Approved Methods for Sampling of Air Pollutants in New South Wales.
5.Surface Water Management - Abel Underground Mine	**5.1 Schedule 1 streams** (a) Schedule 1 streams (as defined in the DIPNR 2005 guideline, "Management of stream/aquifer systems in coal mining developments") will be managed via the implementation of mitigation and remediation works where needed to ensure that: • stream stability is maintained where subsidence occurs • stream fractures are minimised • stream channels are maintained with minimal incision from bed grade change stream bed grade change minimised to provide stable stream length (b) Where any stream stability controls are required they will be designed in accordance with the *Rehabilitation Manual for Australian Streams* (Land and Water Resources Research and Development Corporation, 2000) and will be provided primarily by vegetation.

5.2 Schedule 2 streams

(a) Schedule 2 streams (as defined by DIPNR, 2005) will be managed so as to ensure that:

- they maintain pre-mining course, and maintain bed channel gradients which do not initiate erosion;
- they maintain pool riffle sequences where they pre-existed, or have pool riffle sequences installed where appropriate;
- they maintain connectivity to underground workings, and flow loss to fracture zones in similar levels to pre-mining;
- they maintain geomorphic integrity of the stream;
- the ecosystem habitat values of the stream are protected;
- no significant alteration of the water quality occurs in the stream.

(b) The above commitments for Schedule 2 streams will be achieved by:

- the provision of a minimum barrier of 40m between the 20 millimetre line of subsidence and the bank of any Schedule 2 streams; or
- the carrying out of further detailed studies and the development of a Surface Water Management Plan for the Abel Underground Mine which clearly demonstrates that the above commitments can be met prior to any mining occurring which will impact on any Schedule 2 streams.

5.3 Pambalong Alluvium

For the lower reach of Blue Gum Creek (from the confluence of Long Gully and Blue Gum Creek downstream), a buffer will be provided which provides for no more than 20mm of subsidence at 40m from the edge of the alluvium will be adopted, and within the buffer zone no significant subsidence will occur.

5.4 Rainforest Communities

Subsidence in the rain forest protection zones identified on Figure 2.2 will be limited to 20mm of subsidence at the edge of the zone identified unless further studies can demonstrate that there will be no significant impact on the rainforest communities within the buffer zone with greater subsidence impacts.

5.5 Surface Water Management Plan

Prior to mining occurring that will impact on any Schedule 1 streams the Surface Water Management Plan for the Abel Underground Mine will be developed so as to address the following in relation to schedule 1 streams:

	• detailed identification of risk factors on a case-by-case basis; • setting up of permanent monitoring locations along watercourses as well as regular inspection regimes; • continuation of baseline data collection on water flow conditions and health indicators (such as macro-invertebrates); • establishment of trigger levels that will be used to assess whether any changes observed through monitoring warrant responsive action; and • details of responsive and remedial action to be undertaken if required. • require the identification of any existing degradation in the streams prior to mining to allow differentiation of that degradation induced by the mining. • provide for a post-mining assessment of any streams within the area of mine subsidence within six (6) months of the initial subsidence. • provide for a subsequent assessment within eighteen (18) months of the initial subsidence to confirm that post-mining degradation resulting from the mining is successfully remediated. • require any remediation works to be implemented to a standard approved by DNR, where the assessment has indicated degradation of the streams in the area of mining induced subsidence, and thereafter on an annual basis until any mining induced stream instability is addressed to the standard approved. • require a photographic record of stream stability for areas where either fracturing is detected (at maximum strain points), or at maximum tilts within the subsidence envelope. Where it is proposed not to leave a barrier around a Schedule 2 stream a detailed assessment will be undertaken for the stream and provided to DNR addressing the proposed impacts on it. The detailed assessment will include as a minimum: • assessment of the geomorphic and vegetation condition and aquatic habitat for the stream; • selective measurements of channel boundary sediment size; • predications of subsidence and cracks/fractures throughout the stream; • a detailed photographic record of the existing stream condition; • a map of the spatial distribution of alluvium and colluvial aprons throughout the stream; • collection of background data for the main areas of alluvium for the shallow alluvial aquifer by the installation and regular monitoring of a network of piezometers and/or wells in the main areas of alluvium for the shallow alluvial aquifer; • assessment of the location and activity of springs, pipes/tunnels and/or salt seepages/efflorescences;

	• measurement of current bed slope and any pool-riffle sequences on each channel and periodic assessments of changes over time; • an assessment of likely erosion points, fracturing or seepage zones from the mining area to the stream, along the stream channel occurring as a result of mining activities. • an assessment of any required remedial works on the affected stream, including: - options considered for the remediation program - anticipated lifetime of the remedial works - details of the engineering design or process for engineering - design of the remediation works - long term remediation requirements, including revegetation. • details of the proposed monitoring regime. It will provide for: - post-mining assessment, to a standard approved by DNR, within six (6) months of the initial subsidence. - provide for a subsequent assessment within eighteen (18) months of the initial subsidence to confirm that post-mining degradation resulting from the mining is successfully remediated. Following consultation with DNR on the above assessment for each schedule 2 stream the Surface Water Management Plan for the Abel Underground Mine will be developed to implement the findings of the above assessment.
6. Surface Water Management – Bloomfield CHPP and the Abel Underground Pit Top Facilities	6.1 Separate surface water management systems will be designed for the Bloomfield CHPP and the Abel Underground Pit Top Facilities which provide for: • Separation of clean and dirty water; • Management and control of stormwater flows; • Minimisation of sediment generation, soil erosion and transport off site; • Recycling of water where to minimise demand for potable water; and • Provision of water for fire fighting. • Maintain water supply for the coal handling and preparation plant and for dust suppression at all times; • Achieve zero discharge to the environment from Big Kahuna; • Minimise discharge from the Stockpile Dam; • Minimise discharge from Lake Foster and Lake Kennerson; • Where controlled discharge is necessary, preference is given to Lake Kennerson.

	6.2 The surface water management systems shall be based on the following principles: • Minimise demand for fresh water supply by recycling water collected on the site; • Store recycled water on site to reduce water consumption during operation of the proposed development; • Design drainage and sediment control for the operation in accordance with the Landcom (2004) guidelines; • Provide a water supply for fire fighting and provision for containment of firewater; • Use of a first flush system to ensure "dirty" water is captured in accordance with DEC guidelines. 6.3 The surface water management systems will include an Erosion and Sediment Control Plan (ESCP). The ESCP will outline the measures that will be implemented to ensure that no undue pollution of receiving waters occurs during any earthworks construction or during the operation of the facilities. 6.4 The following erosion and sediment control works will be implemented as part of the project: • All works for the Abel box cut and subsequent construction of surface facilities will be undertaken within the boundaries of the existing Donaldson Mine lease area. These activities will be undertaken in accordance with the approved procedures for erosion protection and sediment control for the Donaldson Mine. • The majority of works in the vicinity of the stockpile area for the Bloomfield CHPP will be undertaken within an area that reports to the existing Stockpile Dam and Dam F. These facilities provide adequate erosion and sediment control for those areas. For minor bunding works to be undertaken on the southern boundary of the enlarged stockpile area, standard erosion control practices such as silt fences will be used. • For any earthworks associated with increasing the capacity of the bypass channel around Lake Foster, standard erosion control practices such as silt fences will be used. • If a conveyor is eventually constructed between the Abel box cut and the Bloomfield CHPP, a separate Erosion and Sediment Control Plan will be prepared that takes account of the details of the conveyor, particularly the crossing of Four Mile Creek.
7. Surface Water Monitoring Program	7.1 An integrated surface monitoring program will be undertaking for the Abel Mine, Donaldson Mine and the Bloomfield CHPP covering all potentially affected catchments including Four Mile Creek, Blue Gum Creek and other creeks on the land overlying the Abel underground lease area.

	7.2 Monitoring of surface water in the creeks that overlie the Abel Underground Mine will commence just prior to mining and continue until one year after mining has passed the contributing catchment and will be undertaken at the following locations: • Four Mile Creek at John Renshaw Drive (same as existing Donaldson site); • Weakleys Flat Ck at John Renshaw Drive (same as existing Donaldson site); • Buttai Creek at Lings Road; • Blue Gum Creek at Stockrington Road; and • Long Gully (downstream). 7.3.The following monitoring regime is proposed: • Routine monthly baseline sampling; • Daily water samples collected from the discharge point on any occasion when there is controlled discharge from Lake Kennerson. Water samples will also be collected at the flow gauging station behind the Four Mile Workshops. These samples will be analysed for: total suspended solids, conductivity, pH and filterable Iron; • Daily water samples will be collected from any overflow from the Stockpile Dam. Water samples will also be collected at the flow gauging station behind the Four Mile Workshops. These samples will be analysed for: total suspended solids, conductivity, pH and filterable Iron. • Collection of extensive baseline data prior to mining, including the ability to collect at least 15 years of baseline data for Blue Gum Creek and Pambalong Nature Reserve; • Monthly monitoring during any substantial subsidence period for each monitoring site, and annual monitoring for all sites; • Water quality sampling from each of the sampling locations shown in Figure 8.2 in the EA with analytes measured including pH, Electrical Conductivity, Total Dissolved Solids, Total Suspended Solids, Chloride, Sulfates, Alkalinity (Bicarbonate), Alkalinity (Carbonate), Calcium, Magnesium, Sodium and Potassium; • Flow gauging stations established on Blue Gum Creek to monitor water flow and level; and • Macro-invertebrate monitoring within Blue Gum Creek and Pambalong Nature Reserve, including the use of AUSRIVAS (Australian River Assessment System) to assess biological health.
8. Groundwater Management Plan and Ground Water Monitoring Program	8.1 Within 6 months of the granting of approval an Groundwater Management Plan will be prepared. The Plan will comply with all relevant guidelines and will address: • Groundwater management within the Abel Underground Mine area, including protection, management, mitigation and

	remediation of groundwaters as required; • Groundwater management within the area of proposed tailings disposal within Bloomfield Colliery; • Proposed groundwater monitoring program; • Proposed groundwater reporting schedule; and • Feedback mechanisms to alter mining methods if documented groundwater monitoring values are triggered. 8.2 The following response plan will be implemented in the event of significant unforeseen variances from the predicted inflow rates and/or groundwater level impacts: • Additional sampling and/or water level measurements to confirm the variance from expected behaviour. • Immediate referral to a competent hydrogeologist for assessment of the significance of the variance from expected behaviour. The review hydrogeologist would be requested to recommend an appropriate remedial action plan or amendment to the mining or water management approach. If appropriate, this recommended action plan would be discussed with DNR and other agencies for endorsement. 8.3 The groundwater monitoring program will be an integrated monitoring program for the Abel Mine, Tasman Mine, Donaldson Mine and the Bloomfield CHPP (including the tailings disposal area)_and will include: • Monthly measurement of water levels in a representative network of piezometers. Initially, all piezometers currently available would be monitored, however it is recommended that the representativeness of the piezometers be reviewed after the first two years of the project, and an appropriate suite of piezometers be selected on the basis of this review for ongoing monitoring. All piezometers located around Pambalong Nature Reserve would continue to be monitored through the life of the project. • Quarterly sampling of all standpipe piezometers, for laboratory analysis of electrical conductivity (EC), total dissolved solids (TDS) and pH. • Annual collection of water samples from all standpipe piezometers for laboratory analysis of a broader suite of parameters - Physical properties (EC, TDS and pH) - Major cations and anions - Nutrients - Dissolved metals • Additional sampling and/or water level measurements to confirm any variance from expected behaviour.

	• Additional regional monitoring piezometers will be installed in the following areas: - Multi-level piezometers to the north and west of Pambalong Nature Reserve, to provide additional data on groundwater pressures in the intervening strata between the Donaldson seams and the alluvium (supplementing the existing data from piezometers C081A and B and C082). - Multi-level piezometers along the eastern side of the Abel project area, located at nominally 3 sites between the F3 Freeway and the lease boundary, to resolve the apparent anomalous water levels below sea level at C063A and B, and to provide additional data on groundwater pressures in the intervening strata between the Donaldson seams and the Hexham Swamp alluvium. - Multi-level piezometers near the western and southern boundaries of the Abel project area to provide information on groundwater pressures at various depths, as this area currently lacks monitoring points. These piezometers would also aim to provide information on the current status of groundwater in the West Borehole seam near the former workings, prior to mining of the Donaldson seams approaching that area. • The additional Pambalong and Hexham Swamp monitoring bores will be installed prior to commencement of coal extraction. The western piezometers will be installed at least five years prior to mining reaching that part of the lease. • The subsidence/fracturing monitoring piezometer network should comprise the following: – Multi-level piezometers situated centrally within the extraction panels (at least 2 locations per panel) with vibrating wire piezometers set at nominally 30m intervals from the surface down to 30m above the Upper Donaldson roof level. – Shallow standpipe piezometers adjacent to each of the above multi-level piezometers, set to the base of the colluvium/weathered bedrock zone, to monitor any impact on the surficial unconfined aquifer. Standpipe piezometers will allow repeat hydraulic testing and water quality sampling, as well as water level monitoring. • The above monitoring network will be implemented prior to commencement of each extraction panel, and would be monitored closely before, during and after extraction. Based on the monitoring results during extraction of the first 4 or 5 panels, an appropriate ongoing monitoring program would be developed for the subsequent deeper panels as the mining progresses downdip.

	8.4 At the end of the second year of underground mining, a comprehensive review will be undertaken of the performance of the groundwater system. This would include re-running the groundwater model in transient calibration mode, to verify that the actual inflow rates and groundwater level impacts are in accordance with the model predictions described in this report. If necessary, further adjustment would be made to the model at that time, and new forward predictions of mine inflows and water level impacts be undertaken. 8.5 The current groundwater model will be expanded to include deeper layers and a larger area that will incorporate the Bloomfield operations and areas of possible groundwater impact around Bloomfield. It is proposed to calibrate this expanded model with ongoing monitoring data from Bloomfield, and more detailed simulation of the Donaldson mining and backfilling. Details of this model and scheduling for completion will be included in the Groundwater Management Plan.
9. Visual Amenity	Visual impacts of the Abel Underground Mine portal and the Bloomfield CHPP will be ameliorated by the following strategies: (a) The access portals for the Abel underground Mine will be located in the high wall of the existing Donaldson Open Cut Pit. (b) If the overland conveyor to the Bloomfield CHPP to the Abel Underground Mine portal is constructed its maximum height will not exceed 15 metres so to ensure that it is concealed from view by the surrounding tree cover. Where possible the route will follow the existing haul roads and tree clearing will be minimised where possible to reduce the visual impact of the conveyor. (c) New buildings and structures, as well as existing buildings and structures at the Bloomfield CHPP, visible from the surrounding areas will be painted a dark charcoal colour. (d) All reasonable measures will be taken to design the stockpiles at the Bloomfield CHPP so as to minimise their visual impact on the surrounding East Maitland and Ashtonfield Areas. (e) Existing lighting will be redesigned and new lighting be designed, so as to minimise, via the use of directional lighting, light spill affecting residents in the East Mainland, Ashtonfield Areas and Black Hill areas.
10. Flora and Fauna	A Flora and Fauna Management Plan for the proposed conveyor corridor and stockpile expansion areas will be developed and implemented prior to any clearing occurring for the conveyor

corridor and stockpile expansion: This plan will include:

- a vegetation clearance protocol that describes the measures to be taken in order to minimise and ameliorate any impact on flora and fauna in general, and threatened species in particular, during the clearing process.
- a commitment to conduct pre-clearance surveys of areas to be cleared of vegetation by a suitably qualified biologist. Searches will be conducted for threatened species of flora or fauna, trees having potential habitat hollows and any habitat assets such as large hollow logs or rocks which could be used in later rehabilitation. If any threatened species of flora are found in the planned clearing areas the Flora and Fauna Management will provide for the consideration of the following options to minimise any impact to the threatened species of flora:
  - modification of the area to be cleared in order to leave the flora in place.
  - translocation of the flora to an area of similar habitat within the Donaldson or Bloomfield properties, applying the best available knowledge about the ecology and translocation of the species.

- the pre-clearing survey will be conducted about 7 days prior to commencement and involve the following:
  - Trees having potential habitat hollows should be clearly marked with a band of survey paint around the stem;
  - Habitat trees watched at dusk to determine what if any fauna are using the hollows;
  - At a minimum all marked trees will be left standing for at least 2 nights following the clearing to allow any mammals to vacate the trees. However as most of the areas to be cleared are narrow or in close proximity to standing forest, it cannot be guaranteed that the mammals will leave and a person experienced in capturing and handling native fauna should be in attendance when these trees are pushed over;
  - Any trees found to contain bats should be left standing and soft-felled at dusk after the bats have left the hollows. This should be conducted under the supervision of a suitably experienced fauna ecologist.

