Centennial Hunter Pty Limited

ANVIL HILL PROJECT

environmental assessment

VOLUME 1 - MAIN TEXT

Umwelt
Environmental Consultants

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EXECUTIVE SUMMARY

THE PROJECT

Centennial Hunter Pty Limited (Centennial) proposes to establish an open cut coal operation in the Wybong area, 20 kilometres west of Muswellbrook and approximately 10 kilometres north of the township of Denman. The proposal, known as the Anvil Hill Project (the Project), is based on a large, undeveloped coal reserve of approximately 150 million tonnes (Mt).

The Project aims to provide a long term secure and profitable supply of high quality coal, whilst conducting operations in an environmentally responsible manner through the effective management, mitigation and offsetting of environmental impacts. The key Project details are summarised in the table below.

Key Project Information

Project	Open cut mine, extracting and processing up to 10.5 million tones per annum (Mtpa) of run of mine (ROM) coal. Construction and operation of rail and coal handling/train loading infrastructure to facilitate transport of product coal to market.
Proponent	Centennial Hunter Pty Limited (Centennial)
Project Life	An expected Project life of 21 years (from the date of grant of a mining lease).
Mining	Open cut mining at a rate of up to 10.5 Mtpa of ROM coal, using truck and shovel mining methods to handle overburden and remove coal.
Coal Washing	Construction and operation of a Coal Preparation Plant (CPP) capable of processing up to 10.5 Mtpa of ROM coal. Coarse rejects will be placed predominantly within mined areas. Tailings will be initially managed through emplacement in a purpose built tailings dam, with ongoing management through emplacement in mined areas.
Employment	Peak construction workforce of up to 200 employees and an operational workforce of up to 240 employees at peak production.
Construction	Construction of the rail loop, road, coal stockpiling, reclaim and train loading infrastructure, CPP and mine facilities area is planned to be undertaken over a period of approximately one year.
Hours of Operation	The mine will operate 24 hours per day, seven days per week. The majority of construction activities will generally be undertaken during daylight hours, up to seven days per week.
Product Coal Transport	Product coal will be loaded onto trains and transported to market via the Project rail loop connected to the Muswellbrook-Ulan railway. Expected average of four trains per day.
Mine Access	Mine road access via Wybong Road only. Intersection to be constructed at the connection of the mine access road and Wybong Road.

The Project Area covers an area of approximately 3763 hectares. The Proposed Disturbance Area covers approximately 2238 hectares and represents the proposed footprint for the 21 year life of the Project.

CONSULTATION

Extensive consultation with the local community and government agencies has been undertaken as part of the environmental assessment process. A range of consultative and assessment mechanisms were used to engage the community in relation to the Project, including:

- over 100 individual landholder meetings;
- many community presentations to regional and local environmental groups, professional and trade associations, community organisations, and other industry groups;
- consultation with education, health, accommodation and community service organisations to understand service provisions;
- conduct of a broader community survey involving a telephone survey of 400 randomly selected households in the Muswellbrook Shire to gauge the views of the wider community on the Project;
- Community Information Days were held in June 2006 at Wybong Hall and the Centennial Muswellbrook office;
- three Community Information Sheets (CIS) were circulated to over 200 stakeholders at key stages of EA preparation;
- Anvil Hill Project newsletters continue to be circulated to local landholders and key stakeholders;
- Community Consultative Committee (CCC) – information on the outcomes of the technical studies was provided by Centennial and its consultants, and feedback was received by Centennial from the Committee and members of the gallery;
- consultation with eighteen Aboriginal stakeholder groups during the Aboriginal Heritage Assessment;
- other general consultation including numerous letters, telephone conversations, and personal discussions with many community stakeholders throughout the assessment process;
- participation in other forums including Project information booths at the Muswellbrook Show and the Upper Hunter Wine and Food Affair at Denman.

Feedback from this consultation process was considered in identifying the key issues for the EA.

KEY ENVIRONMENTAL AND COMMUNITY ISSUES

This EA has comprehensively addressed potential environmental and community impacts and a range of management, mitigation and offsetting measures are proposed to ensure that the short term environmental impact of the Project is minimised and that there is a net benefit from the Project in the medium to long term. An overview of the outcomes of the detailed assessments for the key issues is provided below.

Surface and Groundwater

The potential impacts on both water quality and quantity within surrounding catchments and groundwater were raised as key issues during the consultation process. Mackie Environmental Research has completed a detailed groundwater assessment and Umwelt undertook a comprehensive surface water assessment.

The Proposed Disturbance Area is located primarily in the catchment of Anvil Creek, and extends into the catchments of Big Flat Creek and Clarks Gully to the north, and Sandy Creek to the east. Both Anvil Creek and Clarks Gully flow into Big Flat Creek. Big Flat Creek flows into Wybong Creek which is a tributary of the Goulburn River. The Goulburn River joins the Hunter River approximately 4.8 kilometres downstream from Denman. Sandy Creek drains to the Hunter River at Denman.

A surface water monitoring program has been in place since February 2002 which includes sampling sixteen monitoring locations on a monthly basis and after extended periods of rain. Spot water table heights were taken in June 2003 and regular groundwater monitoring of approximately 53 bores has been undertaken on a bi-monthly basis since October 2004. These bores are routinely analysed for a range of quality parameters. In addition, data loggers which record water table level every eight hours have been installed at ten sites.

Key Findings

The monitoring results highlighted the variability of water quality in local creeks. Big Flat Creek, for example, just north of the proposed mining area, has high salinity. Wybong Creek generally has much lower salinity levels both upstream and downstream of the Project area. Sandy Creek has the highest sediment concentrations.

The Project will disturb less than 3% of the Wybong Creek catchment, and less than 1% of the Sandy Creek catchment at any stage of mining. The Project is unlikely to adversely impact channel stability or instream habitat of Big Flat Creek, Wybong Creek, or Sandy Creek.

The vertical extent of flooding will not be significantly increased as a result of the Project in any reach of Big Flat Creek or Wybong Creek, and there will be no adverse impact on flooding in Sandy Creek. In addition, with the proposed sediment and erosion control measures in place, the Project will not adversely impact on sediment levels in Big Flat Creek or downstream drainage systems. The Project will not increase total salt loads in the Big Flat Creek system.

Within the Study Area, groundwater is generally saline, with the shallow alluvial areas next to Big Flat Creek exhibiting the highest salinity.

Groundwater will seep into mining areas over the life of the mine. Due to the geology and existing groundwater regime, inflow rates will be low and manageable with appropriate controls. Groundwater seepage into mining areas is not predicted to impact on the yield of private groundwater bores within the local area and groundwater quality will not be adversely affected by the proposed mining activities.

Key Management Commitments

Surface water controls have been designed to ensure that clean runoff is separated from runoff within disturbed mining and infrastructure areas. Sediment and erosion controls have been designed to ensure any runoff from disturbed areas is appropriately managed and treated. In addition, the Conceptual Mine Plan has been modified to avoid any diversion of Big Flat Creek.