An Ecological Monitoring Plan will be drafted and implemented prior to any mining which will impact on the areas of sub-tropical rainforest above Abel Underground Mining, and for Pambalong Nature Reserve, outside of the mining area to the south-east. These two areas will be monitored as follows:

	Sub-tropical Rainforest Monitoring plan The collection of the following data: • At suitable locations, record the outer boundary between the rainforest and the surrounding dry forest in order to monitor the stability of the community; • Establish groundwater piezometers at suitable locations and record water depth; • Establish permanent transects along which floristic content is recorded; and • Monitor the stability of selected major rock formations that occur in or near the rainforest. **Pambalong Nature Reserve Monitoring** The data to be collected would be as follows: • Rainfall in the catchments supplying water to Pambalong Nature Reserve (PNR); • Water levels in PNR; • Annual fauna monitoring with emphasis on birds and amphibians; and • Broad vegetation communities and their boundaries.
11. Aboriginal Heritage	11.1 During any construction phase if any Aboriginal sites or relics are uncovered the NSW DEC will be informed. In the event that a site or relic is found then work in the area of the find will cease until it is assessed for significance and an appropriate management strategy is devised if necessary. 11.2 An Aboriginal Heritage Management Plan will be implemented in consultation with the relevant Aboriginal stakeholders to specify the policies and actions required to mitigate and manage the potential impacts of the proposal on Aboriginal heritage. 11.3 The plan will provide procedures for: • ongoing Aboriginal consultation and involvement, • maintenance of an Aboriginal site database, • management of recorded sites within the investigation area, • further archaeological investigation prior to undermining, The plan will be regularly verified to establish that it is functioning as designed (ie. policies adhered to and actions implemented) to the standard required. 11.4 Continued use of surface infrastructure and construction of new surface infrastructure will be assessed against the location of identified Aboriginal heritage evidence and where impacts may occur, mitigation measures will be implemented as specified in the

	Aboriginal Heritage Management Plan. 11.5 The Company will seek to minimise impacts to identified and potential Aboriginal heritage evidence within the northern investigation area and to conserve identified evidence where impacts are not required to occur for operational reasons. 11.6 The Company will seek to mitigate impacts to identified and potential Aboriginal heritage evidence within the northern investigation area where impacts must occur for operational reasons. Staged systematic archaeological survey of each section proposed to be undermined in the southern investigation area will occur with the participation of the Aboriginal stakeholders prior to any underground mining in that section. The survey will sample the geographic extent of each section. The nature, level of integrity, potential impacts and scientific and cultural significance of any evidence identified will be assessed in consultation with the Aboriginal stakeholders and mitigation measures implemented as per the Aboriginal Heritage Management Plan. 11.7 Where site types susceptible to subsidence impacts (grinding grooves and rock shelters) are identified within the southern investigation area, an assessment of the potential impacts of subsidence will be undertaken by an appropriately qualified expert. Where it is determined that subsidence may impact a grinding groove or rock shelter site (including shelters with 'Potential Archaeological Deposits'), mitigation measures will be implemented to ensure that any impact is acceptable. 11.8 A regional monitoring network for Aboriginal heritage across the Abel, Tasman, Donaldson and Bloomfield sites will be established, including continuation of the existing programme of monitoring in the Donaldson Bushland Conservation Areas, monitoring before and after undermining for a sample of Aboriginal sites within the southern investigation area for which it is not anticipated that subsidence related impacts will occur, monitoring before and after undermining for all Aboriginal sites for which it is inferred that undermining may result in impacts in order to ensure the adequacy of conservation measures around those sites, and documentation of the results of all monitoring in an annual report. 11.9 The Company will continue to consult with and involve the registered Aboriginal stakeholders, particularly the Local Aboriginal Land Councils, in the ongoing management of the heritage resources within the investigation area as per the Aboriginal Heritage Management Plan. Should any previously unrecorded Aboriginal heritage evidence be identified within the lease area during the course of operations, Donaldson will ensure that this evidence is subject to temporary

	conservation and is recorded and appropriate management strategies are implemented in consultation with the Aboriginal community as per the Aboriginal Heritage Management Plan. Donaldson will maintain a current database providing details of all identified Aboriginal heritage evidence within the lease area so that the Aboriginal Heritage Management Plan can be effectively implemented and records for any Aboriginal sites identified and copies of all reports prepared in relation to ongoing monitoring and archaeological studies associated with the project will be lodged in a timely manner with DEC. 11.10 In order to form an integrated monitoring network for Aboriginal heritage across the Abel, Tasman, Donaldson and Bloomfield sites, it is proposed for the duration of the mining leases to: • Continue the existing programme of monitoring in the Donaldson Bushland Conservation Areas to ensure that the condition of a sample of Aboriginal heritage sites that occur within the northern investigation area is regularly assessed. This will involve monitoring on an annual basis the seven existing datum points within the Conservation Area by a qualified archaeologist and representatives of the Mindaribba LALC; • A sample of Aboriginal heritage sites within the southern investigation area, comprising site types for which it is not anticipated that subsidence related impacts will occur, will be monitored before and after undermining in their vicinity to confirm the accuracy of these predictions. This will involve inspections prior to undermining then at set periods after undermining by a qualified archaeologist and representatives of the relevant LALC; • All Aboriginal heritage sites for which it is inferred that undermining may result in impacts (ie. rock shelter and grinding groove sites) will be monitored before and after undermining in their vicinity to ensure the adequacy of conservation measures around those sites. This will involve inspections prior to undermining then at set periods after undermining by a qualified archaeologist and representatives of the relevant LALC; • An annual report documenting the results of monitoring will be prepared and provided to the relevant LALC and DEC detailing the methodology of the inspections, conditions of the environment and Aboriginal heritage evidence at the relevant sites, comparisons with previously reported descriptions of each site, identification of any natural and/or human impacts during the intervening period, and identification of any implications for ongoing management and protection of the Aboriginal heritage evidence throughout the lease areas.

12. Environmental Management System	The Environmental Management Plan outlined in Chapter 8 of the Environmental Assessment will be prepared within 6 months of this approval being granted, to the satisfaction of the Department of Planning. The EMP will address, separately for the Abel Underground Mine and the Bloomfield CHPP (unless otherwise specified), the following specific issues for both construction and operation of the proposed mine: • Construction Management Plan; • Community Involvement Plan; • Noise Management Plan; • Water Management Plan; • Waste Management Plan; • Air Quality Management Plan; • Erosion and Sediment Control Plan; • Flora and Fauna Management Plan; • Heritage and Archaeology Area Management Plans; • Landscape Management Plan; • Rehabilitation Management Plan; • *Tetratheca juncea* management plan; • Groundwater Management Plan; • Subsidence Management Plan; • Watercourse Subsidence Management Plan; • Dam Subsidence and Repair Management Plan; • Gas Management Plan • Bloomfield CHPP and RLF Environmental Management Plan Where appropriate the above plans will be integrated plans which will apply across the following mining operation areas: • Proposed Abel Underground Mine; • Tasman Underground Mine; • Donaldson Open Cut Mine; and • Bloomfield Coal Handling and Preparation Plant (CHPP) and Rail Loading Facility (RLF). The Environmental Management Plan will include: • The Company Environmental Policy that guides the direction of environmental management and provides Company commitment to environmental protection, mitigation and management. • Objectives, including legislative requirements to be met and relevant guidelines and Standards; • Work procedures, which detail in practical terms what will be undertaken, when and by whom; • Monitoring, including what will be monitored, when and where this will occur, and reporting of results;

	• Review procedures, being when the management plan and contents will be reviewed; • Feedback mechanisms, to ensure that any required changes to the Plan, due to a review or other mechanism such as other risk assessment, are made and the plan updated; • Training, describing how employees and contractors are trained in the documented procedures and updated on an ongoing basis when changes are made; and • Emergency response procedures. The Company will prepare and implement an Environmental Due Diligence Training Program which will focus on the following matters: • The EMS; • Environment Protection legislation; • Understanding Due Diligence; • Specific Environmental Impacts of construction and operation of the mine; • The Company Safety Health Environmental Policy; • Reporting and recording environmental incidents; • Site environmental management. The mine Site Manager or his/her nominee shall be responsible for implementing the EMS.
12. Rehabilitation	The Company commits to rehabilitating the Abel Underground Mine area and Abel pit top in accordance with DOP and DPI guidelines. This includes ongoing rehabilitation in response to mine subsidence as well as rehabilitation of pit top areas after completion of mining. The Company will provide a Mine Closure Plan as part of the MOP required under the relevant condition of the mining lease for the Abel Underground Mine. This Mine Closure Plan will be produced in consultation with DOP, DPI and other stakeholders as required.
13. Site Security	Unauthorised entry of people into the Abel Underground Mine Portal Surface works and the Bloomfield CHPP is to be prevented to ensure site security and to prevent damage to components of the mine particularly damage which may result in harm to the environment.
14. Community Consultation	A Community Liaison Committee will be created which will meet on a regular basis to review environmental performance of the Abel Underground Mine and the Bloomfield CHPP. Membership of the Committee is to be determined by the Company and the Committee is o be chaired by an Independent

	Facilitator and will include representatives of the local community and adjoining property holders, DOP, the DEC and local councils. The Environment Protection Licence for the mine will require the Company to keep a record of all complaints made in relation to pollution arising from any activity to which this Licence applies and will also specify the details to be provided in the record and a complaints handling procedure. The Environment Protection Licence for the mine will require that a telephone complaints line operates during the operating hours of the premises for the purpose of receiving any complaints from members of the public and that the telephone number of this line be notified to the community. A 24 hour telephone complaints line will be established and the local community will be notified of the phone number. Complaints received would be recorded. All information from the complainant, including the nature of the complaint would also be recorded. The appropriate site manager or his/her nominee will undertake an immediate investigation into the cause of any complaint relating to operations of the site and in particular environmental issues and will ensure that corrective action is taken as required. The appropriate site manager or his/her nominee will provide the complainant with an explanation of the cause of any environmental incident and details of any actions taken to mitigate its effect. If necessary, the appropriate site manager would initiate further corrective action, such as introducing changes in operational procedures, work instructions or modifications to equipment etc as may be required to reduce the possibility of further environmental incidents. A record of all complaints received will be kept on site for 4 years.
15. Environmental Incidents	15.1 Prior to commencement of construction an Emergency Response Plan (ERP) will be prepared for the site which will describe the general policy and approach to be adopted by The Company when managing and responding to an emergency or incident at the site. The ERP will contain a specific definition of 'incident' and 'environmental incident' which is to be consistent with the definition of 'incident' in the POEO Act. 15.2 In accordance with Part 5.7 of the POEO Act , the appropriate site manager must notify the NSW DEC of 'incidents' which occur in the course of operations of the AUP where material harm to the environment is caused or threatened, as soon as practicable after they become aware of the incident or threatened

	material harm. 15.3 Initial notification of an 'incident' (as defined) is to be made by telephoning the NSW DEC's Pollution Line. 15.4 The following information will be required by Donaldson: • The time, date, nature, duration and location of the incident; • The location of the place where pollution is occurring or is likely to occur; • The nature, the estimated quantity or volume and the concentration of any pollutants involved; • The circumstances in which the incident occurred (including the cause of the incident, if known); • The action taken or proposed to be taken to deal with the incident and any resulting pollution or threatened pollution; and • Other relevant information. 15.5 The appropriate site manager will assess specific incidents taking into consideration the impact(s) on the environment, to determine whether what resources are required to determine what response is required , or to assist in responding to the impacts. The appropriate site manager would contact an outside agency if required. 15.6 All employees working on the site will be responsible for ensuring that the appropriate site manager is informed of any environmental incidents. All environmental incidents would be recorded on an Environmental Incident Report form. As required by Part 5.7 of the POEO Act and the EPL, the Site Manager must notify the NSW DEC of incidents, or the threat of material harm to the environment, as soon as practicable after they become aware of the incident or threat of material harm. 15.7 The management strategies for responding to and controlling incidents/emergencies will include the following: General Procedures • Provide adequate resources including staffing and fire fighting equipment; • Training of staff so that a high level of preparedness is maintained by all people who could be involved in an emergency; • Provide a first aid station which would be fully equipped and maintained at the site; and • Periodic review and update of emergency procedures for the site. Fire • Consultation has been initiated with the NSW Rural Fire Service and this would be ongoing;

	• Consult with adjoining landholders; • Undertake hazard reduction as required; • Provide fire fighting equipment at site buildings; • Provide clear signposting and access for all fire fighting equipment; • Make available water for fire fighting from water holding tanks or mains; and • Regularly inspect and maintain fire fighting equipment. Chemicals • Store all chemicals in appropriately bunded areas in accordance with their Material Safety Data Sheets (MSDS) and the relevant Australian Standards; and • Store all fuels or flammable solvents in adequately ventilated areas 15.8 All environmental incidents are be recorded on an Environmental Incident Report form. 15.9 An Environmental Incident Folder is to be maintained and shall contain the following: • Copies of work instructions on how to deal with particular situations; • Incident contact names/numbers; and • Environmental Incident Report form containing all the details required in the “Notification of Environmental Harm” procedure.

Subsidence Specific Commitments by the Company

A. Principal Residences	The Company commits to producing and implementing a plan of management for each Principal Residence existing at the date of approval of this project. A Principal Residence is defined as an existing building capable of being occupied as a separate domicile and used for such purpose. The plan of management will be produced and implemented as follows: A1. Each Principal Residence will be individually assessed by the Mines Subsidence Board /structural engineer who will determine tolerable levels for individual subsidence parameters. Tolerable limits are those limits which will result in no mitigation works being required to the Principal Residence due to subsidence impacts from the Abel Underground Mine. A2. Each Principal Residence will have a pre-mining survey to identify and record pre-existing imperfections that will not be covered by the Mines Subsidence Board. A3. Such assessments will be done as and when the progression of the mining process dictates – i.e. mining may have commenced in other areas prior to the individual Principal Residence assessment being undertaken. A4. Tolerable levels will be set according to such factors as dwelling construction (e.g. brick veneer, clad), type (single, double storey), size (length and width), footings (slab, strip footings, piers), surface conditions (sand, rock, clay, steep slope) etc, with reference to the MSB Graduated Guidelines (compatible with AS 2870 and the Building Code of Australia). A5. The mine plan in proximity to each Principal Residence will be modified by the Company to maintain subsidence parameters within the tolerable levels determined above for each Principal Residence. A6. The mine plan will be reviewed by the MSB and the DPI prior to any Subsidence Management Plan being approved under the relevant lease. A7. Each Principal Residence will have a specific subsidence monitoring plan to monitor subsidence impacts before and after mining at the Principal Residence and to ensure that tolerable limits are achieved in practice. A8. The Mines Subsidence Board has the responsibility to rectify any impacts to structures that may occur as a result of mining. In cases where the owner of the Principal Residence and the Company can agree to terms which permit second workings under the Principal Residence greater than those permitted above, the

	Company agrees to negotiate a plan of management similar to that proposed in the section of this Statement of Commitments titled "All Other Surface Structures"..
B. Future Principal Residence	If there is no existing residence on a landholding and a residence is planned to be built, the site for this Future Principal Residence will be protected in the same way as that proposed above for Principal Residences. This commitment applies to a maximum of one Future Principal Residence per landholding. NOTE: Once the Mine Subsidence District is declared for the area all Future Principal Residences will require approval from the Mine Subsidence Board and must comply with the *Mine Subsidence Compensation Act 1961.*
C. Black Hill School	All buildings and structures located at Black Hill School will be managed as if they were a Principal Residence.
D. Black Hill Church and Cemetery	The Black Hill Church and cemetery will be managed as if they were a Principal Residence.
E. All Other Surface Structures	"All Other Surface Structures" is defined as any building or structure impacted by mining-induced subsidence from the Abel Underground Mine Project which is not categorised as a Principal Residence, Future Principal Residence, Black Hill Church and Cemetery or Black Hill School. The Company shall prepare and implement plans of management for the mitigation and remediation of any damage to All Other Surface Structures prior to any mining occurring that would impact on them. The plan of management will include: (a) pre-mining audit of the structure; (b) the provision of a plan of management as part of the SMP approval process which requires the Company to mitigate/remediate any damage to improvements associated with the structure in conjunction with the Mines Subsidence Board; (c) post-mining monitoring of the improvements associated with the Structure. The mitigation/remediation measures to be undertaken will be related to the extent of damage experienced – see Schedule 1 for details.
F. Dams	A Dam Monitoring and Management Strategy (DMMS) will be formulated for all dams prior to any mining occurring which will impact on the dams. The DMMS will provide for: F1. The individual inspection of each dam by a qualified engineer for: • current water storage level;

	• current water quality (EC and pH); • wall orientation relative to the potential cracking; • wall size (length, width and thickness); • construction method and soil / fill materials; • wall status (presence of rilling / piping / erosion / vegetation cover); • potential for safety risk to people or animals; • downstream receptors, such as minor or major streams, roads, tracks or other farm infrastructure; and • potential outwash effects. F2. Photographs of each dam will be taken prior to and after undermining, when the majority of predicted subsidence has occurred. F3. Dam water levels, pH and EC will be monitored prior to and after undermining to assess the baseline and post mining dam water level and water quality in order to determine whether rehabilitation is required. F4. In the event that subsidence / crack development monitoring indicates a significant potential for dam wall failure, dam water will be managed in one of the following manners: • pumped to an adjacent dam to lower the water level to a manageable height that reduces the risk of dam wall failure, • discharged to a lower dam via existing channels if the water can not be transferred, or • not transferred if the dam water level is sufficiently low to pose a minor risk. An alternate water supply will be provided to the dam owner until the dam can be reinstated. F5. In the event of subsidence damage to any dams the Company shall remediate the damage and reinstate the dam in conjunction with the Mine Subsidence Board.
G. Public Roads	The Company shall prepare and implement a plan of management as part of the SMP process implemented under the mining lease for the Abel Underground Mine. This plan of management will ensure the safety and serviceability of public roads and 4WD tracks and existing fire fighting access tracks.
H. Powerlines	The Company shall prepare and implement a plan of management as part of the SMP process which will ensure the safety and serviceability of powerlines.
I. Gas Pipeline	The Company shall prepare and implement a plan of management as part of the SMP process which will ensure the safety and serviceability of the gas pipeline.