Final voids have been designed to intercept leachate from overburden emplacement areas and minimise discharge of saline groundwater. These will be sized to ensure they do not overflow.

Water demand over the life of the Project will vary between approximately 1 ML and 4 ML per day mainly for coal processing and dust suppression. This water will be collected from a variety of sources including surface runoff from within disturbance areas, groundwater inflow into mining areas and the Hunter River, as necessary.

A comprehensive water monitoring program will be put in place to monitor the surrounding groundwater and surface water quality over the life of the Project.

Centennial is also committed to contributing to broader catchment management with the objective of improving water quality in the local area. In this regard, Centennial plans to investigate tree planting and other land management activities in association with relevant stakeholders, in order to address specific existing issues such as dryland salinity in Big Flat Creek catchment.

Flora and Fauna

During the consultation process, clearing land for development of the Project and its impact on native flora and fauna was raised as a key issue. A comprehensive ecological assessment was undertaken throughout all seasons to assess the impact of the Project on native flora and fauna.

The ecological assessment included extensive field work to identify the major vegetation communities and flora and fauna species. The Study Area comprised 4140 hectares and included the Project Area and adjacent land that was considered to have potential to be managed for conservation as an offset for ecological impacts from the Project. Over a period of three years, 157 person-days of fieldwork were completed in this area.

Peake (2006) found that approximately 65% of all remnant vegetation on the Hunter Valley floor occurs within a few remnants that are over 100 hectares, with the largest, at Myambat Military Area near Denman, being approximately 2250 hectares. This is located south of the Project Area. The second-largest remnant mapped was in an area referred to as the Wybong Uplands which covers 2067 hectares and includes vegetation within the Project Area.

Key Findings

Two vegetation communities (Ironbark Woodland Complex and Slaty Box Woodland) cover most of the Study Area. Most other vegetation communities occur in specific landscape positions, such as riparian areas, rocky ridges or steep, sheltered slopes, which are small, restricted locations.

Approximately 1300 hectares of treed vegetation communities will be directly impacted by the Project. Analysis of historical aerial photographs dating back to the 1930s has demonstrated that the majority of this area has been cleared at some time in, or prior to, the last 75 years. Approximately 42% of the Proposed Disturbance Area is grassland that was derived by previous clearing of woodland.

Six threatened flora species, two endangered populations and one endangered ecological community (EEC) were recorded within the Study Area. Three threatened plants, narrow goodenia (*Goodenia macbarronii*), *Pomarderris queenslandica* and *Cymbidium canaliculatum*, were recorded in the Proposed Disturbance Area, while five were recorded in

the Potential Offset Area. Two threatened flora populations and one EEC were found within the Study Area, of which none are proposed to be disturbed by the Project.

Nineteen threatened fauna species were recorded within the Study Area which included two parrots, two owls, five woodland birds, two arboreal mammals, one terrestrial mammal and seven micro-bats. Four listed migratory bird species were also recorded. Of these, 13 species were recorded in the Proposed Disturbance Area, while 17 species occurred in the Potential Offset Area. Several threatened woodland bird species are widespread across the Study Area, while signs of the koala (*Phascolarctos cinereus*) were found only in the south-east of the Potential Offset Area. Based on assessment without mitigating measures, 13 of these threatened fauna species are likely to be significantly impacted by the Project.

Key Management Commitments

In response to the identified likely and potential ecological impacts of the Project, detailed impact mitigation strategies have been developed to minimise short term impacts and ensure no net loss in the medium to long term. These strategies include:

- Approximately 1924 hectares of Conservation and Enhancement Areas will be established and maintained outside the Proposed Disturbance Area. This will protect and conserve 16 vegetation communities, 5 threatened flora species, 17 threatened fauna species, 2 endangered flora populations and 1 EEC.

  The Conservation and Enhancement Areas will consolidate and immediately conserve 1038 hectares of existing treed vegetation that has primarily been in private ownership and previously used for grazing purposes. The proposed ecological offset strategy will also focus on the regeneration and revegetation of an additional 516 hectares of native vegetation. Combined with proposed rehabilitation, the total area of treed vegetation at the end of the mine life will be 3654 hectares, a net increase of 1286 hectares from the current area of vegetation that occurs within the Study Area.

- A detailed corridor strategy incorporating regeneration and revegetation is proposed to increase the functioning of existing corridors, both within the Study Area and in connections to nearby areas.

- Nest boxes will be installed and habitat features such as hollow logs, fallen timber and boulders will be salvaged or replaced.

- Specific habitat resources will be planted within existing vegetation to increase the quality of habitat.

- All Centennial controlled land will be effectively managed, including weed management, pest animal management and bushfire management.

- Only the minimum area necessary for progressive mining will be disturbed at any time. Reshaping and rehabilitation of mining and overburden emplacement areas will be undertaken as soon as practicable after mining.

In addition to the above project specific commitments, Centennial is committed to working with relevant local stakeholders to contribute to local land management initiatives, including replanting and revegetation projects, dryland salinity management and riparian zone management.

Based on the measures proposed to mitigate impacts, it is expected that there will be no net loss of flora and fauna value in the medium to long term.

Air Quality

Dust Impacts

A detailed air quality assessment has been undertaken by air quality specialists (Holmes Air Sciences) to assess potential air quality impacts. The main focus of this assessment is on the potential effects of dust emissions. The assessment was based on a conventional approach following the procedures outlined by the NSW Department of Environment and Conservation (DEC) which includes consideration of background levels (dust from all other sources) in the assessment of potential dust impacts.

A dust monitoring network was established early in the Project to measure existing dust levels (background levels) within the local area. This includes both dust deposition and dust concentrations such as TSP and PM_{10}. Dust deposition has been monitored since 2002 using 20 dust deposition gauges located in the area surrounding the Project, and dust concentration has been monitored since 2004 using two PM_{10} and one TSP gauge. In addition, two weather stations have been collecting meteorological data in the vicinity of the Project area since 2002.

Key Findings

The existing dust deposition and dust concentration levels measured in the area surrounding the Project are considered typical of a rural area remote from industrial emission sources. Air quality in the area is largely determined by emissions from natural sources, road traffic and residential and agricultural activities. From time to time particulate matter levels would be expected to be affected by smoke from bushfires and dust from regional dust storms.

A computer-based dispersion model has been used to predict dust concentration and dust deposition levels due to the potential dust generating activities associated with the Project. The dispersion modelling accounts for the local meteorology and terrain information and used dust emission estimates to predict the air quality impacts for the five representative mine stages over the planned life of the mine.

For each of the operational scenarios selected, dust impacts were predicted in the form of single point calculations at private residences. Dust contours have been derived from these results to approximate air quality impacts over a defined area and to determine impacts on privately owned vacant land.

Overall, the modelling predicts that up to 18 private residences and 4 vacant properties (that are not subject to agreement with Centennial) are likely to be subject to adverse air quality impacts, above the DEC air quality criteria, at some stage during the life of the Project. Seventeen of these residences and 4 of these vacant properties are also predicted to be affected by noise impacts.

Cumulative effects of dust emissions from the nearest existing and approved mining operations located approximately 12 kilometres east of the Project area will make a very minor contribution to predicted total dust levels in the area surrounding the Project.

Key Management Commitments

Centennial is committed to implementing all feasible measures to reduce the extent of dust impact on the local community. For this reason, the following key management commitments have been incorporated into the Project.

- Use of water carts on active haul roads and unsealed working areas.

- Use of water sprays on coal handling transfer locations and on coal stockpiles.
- Only the minimum area necessary for the mining process will be disturbed at any time. Reshaping and rehabilitation of mining and overburden emplacement areas will be undertaken as soon as practicable as mining progresses.
- Drills will be fitted with dust suppressant measures.
- Appropriate blast design to minimise dust emissions.
- Cover crops will be established on any topsoil stockpiles that are not planned to be used in less than six months.
- Continued monitoring of meteorological conditions and consideration of weather data in the timing of blasts to minimise the impacts of blast generated dust.
- Continuation of the current monitoring program and reviewing results regularly over the life of the operation to verify that predicted levels are not exceeded and dust controls are effective.
- Ongoing liaison with the local community regarding relevant mitigation strategies, such as installation of filters on rainwater tanks.
- Centennial is offering an agreement with landholders that are predicted to experience dust levels above the relevant DEC criteria at some stage during the life of the mine, subject to Project approval.

Greenhouse Assessment

Potential greenhouse gas emissions from the Anvil Hill Project were raised as a key issue in the Director-General's Requirements, and consequently a detailed greenhouse gas and energy assessment has been undertaken. This included an assessment of the energy and greenhouse gas emissions from the Project in accordance with NSW government assessment guidelines and identification of relevant management controls that can be utilised to minimise energy use and greenhouse gas emissions.

Key Findings

The average annual greenhouse emissions for the Project are estimated at 167,574 tonnes CO2 equivalent (TCO2e). The greenhouse index of 0.03 TCO2e per tonne of saleable coal is less than the Australian open cut black coal mining industry average of 0.05 TCO2e per tonne (AGSO, 2000).

Greenhouse emissions for the Project are dominated by energy use with diesel at 39% and electricity at 36% of the total. Emissions from methane make up 23% of the total and explosive use at 2% makes up the remainder of the inventory.

The estimated energy usage for the Project is dominated by diesel usage with the remainder consisting of electrical energy. This is due to the reliance on diesel powered mining equipment, with no plan to use a dragline or electric shovels. The energy index of 0.23 GJ per tonne of saleable coal is less than the Australian open cut black coal mining industry average of 0.29 GJ/tonne (AGSO, 2000).

Key Management Commitments

Centennial has committed to assessing the viability of the following key measures to improve energy efficiency and reduce greenhouse emissions from the Anvil Hill Project.

- Energy management systems.
- Energy efficiency in the mining fleet, stationary equipment, mining processes and coal preparation.
- The use of some proportion of biodiesel in the mining fleet.
- Electric boosted solar hot water.
- Small scale planting for carbon sequestration.

Where feasible, Centennial will continue to assess and implement energy and greenhouse management initiatives during the project design, operation and decommissioning.

Noise and Blasting

Potential noise and blasting effects from the Project were raised as key issues during the consultation process, and a detailed noise and blasting assessment was undertaken by independent specialists (Wilkinson Murray). The assessment has been conducted in accordance with the government's required standards, including DEC's Industrial Noise Policy and Environmental Criteria for Road Traffic Noise (ECRTN).

The existing background noise levels around the Project have been monitored on several occasions, both by means of unattended noise logging and by attended measurements. These were undertaken during a range of seasons from 2002 to late 2004.

Operational noise levels at residences were calculated using a computer model endorsed by DEC for environmental noise assessment. The model takes account of noise attenuation due to geometric spreading, atmospheric absorption, shielding and existing ground conditions and vegetation. It also predicts noise levels under various meteorological conditions, defined by a combination of temperature gradient, wind speed and wind direction. An important atmospheric factor that influences noise impacts is temperature inversion. The Industrial Noise Policy includes a methodology for estimating the effect of inversions; however the noise modelling for the Project has considered existing temperature inversion conditions. As a result, the calculated noise levels are higher than would have been predicted using standard Industrial Noise Policy methods, more closely representing expected actual conditions.

Noise levels have been calculated under a total of 41 meteorological conditions for 10 operational scenarios (day and night for the five mine stages) at all residences up to 8 kilometres from the Project area. For indicative Project Years 2, 5, 10, 15 and 20 a typical "worst-case" scenario was modelled, with equipment operating in locations that were likely to generate the highest noise levels at nearby residences. Where equipment could be operating in more than one position around the Project, noise levels have been calculated at a range of possible positions, and the highest noise level used as the worst case.

The existing noise environment around the Project is typical of a quiet rural area, with little exposure from existing traffic noise and no recorded exposure from any existing industrial noise. Measured background noise levels are generally below 30 dBA. DEC's Industrial Noise Policy specifies that in such circumstances, 30 dBA should be adopted as the Rating Background Level (RBL) for setting noise goals for a proposed development. Based on the

approach adopted for recent mining approvals, it is considered that a noise level that exceeds the relevant background noise level by more than 10 dBA (that is, more than 40 dBA in this case) is a significant noise impact.

Key Findings

The modelling results indicated that there are 71 private residences and 17 vacant private properties (that are not subject to agreement with Centennial) which will be significantly affected by operational noise at some stage during the Project. Sixteen of these residences and 3 of these vacant properties are also predicted to be affected by dust impacts.

Noise levels at residences during the 12 month construction period are predicted to be lower than those levels predicted for operational noise. Off-site rail transportation will result in an additional 2 residences that will have noise levels that exceed the relevant criteria. All private residences with potential blast impacts above the relevant vibration and overpressure limits are located within the area affected by dust and noise impacts.

Key Management Commitments

The noise and blast modelling have been refined through a series of changes to enable consideration of the feasibility and effect of a range of potential control measures. As a result, Centennial has committed to incorporation of the following key controls as part of the Project.

- The CPP and associated infrastructure will be located in positions on the site with natural topographic shielding, with these locations being specifically chosen to reduce noise and visibility impacts to adjacent residences.

- The CPP and crushers will be clad to reduce noise and shielding will be installed on conveyors.

- The rail loop will be located to use natural topography for shielding as much as possible. In addition, a noise barrier will be constructed on parts of the track that are exposed to nearby residences.

- At night, haul trucks will be restricted to operating below the maximum elevation of the overburden emplacement areas where possible.

- Blasts will be designed to meet the relevant criteria for protection of the 500 kV transmission line and also to protect the structural integrity of culturally significant rockshelters and to minimise impacts on Anvil Rock.

In addition to the regular noise and blast monitoring to assess compliance, a real-time noise monitoring system will be utilised to assist with managing operational noise performance and determining further noise controls, as necessary.

Centennial is offering to reach agreement with landholders that are predicted to experience noise levels above 40 dBA at some stage during the life of the mine, subject to Project approval.