J. Survey Marks	At the completion of subsidence or otherwise as required by Government Authorities, the functionalities of any survey marks affected by subsidence will be fully restored to the satisfaction of the Government Authorities.
K. Cliffs	Trigger-action response plans (TARPs) will be developed by the Company based on consultation with DEC and Local Councils to ensure the general public and employees working in the vicinity of the cliffs are not exposed to rock falls caused by mine subsidence damage. Appropriate rock fall hazard controls may include such items as rock fall catch ditches, barrier fencing, earth mounds and warning signs installed at appropriate locations to promote awareness that a rock fall hazard could exist along the top and bottom of cliff lines that will be undermined.
L. Water Supply	In the event of interruptions to water supplies due to subsidence impacts on farm dams, water tank pipelines, water mains and irrigation systems within the application area, the Company commits to providing water supplies of equivalent quality and quantity to locations convenient to those affected until such time that the affected farm dams, water tanks, pipelines, water mains and irrigation systems are restored.
M. General Surface Water Flow	The Company shall prepare and implement a plan of management to maintain the surface drainage of areas surrounding any dwellings and other structures or infrastructure, where required. This plan shall include but not be limited to monitoring, mitigation or remediation of mining-induced ponding, drainage pattern changes and any resulting serviceability difficulties and/or hazards to the public. NOTE: Also see Water Supply.
N. Public Safety	The Company shall prepare and implement a surface safety management program to ensure public safety in any surface areas that may be affected by subsidence arising from the proposed underground mining. This program shall include, but not be limited to, regular monitoring of areas posing safety risks, erection of warning signs, entry restrictions, backfilling of dangerous surface cracks and securing of unstable man-made structures or rockmass, where required and appropriate, and the provision of timely notification of mining progress to the community and any other relevant Stakeholders where management of public safety is required.
O. Landowner Agreements	The Company will enter into separate arrangements with Coal and Allied for its Black Hill land and with the Catholic Diocese of Maitland and Newcastle with regard to an agreed mining schedule underneath these respective lands. These arrangements will set timeframes for the completion of mining beneath these areas.

Schedule 1 - Subsidence Effects on All Other Surface Structures

This Schedule only applies to All Other Surface Structures and does not apply to Principal Residences as they are protected in accordance with the above commitments which relate only to them.

The main features that determine impact on buildings/structures are tilt and strain. Subsidence effects on buildings/structures are categorised according to the degree of structural damage that is likely to result from underground mining (Tables 1 and 2). These tables have been developed to assist the categorising of the subsidence impacts of this project. Accordingly, to determine the appropriate Preventative Mitigation Measures the following must occur in relation to the relevant surface structure:

1. Look at Table 1 and determine the appropriate Strain Damage Category
2. Look at Table 2 and determine the appropriate Tilt Damage Category
3. Look at Table 3 and using the Strain Damage Category from Table 1 and the Tilt Damage Category from Table 2 determine the appropriate Preventative Mitigation Measures.
4. Look at Table 4 and see the outlined of the Preventative Mitigation Measures provided by Table 3.

Table 1 – Determine Strain Damage Category

Damage Category	Description of typical damage to walls and required repair	Approximate crack width limit
0 (negligible)	Hairline cracks.	<0.1 mm
1 (very slight)	Fine cracks that do not need repair.	0.1 mm to 1.0 mm
2 (slight)	Cracks noticeable but easily filled. Doors and windows stick slightly.	1.0 mm to 5.0 mm
3 (moderate)	Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weather-tightness often impaired.	5.00 mm to 15.0 mm (or a number of cracks 3mm to 5mm in one group)

Table 1 – Determine Strain Damage Category (Cont.)

Damage Category	Description of typical damage to walls and required repair	Approximate crack width limit
4 (severe)	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window or doorframes distort. Walls lean or bulge noticeably. Some loss of bearing in beams. Service pipes disrupted.	15 mm to 25 mm but also depends on number of cracks
5 (very severe)	As above but worse, and requiring partial or complete rebuilding. Roof and floor beams lose bearing and need shoring up. Windows have been broken with distortion. If compressive damage, severe buckling and bulging of the roof and walls.	>25 mm

Table 2 - Tilt Damage Category

Damage Category	Tilt	Description of typical damage to walls and required repair
A (negligible)	<5	Unlikely that remedial work will be required.
B (tolerable)(	5 to 7	Adjustment to roof drainage and wet area floors might be required.
C (questionable)	7 to 10	Minor structural work might be required to rectify tilt. Adjustments to roof drainage and wet area floors will probably be required and remedial work to surface water drainage and sewerage systems might be necessary.
D (intolerable)	>10	Considerable structural work might be required to rectify tilt. Jacking to level or rebuilding could be necessary in the worst cases. Remedial work to surface water drainage and sewerage systems might be necessary.

For some structures, the levels of damage shown in Tables 1 and 2 can be significantly reduced by various simple, preventative measures. The general types of management measures, and the residence types and categories of structural damage to which they apply, are provided in Table 4. The specific management measures for individual residences will be developed in consultation with the improvement owner and the Mine Subsidence Board, prior to mining.

Table 3 – Determine Preventative Mitigation Measures

Type of Construction		Strain Damage Category						Tilt Damage Category			
		0	1	2	3	4	5	A	B	C	D
1	Flat slab or waffle slab on ground	None	14	14 & 15	1, 15, 17, 18 & 19	1, 15, 17, 18, 20 & 25	1, 15, 17, 18, 20 & 25 or 21 & 26	None	16	11	11 & 25 or 21 & 26
2	Strip footing	None	14	14 & 15	1, 2, 15, 17, 18 & 19	1, 2, 15,17, 18, 2 & 25	1, 2, 15, 17, 18, 20 & 25 or 21 & 26	None	16	12	13 & 25 or 21 & 26
3	In-ground concrete or steel piers	None	14	14 & 15	1, 2, 15, 17, 18 & 19	1, 2, 15,17, 18, 2 & 25	1, 2, 15, 17, 18, 20 & 25 or 21 & 26	None	16	13	13 & 25 or 21 & 26
4	Below-ground construction with retaining walls or basement walls	None	14	14 & 15	1, 2, 15, 17, 18 & 19	1, 2, 15,17, 18, 2 & 25	1, 2, 15, 17, 18, 20 & 25 or 21 & 26	None	16	13	13 & 25 or 21 & 26
5	Stiffened waffle slab on secondary foundations	None	14	14 & 15	1, 5, 14 & 18	1, 5, 14, 18, 19 & 25	1, 5, 14, 18, 20 & 25	None	5 & 18	5 & 18	5, 18 & 25
6	Suspended floor with ground clearance less than 600 mm	None	14	14 & 15	1, 3, 6 & 14	1, 3, 6, 14, 19 & 25	1, 3, 6, 14, 20 & 25	None	6 & 16	3 & 6	3, 6 & 25
7	Above-ground stilts or poles	None	14	14 & 15	1, 4, 6 & 14	1, 4, 6, 14, 19 & 25	1, 4, 6, 14, 20 & 25	None	4 & 6	4 & 6	4, 6 & 25
8	Above-ground brick piers	None	14	14 & 15	1, 3, 6 & 15	1, 3, 6, 14, 19 & 25	1, 3, 6, 14, 20 & 25	None	3 & 6	3 & 6	3, 6 & 25
9	Demountable building	None	14	5, 6 & 14	5, 6 & 14	5, 6 & 14	5, 6 & 14	None	5 & 6	5 & 6	5, 6 & 25
10	Paved areas, paths and driveways	None	None	None	7 or 8	7 or 8 & 24	7 or 8 & 24	None	None	None	11 or 24
11	Steel sheds & outbuildings	None	None	None	1 & 14	1, 9 & 17	9, 22 & 11 or 23	None	None	None	22 & 11 or 23
12	Fences & handrails	None	None	None	10	10	10	None	None	None	None

Strategies that can be used to ameliorate damage to building structures as mine subsidence occurs or to remedy the damage on completion of subsidence are listed below.

Table 4 - Preventative Mitigation Measures

1. Increase the capacity of structures to articulate by cutting vertical slots in the walls or slabs.
2. Excavate trenches or slots alongside the building to isolate the structure from ground strains.
3. Install jacks and relevel the structure as subsidence occurs. Rebuild piers on completion.
4. Install steel beams and jacks and relevel the structure as subsidence occurs.
5. Install jacks to relevel the building and provide packs and shims beneath bearers.
6. Provide flexible couplings to service pipes.
7. Remove pavers or paving slabs and replace after mining.
8. Cut slots in paths and drives and repair on completion of mining.
9. Provide temporary supports, bracings and ties if required to ensure the safety of the structure during mining.
10. Provide expansion or contraction joints in fences and handrails or temporarily remove a section.

Remedial Rehabilitation Measures

11. Raise slabs up to 300 mm using grout injection.
12. Raise walls using grout injection.
13. Underpin and jack walls to level.
14. Cosmetic repair and repainting.
15. Rehang sticking doors and adjust windows.
16. Relevelling of wet area floors and roof gutters.
17. Major repairs and painting.
18. Repairs to service pipes.
19. Demolish small area of brickwork and repair.
20. Demolish brick walls and rebuild.
21. Completely demolish building and rebuild.
22. Provide jacks and relevel steel structure.
23. Break out and replace concrete floor slab to required levels.
24. Possibly remove paving or slabs, relevel subgrade and replace on completion of mining.
25. Possible repairs to drainage and sewerage pipes or septic tanks.
26. Provide temporary replacement structure.

8 ABEL ENVIRONMENTAL MANAGEMENT SYSTEM

8.1 Overview

All Abel Underground Mine construction and operation works will be undertaken in accordance with a set of environmental management procedures which will form part of the Donaldson Coal Environmental Management System. This system is used to effectively protect, manage, control, mitigate, offset and/or monitor any identified environmental risk, as well as describe procedures that will to be undertaken in the event of unidentified risk. Operation of the Bloomfield CHPP and associated facilities that form part of the Abel Underground Mine project will be managed in accordance with existing Bloomfield procedures, expanded to include additional operations. Outlines of proposed environmental management procedures are provided in this section. An Outline Surface Water Management Plan with erosion and sediment control plan procedures is provided in Appendix F as part of the Surface Water Assessment.

These management plans and principles are based on the risks identified through the risk analysis process described in Section 5.1 and also include actions identified in the draft Statement of Commitments provided in Section 7.

Prior to implementation, environmental management procedures will be developed in full and amended to include additional items that may arise from:

- the Director-General's Environmental Assessment Report;
- ongoing consultation;
- ongoing monitoring;
- any change to environmental conditions that would alter management actions; and
- any change to operations that would alter management actions.

8.2 Environmental Management System and Procedures

A key principle of the Environmental Management System for the proposed Abel Underground Mine will be the integration of environmental management policies, documentation and actions across mining operation areas. Integration will occur across these sites:

- Proposed Abel Underground Mine;
- Tasman Underground Mine;
- Donaldson Open Cut Mine; and
- Bloomfield Coal Handling and Preparation Plant (CHPP) and Rail Loading Facility (RLF).

The first three sites listed above are owned by Donaldson Coal Pty Limited. The Bloomfield CHPP and RLF is owned by Bloomfield Collieries Pty Ltd.

For example, rather than preparing individual monitoring plans for the Tasman, Abel and Donaldson Mines and the Bloomfield CHPP and RLF site, one Integrated Monitoring System will be developed that enables one set of dust monitoring to be undertaken across these four sites. This will reduce duplication, provide for more meaningful data and increase data sharing across these four sites. It also enables one Integrated Monitoring Report for all these sites to be presented to government authorities and the community. Separate reports will be provided for Environmental Protection Licence reporting where required by licence conditions.

Where management procedures are integrated across sites, they will continue to be reviewed and updated to address new issues that may require inclusion as mining progresses to new areas, or to remove items and ensure remaining sites retain necessary equipment when a site, for example, Donaldson Open Cut Mine, completes its operations and closes.

Figure 8.1 provides a schematic diagram of how the Environmental Management System will be integrated across the four sites.

Donaldson Coal's Environmental Policy was adopted in September 2000. This is provided in Appendix D. In its Environmental Policy, Donaldson Coal acknowledges that it operates in an area that requires a genuine commitment to the environment and the community. To achieve this Donaldson Coal has developed and adopted its Environmental Management System (EMS) and through its implementation, Donaldson Coal has maintained a high level of environmental compliance.

The operations of Tasman Underground and Donaldson Open Cut Mines are governed by the Donaldson Coal Environmental Policy, which will also be applied to the proposed Abel Underground Mine. As shown on Figure 8.1, existing Environmental Management Plans have been developed under this Environmental Policy, for these two mine sites. For Abel Underground Mine, it is proposed to prepare new plans and also amend existing plans to include Abel Underground Mine activities. By amending existing plans with new objectives, procedures and monitoring, the management of a particular issue, for example, water management, is integrated across the Donaldson Coal sites rather than being treated as a separate issue in isolation to each site, even though they are adjacent to each other in their workings and share common surface areas and facilities.

Plans that are already in place for Donaldson Mine operations that will be amended and extended for Abel Underground Mine operations are:

- Community Consultation Plan;
- Noise Management Plan;
- Water Management Plan;
- Waste Management Plan;

- Air Quality Management Plan;
- Erosion and Sediment Control Plan;
- Flora and Fauna Management Plan;
- Heritage and Archaeology Area Management Plans;
- Landscape Management Plan;
- Rehabilitation Management Plan; and
- *Tetratheca juncea* management plan.

New plans that will be required for Abel Underground Mine operations are:

- **Subsidence Management Plan** (linked to the Subsidence Management Plan process required under the *Mining Act 1992*) which is prepared for each seven years of mining and includes individual Subsidence Management Plans and agreements for particular items such as residences and infrastructure;
- **Groundwater Management Plan** to include detailed procedures for the protection, management, mitigation and monitoring of groundwater and also tailings disposal to underground workings associated with Bloomfield CHPP operations;
- **Watercourse Subsidence Management Plan** detailing procedures for monitoring and managing subsidence to watercourses above the Abel Underground Mine;
- **Gas Management Plan** – whilst the proposed Abel Underground Mine is not expected to produce large quantities of gas, a management plan will be prepared to determine how gas will be managed if it is found that significant quantities of gas are produced.
- **Construction Management Plan** to detail protection, management and mitigation of potential impacts that could occur during the construction phase – for example, temporary sediment controls and traffic arrangements. The Construction Management Plan will be prepared in a format able to be provided to all construction Contractors as part of their Contract conditions and Induction Procedures.

A new plan will also be prepared for the Bloomfield Collieries Coal Handling and Preparation Plant (CHPP) and rail loading facility (RLF). This Plan will be a stand-alone document due to the use of the Plant by Donaldson Coal with operation by Bloomfield Collieries. This document will include information from existing plans where relevant, for example, the water management plan, which covers the Donaldson, Abel surface area and Bloomfield processing sites, and also incorporate new procedures where required, for example, new water management arrangements.

Outline plans and procedures that have been prepared for particular Abel Underground Mine items, such as flora and fauna monitoring, are provided in Appendix D. The following provides a description of procedures for plans that will be prepared in detail prior to commencement of mining, such as the Subsidence Management Plan.

All Environmental Management Plans will include:

- The Company Environmental Policy that guides the direction of Environmental management and provides Company commitment to environmental protection, mitigation and management.
- Objectives, including legislative requirements to be met and relevant guidelines and Standards;
- Work procedures, which detail in practical terms what will be undertaken, when and by whom;
- Monitoring, including what will be monitored, when and where this will occur, and reporting of results;
- Review procedures, being when the management plan and contents will be reviewed;
- Feedback mechanisms, to ensure that any required changes to the Plan, due to a review or other mechanism such as other risk assessment, are made and the plan updated;
- Training, describing how employees and contractors are trained in the documented procedures and updated on an ongoing basis when changes are made; and
- Emergency response procedures.

8.3 Subsidence Management Plan

The mine will operate under approval conditions that will require it to manage subsidence via the process and guidelines introduced by the Department of Mineral Resources (now Department of Primary Industries) in 2004.

It is intended that sufficient information be provided in the Environmental Assessment to be able to show that subsidence can be managed in an acceptable manner, and that particular surface and sub-surface features can be protected from subsidence impacts where required, or that subsidence can be managed to levels to levels that achieve protection objectives for specific items.

The Subsidence Management Plan (SMP) is then prepared to determine subsidence management for individual surface and sub-surface items, such as individual houses, dams and creeklines. The SMP is approved by the Director-General of the Deportment of Primary Industries (DPI) only after a review by an interagency review committee. The Community will be advised by advertisement in the local press when the draft SMP is to be prepared and may make submissions to the DPI.