Visual Assessment

A visual assessment has been undertaken to determine the impact of the Project on the visual amenity of the local area. This was an issue raised during the consultation process. The visual assessment was undertaken at numerous vantage points around the Project Area which are considered representative of the major visual catchments within the local area.

The assessment used terrain analysis and site inspections to assess the visibility of the Project from surrounding residences and other vantage points in the local area.

Key Findings

The detailed visual assessment concluded that potential views to the Project are highly variable and dependent on the location of vantage points in relation to the Project Area and the operational stage of the Project.

In general, residences to the north of the Proposed Disturbance Area may have views into the active mine workings and overburden emplacement areas. The prominence of these features within the visual catchment of these residences is moderate and will decrease over the proposed 21 year life of the Project.

Residences to the west of the Proposed Disturbance Area may have limited views of the active mining, overburden emplacement and surface infrastructure areas. These features will have low prominence within the visual catchment of these residences.

Residences to the south and south-east along Mangoola and Denman Roads may have views of the site infrastructure area and rail load out facilities. The active mining and overburden emplacement areas will form a background element.

Residences to the east along the northern extent of Roxburgh Road will have limited views into the Proposed Disturbance Area. From this area the active mining, overburden emplacement and surface infrastructure areas will form minor background elements in the landscape.

Key Management Commitments

In order to minimise the potential visual impacts of the Project, Centennial has committed to the following landscape management measures.

- Site infrastructure will be located in the less visually prominent sites within the Proposed Disturbance Area. This includes locating the CPP and site facilities within a naturally forming valley largely screened by surrounding topography.

- Only the minimum area necessary for mining will be disturbed at any time. Reshaping and rehabilitation of mining and overburden emplacement areas will be undertaken as soon as practicable after mining.

- Appropriate colourings on all buildings and infrastructure will be selected in order to reduce the prominence of these features within the landscape.

- Screening will be established along key Project area boundaries including along sections of the rail loop, in order to screen views into prominent areas of the Project.

- Appropriate lighting will be located and used both to provide a safe workplace and reduce potential impacts from night lighting.

Centennial is committed to continuing to liaise with relevant stakeholders to determine any further feasible landscape management measures. These may include specific landscape controls for private residences with prominent views of the mining operation, or supplementary tree planting at locations surrounding the site.

Cultural Heritage

A detailed Aboriginal heritage study was undertaken with involvement of relevant Aboriginal stakeholder groups to identify and assess the nature and significance of Aboriginal cultural heritage within an area of approximately 3460 hectares. This area included both the Proposed Disturbance Area and adjacent land with potential for conservation as offsets to potential cultural heritage impacts (Proposed Offset Areas).

A total of 173 Aboriginal heritage sites were recorded during the survey, including 69 in the Proposed Disturbance Area and 98 in the Proposed Offset Areas. These sites consisted of 88 artefact scatters, 69 isolated finds and 16 rockshelters on rocky plateaus. The majority of these sites were found within 30 metres of a watercourse.

Extensive consultation has been conducted with the representatives of the Aboriginal community and DEC regarding cultural heritage management for this project. As a result, the following key commitments have been adopted for the Project.

- Aboriginal cultural heritage offset areas will be established, to conserve and manage 98 sites, including the majority of sites of high scientific significance comprising the sixteen identified rockshelter sites.

- Surface collection of artefacts and sub-surface investigation of selected sites within the Proposed Disturbance Area will be undertaken in consultation with the relevant Aboriginal community representatives.

- The rail loop location has been modified to ensure that it does not impact on the known boundary of an artefact scatter of moderate research potential and high Aboriginal heritage value.

Ongoing liaison will be conducted with the local Aboriginal community and DEC to refine the approach to cultural heritage management for the Project.

Historic Heritage

A Historic Heritage study was undertaken to identify and assess European heritage items potentially impacted by the Project. No items of State or National Heritage significance have been identified within the area potentially affected by the Project. Items of local historical significance have been identified both within and in close proximity to the Proposed Disturbance Area.

Centennial has committed to the further documentation of local history in consultation with local landholders, and full recording of a range of heritage items identified within the Proposed Disturbance Area.

Blasting impacts on heritage structures will be monitored, and the blast design will be refined as necessary, to reduce impacts. Any items of local heritage value will be fully recorded for archival purposes prior to any significant impacts.

Traffic and Road Safety

Specific concerns were raised by community stakeholders regarding the potential increase of traffic. A detailed traffic study was undertaken to assess the potential impacts of construction and operational road traffic on the local road network.

The detailed traffic assessment concluded that with the proposed road improvements in place, traffic generated by the Project will not have an adverse impact on the integrity of the existing road network or on road safety in the local area.

On the basis that the Bengalla Link Road is available, Project related traffic, including employee movements, will be required to use the extension of the Bengalla Link Road to Wybong Road to minimise any impacts on Mangoola and Roxburgh Roads. Centennial has committed to undertaking a number of road improvements along the section of Wybong Road between Bengalla Link Road and the mine access road in order to ensure the safe and efficient movement of traffic within the local area.

There will be ongoing consultation with local residents and Council regarding roads and traffic management.

Socio-economic Assessment

The Project, like many developments of its size, has the potential to impact on the social environment in both a positive and a negative manner. The issues of the local community and the wider Muswellbrook Shire community have been identified by a thorough consultation process. Centennial has sought to address the issues raised by the community, through the development of appropriate mitigation, amelioration and enhancement strategies.

A development of the scale and size of the Project brings significant advantages to particular stakeholders and disadvantages to others. The population impacts, associated with the project, on service provision within the local government area (LGA) can be adequately managed for the Project individually, and indeed will have considerable economic benefits for the local community.

From a social impact perspective, a key issue is the impact of the development on the sense of community of Wybong due to the potential dislocation of households in this area. To seek to manage this uncertainty, Centennial has endeavoured to provide assurance to local landholders through the provision of landowner purchase agreements, during the assessment phase of the project. While this has been viewed by some stakeholders, who are opposed to the Project, as co-option of landholders; for many the process has provided greater certainty and provided landholders with the option to relocate should they perceive that the impacts of the project on their lifestyle are significant.

The Project has the potential to make significant positive economic contributions at local, regional and state levels. On a regional basis, construction of the Project is anticipated to contribute between $19M and $21M in annual direct and indirect regional output or business turnover; between $9M and $10M in annual direct and indirect regional value added; between $5M and $6M in annual direct and indirect household income; and indirect and direct employment of approximately 121 to 143 people, as an annual average during the construction period.

In the operational phase, it is estimated that the Project will contribute to the regional economy, between $212M and $224M in annual direct and indirect regional output or business turnover; between $115M and $121M in annual direct and indirect regional value added; between $25M and $28M in annual household income; and indirect and direct employment of between 343 and 449 direct and indirect jobs. Royalties for the life of the Project are estimated to be approximately $380M.

As has been previously outlined, Centennial has committed to work with local landholders to effectively manage any predicted negative impacts of the project; and has also committed to enhance the positive benefits of the project through the development of a Community

Enhancement Program. The components of this program are summarised in the table below. Should the project be approved, such strategies will be implemented in conjunction with a comprehensive social impact monitoring and ongoing community involvement program.