The Guidelines state that the proposed SMP must be capable of managing potential subsidence impacts to produce outcomes that are consistent with government policies and which take into account community expectations. It will include detailed descriptions of all surface features and management, remediation and mitigation measures for any subsidence impacts on these items. Detailed descriptions and management measures will be developed in consultation with individual landowners and other relevant stakeholders such as government agencies, Aboriginal communities and public utility authorities.

An SMP is prepared for every seven years of mining. The first SMP prepared for the Abel Project will therefore address the surface and sub-surface area that is likely to be impacted by the first seven years of mining.

The SMP application will need to include:

- *'The proposed mining system(s) and resource recovery;*
- *Community consultation;*
- *Statutory requirements that apply to the Application Area;*
- *Expected subsidence and its potential impacts on public safety, the environment, community, land use, surface improvements and infrastructure; and*
- *The proposed Subsidence management Plan for the expected subsidence impacts.'* (DMR, 2003*)*

As part of the SMP process, Donaldson Coal will also develop Individual Subsidence Management Agreements with landowners. Dam Management Plans will also be prepared where required for individual properties.

Subsidence management procedures and methods are described in Section 6.2.2. Proposed subsidence monitoring is described in Section 6.2.8.

8.4 Groundwater Management Plan

A Groundwater Management Plan will be prepared that addresses:

- Groundwater management within the Abel Underground Mine area, including protection, management, mitigation and remediation of groundwaters as required;
- Groundwater management within the area of proposed tailings disposal within Bloomfield Colliery;
- Proposed Groundwater monitoring program;
- Proposed groundwater reporting schedule; and
- Feedback mechanisms to alter mining methods if documented groundwater monitoring values are triggered.

Groundwater will be monitored as part of the Integrated Monitoring Program described in Section 8.15. This will provide groundwater monitoring results for the Abel, Tasman and Bloomfield areas.

8.5 Watercourse Subsidence Management plan

8.5.1 Overview

Prior to mining occurring that will impact on any Schedule 1 Streams, the Watercourse Subsidence Management Plan (WSMP) for the Abel Underground Mine will be developed so as to address the following in relation to Schedule 1 Streams:

- detailed identification of risk factors on a case-by-case basis;
- setting up of permanent monitoring locations along watercourses as well as regular inspection regimes;
- continuation of baseline data collection on water flow conditions and health indicators (such as macro-invertebrates);
- establishment of trigger levels that will be used to assess whether any changes observed through monitoring warrant responsive action;
- development of responsive and remedial action to be undertaken if required;
- identification of any existing degradation in the streams prior to mining to allow differentiation of that degradation induced by the mining and provide for post-mining assessment of any streams within the area of mine subsidence within six (6) months of the initial subsidence;
- provide for a subsequent assessment within eighteen (18) months of the initial subsidence to confirm that post-mining degradation resulting from the mining is successfully remediated;
- require any remediation works to be implemented to a standard approved by DNR, where the assessment has indicated degradation of the streams in the area of mining induced subsidence, and thereafter on an annual basis until any mining induced stream instability is addressed to the standard approved; and
- provide a photographic record of stream stability for areas where either fracturing is detected (at maximum strain points), or at maximum tilts within the subsidence envelope.

Where it is proposed not to leave a barrier around a Schedule 2 stream, a detailed assessment will be undertaken for the stream and provided to DNR addressing the proposed impacts on it. It will include as a minimum:

- assessment of the geomorphic and vegetation condition and aquatic habitat for the stream;

- selective measurements of channel boundary sediment size;
- predications of subsidence and cracks/fractures throughout the stream;
- a detailed photographic record of the existing stream condition;
- a map of the spatial distribution of alluvium and colluvial aprons throughout the stream;
- collection of background data for the main areas of alluvium for the shallow alluvial aquifer by the installation and regular monitoring of a network of piezometers and/or wells in the main areas of alluvium for the shallow alluvial aquifer; assessment of the location and activity of springs, pipes/tunnels and/or salt seepages/efflorescences;
- measurement of current bed slope and any pool-riffle sequences on each channel and periodic assessments of changes over time;
- an assessment of likely erosion points, fracturing or seepage zones from the mining area to the stream, along the stream channel occurring as a result of mining activities;
- an assessment of any required remedial works on the affected stream, including:

  - options considered for the remediation program
  - anticipated lifetime of the remedial works
  - details of the engineering design or process for engineering
  - design of the remediation works
  - long term remediation requirements, including revegetation.

- details of the proposed monitoring regime, providing for:

  - post-mining assessment, to a standard approved by DNR, within six (6) months of the initial subsidence.
  - provide for a subsequent assessment within eighteen (18) months of the initial subsidence to confirm that post-mining degradation resulting from the mining is successfully remediated.

Following consultation with DNR on the above assessment for each Schedule 2 Stream the WSMP for the Abel Underground Mine will be developed to implement the findings of the above assessment.

8.5.2 Monitoring

In conjunction with the monitoring described above, monitoring under the WSMP will include:

- Collection of extensive baseline data prior to mining, including the ability to collect at least 15 years of baseline data for Blue Gum Creek and Pambalong Nature Reserve;
- Monthly monitoring during any substantial subsidence period for each monitoring site, and annual monitoring for all sites;
- Water quality sampling from each of the sampling locations shown in Figure 8.2 and an additional site in Pambalong Nature Reserve, with analytes measured in the laboratory including pH, Electrical Conductivity, Total Dissolved Solids, Total Suspended Solids, Chloride, Sulfates, Alkalinity (Bicarbonate), Alkalinity (Carbonate), Calcium, Magnesium, Sodium and Potassium;
- Detailed assessment of geomorphic characteristics for specific watercourses reaches and more general assessment of larger watercourse lengths, with monitoring locations selected from those areas at greatest risk of subsidence impact (including predicted ponding locations and large sandstone outcrops);
- Flow gauging stations established on Blue Gum Creek to monitor water flow and level; and
- Macro-invertebrate monitoring within Blue Gum Creek and Pambalong Nature Reserve, including the use of AUSRIVAS (Australian River Assessment System) to assess biological health.

The precise nature of the monitoring to be undertaken will be determined in consultation with the relevant stakeholders as part of the preparation of the WSMP.

The monitoring will form part of the Integrated Monitoring Network as discussed in Section 8.22.

8.6 Gas Management

Methane testing undertaken as part of the most recent exploration program indicates that the seams generate very low levels of methane. Therefore, it is unlikely that methane extraction equipment will be required. However, if the mine experiences methane generation from strata above or below the target seam that impedes production or overloads the ventilation system, goaf drainage plants may need to be installed.

Goaf drainage plants are used to bleed off methane gas from the recently extracted areas of the mine. If required, boreholes would be drilled into the coal seam before mining commences and a diffuser attached at surface level. The diffuser has valves, flame traps and monitoring and occupies a small surface

footprint which is security fenced. The wells would operate once secondary workings have occurred.

8.7 Construction Management

A Construction Management Plan will be prepared that details environmental protection, management and monitoring requirements for the construction phase of the Abel Underground Mine project. This will be prepared in a format where procedures can be provided to Contractors who come onto the site during construction, so that they can include them in their site inductions. The Construction Management Plan will include such elements as:

- Nature and location of temporary erosion and sediment controls to be installed;
- Temporary traffic and access arrangements;
- 'No go' areas for construction traffic and equipment – to protect surrounding native vegetation, any identified archaeological areas along Four Mile Creek and Donaldson Coal Mine's existing rehabilitation areas;
- Contractor's reporting and induction requirements by Donaldson Coal;
- Hours of operation and details of any equipment that can only be used during certain hours;
- Dust suppression requirements; and
- Waste management requirements.

This Plan will be formed in association with Bloomfield Collieries so that construction areas, such as access roads and pipelines, that are located in both Lease areas apply the same management procedures.

8.8 Surface Water Management

An Outline Surface Water Management Plan that applies to the proposed Abel Underground Mine as well as existing Donaldson Open Cut and Bloomfield sites is provided in Appendix F as part of the Surface Water Assessment. This plan has the following objectives:

- Maintain water supply for the coal handling and preparation plant and for dust suppression at all times;
- Achieve zero discharge to the environment from Big Kahuna;
- Minimise discharge from the Stockpile Dam;
- Minimise discharge from Lake Foster and Lake Kennerson;
- Where controlled discharge is necessary, preference is given to Lake Kennerson.

The location of these dams is shown schematically on Figure 2.15.

The Outline Water Management Plan includes:

- Proposed modifications to the existing water management facilities;
- Proposed modifications to existing water management operations, including target operating levels for various water storages and required pumping rates;
- Required surface water monitoring; and
- Proposed surface water response plan, which is a procedure to follow in the event of unforeseen surface or groundwater impacts being detected during the project.

8.9 Noise Management

No additional noise management procedures are proposed for the Abel Underground Mine surface facilities north of John Renshaw Drive. Existing noise management procedures that apply to the Donaldson Open Cut Mine will apply to the Abel surface operation. These include:

- the use of reversing quackers to reduce night-time noise;
- noise monitoring consisting of operator attended and unattended noise measurements at four locations relevant to the mining operations at the time of monitoring, together with a log of operational activities to identify any significant generated noise sources;
- daily contact with neighbours of the mine when blasts are occurring to keep them informed of actions on site.

The Bloomfield CHPPP will partially enclose the plant to reduce noise to residences to the north.

The Abel Underground Mine and Bloomfield CHPP will operate continuously 24 hours per day for up to 7 days per week, 50 weeks per year.

8.10 Air Quality Management

To reduce dust from Abel Mine surface facilities, including the Bloomfield CHPP operation, the following actions will be undertaken:

- Stockpiles at the Abel Underground Mine portal will be kept at a height that is below ground level;
- The main ROM coal stockpile at the portal will be fitted with water sprays to reduce coal dust emissions;
- Conveyors will be enclosed on three sides;
- Vegetation will be maintained around the mine surface facilities to mitigate visual impacts and reduce off-site transport of dust; and

- The haul road from the Abel Underground Mine surface facilities area to Bloomfield CHPP will be sealed.

Procedures for training employees and contractors in these procedures will be added to the existing Donaldson Mine Air Quality Management Plan. This existing Management Plan also includes the following measures that will be applied to Abel Mine operations:

- Maintenance of an adequate distance between the mine and neighbouring residents;
- Minimisation of disturbance of land to only what is required by mining activities;
- Minimisation of the distance travelled by hauling overburden the shortest distance possible;
- Using mine water for dust suppression on roads, stockpiles and work areas; and
- Monitoring real time weather conditions and altering or ceasing operations if dust becomes difficult to control due to meteorological conditions.

Monitoring of meteorological conditions, dust deposition and concentration levels will be continued using the current monitoring network as described in Section 8.15. Regular analysis and reporting of the monitoring results will be undertaken to identify any problems that may arise.

8.11 Waste Management

Waste management will be as per the existing Donaldson Mine and Bloomfield CHPP Waste Management Plans, which outlines the management of wastes such as general refuse, waste oils and greases, used tyres and equipment, scrap metal and drums.

The Waste Management Plans adopt the Waste Management hierarchy of:

- Avoidance;
- Re-use;
- Recycling & reprocessing;
- Disposal.

Under this hierarchy the avoidance of waste is promoted by providing appropriate resources and ensuring that site personnel (including contractors) are not undertaking wasteful practices. All employees are encouraged to re-use or recycle wastes – with disposal to landfill being the last alternative. Waste storage, transport and disposal is currently and will continue to be in accordance with the *Environmental Guidelines: Assessment, Classification and Management of liquid and Non-Liquid Wastes* (DEC, 1999). This includes the containment within bunded areas of hazardous liquid wastes such as waste oils and the use of licenced Contractors to transport and dispose of waste materials.

The disposal of tailings and coarse reject material from the Bloomfield CHPP is described in detail in 2.9. Rehabilitation that will occur after the disposal of tailings and coarse reject is discussed in Section 2.13.

8.12 Fuel and Chemical Storage

All fuels and chemicals will be stored in accordance with the existing Donaldson Fuel and Chemical Storage Controls and Bloomfield CHPP procedures. No fuels or chemicals will be stored south of John Renshaw Drive, except for any minimal amounts required to service the ventilation shaft, which will be contained within this proposed compound. All fuels and chemicals are to be stored within bunded compounds in the proposed Abel surface facilities area or within existing Bloomfield facilities for the CHPP operation.

At the existing Donaldson Mine, fuels and chemical are appropriate managed as follows. Fuel and chemical management for the Abel Underground mine would follow the same management principles. A permanent bulk fuel farm facility has been constructed on the Donaldson Mine site in accordance with the appropriate standards. The area is contained by an earthen bund and stores up to 100,000L of diesel fuel at any one time.

Oil and grease is delivered to site in 205L drums. A bunded storage pad is used to store full 205L drums. All waste oil collected during servicing is stored in a 5000L-storage tank and routinely collected for recycling. Empty drums are stockpiled inside earthen bunds and collected by a licensed drum recycler on a regular basis. Oily water is treated by an oil:water separator and collected and disposed of by a licensed waste disposal contractor.

8.13 Erosion and Sedimentation Control

A draft outline Erosion and Sediment Control Plan (ESCP) is provided in Appendix F as part of the Surface Water Impact Assessment. The outline ESCP provides an outline of the measures that will be implemented to ensure that no undue pollution of receiving waters occurs during earthworks construction for the surface infrastructure facilities and the operation of the Abel Mine Project, including the operation of the Bloomfield CHPP.

The ESCP will be prepared in accordance with guidelines contained in *"Managing Urban Stormwater: Soils and Construction" (4th Edition)* (Landcom, 2004).

There are minimal activities associated with the project that will require erosion and sediment control works other than existing facilities. The following general measures are proposed:

- All works for the Abel box cut and subsequent construction of surface facilities will be undertaken within the boundaries of the existing Donaldson Mine lease area. These activities will be undertaken in accordance with the approved procedures for erosion protection and sediment control for the Donaldson Mine.

- The majority of works in the vicinity of the stockpile area for the Bloomfield CHPP will be undertaken within an area that reports to the existing Stockpile Dam and Dam F. These facilities provide adequate erosion and sediment control for those areas. For minor bunding works to be undertaken on the southern boundary of the enlarged stockpile area, standard erosion control practices such as silt fences will be used.
- For any earthworks associated with increasing the capacity of the bypass channel around Lake Foster, standard erosion control practices such as silt fences will be used.
- If a conveyor is constructed between the Abel box cut and the Bloomfield CHPP, a separate Erosion and Sediment Control Plan will be prepared that takes account of the details of the conveyor, particularly the crossing of Four Mile Creek.

8.14 Flora and Fauna Protection

Flora and fauna protection will be required in surface infrastructure areas north of John Renshaw Drive where construction will be undertaken with some clearing for the overland conveyor to Bloomfield CHPP. Approximately 13 hectares of remnant vegetation will be cleared around the Bloomfield CHPP to enable enlargement of the stockpile pads. An outline Flora and Fauna Management Plan for the proposed conveyor corridor and stockpile expansion areas is provided in Appendix D. This fauna management plan provides for the minimisation of damage to surrounding remnant vegetation, protection of fauna and the rehabilitation of disturbed areas during and following construction.

South of John Renshaw Drive, flora and fauna impacts are limited to potential subsidence impacts, which are assessed as minimal in Section 6.7. An Ecological Monitoring Plan for the areas of sub-tropical rainforest above Abel Underground Mining, and for Pambalong Nature Reserve, outside of the mining area to the south-east will be prepared and included in Donaldson Coal's existing flora and fauna management plan. These two areas will be monitored as follows:

8.14.1 Sub-tropical Rainforest Monitoring plan

Approximately 37 hectares of sub-tropical rainforest is located in the Long Gully system and in an unnamed gully at the southeastern extent of the Abel surface area (refer Figure 6.7). Indications are that this rainforest is a Groundwater Dependant Ecosystem (GDE). During a long dry period in late 2005 through into 2006 base flow was still evident in these gullies. It will be integral to the survival of these rainforest remnants that the groundwater on which they are dependant is not depleted through any bed cracking resulting in downward diversion of the groundwater.

Baseline data will be collected over the years prior to subsidence in order that meaningful conclusions can be drawn as whether or not a post-subsidence impact occurs.

The data to be collected would be as follows:

- At suitable locations, record the outer boundary between the rainforest and the surrounding dry forest in order to monitor the stability of the community;
- Establish groundwater piezometers at suitable locations and record water depth;
- Establish permanent transects along which floristic content is recorded; and
- Monitor the stability of selected major rock formations that occur in or near the rainforest.

8.14.2 Pambalong Nature Reserve Monitoring

Anecdotal information, particularly from amateur bird observers, indicates that the water levels in Pambalong Nature Reserve (refer Figure 6.9) vary considerably over time. Even though it would be several years before any subsidence could potentially impact on the Reserve, it is important to obtain good baseline data as to the natural variation within the reserve over time. Without this baseline data it would not be possible to draw meaningful conclusions as to whether or not a post-subsidence impact was occurring.