Community Enhancement Program

Issue of Concern	Detail	Mechanism/Contribution
Community Projects	For ongoing community projects, to be distributed with community input	1 cent per saleable tonne of coal produced
Local Environmental Management	External to the mine site Wybong Uplands Land Management Strategy	$100,000 per annum for 5 years
Education and Training	Sponsorship of TAFE courses, apprenticeships, traineeships	$200,000 per annum for 3 years
Local Employment	To work with the local Council to facilitate local employment and residential opportunities within the Muswellbrook Shire	To be confirmed through consultation with key stakeholders
Community Infrastructure	Focus on Denman and Wybong, for example sporting and recreation facilities	$500,000

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16 Traffic Assessment

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Introduction

Section 1.0

1.0 Introduction

Centennial Hunter Pty Limited (Centennial) proposes to establish an open cut coal operation in the Wybong area, 20 kilometres west of Muswellbrook and approximately 10 kilometres north of the township of Denman (**Figure 1.1**). Centennial is a wholly owned subsidiary of Centennial Coal Company Limited, which is an Australian company established in 1989 and listed on the Australian Stock Exchange in 1994.

The proposal, known as the Anvil Hill Project (the Project), is based on a large, undeveloped coal reserve of approximately 150 million tonnes (Mt) that is suitable for production of coal for electricity generation.

The Project is defined as a 'Major Project' under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), and requires the approval of the NSW Minister for Planning. A Project Application has been made to mine up to 10.5 million tonnes per annum (Mtpa) of run of mine (ROM) coal using truck and shovel methods and for associated infrastructure. Approval is sought for a 21 year project life, concurrent with the duration of a mining lease to be sought for the operation.

This Environmental Assessment (EA) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) in accordance with the Director-General's Requirements (DGRs) for the Project, issued by the Department of Planning (DoP) (refer to **Section 8.0**). The DoP reviews whether this document adequately addresses the DGRs prior to the EA being made available for public exhibition.

1.1 Project Overview

1.1.1 Project Approach

The Project has been designed through an integrated multi-disciplined and risk-based approach that aims to maximise resource extraction efficiency whilst minimising impacts on the local environment and community. This approach has included:

- a comprehensive program of consultation with over 150 stakeholders, which commenced in 2003, to identify issues of interest and concern. This included personal interviews with local residents in close proximity to the site; meetings with Council and government agencies; and presentations to community organisations with an interest in the proposal;

- conduct of extensive baseline environmental monitoring since 2002 and involvement of a diverse range of specialists throughout all stages of Project planning to ensure that environmental and community constraints were considered in the Project design; and

- continual refinement of geological modelling, mine planning and engineering investigation to accurately define the extent and characteristics of the coal resource in order to maximise the efficiency of resource extraction.

1.1.2 Project Objectives

The objectives of the Project are to:

- provide a long term secure and profitable supply of high quality coal to the domestic power generation and export markets;

- develop the coal resource to maximise resource recovery and yield whilst addressing the principles of sustainable development;

FIGURE 1.1

Locality Plan

- conduct operations in an environmentally responsible manner by understanding and effectively managing, mitigating and offsetting environmental impacts;
- develop an ongoing relationship with the local community through development of effective communication channels, understanding concerns, and ongoing involvement in the development of sustainable outcomes; and
- contribute to the local, regional and State economies through capital expenditure, employment and training.

1.1.3 Project Summary

The Project comprises the design, construction and operation of:

- an open cut coal mine;
- coal handling, crushing and stockpiling facilities and a coal preparation plant (washery);
- water management, supply and distribution infrastructure;
- handling and placement of overburden (rock);
- mine access road including a new intersection on Wybong Road, internal access roads and haul roads;
- infrastructure including offices, staff amenities, workshop, conveyors, and ancillary services; and
- rail loop and rail loading infrastructure for the transport of all product coal.

The Project Area is shown on **Figure 1.2** and covers approximately 3763 hectares. The Proposed Disturbance Area covers an area of approximately 2238 hectares and represents the proposed footprint for the Project. All land within this boundary may be directly impacted or disturbed in some way due to activities associated with the operations, such as mining, infrastructure or construction, at some time during the 21 year project life.

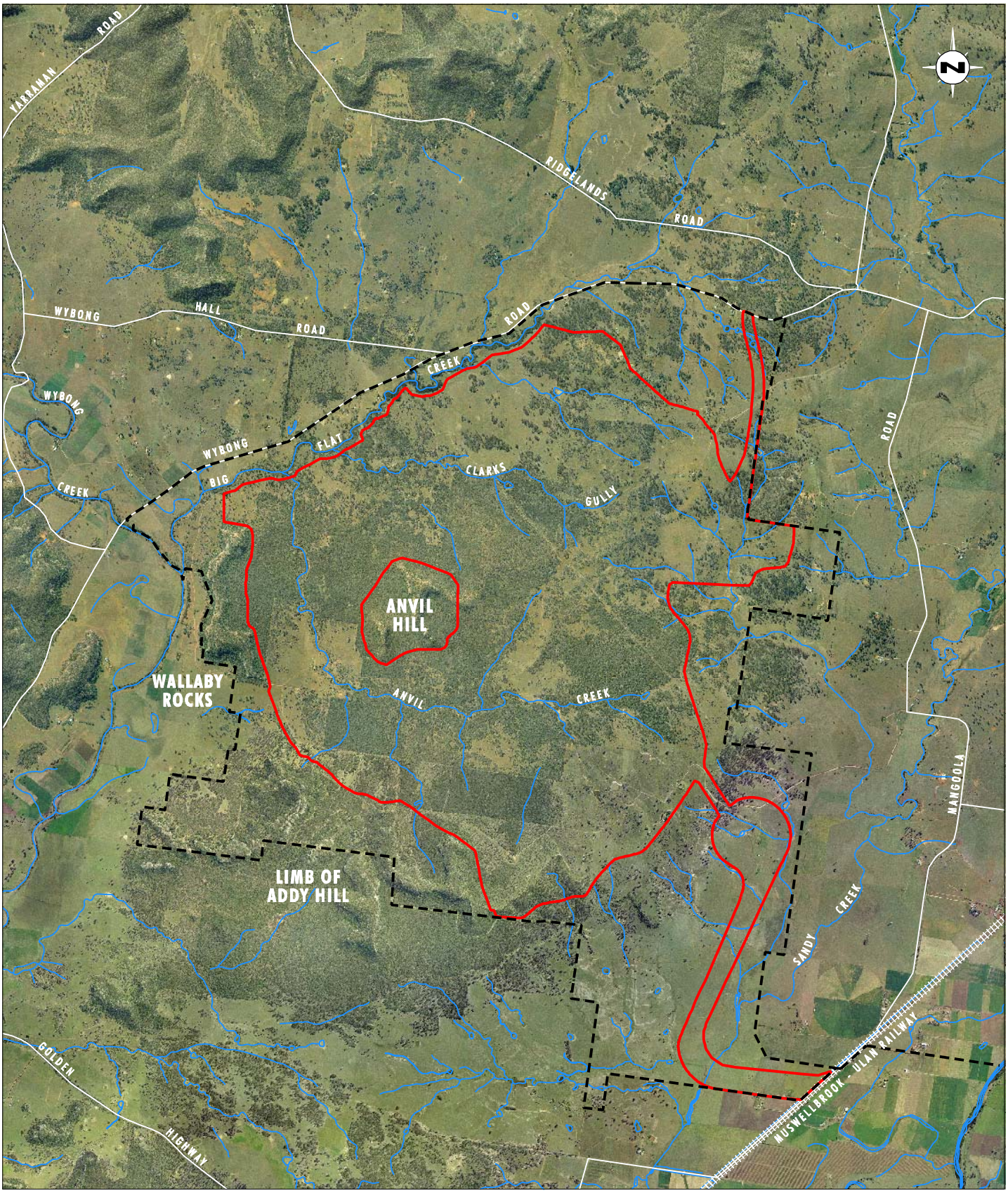
Rehabilitation will be scheduled to commence as soon as possible after mining disturbance, to minimise the disturbed area at any time. The proposed final land use will primarily include self sustaining indigenous vegetation communities, consisting of native and naturalised plants, in addition to agricultural land uses.

Section 2.0 provides a detailed description of the Project and **Section 5.0** provides an assessment of the environmental issues.

1.2 Site Context

1.2.1 Environmental Setting

The Project Area is located in the Upper Hunter Valley, on the margin of the valley floor. The Project Area has been extensively used for agriculture since the 1800s and is dominated by rolling grazing land with remnant and regrowth woodland. Grazing is the predominant land use surrounding the Project. Other land uses include rural residential land and more intensive agricultural land uses such as vineyards, irrigation for Lucerne, and dairies, as described in **Section 5.1**. An aerial photo of the site and surrounds is shown in **Figure 1.2**.



Base Map: Dept of Lands (2003), orthorectified by Plateau Images

0 1 2 2.5km

Legend

- Proposed Disturbance Area
- Project Area

FIGURE 1.2

Aerial View of Project Area & Surrounds

The topography of the Proposed Disturbance Area ranges from lower slopes through undulating and hilly lands to rocky outcrops. A 500 kV TransGrid powerline crosses the Project Area in a south-east/north-west direction. A notable topographical feature within the Project Area is Anvil Hill itself which rises to a height of approximately 285 mAHD, which is 70 metres above the surrounding area. It is located at the centre of the proposed mining area and consists of two hills connected by a saddle. Anvil Hill is not within the Proposed Disturbance Area.

The topography of the area surrounding the Proposed Disturbance Area is dominated by a row of hills to the west and south. The hills to the west are not named, although they are known locally as "Wallaby Rocks". Wallaby Rocks rise to a height of 264 mAHD, being approximately 100 metres above the surrounding area, and contain a visually dominant escarpment along the western side. The rocky area to the south known as Limb of Addy Hill rises to a height of 302 mAHD, which is also approximately 100 metres above the surrounding area.

The Proposed Disturbance Area is located primarily in the catchment of Anvil Creek, and extends into the catchments of Big Flat Creek and Clarks Gully to the north, and Sandy Creek to the east. Both Anvil Creek and Clarks Gully flow into Big Flat Creek. Big Flat Creek flows into Wybong Creek which is a tributary of the Goulburn River. The Goulburn River joins the Hunter River approximately 4.8 kilometres downstream from Denman. Sandy Creek drains to the Hunter River at Denman.

The Project is located within part of a large area of remnant and regenerating vegetation (refer to **Section 5.4**). The Proposed Disturbance Area includes approximately 1300 hectares of treed vegetation and 960 hectares of grassland.

1.2.2 Land Tenure and Ownership

Land ownership and the location of residences within and surrounding the Project are shown in **Figure 1.3**. Details of land ownership are provided in **Appendix 1**. The majority of land within the Project Area is either owned by Centennial or secured by a right to purchase by Centennial (refer to **Table 1.1**).

Table 1.1 – Property and Residence Ownership within Project Area

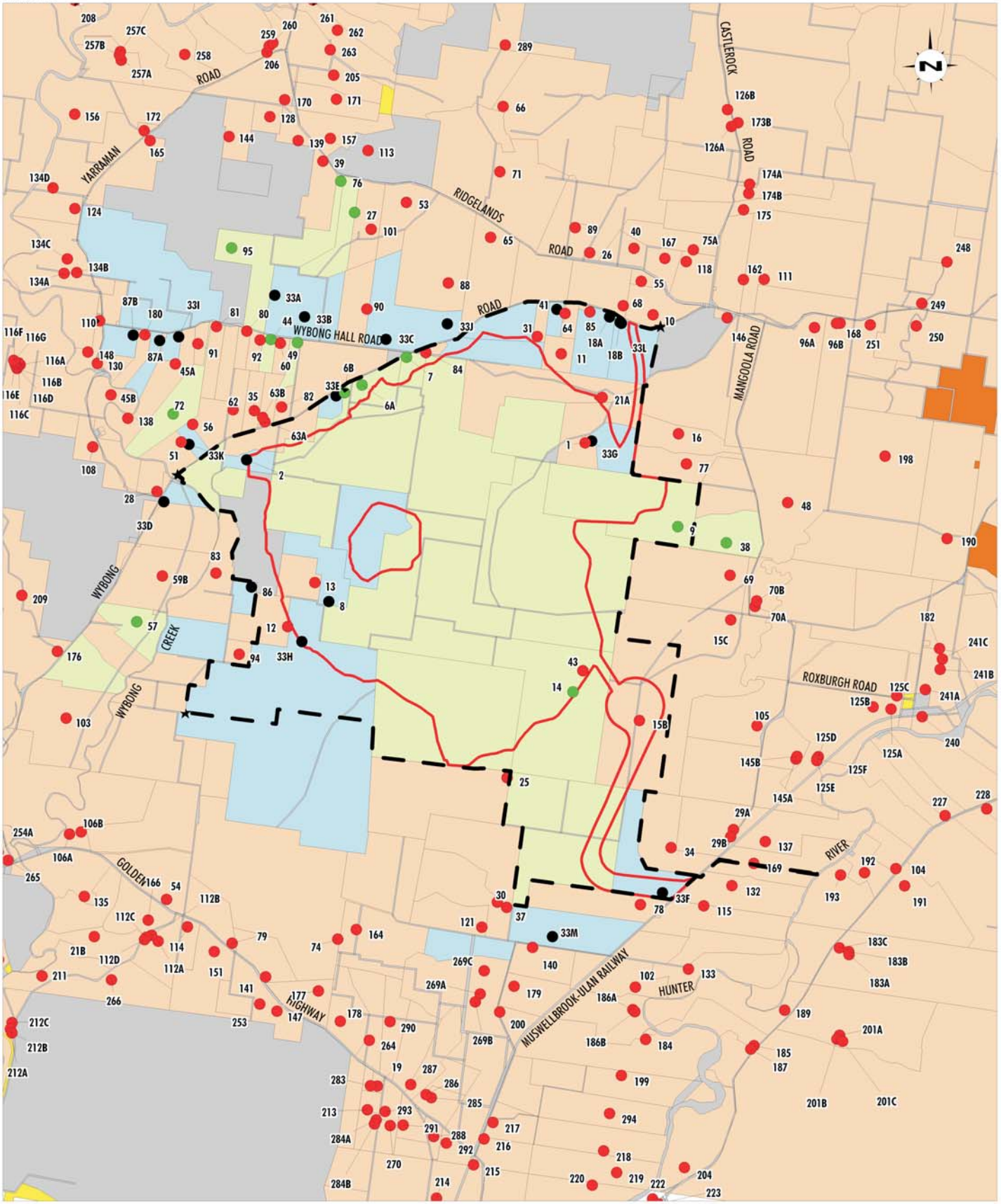
	Privately Owned[2]	Centennial Owned[2]	Contractual Right to Purchase (Agreement)[2]	Total
No. of Residences	11	10	5	26
No. of Properties[1]	14	12	10	36