The data to be collected would be as follows:

- Rainfall in the catchments supplying water to PNR;
- Water levels in PNR;
- Annual fauna monitoring with emphasis on birds and amphibians; and
- Broad vegetation communities and their boundaries.

8.15 Aboriginal Heritage Management

An Aboriginal Heritage Management Plan will be implemented in consultation with the relevant Aboriginal stakeholders to specify the policies and actions required in every conceivable circumstance to mitigate and manage the potential impacts of the proposal on Aboriginal heritage. The plan includes procedures for ongoing Aboriginal consultation and involvement, maintenance of an Aboriginal site database, management of recorded sites within the investigation area, further archaeological investigation prior to undermining, identification and management of previously unrecorded sites (including skeletal remains) and a programme of monitoring. The plan will be regularly verified to establish that it is functioning as designed (ie. policies adhered to and actions implemented) to the standard required.

Continued use of surface infrastructure and construction of new surface infrastructure will be assessed against the location of identified Aboriginal heritage evidence and where impacts may occur, mitigation measures will be implemented as specified in the Aboriginal Heritage Management Plan. Donaldson will seek to *minimise* impacts to identified and potential Aboriginal

heritage evidence within the northern investigation area and to conserve identified evidence where impacts are not required to occur for operational reasons. Donaldson will seek to *mitigate* impacts to identified and potential Aboriginal heritage evidence within the northern investigation area where impacts must occur for operational reasons.

Staged systematic archaeological survey of each section proposed to be undermined in the southern investigation area will occur with the participation of the Aboriginal stakeholders prior to any underground mining in that section. The survey will sample the geographic extent of each section. The nature, level of integrity, potential impacts and scientific and cultural significance of any evidence identified will be assessed in consultation with the Aboriginal stakeholders and mitigation measures implemented as per the Aboriginal Heritage Management Plan.

Where site types susceptible to subsidence impacts (grinding grooves and rock shelters) are identified within the southern investigation area, an assessment of the potential impacts of subsidence will be undertaken by an appropriately qualified expert. Where it is determined that subsidence may impact a grinding groove or rock shelter site (including shelters with 'Potential Archaeological Deposits'), the mine plan will be altered to avoid all risk of subsidence impacts to that site.

A regional monitoring network for Aboriginal heritage across the Abel, Tasman, Donaldson and Bloomfield CHPP sites will be established, including continuation of the existing programme of monitoring in the Donaldson Bushland Conservation Areas, monitoring before and after undermining for a sample of Aboriginal sites within the southern investigation area for which it is not anticipated that subsidence related impacts will occur, monitoring before and after undermining for all Aboriginal sites for which it is inferred that undermining may result in impacts in order to ensure the adequacy of conservation measures around those sites, and documentation of the results of all monitoring in an annual report.

Donaldson will continue to consult with and involve the registered Aboriginal stakeholders, particularly the Local Aboriginal Land Councils, in the ongoing management of the heritage resources within the investigation area as per the Aboriginal Heritage Management Plan.

Should any previously unrecorded Aboriginal heritage evidence be identified within the lease area during the course of operations, Donaldson will ensure that this evidence is subject to temporary conservation and is recorded and appropriate management strategies are implemented in consultation with the Aboriginal community as per the Aboriginal Heritage Management Plan.

Donaldson will maintain a current database providing details of all identified Aboriginal heritage evidence within the lease area so that the Aboriginal Heritage Management Plan can be effectively implemented and records for any Aboriginal sites identified and copies of all reports prepared in relation to ongoing monitoring and archaeological studies associated with the project will be lodged in a timely manner with DEC.

In order to form an integrated monitoring network for Aboriginal heritage across the Abel, Tasman, Donaldson and Bloomfield CHPP sites, it is proposed for the duration of the mining leases to:

- Continue the existing programme of monitoring in the Donaldson Bushland Conservation Areas to ensure that the condition of a sample of Aboriginal heritage sites that occur within the northern investigation area is regularly assessed. This will involve monitoring on an annual basis the seven existing datum points within the Conservation Area by a qualified archaeologist and representatives of the Mindaribba LALC;
- A sample of Aboriginal heritage sites within the southern investigation area, comprising site types for which it is not anticipated that subsidence related impacts will occur, will be monitored before and after undermining in their vicinity to confirm the accuracy of these predictions. This will involve inspections prior to undermining then at set periods after undermining by a qualified archaeologist and representatives of the relevant LALC;
- All Aboriginal heritage sites for which it is inferred that undermining may result in impacts (ie. rock shelter and grinding groove sites) will be monitored before and after undermining in their vicinity to ensure the adequacy of conservation measures around those sites. This will involve inspections prior to undermining then at set periods after undermining by a qualified archaeologist and representatives of the relevant LALC;
- An annual report documenting the results of monitoring will be prepared and provided to the relevant LALC and DEC detailing the methodology of the inspections, conditions of the environment and Aboriginal heritage evidence at the relevant sites, comparisons with previously reported descriptions of each site, identification of any natural and/or human impacts during the intervening period, and identification of any implications for ongoing management and protection of the Aboriginal heritage evidence throughout the lease areas.

8.16 Community Consultation

A Community Consultative Committee is operational for the Donaldson open Cut Mine and it is expected that a new Committee will be formed for the Abel Underground Mine. An informal Community Liaison Committee is operational for the Abel Underground Mine proposal to keep the community informed of this project and its key issues, as discussed in Section 4.2.

8.17 Complaints Protocol

The Complaints Protocol for the Abel Underground Mine will be as per the protocol currently operating for Donaldson Open Cut Mine, that provides a 24 hour hotline for community use and follow-up procedures for investigation and reporting of complaints. The complaints protocol for the Bloomfield CHPP will also be continued.

8.18 Emergency Response

The existing Emergency Response procedures for Donaldson Open Cut Mine will be revised to include the Abel Underground Mine activities. Existing Bloomfield CHPP Emergency Response Procedures will be continued.

Emergency responses include actions to be taken in the event of:

- Site accident;
- Spillage of chemicals;
- Flooding;
- Bushfire; and
- Spontaneous combustion of coal on stockpiles, in rehabilitation or in other areas.

8.19 Site Traffic

The Site Transport Rules for Donaldson Coal will be amended to include the Abel Underground Mine operation as required. These rules apply to all traffic that enters the Donaldson Coal site and include such items as:

- speed limits;
- areas where particular vehicles are not permitted (eg: rehabilitation areas);
- safety and induction requirements; and
- traffic arrangements, including temporary construction phase arrangements.

Existing Bloomfield Site Transport Rules will apply on land within the Bloomfield Coal Mine Lease, which includes part of the internal haul road and the CHPP.

8.20 Training, Induction and Inspections

Training and induction procedures for employees, contractors and visitors will be developed for the Abel Underground Mine, which will contain new procedures for underground mining as well as for environmental issues that relate to the Abel project. These include induction training when people first come on site and ongoing training (toolbox talks).

Regular Environmental Inspections are undertaken for Donaldson Mine site activities and all Abel Underground Mine environmental interactions will be included in these Inspections.

Existing training and induction procedures and inspections will continue for the Bloomfield CHPP operation.

8.21 Management Plan Review

All management plans that will be prepared or updated for the Abel Underground Mine will be reviewed and updated in accordance with existing Donaldson Mine procedures. These require that plans be reviewed and updated as required. An Annual Environmental Management Report (AEMR) will also be prepared that will include a description of all Abel Underground Mine operations and results of monitoring and compliance.

8.22 Integrated Monitoring Network

The Abel Underground Mine Project Development Application includes the development of an Integrated Monitoring Network that will monitor, review and report environmental data across four sites located in close proximity to each other. These sites are:

- Tasman Underground Mine, owned by Donaldson Coal;
- The proposed Abel Underground Mine, owned by Donaldson Coal;
- Donaldson Open Cut Mine, owned by Donaldson Coal; and
- Bloomfield Coal Handling and Preparation Plant and Rail Loading Facility, owned by Bloomfield Collieries.

The Integrated Monitoring Network will assist the development of a sub-regional model of environmental data collection from coal mining activities. It will reduce duplication of monitoring on individual sites and identify sensitive areas that may be between mine sites that require monitoring to enable more effective sub-regional data sets. Data will be shared across the sites and reported in one Integrated Monitoring Network document. Individual site reporting will still be provided as required by the Environmental Protection Licences.

This Integrated Monitoring Network is a key aspect of the proposed Abel Underground Mine proposal as it enables a more detailed 'picture' of the sub-regional environment to be gained and a report to be produced that addresses issues across the whole sub-region from Mount Sugarloaf to Ashtonfield, rather than focussing on individual mine site issues. This Integrated Monitoring Network will in particular be able to more effectively monitor cumulative impacts from the four sites.

Monitoring to be included in the Regional Monitoring Network includes:

- Noise;
- Air Quality;
- Surface Water; and
- Groundwater.

The location of monitoring points for the above items are shown on Figure 8.2.

i. Noise Monitoring

The Noise Monitoring Integrated Network will consist of:

- Eleven existing monitoring locations representative of the surrounding noise environment for the nearest potentially affected residential areas, set up to monitor the Donaldson Open Cut Mine.
- Two proposed monitoring locations for the Tasman Mine, being at West Wallsend and Seahampton, to be monitored on a quarterly basis.

ii. Air Quality monitoring

Donaldson Mine's existing air quality monitoring equipment that will continue to operate as part of the integrated monitoring network includes:

- one High Volume Air Sampler (HVAS) measuring Total Suspended Particulates (TSP);
- two HVAS measuring sub-ten micron particulates (PM_{10});
- two continuous DustTrack monitors measuring PM_{10};
- eleven depositional dust gauges measuring insoluble solids; and
- one GRIMM monitor measuring PM_{10} and $PM_{2.5}$ on two campaign events.

At Tasman Mine, there will be six depositional dust gauges installed around the site which will be monitored on a monthly basis. In addition a High Volume Sampler measuring TSP and PM_{10} will be installed in close proximity to the mine site.

At Bloomfield there are ten Depositional Dust Gauges located around the site.

iii. Surface Water – Abel Underground Mine Surface Area

This monitoring includes:

- Monthly water quality sampling from each of the sampling locations shown in Figure 8.2 and an additional site in Pambalong Nature Reserve, with analytes measured including pH, Electrical Conductivity, Total Dissolved Solids, Total Suspended Solids, Chloride, Sulfates, Alkalinity (Bicarbonate), Alkalinity (Carbonate), Calcium, Magnesium, Sodium and Potassium;
- Flow gauging stations established on Blue Gum Creek to monitor water flow and level; and
- Macro-invertebrate monitoring within Blue Gum Creek and Pambalong Nature Reserve, including the use of AUSRIVAS (Australian River Assessment System) to assess biological health.

iv. Surface Water Monitoring – Abel Surface Infrastructure Area (north of John Renshaw Drive)

Surface water monitoring will be undertaken at:

- Four Mile Creek at John Renshaw Drive; and
- Weakleys Flat Ck at John Renshaw Drive.

The following monitoring regime is proposed:

- Routine monthly baseline sampling;
- Daily water samples collected from the discharge point on any occasion when there is controlled discharge from Lake Kennerson. Water samples will also be collected at the flow gauging station behind the Four Mile Workshops;
- Daily water samples will be collected from any overflow from the Stockpile Dam. Water samples will also be collected at the flow gauging station behind the Four Mile Workshops.

These samples will be analysed for:

- non-filterable residue (NFR)
- turbidity
- pH
- conductivity.

v. Groundwater

The groundwater monitoring program will include:

- Monthly measurement of water levels in a representative network of piezometers as shown on Figure 8.2;
- Quarterly sampling of all standpipe piezometers, for analysis of electrical conductivity (EC), total dissolved solids (TDS) and pH;
- Annual collection of water samples from all standpipe piezometers for analysis of a broader suite of parameters:
  - Physical properties (EC, TDS and pH)
  - Major cations and anions
  - Nutrients
  - Dissolved metals;
- Weekly measurement of the volume of mine water pumped from the underground workings, with separate inflow rates monitored if two or more separate mining areas are active at any time;

- Weekly measurement on site of the electrical conductivity (EC), total dissolved solids (TDS) and pH of the mine water pumped from the underground workings; and
- Additional sampling and/or water level measurements to confirm the variance from expected behaviour.

Subsidence monitoring will be specific to the Abel Underground Mine project and will be undertaken as described in Section 6.2.8 and in accordance with the Subsidence Management Plans.

9 ENVIRONMENTAL RISK ASSESSMENT

9.1 Assessment of Residual Risk

Section 5 describes the methodology used to develop a Risk Register for the project. The Risk Register considered the various aspects of the proposed Abel Underground Mine, undertook preliminary screening of potential impacts, identified those impacts that had the highest level of risk to the environment, and provided a focus for the issues to be considered as part of the environmental impact assessment.

For each project aspect, three separate scenarios were considered:

- No controls – being a measure of 'raw' risk associated with an activity, or what may occur if no controls or mitigation measures are in place;
- Current controls – where applicable, as many aspects are already controlled as part of the environmental management of Donaldson Mine; and
- Proposed controls – which were determined by the working group to form part of the proposed development, for example, a bund, diversion, mining method or management plan.

The Environmental Risk Register (Appendix C) developed from the above process and in accordance with 'Risk Management Guidelines Companion to AS/NZS 4360:2004', showed that many aspects of the proposed development, even with no controls, would be what is classified as a low or medium risk. Environmental risk associated with subsidence related issues, if no controls were proposed, was generally considered to be a high risk.

In order for an aspect of the operation to be acceptable, the minimum requirement adopted for the project was that the residual environmental risk should be a low level risk after additional impact assessment and implementation of the recommended controls was considered. Initially where a low level risk could not be achieved, additional controls were applied. In a number of cases this was achieved by adopting the controls already in place and documented (or proposed as amendments) to the existing approved Environmental Management Plans for the Donaldson Open Cut Mine (refer Section 8).

Where existing controls did not address the identified environmental impact, or where it was considered a low level residual risk could not be obtained through implementation of existing controls, additional controls were proposed by the individual specialist studies undertaken to assess specific impacts. These additional controls are detailed in the Statement of Commitments (refer Section 7).

After completion of the assessment studies for key issues, the risk register and risk ratings were reviewed and updated to determine whether the risk ratings had increased or decreased as a result of the detailed investigation undertaken for the Environmental Assessment. The risk rating allocated to a proposed activity after consideration of detailed studies and proposed management and mitigation

measures is referred to as the 'residual risk' (being a measure of the remaining environmental risk once appropriate controls and mitigation strategies have been applied).

All aspects of the proposal following assessment and implementation of appropriate controls as identified in the Statement of Commitments are categorised as having a 'low environmental risk' and considered acceptable. The Statement of Commitments provides a system whereby the key issues for the project will be subject to various plans of management. Such plans will provide for appropriate monitoring of these issues and will provide various trigger levels which will require further action if the monitoring demonstrates impacts greater than those outlined in the environmental assessment for the Project.

10 PROJECT JUSTIFICATION

10.1 Project Overview

Donaldson Coal Pty Ltd (Donaldson) proposes to develop a new underground mine called 'Abel Underground Mine'. This mine will be located south of John Renshaw Drive, approximately 23 kilometres north-west of Newcastle. Abel Underground Mine covers a surface area of approximately 2750 hectares and will extract up to 4.5 million tonnes of run-of-mine coal per year over 21 years. Mine depths will range from 50 metres (near John Renshaw Drive) to 450 metres beneath the surface in the southern area. Coal will be extracted using high productivity bord and pillar methods with continuous miners, with secondary pillar extraction. This method enables flexibility in mining to enable the protection of identified surface features, including Primary residences.

Surface disturbance will be minimised by accessing the mine via portals constructed off the high wall left within the Donaldson Open Cut Mine final void. It is proposed to place surface infrastructure on land already disturbed by the Donaldson Open Cut Mine and use the existing Bloomfield Coal Handling and Preparation Plant and rail loading facility. All coal from the Abel Underground Mine will be transported by rail to the Port of Newcastle for export.

The project will employ approximately 375 people, with an additional construction workforce.

10.2 Environmental Assessment Process

This Environmental Assessment has been prepared in accordance with Part 3A of the *Environmental Planning and Assessment Act 1979*. Part 3A of the Act requires a Project Application with Preliminary Assessment to be prepared and lodged with the NSW Department of Planning. The Project Application (Donaldson Coal, December, 2005) provided sufficient information for the Department to confirm that the proposed development was a Part 3A project under the Act, and also included:

- a description of the project;
- information on planning provisions;
- preliminary consultation;
- a description of required approvals and licences; and
- a preliminary assessment to identify likely environmental issues.

Part 3A projects are required to identify key project issues for detailed investigation. These were identified by undertaking a risk assessment process with the project team to identify all activities associated with the project and likely impacts. Impacts were determined by considering the likelihood of occurrence and the consequences if they occurred. The qualitative risk assessment methodology

adopted for the Project is in accordance with Australian Standard *AS/NZS 4360:2004 – Risk Management*.

The Project Application included a Planning Focus Meeting held in November 2005 which was attended by all relevant government departments. These departments were briefed on the project and provided with an opportunity to comment and make recommendations for impact assessment studies.