Note:
1 For the purposes of this EA, a property is defined as contiguous parcels of land owned by the same person or entity.
2 Centennial is continuing to progress purchase and agreements in relation to purchase of properties and these details are current as at 8 August 2006.

Of the residences shown in **Table 1.1**, there are nine residences within the Proposed Disturbance Area, four of which are owned or secured by a right to purchase by Centennial.

In addition to the properties shown in **Table 1.1**, there are also a number of Crown roads within the Project Area. Centennial will seek approval from the Department of Lands for the transfer of Crown land reserves and closure of Crown roads within the Project Area.

To the extent native title has not or may not have been extinguished on the Crown land the subject of the Project, the proponent will be required to comply with relevant native title legislation in carrying out the Project.



Base Map : Dept. of Lands (2003)
Note : Refer to Appendix 1 for Residence Ownership Details

0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Private Residences
- Centennial Agreement Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 1.3

Land Ownership

Land surrounding the Project Area is predominantly privately owned with some areas of Crown, State and Commonwealth owned land. Centennial owns or has agreement over a number of properties, as shown on **Figure 1.3**. Centennial has approached all relevant landowners with an offer to purchase all land that is predicted to be significantly affected by dust and/or noise impacts at some stage during the life of the Project.

1.2.3 Mining Tenements

The Project Area is covered by a number of tenements held by Centennial under the Mining Act 1992, as shown in **Figure 1.4**. These tenements are:

- Assessment Lease 9 (AL9) granted in November 2004, which covers the majority of the area;
- Mining Lease Application 220 (MLA 220) which covers a small area within AL9 where it was previously proposed to extract a bulk sample. This bulk sample is no longer required;
- Exploration Licence 5552 (EL5552) renewed in May 2006 to cover some areas previously included in EL5552, which are not covered by AL9.

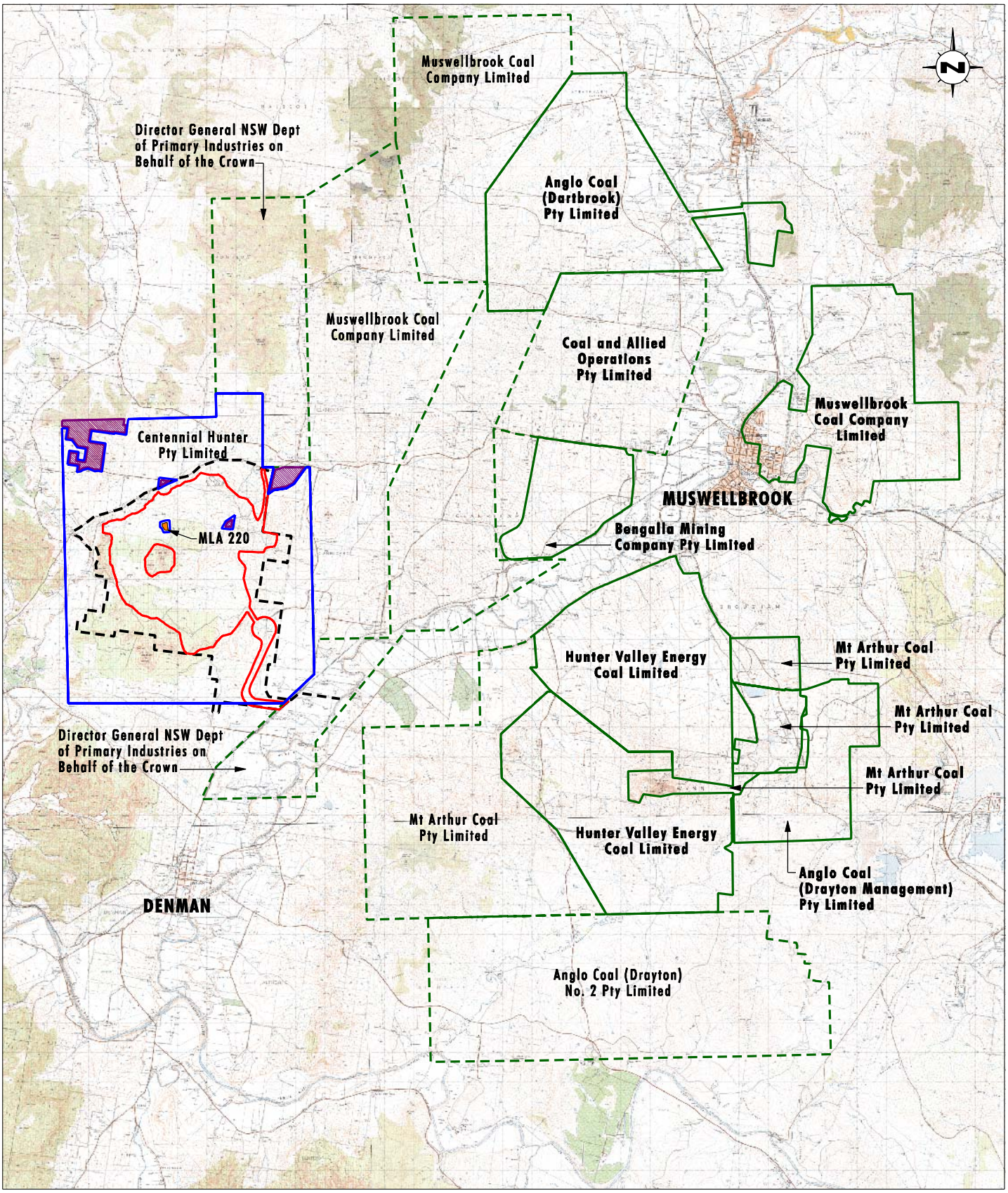
Centennial will submit a Mining Lease Application for the Project.

As shown in **Figure 1.4**, the Project is separated from other upper Hunter Valley coal mines such as Bengalla, Mt Pleasant, Mt Arthur Coal and Dartbrook. The closest mine to the Project is Bengalla which is located approximately 12 kilometres to the east. There are other mining titles that adjoin the Project area to the east, south-east and north-east. These are held by Muswellbrook Coal Company and there has been no development consent sought for mining within these areas.