The Director-General of the Department of Planning then issued Environmental Assessment Requirements in January 2006. These Requirements form the basis of what is required to be addressed by the Environmental Assessment, the second, more detailed study required to be prepared for the proposed development.

This document is the Environmental Assessment that has been prepared for the proposed Abel Underground Mine, in accordance with the Environmental Assessment Requirements. It provides:

- a detailed description of the proposed development;
- planning considerations (for example, identification of relevant legislation to comply with, licences to be obtained and guidelines and policies to follow);
- a description of consultation that has been undertaken during the project, including discussions with the local community and government authorities;
- Detailed description of key issues for the project, including the process undertaken to investigate the key issue, potential impacts and methods to prevent, reduce, manage and monitor of these impacts;
- a description of the environmental management system and procedures that will be put in place to prevent, reduce, manage, mitigate and/or monitor any potential impacts;
- a Statement of Commitments, being a set of draft consent conditions for the proposed development, that will require the proposed mine to implement certain actions to ensure minimal environmental and community impact;
- an environmental risk assessment that considers all of the above that has determined that the proposed development can satisfactorily manage all key issues to provide minimal impact on the environment.

10.3 Consideration of Key Issues

The Environmental Assessment Requirements issued for the proposed Abel Underground Mine require the Environmental Assessment to *'consider the impacts of the project (as a whole)'*. Section 6 provides a description and impact assessment for the key project issues. Detailed technical studies are provided as Appendices. Section 8 provides the environmental management procedures that will be implemented to prevent, reduce, manage, mitigate, and/or monitor environmental risks identified by the assessment of key issues.

The key issues investigated in detail for the Environmental Assessment were:

- Subsidence;
- Water (including groundwater and surface water);
- Noise;
- Air Quality;
- Aboriginal and European heritage;
- Flora and fauna;
- Traffic and transport;
- Visual aspects; and
- Waste (including general waste management as well as the disposal of reject from the coal washing process, being coarse reject and tailings).

The following provides a concluding summary of any risk identified from the investigation of each key issue and a discussion of the impacts of the project as a whole.

i. Subsidence

Donaldson Coal has committed to a flexible mining method that provides for areas within the mine plan where mining will not occur, or where the extraction of coal will be reduced so that subsidence can be minimised on the surface. This enables the protection of a range of identified surface features including Principal residences, Black Hill School and Church, Schedule 2 creeklines and the rainforest communities. Pambalong Nature Reserve and the F3 Freeway have been removed from the Mine Plan area.

Subsidence management options for other natural and man-made items will be determined on a case by case basis through the preparation of detailed Subsidence Management Plans to be prepared prior to the commencement of each stage of mining. These detailed plans will include detailed plans to manage any impact on infrastructure such as transmission lines, dams and roads.

A preliminary assessment of the tolerable subsidence limits for the natural surface features indicates that the impacts can be managed by the strategies described in Subsidence Impact Assessment. These strategies will be implemented via the Subsidence Management Plans.

'Safe and serviceable' tolerance limits for the man made surface features are expected to be met through the implementation of the protection and management strategies described in the Subsidence Impact Assessment.

ii. Surface Water

Through adoption of the relevant guidelines and performance criteria, potential impacts on watercourses associated with underground mining will be eliminated or adequately controlled. Surface water studies have determined that there will be

negligible change to the overall catchment topography and negligible surface disturbance within the underground mine area.

Subsidence impacts on Schedule 1 Streams are assessed to be within acceptable levels, and monitoring under the Watercourse Subsidence Management Plan will detect any actual impacts so that they can be remediated as soon as practicable to prevent downstream impacts. Subsidence impacts on Schedule 2 Streams and significant features such as Blue Gum Creek and Pambalong Nature Reserve will be negligible.

iii. Groundwater

The groundwater investigations concluded that no adverse impacts on water quality are expected, no existing groundwater supplies are expected to be impacted and no adverse impacts are expected on any groundwater dependent ecosystems (GDEs).

The total groundwater inflow rate for the Abel Underground Mine workings is predicted to increase steadily through the project life, reaching a maximum of 3 ML/d by the 20 year mark. Sensitivity modelling suggests that the maximum inflow rates could be between about 1.5 and 4.5 ML/day. Dewatering is predicted to locally impact groundwater levels in the Donaldson Seam and the immediately overlying coal measures sediments.

There is believed to be negligible hydraulic interconnection between the Donaldson seams and the Hexham Swamp / Pambalong Nature Reserve. Limited connection was simulated in the groundwater modelling to assess a possible worst case condition. Drawdowns of just 10 cm after 20 years were predicted by the groundwater model for the alluvium beneath the Pambalong Nature Reserve, and less beneath the main Hexham Swamp region to the east of the F3 freeway. In practice, no impact is expected.

Pressure heads in the Donaldson Seam are predicted to recover to 80% of the pre-mining levels within 6 years after cessation of mining.

iv. Noise

The potential for noise impact is greatly reduced as the proposal is for an underground mine. The Noise Impact Assessment investigated any potential increase in noise from proposed surface facilities to be located north of John Renshaw Drive, including intrusiveness, amenity and sleep disturbance criteria. Potential noise from construction, operation, rail traffic, the use of the Bloomfield CHPP and the cumulative impact of the Abel Underground Mine and Donaldson Open Cut Mine operating simultaneously were investigated. The Assessment concluded that all noise would be below set noise criteria, with the exception of a 1dB(A) exceedance at one residence to the south-west, that would be experienced at night-time in a north-westerly wind. The owner of this residence has an existing agreement with Donaldson Coal regarding noise. All other residential noise predictions, including residential areas at Black Hill, Ashtonfield and Thornton, are below determined project noise criteria.

v. Air Quality

The underground nature of the proposed mine greatly reduces the potential for dust generation from operations. The Air Quality Assessment investigated potential air quality reductions due to the operation of surface facilities, including stockpiles, internal road transport, conveyors, and the operation of the Bloomfield CHPP. The Assessment concluded that there would be no exceedances of air quality criteria as a result of construction or operation of the Abel Underground Mine and Bloomfield CHPP.

Model predictions of the dispersion of dust emissions from the mine indicate that no residences are likely to experience any exceedances of the Department of Environment and Conservation's long-term assessment criteria for particulate matter (PM_{10}), total suspended solids (TSP) or dust (insoluble solids) deposition.

The DEC's 24-hour average PM_{10} assessment criterion of 50 $\mu g/m^3$ is currently exceeded in the local area from time to time, particularly at times when bushfire smoke affects air quality. This situation will continue, however, emissions from the mine are not predicted to significantly affect the number of exceedances.

vi. Aboriginal and European Heritage

After implementation of proposed management and mitigation measures, it is concluded that the risk of residual impact to Aboriginal heritage from Project Abel is low. Particular items identified within the Abel Underground Mine surface area will be included in Subsidence Management Plans. Items located along Long Gully and other Schedule 2 creeklines will be protected by the Schedule 2 creekline subsidence management objectives.

There is only one item of European heritage on the site, being a section of the Richmond Vale railway line. The impact of subsidence on this item is predicted to be negligible.

vii. Flora and fauna

The ecological investigation found that there would be no impact on threatened species or endangered ecological communities resulting from the construction and operation of the Abel Underground Mine.

viii. Traffic and transport

As a result of analyses it is concluded that the future operation of the proposed Abel Mine is unlikely to have an adverse impact on the existing road network or the key access intersection to the internal site infrastructure and surface facilities. The access to the proposed mine from John Renshaw Drive would perform adequately under all operating scenarios for at least ten years after a possible mine opening next year, that is up to 2017.

ix. Visual aspects

Overall, the proposal to mine coal underground would not noticeably alter the visual environment of either the underground mining area or of surface study area within the existing Donaldson Mine Lease. The visual impacts of the proposed works, as assessed by the detailed visual impact assessment, confirmed that the environmental risk rating is low.

x. Waste

The main waste product to be produced by the proposed Abel Underground Mine is tailings and coarse reject, which will be produced when the run-of-mine coal is processed at the Bloomfield CHPP. Two scenarios were modelled for waste disposal, being maximum production and target production. For both these scenarios there is sufficient capacity to accept all reject and tailings material over the anticipated life of all four mines (Tasman, Donaldson, Abel and Bloomfield) that contribute to the Bloomfield CHPP.

Coarse reject and tailings will be disposed to various Bloomfield Colliery areas including pumping underground into the Big Ben seam and into the remaining open cut pits, including U Cut North, U Cut South, Creek Cut and S Cut (final). Disposal of coarse reject and tailings into these open cut areas will assist with rehabilitation and final landform of these areas, as described in the Bloomfield Colliery Mining Operations Plan.

Other wastes that will be produced by the Abel Underground Mine will be similar to those produced by the Donaldson Open Cut Mine and will be managed by similar procedures to be documented as part of a Waste Management Plan.

xi. Cumulative Impact

All studies have considered and included cumulative impact in their impact assessment. The noise and air quality studies concluded that with the simultaneous operation of the Abel Underground Mine, Donaldson Open Cut Mine and Bloomfield CHPP, levels would remain below determined criteria.

The traffic and transport assessment included the future haulage of Tasman coal and Donaldson Open Cut employee use in its consideration of the safety and serviceability of the access intersection off John Renshaw Drive.

Water studies have determined impacts associated with the use, production and management from the Tasman Mine (which could truck water to Donaldson if required), Abel Underground Mine, Donaldson Open Cut Mine and Bloomfield Colliery and CHPP and include new procedures to better manage water across all sites.

All operational interactions between these mines has been considered and appropriate management strategies developed to ensure minimal impact.

xii. Overall Project Impact

The environmental risk assessment undertaken for the project determined key issues where potential impacts could be higher. Detailed technical studies were undertaken to investigate and assess these potential impacts and develop management strategies where appropriate to reduce risk to either 'safe and serviceable' levels or below required criteria.

The Abel Underground Mine operation has been designed so that coal can be extracted in a manner that manages subsidence to safe and serviceable levels for all surface and sub-surface features.

Surface infrastructure design has utilised existing areas of disturbance and facilities to further reduce potential surface impacts such as dust and noise and protect flora and fauna through minimal clearing.

Water studies have considered the potential impact of changes to existing surface and groundwater, as well as the management of the water management system over the interacting mine sites. All studies conclude that water can be managed in a satisfactory manner with minimal environmental impact.

All key issue studies undertaken for the proposed Abel Underground Mine conclude that the proposed development can satisfactorily manage all key issues to provide minimal impact on the environment.

10.4 Environmental Management

Examination and prediction modelling of key issues has determined potential impacts associated with the Abel Underground Mine project, including the continuation of the Bloomfield CHPP with expansion to cater for increased coal throughput. Where these impacts were considered unacceptable, the mine plan and method were altered to reduce the predicted impact to an acceptable level.

The Abel Underground Mine project will ensure its environmental impact remains at a minimal or negligible level through adoption of the following principles:

- Implementation of the Statement of Commitments and Environmental Management System, which contains actions to prevent, reduce, manage and monitor potential environmental impacts;
- Continued application of the Donaldson Coal Pty Ltd Environmental Policy, environmental management system and procedures, which have demonstrated successful environmental management at the existing Donaldson Open Cut Mine operation, as well as continuation of the existing Bloomfield procedures;
- Monitoring the environment on an ongoing basis using the Integrated Monitoring Network, and using results to ensure actual impacts are as per predicted impacts;
- Modifying the mine plan and methods if it is found that actual impacts are higher than predictions; and

- Providing operational transparency by continuing to provide monitoring results and reports on the Donaldson Coal public website, and working with the local community through the Community Consultative Committee and individual landowners through the Subsidence Management Plan process.

The selected mining method has the advantage of being able to be modified to cater for any change in surface conditions and to manage surface subsidence where required.

A process whereby monitoring, management documentation, training and procedures are reviewed on a regular basis and updated where necessary will ensure that protection and management systems remain up to date.

10.5 Alternatives to the Proposed Development

10.5.1 Introduction

During the mine planning and environmental assessment phases of the project, various alternatives were considered. The description of the Abel underground Mine proposal provided in Section 2 was selected after consideration of the various alternatives as the method that was able to best achieve the following objectives:

- to minimise environmental impacts so as to ensure that they are not significant and are acceptable;
- achieve coal extraction requirements; and
- enable economical coal extraction and processing.

The following provides a brief description of the alternatives that were considered.

10.5.2 Mining techniques

Coal can be extracted using open cut mining or underground mining. Underground mining methods include continuous (bord and pillar) mining, partial extraction mining and longwall mining.

Open cut mining requires the removal of soil and rock material over the coal seam so that it can be removed. The majority of coal to be removed in the Abel area is too deep to be extracted by this method and open cut mining would create unacceptable environmental impacts, including the removal of all structures, vegetation and surface features such as creeks.

Longwall mining extracts larger amounts of coal from the coal seam but does not enable subsidence to be reduced in particular surface areas. A longwall face 400 metres wide or more removes all coal from the face at this width, leaving no support pillars. Longwall mining leads to subsidence across the surface area varied by seam thickness, depth of cover, face width and strata conditions, but

does not enable particular areas to be left unsubsided, or with subsidence reduced to a particular level.

The Abel Underground Mine proposes to extract coal using a partial extraction method. This means that subsidence can be controlled by varying the size and stability of supporting coal pillars left in the configuration, and the proportion of coal extracted.

Bord and pillar mining only removes approximately 40% of the coal and would sterilise the large amount of remaining coal and produce an uneconomical return on investment.

The selected method is able to extract up to 80% of coal in some areas and manage subsidence to an acceptable level. It was selected for its flexibility to manage subsidence beneath a wide range of surface features.

10.5.3 Mine planning

The mine plan was originally developed with extraction occurring throughout the proposed underground lease area with the exception of Pambalong Nature Reserve and the F3 Freeway. After environmental assessment studies of key issues were undertaken and recommendations made for protection of particular surface features, the mine plan was modified to reduce the amount of coal extracted below certain key features such as principal residences. Further detailed modifications such as identifying which individual pillars to retain to manage subsidence will be made during the preparation of the Subsidence Management Plans.

10.5.4 Surface Infrastructure

A key aspect of this proposal is its ability to use existing infrastructure to minimise environmental disturbance and potential impact. Abel Underground Mine proposes to use existing disturbed areas within the Donaldson Open Cut Mine to locate surface infrastructure such as stockpiles, mobile equipment, plant and buildings. The high wall of the remaining Donaldson pit will also be used to access the proposed underground mine area. The existing Bloomfield Coal Handling and Preparation Plant (CHPP) and rail loading facility, adjacent to the northern boundary of the Donaldson lease will be used to process coal and load it onto trains to the Port of Newcastle. Existing underground areas and surface disturbed areas within the Bloomfield coal lease will be used for the disposal of tailings.

The alternative to the above arrangement is for Donaldson Coal to construct new facilities for Abel Underground Mine. This would require clearing of a significant area to enable access to the underground workings and the placement of buildings and plant. The option to locate these items south of John Renshaw Drive would lead to significant surface disturbance and environmental impacts that have been avoided by utilising areas of disturbance within existing coal mine areas, and by using the Donaldson Open Cut high wall to access the underground mine area.

Placement of facilities within the open cut void also provides a reduction in visual and noise disturbance and enables better surface water management.

Use of the existing processing and loading facilities at Bloomfield Colliery means an additional large plant and rail loop accessing the Main Northern Railway does not need to be constructed in the local area.

10.5.5 Reject disposal

It is proposed to continue the current practice of placing coarse reject material from the coal washing process into existing Bloomfield open cut voids. This assists with filling of these voids so that they may be rehabilitated after completion of mining. There is no other suitable location for coarse reject material in the local vicinity, other than piling it up on the surface which would create unacceptable visual disturbance and lead to issues associated with water management, dust and noise. This process assists with rehabilitating open cut voids.

Tailings (the 'slurry') produced by the washing of coal will be pumped into old underground workings within the Bloomfield lease, and also used to fill old, unrehabilitated open cut voids within Bloomfield. These processes have been undertaken at Bloomfield for some time, with tailings currently being pumped into the former underground workings. This process assists with rehabilitating open cut voids. Potential impacts associated with the pumping of tailings into the former underground workings have been considered in the Groundwater Impact Assessment for this project. Other than disposing of tailings in surface tailings dams there is no other environmentally acceptable method of disposing of tailings on the site.

10.5.6 Not proceeding

If the project were not to proceed, there would be the following implications:

- Donaldson open cut mine would close in 2012 and the opportunity to use existing plant, roads and areas of disturbance would cease;
- Approximately 45-55 million tonnes of coal would be effectively sterilised, as it is not considered acceptable to recover this coal by accessing it in any way except from the existing Donaldson Open Cut Mine high wall;
- Employment of approximately 375 employees from the lower Hunter Region would not proceed and the estimated $940 million would not be provided to the local community via wages and other labour costs;
- The State and Federal Governments would not receive approximately $360 million in expected royalties.

10.6 Socio-Economic Benefits

The Abel Underground Mine project will employ approximately 375 people. It is expected that these employees will be sourced mainly from the lower Hunter Region and will include employees skilled in underground mining operations, surface infrastructure operations, mine management and administration. Approximately $940 million will be invested in labour costs over the 20 year life of the mine.

The project will also lead to increased indirect employment within the local business community, who will supply various items to the mine such as fuels, parts and equipment and clothing and provide contractor services such as equipment refits, weed spraying and small vehicle servicing. The local community will also benefit from the increase in local employment as employees purchase local goods and services.

Royalties to be paid to the State and Federal Government from the sale of coal are expected to be approximately $360 million over the life of the mine.

10.7 Ecologically Sustainable Development Principles

10.7.1 National Strategy for ESD

Australia's National Strategy for Ecologically Sustainable Development (Australian Government, 1992) defines ecologically sustainable development (ESD) as:

'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

This National Strategy contains three objectives related to mining, being:

- to ensure sound environmental practices throughout the mining industry;
- to provide appropriate community returns from mineral resource developments; and,
- to improve community consultation and information, and to improve performance in occupational health and safety.

Environmental practices that will be implemented for the Abel Underground Mine are described in Section 8 and a draft Statement of Commitments, describing how the mine will implement sound environmental practices, is provided in Section 7. These practices include:

- the use of a mining process that has the flexibility to protect surface features as required;
- the use of existing disturbed surface areas and surface infrastructure to avoid further land disturbance;

- implementation of a comprehensive environmental management regime that includes training, monitoring, reporting and review to ensure environmental practices are used throughout the project; and
- continued community liaison to ensure the local community is informed of mine developments and is able to discuss any concerns they may have with the mine.

An Intergovernmental Agreement on the Environment (Australian Government, 1992) made between the Federal Government and the Australian States defined four main ESD principles that *'should inform policy making and program implementation.'* These are listed as follows, together with a description of how they apply to the proposed Abel Underground Mine.

10.7.2 Precautionary Principle

The precautionary principle requires that where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The precautionary principle has been applied to several aspects of the Abel Underground Mine proposal. The subsidence impact assessment has considered 'worst case' subsidence scenarios for surface features and this information has been used in the various assessment studies, for example, flora and fauna, surface water and Aboriginal heritage. While it is considered that in certain locations subsidence will be less than 'worst case', a lack of full scientific certainty has not been used to postpone measures to prevent environmental degradation by requiring the consideration of 'worst case' scenarios for assessment.

The impact of subsidence under principal residences and Schedule 2 creeklines has also been considered and in the case of principal residences, a rule of no secondary workings has been imposed. Under Schedule 2 creeklines, there is a lack of scientific knowledge of the impacts subsidence may have on the creek bed. Therefore an interim limited extraction plan for Schedule 2 creeklines has been imposed. A process his proposed whereby further research is undertaken for each Schedule 2 stream prior to any mining occurring which would impact on it. Following this research being completed, the mine plan in relation to each Schedule 2 stream will be finalised.

Assessment studies for all key issues for the proposed Abel Underground Mine have included measures to prevent environmental degradation, based on 'worst case' scenarios.

Best practice scientific modelling has been used for all Abel Underground Mine assessment studies to predict potential impacts. A validation program has also been proposed that will monitor actual impacts for comparison against predicted impacts, and the management plans and mine plan will be adjusted accordingly if it is found that actual impacts differ from predictions.

The Surface Water Management and Groundwater studies completed for this proposal have been peer reviewed to ensure scientific rigour.

10.7.3 Intergenerational equity

Inter-generational equity refers to the requirement for the present generation to ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The assessment of each key Abel Underground Mine issue included consideration of protecting the existing environment to conserve it for future generations. The nature of underground mining minimises surface disturbance and will maintain the rural/native vegetation character of the Black Hill area. Rehabilitation of the area north of John Renshaw Drive at the completion of mining will enhance this area and improve its environmental health and productivity.

10.7.4 Conservation of biological diversity and ecological integrity

Conservation of biological diversity and ecological integrity has been considered by the flora and fauna assessment for the project, which concludes that potential impacts from the project on flora and fauna will be minimal. Significant rainforest communities will be protected by altering the mine plan beneath these areas. Pambalong Nature Reserve, a significant wetland area within the Exploration Lease has been excluded from the proposed mine area. By using a flexible underground mining method and using existing surface facilities where possible, the need to disturb the ecological integrity of surface areas is minimised.

10.7.5 Improved valuation, pricing and incentive mechanisms

This principle requires that environmental factors be included in the valuation of assets and services, including the need for pollution generators to be responsible for the cost of containment, avoidance and abatement. It also addresses the need for full life cycle costings for goods and services to be considered and establishing cost effective and incentive based mechanisms to develop solutions and responses to environmental problems.

The Abel Underground Mine proposal includes actions to be taken to contain pollution on site. The actions and associated costs involved in rehabilitation, waste management and site clean up associated with water or land pollution form part of this proposed development and will be required as part of the Mining Lease issued by the Department of Primary Industries.

Donaldson Coal and Bloomfield Collieries have developed an Integrated Monitoring Network as part of this proposal that will provide improved monitoring across the Tasman, Abel, Donaldson and Bloomfield sites and at the same time reduce costs associated with monitoring and reporting.

Where possible, Donaldson Coal will utilise innovative opportunities to prevent or mitigate environmental impacts, for example, by maximising recycling, investigating fuel efficiencies through modified site layouts and investigating new

technologies that may come about during mining to determine whether they can provide better environmental protection or management.

10.8 Conclusion

The proposed Abel Underground Mine will employ approximately 375 people and create significant royalties and taxes for the NSW Government. Up to 4.5 million tonnes per year of high quality coal will be extracted using an underground mining process that enables surface protection for features sensitive to subsidence, such as residences, dams, creeklines and rainforest habitat.

A risk assessment process has been used to identify all activities associated with the proposal and their potential environmental impacts. Mitigation measures and controls have been identified and applied to these activities, and a resulting environmental risk rating applied to determine the key project issues. Studies on these key issues have been completed to determine potential impacts and develop mitigation and management strategies.

All studies undertaken for the proposed Abel Underground Mine predict that any impacts will not be significant and that the risk of environmental impact from underground mining or the use of surface facilities will be low. Studies will continue to be updated through further investigation and monitoring to ensure predictions remain accurate. This enables the maximum amount of data to be applied to prediction modelling ahead of mining.

The Abel Project has key features that provide a unique Lower Hunter Region opportunity to remove high grade coal with minimal environmental impact. These are:

- the use of existing Donaldson and Bloomfield Mine infrastructure and areas of disturbance to minimise surface impacts;
- the selection of flexible bord and pillar techniques with secondary extraction to minimise subsidence in certain areas and exclude mining in others to protect identified surface and sub-surface features; and
- development of an Integrated Monitoring Network to monitor potential impacts over a wider area, with greater data sharing and management to assist in providing a more comprehensive regional data set for items such as air and water quality.

Key decisions were made early in the mine planning process to not use longwall mining so that surface subsidence could be managed to acceptable levels. Exclusion areas such as Pambalong Nature Reserve and restricted subsidence zones such as under Principal Residences, Schedule 2 creeklines and rainforest areas were also determined, and monitoring systems installed to collect baseline data. The mine plan was designed to include the needs of landowners, in particular to ensure minimal impact to principal residences, and to also be compatible with the draft Lower Hunter Regional Strategy and future reservation of environmentally protected lands in this locality.

The proposed Abel Underground Mine offers a unique opportunity to extract high quality coal in a manner that has minimal environmental impacts, whilst minimising surface disturbance and maximising the efficient use of existing surface facilities so that additional facilities with their associated environmental impacts do not need to be constructed. The mine planning process has worked in tandem with environmental assessment studies throughout the project to continuously monitor predicted impacts and alter the mine plan as required to provide negligible or minimal environmental impact.

All key issue studies undertaken for the proposed Abel Underground Mine conclude that the proposed development can satisfactorily manage all key issues to provide minimal impact on the environment.

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12 LIST OF ABBREVIATIONS

ACARP	Australian Coal Association Research Program
AEMR	Annual Environmental Management Review
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AMER	Annual Environmental Management Review
ANZECC	Australian & New Zealand Environment & Conservation Council
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
AS/NZS	Australian Standard/New Zealand Standard
AUSRIVAS	Australian River Assessment System
Avg	Average
CAMBA	China & Australia Migratory Bird Agreement
CH4	methane
CHPP	coal handling and preparation plant
CO	Carbon monoxide
dB/dBA	decibel
DEC	Department of Environment and Conservation, NSW
DG	Director-General
DIPNR	Department of Infrastructure Planning and Natural Resources, NSW (Now DNR and DOP)
DLWC	Department of Land and Water Conservation (now DNR)
DOP	Department of Planning, NSW
DNR	Department of Natural Resources, NSW
DPI	Department of Primary Industries, NSW
E	Endangered
EA	environmental assessment
EC	electrical conductivity
EIS	environmental impact statement
EL	exploration licence
ENCM	NSW Environmental Noise Control Manual
EPA	Environment Protection Authority (now DEC)
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environmental Pollution Licence
ESCP	Erosion and Sediment Control Plan
FOC	fibre optic cable
g	grams
GDE	groundwater dependent ecosystems
GIS	geographic information system
GPS	global positioning system
HCCREMS	Hunter and Central Coast Regional Environmental Strategy
HFC	hydrofluorocarbons
INP	Industrial Noise Policy
JAMBA	Japan & Australia Migratory Bird Agreement
Kg	kilograms
Km	kilometres
KV	kilovolt
LA90	measured background level
Laeq	equivalent continuous noise level
LALC	Local Aboriginal Land Council

Lamax	maximum continuous noise level
LGA	local government area
LHCCREMS	Lower Hunter and Central Coast Regional Environmental Management Strategy
LoS	Loss of Service
M_3	cubic metres
M	metres
MAHD	metres above the Australian Height Datum
Max	maximum
MDBC	Murray Darling Basin Commission
mg/L	milligrams per litre
Min	minimum
ML	megalitres ALSO Mining Lease
ML/d	megalitres per day
Mm	millimeters
mm/m	millimeters per metre
MOP	Mining Operation Plan
MSB	Mine Subsidence Board
Mt	million tonnes
Mtpa	million tonnes per annum
NATA	National Association of Testing Authorities
N2O	nitrous oxide
NO2	nitrogen dioxide
NP&W Act	National Parks and Wildlife Act 1974
NPER	National Professional Engineers Register
NPWS	NSW National Parks and Wildlife Service (now DEC)
NSW	New South Wales
NW	north west
PFC	perfluorocarbons
pH	a measure of acidity
PM	particulate matter
$PM_{2.5}$	particulate matter with a diameter less than 2.5 micrometres
PM_{10}	particulate matter with a diameter less than 10 micrometres
PNR	Pambalong Nature Reserve
PoEO Act	Protection of the Environment Operations Act 1997
REP	Regional Environment Plan
RLF	Rail Loading Facility
ROM	run-of-mine
RTA	Roads and Traffic Authority
ROTAP	Rare or Threatened Australian Plants
SE	south east
SEPP	State Environmental Planning Policy
SF_6	sulphur hexafluoride
SMP	Subsidence Management Plan
SO_2	sulphur dioxide
t	tonnes
TARP	trigger-action response plans
TBA	To be Advised
TDS	Total dissolved solids
TSP	total suspended particulates
TSS	total suspended solids
ug/m3	micrograms per cubic metre
um	micrometre

uS/cm	micro-siemens per centimetre
V	vulnerable
WSMP	Watercourse Subsidence Management Plan

13 GLOSSARY OF TERMS

Alkalinity The extent to which a solution is alkaline. See pH

Alluvial aquifer A geological formation which holds water in sufficient quantity to provide a source of water that can be tapped by a bore that is made from sediment deposited by a flowing stream, e.g., clay, silt, sand, etc.

Alluvium Usually sands and gravels which have been transported by water and then deposited. Many important ore minerals, including gold, are concentrated in alluvium

Amenity An agreeable feature, facility or service which makes for a comfortable and pleasant life.

Amphibian frogs

Analytes The substance in an analysis that is being identified or determined.

Angel of draw The angle from the vertical of the line drawn between the limit of extraction at seam level to the 20 mm subsidence contour at the surface (20 mm is an industry defined limit and represents the practical limit of subsidence).

Anion A negatively charged ion

Annulus A ring; a ringlike part, band, or space

Aquifer system A system of porous and permeable body of rock that can yield significant quantities of groundwater.

Arboreal An animal that lives in or among trees

Archaeology The systematic study of any culture, especially a prehistoric one, by excavation and description of its remains

Artefacts Any object made by humans with a view to subsequent use.

Average Recurrence Interval (ARI)
The statistically calculated interval likely to be exceeded once in a given period of time. A term used in hydrology, also known as return period.

Background Noise
Existing noise in the absence of the sound under investigation and all other extraneous sounds.

Barrier pillar The unmined pillar of coal left between adjacent pillar extraction panels or within an extracted area to control subsidence at the surface.

Baseline A basic standard or level, usually regarded as a reference point for comparison: baseline data

Bath-house Amenities/ablutions block on a mine site – for use by employees for washing and also for storage of personal clothing while on the mine site.

Batter The excavated or constructed face resulting from earthmoving operations.

Bedrock The rock on which gravel or detrital matter rests

Biodiversity/biological diversity
The variety of life forms: the different plants, animals and micro organisms, the genes they contain and the ecosystems they form.

Block width and length
A block is a mining panel approximately 150m wide and from 500m to 2000m in length.

Bord and Pillar Mining Techniques
A method of underground coal mining which uses a continuous mining machine to remove coal. Pillars of coal are left to support the roof.

Box-cut An area of land cut away by extracting material to form a box-shaped lower elevated part of the site, generally accessed by a ramp of material left in place on one side.

Braun-Blanquet A system for classifying Australian vegetation based on its structure. The system is based on the life form occupying the tallest vegetation layer (stratum), the height of that stratum, and the percentage cover it provides.

Buffer areas/zone
Area of land set aside to provide a buffer from impacts.

Bund/bunding Earth material or concrete placed to form a barrier – for example, a noise or visual bund would be a long elevated earthen area, a fuel farm bund would be constructed to hold and contain fuels in the event of a spill.

Calibrated When an instrument has been checked for accuracy.

Call playback A loud speaker system used to play natural calls of some nocturnal animals can prompt a response to detect their presence.

Catchment The area from which a river or stream receives its water.

Cation A positively charged ion

Claystone beds A fine-grained sedimentary rock composed predominately of clay minerals and small amounts of quartz and other minerals of clay size.

Clean coal Coal that has been washed and the rock, sand and clay material removed.

Cleat A vertical plane of breakage in coal

Climate change A change in the long-term average condition of the weather in a given area.

Coal Lease A coal lease may be granted under Section 41 of the Mining Act 1992 to allow the holder to extract coal from a certain area and to a certain depth.

Coal measures Stratagraphic geological structure that contains coal seams.

Coal Reserves Those parts of the Coal Resources for which sufficient information is available to enable detailed or conceptual mine planning and for which such planning has been undertaken.

Coal Resources: All of the potentially useable coal in a defined area, based on geological data at certain points and extrapolations from these points.

Coal surge stockpile
A stockpile of coal

Coarse rejects rock material that is separated from the coal during the washing process.

Coking Coal Low volatility hard coal and low ash semi-soft coal used in the production process of iron and steel.

Colliery coal mine

Colluvium loose and incoherent deposits, usually at the foot of a slope or cliff line and brought by gravity.

Cone of depression
A cone like depression in the water table formed when water is pumped out of a well more rapidly than it can flow through the aquifer

Confidence Limits
A term used to define the level of confidence in a predicted subsidence impact parameter and based on a data base of previously measured values above geometrically similar mining layouts.

Conglomerate A rock type comprising greater than 50 per cent rounded water-worn fragments (>2 mm in size) of rock or pebbles cemented together by another mineral substance.

Conservation The management of natural resources in a way that will preserve them for the benefit of both present and future generations.

Cover depth The distance between the surface of the land and the mine workings.

Cross fall slope

Cruciform cross shaped

Curvature The rate of change of tilt between three points (A, B and C) that are measured at a known distance apart (usually 10 m). The curvature is plotted at the middle point or point B. i.e. Curvature = (Tilt between points A and B - Tilt between points B and C)/(average distance between points A to B and B to C) and usually expressed in 1/km or mm/m2.

Dangerous Goods Act 1975
Legislation which places controls on the handling of certain goods including explosives, gases, flammable liquids and radioactive substances.

Data facts, observations or numerical results of an experiment.

Decibel (dB) A unit for expressing the relative intensity of sounds on a logarithmic scale from zero (for average least perceptible sound) to about 130 (for the average pain level).

Decibel dB(A) A modified decibel scale which is weighted to take account of the frequency response of the normal human ear.

Development The work of driving openings to and into an orebody to explore and prepare it for mining and transport of the ore.

Dewatering The process of removing water from an underground mine by a series of pipes – generally flowing into a surface dam.

Dip The angle at which a bed of rock or a vein is inclined from the horizontal.

Drawdown The lowering of the water level or the potentiometric head in an aquifer due to the removal of water from a nearby bore or excavation.

Dry forest native vegetation that is not considered a rainforest.

Dyke A wall-like intrusive igneous rock (formed when molten rock solidifies), filling a fissure.

Ecological communities
An assemblage of species occupying a particular area.

Ecologically sustainable development:
Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and quality of life for both present and future generations is increased

Ecosystem Organisms of a community together with its non-living components through which energy and matter flow.

Electrical Conductivity
The measure of electrical conduction through water or a soil-water suspension generally measured in millisiemens per centimetre or microsiemens per centimetre. An approximate measure of soil or water salinity.

Elliot trap A small elongated box made of aluminium which collapses flat for easy transport. The trap is operated by providing a lure bait and setting the treadle at one end. When a small animal enters the trap and steps on the treadle it triggers the door of the trap to close.

Endangered ecological communities
Groups of living organisms occupying a common environment and have a relationship with each other which are endangered.

Environment Protection and Biodiversity Conservation Act 1999
Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance.

Environmental impact assessment
A procedure for considering the potential environmental effects of a proposed development or land use

Environmental management systems
Tool for managing the impacts of an organisation's activities on the environment. It provides a structured approach to planning and implementing environment protection measures.

Environmental Planning and Assessment Act 1979
NSW Government Act to provide for the orderly development of land in NSW.

Environmental Risk Register
The list of site activities and potential risks associated with these activities, together with a rating of the probability of these risks occuring and their potential consequences.

Environmentally Hazardous Chemicals Act 1985
NSW legislation administered by DEC which oversees the assessment and control of the use of chemicals and their impact on the environment

Ephemeral lasting only a day or a very short time; short-lived; transitory.

Erosion the process by which the surface of the earth is worn away by the action of water, glaciers and winds.

Estuary a partially enclosed body of water where a freshwater stream or river meets the ocean and in characterised by abrupt changes in salinity.

Estuarine formed in an estuary

Face The end of a drive or wall of a surface.

Factor of Safety The ratio between the strength of a structure divided b the load applied to the structure. Commonly used to design underground coal mine pillars.

Fault A fracture or fracture zone along which there has been displacement of the sides relative to one another. Displacement can be vertical and/or horizontal.

Fauna All vertebrate animal life of a given time and place.

Feeder breaker
A piece of equipment in a production panel that accepts coal from the shuttle cars then partially crushes the coal and meters it onto the conveying system.

Firing The process of setting off an explosive charge.

First flush The first amount of water that enters a channel,pipe or stream at the beginning of a rainfall event – usually containing more sediment or possible contaminants such as oils.

First workings The first tunnels, roadways or bords which are driven by a continuous mining machine to provide access to the production panels in a mine. Subsidence above first workings pillars are generally negligible or < 20mm.

Fish passage the movement of fish between habitats in a certain body of water. These movements are necessary for maintaining fish populations

Five Heading layout
The number of roadways that are driven within a mining panel.

Floodplain Large flat area of land adjacent to a stream which is inundated during times of high flow. Flora: All vascular plant life of a given time and place.

Flora The plants of a particular region or period, listed by species

Floristic refers to the species composition of a plant community.

Gantries A spanning framework, as a bridge-like portion of certain cranes, a structure holding railway signals above the tracks

Geographical referring to a characteristic of a certain locality, especially in reference to its location in relation to other places.

Geological the geological features of a locality

Geometry the shape of a surface or solid.

Geomorphic of or relating to the figure of the earth, or the forms of its surface.

Geotechnical Relates to the form, arrangement and structure of geology.

Goaf The mined out area that the immediate roof or part of the overburden collapses into. The overlying rock then sags and re-compresses the collapsed rock or 'goaf' which subsequently results in a subsidence 'trough' at the surface.

Grade The rate of rise or fall of a roadway with respect to the horizontal expressed as a ratio or as a percentage

Greenhouse Gas Emissions
Greenhouse gases are a natural part of the atmosphere. They absorb and re-radiate the sun's warmth, and maintain the Earth's surface temperature at a level necessary to support life. Human activities such as burning fossil

fuels (coal, oil and natural gas), agriculture and land clearing are increasing the concentrations of the greenhouse gas emissions.

Grinding groove
A groove found in a rock that was used for sharpening objects by Aboriginals.

Groundwater Sub-surface water which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table.

Grouting A method of repairing cracks in the ground caused by subsidence whereby cementitious material is used to fill in the spaces.

Habitat The environment in which a plant or animal lives; often described in terms of geography and climate.

Hair tubes Tubes from 4 to 15 cm in diameter that have sticky strips applied along the inside and a bait to lure the animal at the end of the funnel generally behind a mess plate. The sticky strips collect hairs from any animal that puts its head in the funnel. The sticky strips are then sent away to be analysed to determine which animals are present in that particular area.

Harp trapping A method of catching insectivorous bats. It consists of a network of fine nylon string pulled tightly between to horizontal poles with a purpose made canvas bag at the bottom of the strings where the bats fall when fly into the network of string.

Headings Roadways providing access in an underground mine.

Horizons The surface separating two beds of rock

Horizontal displacement
The horizontal movement of a point after subsidence has occurred above an underground mining area.

Hydrocarbon storage area
Bunded storage area for greases, oils, etc constructed in accordance with DEC Guidelines.

Hydrogeological
The relation of hydrological phenomena to the surface geology.

Insectivorous Feeds on insects

Inter-modal freight facility
A proposal by the State Government to site a facility on part of the rehabilitated Donaldson Open Cut Mine in the future, consisting of a range of industries that transport goods.

Ion An atom with an electrical charge.

Kilo Volt (kV) One thousand volts.

LA1 Noise Level
The noise level exceeded for one per cent of the time. It is used in assessment of sleep disturbance.

LA10 Noise Level
The noise level, measured in dB(A), which is exceeded for 10 per cent of the time, which is approximately the average of the maximum noise levels.

LA90 Noise Level
The noise level, measured in dB(A), exceeded for 90 per cent of the time, which is approximately the average of the minimum noise levels. The L90 level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes.

LAeq Noise Level The average noise energy, measured in dB(A), during a measurement period.

LAmax Noise Level
The maximum noise energy, measured in dB(A), during a measurement period.

Landform Sections of the earth's surface which have mountain range, plain, etc).

Lantana A weed that is listed on the Weeds of National Significance and occurs in tropical and subtropical regions of Australia.

Leaching The extraction of a metal or mineral from an ore by selectively dissolving it in suitable solvent

Level A certain horizon in a deep mine. Usually referred to by the depth in metres, feet or fathoms (6') from the surface.

Life-of-mine roadways
Tunnels developed that remain functional for the life of the operation.

Lithic Relating to or consisting of stone

Lithology The physical characteristics of rock, with reference to qualities such as colour, composition and texture

Longitudinal Subsidence Profile
Refers to the direction that subsidence is measured (or predicted) along a pillar panel or centre line.

Longwall Mining
A panel of coal is removed by shearing machinery, which travels back and forth across the coal face. The area immediately in front of the coal face is supported by a series of hydraulic roof supports providing working space.

Macro-invertebrates
Large animals without a backbone, such as insects, crustaceans, molluscs, spiders and worms.

Marsupial Mammals in which the young are born in an undeveloped state and move to a pouch where they develop.

Mean The average value of a particular set of numbers.

Megachiropteran Bats
Large insectivorous bats.

Megalitre (ML) One million litres.

Methane drainage equipment
A system of boreholes, pipes and pumps that extracts methane gas from either the unworked coal seam or the goaf areas.

Meteorological phenomena of the atmosphere or weather.

Microchiropteran Bats Small insectivorous bats

Micro-climate The meteorological conditions, or climate, in small areas such as the north or south side of a rock.

Migratory species
Animals that move from one area to another to feed or breed.

Mine Subsidence Compensation Act 1961
NSW legislation administered by the Mine Subsidence Board to deal with and determine any claim for damage caused by subsidence due to the extraction of coal or shale.

Mining Act 1992 NSW legislation to regulate the prospecting and mining of minerals in the State of NSW. Department of Mineral Resources administers the legislation, which places controls on methods of exploration and mining as well as the disposal of mining wastes, land rehabilitation and environmental management.

Mining Height The height at which the seam is mined or extracted.

Mining panels
Area of planned extraction (see mining block)

Mitigation To lessen in force, intensity or harshness. To moderate in severity.

Mobile chain haulage system
A relocatable conveyor system

Mudstones Rock composed of clay and silt.

National Parks and Wildlife Act 1974
NSW legislation administered by DEC that aims to conserve nature including habitat, ecosystems, biodiversity, landforms and landscapes of significance. It also aims to conserve objects, places or features of cultural value.

Native Belonging to the natural flora or fauna in a region.

Open cut void The hole created by surface mining activity.

Outcrop Bedrock exposed at the ground surface.

Outloading facilities
Equipment to transport coal out of the underground workings

Overburden material
The soil or rock overlying a mineral deposit, especially in open cut mining.

Panel length The longitudinal distance along a panel measured in the direction of (mining from the commencing rib to the finishing rib.

Panel width The transverse distance across a panel, usually equal to the face length plus the widths of the roadways on each side.

Particulates Fine solid particles which remain individually dispersed in gases.

Percolation To filter through; permeate.

Permeability A measure of the ease with which fluid can travel through porous material.

Permian Relating to the latest Palaeozoic geological period or system.

pH Scale used to express acidity and alkalinity. Values range from 0-14 with seven representing neutrality. Numbers from seven to zero represent increasing acidity whilst seven to fourteen represent increasing alkalinity.

Piezometer A small diameter bore lined with a slotted tube used for determining the standing water level of groundwater.

Pillar extraction panels
Mining panels specifically laid out for secondary extraction by either pillar reduction or pillar extraction

Pillar extraction techniques
The technique of extracting pillars formed during first workings by lifting off (mining coal systematically from each pillar)

Pillar A block of solid ore (coal) left to support the walls or roof of an underground mine.

Piper Tilinear diagram
Allows each sample to be plotted at a unique point on the basis of the relative concentrations of the major ions in solution – the cations calcium, magnesium, sodium and potassium, and the anions carbonate/bicarbonate, sulphate and chloride. This plot allows an assessment of the recharge-discharge processes, and also allows a comparison of water samples derived from different environments within the hydrological cycle. It can also be used to assess the possible mixing of waters from different sources.

Pollution control ponds
A dam or depression formed in the landscape to capture runoff that could potentially be contaminated with pollution, such as soil, fuel or other contaminants.

Pool-riffle sequences
The alternating sequence of deep pools and shallow riffles along the course of a river or creek. Riffles are where shallow water is rippling over rocks, and pools are deeper and calmer areas.

Portal A structure erected over the individual entrances to the mine

Prediction modelling
A method of predicting certain outcomes using a mathematical calculation.

Pressure head The height of a column of fluid of specific weight

Principal Residence
An existing building above the proposed Abel Underground Mine capable of being occupied as a separate domicile and used for such purpose.

Production panels
Refers to the panel of coal which is subject to second workings or pillars in it are extracted, stripped or lifted.

Protection of Environment Operations Act 1997
The NSW legislation administered by the DEC that regulates discharges to land, air and water.

Quadrats A sampling frame or an area marked out for sampling plants and animals.

RAMSAR wetlands
A wetland that has been placed in the 'List of Wetlands of International Importance' under the Ramsar Convention. The Ramsar Convention was named after the Iranian town where it was first signed in 1971. The aim of this treaty is to halt the world wide loss and decline of wetlands. Australia is a signatory to the Ramsar Convention.

Reclaim facilities
Equipment used to remove coal from a stockpile to transfer it to the next processing unit, for example, a conveyor, a washery or a rail loader.

Reclaim tunnel A tunnel beneath a stockpile that is used to remove coal from the stockpile for transfer to the next processing unit, usually the washery.

Recharge To provide more water or return water to an item, for example, to recharge a dam means to return water to the dam.

Rehabilitation The process of restoring to a condition of usefulness. In regard to mining, relates to restoration of land from a degraded or mined condition to a stable and vegetated landform.

Roads Act 1993 The NSW legislation administered by Roads and Traffic Authority (RTA) to determine who has access to what roads, road classification certain activities on public roads.

Rock shelter The rock-backed area under a large overhanging rock as used by Indigenous Australians for protection from sun and rain and for ritual painting.

Run of Mine (ROM)
Bulk material extracted from a mine, before it is processed in any way.

Sandstone A cemented or otherwise compacted sedimentary rock composed predominantly of sand-size quartz grains.

Salinity The concentration of salts in soil or water.

Scarp A line of cliffs created by faulting or by erosion.

Scarred tree Scars are wounds from deliberate impacts to a tree that cause damage to living plant tissue on a trunk or limb. Where the tissue is damaged it stops any further growth and so the tree bears a permanent scar. Aboriginal scarred trees are trees that have been scarred by the deliberate removal of bark or wood to be used for shelter or construction of water craft.

Seam An identifiably discrete coal unit.

Second workings (or secondary workings or secondary extraction)
The extraction or stripping of production panel coal pillars in a controlled manner which may or may not result in the formation of goaf as the support to the immediate roof is removed.

Sedimentary rock
formed when the weathered and eroded particles of pre-existing rocks are transported by wind or water and deposited elsewhere.

Sedimentation The deposition or accumulation of sediment.

SEPP 44 Koala Habitat Assessment
NSW Legislation administered by DOP to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

Shaft A vertical, or near vertical passageway to access an underground mineral deposit. A shaft may serve for handling people, rocks, or supplies, for ventilation, or for pumping.

Shear failures failure with displacement caused by opposing forces

Shell middens Places where shells and other food debris have accumulated over time.

Siltstone A rock comprised of compacted silt.

Slurry A fluid composed of part liquid, part solid which can be pumped.

Species A group of similar plants of animals that are capable of interbreeding and producing fertile offspring.

Spotlighting A field survey method used to detect arboreal mammals, nocturnal birds as well as birds roosting in trees. A powerful torch is used in a particular fashion to detect the presence of animals.

Stackout conveyor
A conveyor used to stockpile coal

State survey marks
Markers placed at various locations around NSW that enable surveyors to accurately determine location and elevation.

Steady state production
When coal is extracted and/or processed at a similar rate over time. When a mine first starts it needs to 'ramp-up' production, wherby production increases over time as more equipment is introduced. It then reaches 'steady state production' before it 'ramps-down' prior to closure.

Strain The change in horizontal distance between two points at the surface after mining, divided by the pre-mining distance between the points.

Strata Plural for stratum meaning a single bed of sedimentary rock, generally consisting of one kind of matter representing continuous deposition.

Stratigraphically
The distribution, deposition and age of sedimentary rocks.

Strike The horizontal course bearing an inclined bed.

Stook The portion of a streipped or secondary workings pillar that provides support to the mine workings roof during mining and expected to collapse as the mining face retreats away from it. Some redution in subsidence is expected to occur above second workings pillars due to the presence of stooks.

Subcrop A unit of material that occurs just below the soil profile.

Subsidence The difference between the pre-mining surface level and the post mining surface level at a point after it settles above an underground mining area.

Subsidence Impact
The effect that subsidence has on natural or man-made surface and subsurface features above a mining area.

Subsidence mitigation
Modifying or reducing the impact of subsidence on a feature so that the impact is within safe, serviceable and repairable limits (normally applied to moderately sensitive man-made features that can tolerate a certain amount of subsidence).

Sub-vertical shear failure
Near vertical failure displacement due to opposing forces

Sump An excavation to collect drainage water, commonly at the bottom of a shaft or at a suitable place on levels.

Surface deformation predictions
The predicted change in the terrain induced by mining activities

Surface drainage system
The method used for runoff to move over the land – in channels, creeks, etc.

Surface Infrastructure
Any man made object, facility or structure on the surface of the land.

Survey To view in detail, especially to inspect or examine formally or officially in order to ascertain condition

Swamp A piece or tract of wet, spongy land; marshy ground; an area of still, often stagnant water

Switchyard An electrical substation

Tailings Fine residual waste material separated in the coal preparation process.

Terrestrial Relating to the land and also used to mean ground dwelling.

Thermal Coal Includes medium to high ash, low sulphur coals used for domestic power generation and medium to low ash high energy coals which are exported.

Threatened Species Conservation Act 1995
NSW legislation administered by DEC to protect and conserve plants and animals that may be endangered with extinction.

Tilt The change in slope of the surface landform as a result of underground mining

Tonnage-based coal royalties
An amount of money paid to the government to enable a company to extract coal – the fee is based on a per tonne amount.

Tool box talks A training talk provided by a supervisor to a group of mine workers to update knowledge on particular work procedures

Topography The surface features of a geographical area.

Total Dissolved Solids (TDS)
A measure of salinity expressed in milligrams per litre (mg/L)

Total extraction panel
A mining panel where more than 70% of coal has been extracted.

Total Suspended Particulates (TSP)
A measure of the total amount of un-dissolved matter in a volume of water or air usually expressed in milligrams per litre (mg/L) (for water) or micrograms per cubic metre (ug/m) for air.

Transect A line, or narrow strip used to conduct a census of plants or animals in a given area.

Transverse Subsidence Profile
Refers to the direction that subsidence is measured (or predicted) across a pillar panel or cross line.

Transverse Lying or being across or in a crosswise direction.

Tributaries Streams contributing its flow to a larger stream or other body of water.

Washery The plant and equipment used to wash coal, extracting

Water table The upper surface of a body of ground water at the top of the zone of saturation and below the zone of aeration.

Wetlands An area of low lying land that is irregularly, regularly or permanently covered with either fresh or salt water. Develop where the water table intersects the land surface.