1.3 Environmental Assessment Team

Umwelt prepared this EA on behalf of Centennial. A number of organisations undertook specialist studies as part of the EA process, including:

- Wilkinson Murray Pty Limited - Noise and Blasting Assessment
- Holmes Air Sciences - Air Quality Assessment
- Mackie Environmental Research - Groundwater Assessment
- Coakes Consulting Pty Ltd - Community Consultation Program and Socio-economic assessment
- TPK & Associates - Traffic and Transport Impact Assessment
- SEE Sustainability Consulting - Greenhouse Gas and Energy Consumption Assessment
- O'Hanlon Design Limited - Visual Assessment
- GSS Environmental - Soils and Land Capability Assessment
- Groundtruth Consulting - Geomorphological Advice for Cultural Heritage Assessment



Source: DPI (2006)
Base Map: Dept. of Lands (2000)

0 2 4 8km

Legend

- Proposed Disturbance Area
- Project Area
- Active Mines
- Other Mining Titles (Mining Act 1992)
- MLA 220
- AL9
- EL5552

FIGURE 1.4

Mining Authorities

- Gillespie Economics - Economic Assessment
- Weir Phillips - Contribution to Historic Heritage Assessment
- RCA Australia - Geotechnical Assessment of Rockshelters

The assessments of surface water, ecology and archaeology were completed by Umwelt's in-house specialists. Further details of the Project Team are provided in **Appendix 1**.

1.4 EA Structure

The purpose of this EA is to enable consideration of the implications in proceeding with this development. The EA has been prepared in accordance with EP&A Act and Regulations (refer to EA Statement of Authorship in **Appendix 1**). An overview of the layout of this EA is provided below:

The **Executive Summary** provides a brief overview of the Project, the extensive community consultation process, the major outcomes of the environmental assessment, and an outline of the key project commitments to mitigate potential impacts.

Section 1.0 provides background and context for the Project and specifically introduces the Project, outlines Project objectives, approval process and the Project team involved in producing the EA.

Section 2.0 contains a detailed description of the proposed development.

Section 3.0 describes the planning context for the Project, including the applicability of Commonwealth and State legislation.

Section 4.0 describes the extensive community consultation process and the environmental and community issues identified as part of this process for detailed assessment in the EA.

Section 5.0 contains a description of the existing environment and a comprehensive analysis and assessment of the environmental impacts of the Project, including the Project specific and cumulative impacts.

Section 6.0 details the draft Statement of Commitments proposed to be adopted throughout the life of the Project in order to mitigate impacts.

Section 7.0 contains a conclusion as required by the DGRs.

Sections 8.0 to **10.0** provide a checklist of the Environmental Assessment Requirements (EAR) considered in the preparation of the EA, a list of references referred to in the EA, a list of abbreviations and glossary of technical terms.

Description of the Proposal

Section 2.0

2.0 Description of the Proposal

The conceptual design of the Project has evolved throughout the EA process in light of ongoing exploration, in consideration of stakeholder consultation and detailed analysis of environmental constraints and opportunities. A description of the conceptual features that comprise the Project is included in this section and **Table 2.1** below provides a summary of the key project details.

Table 2.1 – Key Project Information

Project	Open cut mine, extracting and processing up to 10.5 million tones per annum (Mtpa) of run of mine (ROM) coal. Construction and operation of rail and coal handling/train loading infrastructure to facilitate transport of product coal to market.
Proponent	Centennial Hunter Pty Limited (Centennial)
Project Life	An expected Project life of 21 years (from the date of grant of a mining lease).
Mining	Open cut mining at a rate of up to 10.5 Mtpa of ROM coal, using truck and shovel mining methods to handle overburden and remove coal.
Coal Washing	Construction and operation of a Coal Preparation Plant (CPP) capable of processing up to 10.5 Mtpa of ROM coal. Coarse rejects will be placed predominantly within mined areas. Tailings will be initially managed through emplacement in a purpose built tailings dam, with ongoing management through emplacement in mined areas.
Employment	Peak construction workforce of up to 200 employees and an operational workforce of up to 240 employees at peak production.
Construction	Construction of the rail loop, road, coal stockpiling, reclaim and train loading infrastructure, CPP and mine facilities area is planned to be undertaken over a period of approximately one year.
Hours of Operation	The mine will operate 24 hours per day, seven days per week. The majority of construction activities will generally be undertaken during daylight hours, up to seven days per week.
Product Coal Transport	Product coal will be loaded onto trains and transported to market via the Project rail loop connected to the Muswellbrook-Ulan railway. Expected average of four trains per day.
Mine Access	Mine road access via Wybong Road only. Intersection to be constructed at the connection of the mine access road and Wybong Road.

The Project Application boundary is referred to as the Project Area, as shown in **Figure 1.2**.

2.1 Geological Setting

Since 1999, Powercoal and Centennial (after its acquisition of Powercoal in 2002) have completed intensive exploration within the Project Area. A resource of some 180 Mt of coal at shallow depth has been delineated, the majority of it to “Measured” status, the highest level of confidence for reporting purposes.

The exploration program has clarified that the seams of interest, in order from the surface, correlate with the Great Northern Seam, Fassifern Seam and Upper Pilot Seam in the Newcastle Coal Measures. These seam names are used for the Project.

As core samples have been recovered from most of the drill holes on site and analysed, Centennial is confident that the coal is well-suited to producing a low sulphur coal.

The mine plan proposes to extract some 150 Mt of the resource, which occurs within the Proposed Disturbance Area. The coal seams are typically contained within a 15 metre thick sequence with an aggregate coal thickness of about 10 metres. The predominant overburden material above the Great Northern seam is a massive conglomerate. The Great Northern and Fassifern seams are separated by a fine-grained tuffaceous siltstone known as the Awaba Tuff.

The coal seams gently dip (get deeper) to the west at about 2 degrees below horizontal, reaching a maximum depth to the floor of the lowest seam of about 100 metres. The only significant structural feature identified is a north-east trending dyke (a near vertical intrusion of once-molten rock). **Figure 2.1** shows the outline of the coal resource and conceptual pit layout and **Figure 2.2** shows vertical sections through the Proposed Disturbance Area.

Preliminary assessment has indicated that the coal resource has a medium high to high propensity for spontaneous combustion. Management of this aspect is covered in **Section 5.5.4.3**.

2.2 Construction Phase

Substantial construction works will be required prior to the mine becoming operational. These works will initially include establishing site access from Wybong Road (**Figure 2.3**) and temporary construction facilities such as offices, maintenance workshops, equipment and supply storage and yards, and construction employee facilities. Further construction works will focus on:

- completion of the site access road, including the construction of an intersection with Wybong Road;
- coal handling, CPP, rail loop and load out and other site infrastructure;
- development of initial pits (box cuts) to uncover coal and concurrent establishment of the initial out of pit overburden emplacement areas;
- haul roads to link open cut mining areas with infrastructure;
- installation of appropriate fencing and gates to ensure public safety and security for the mining operations and construction.

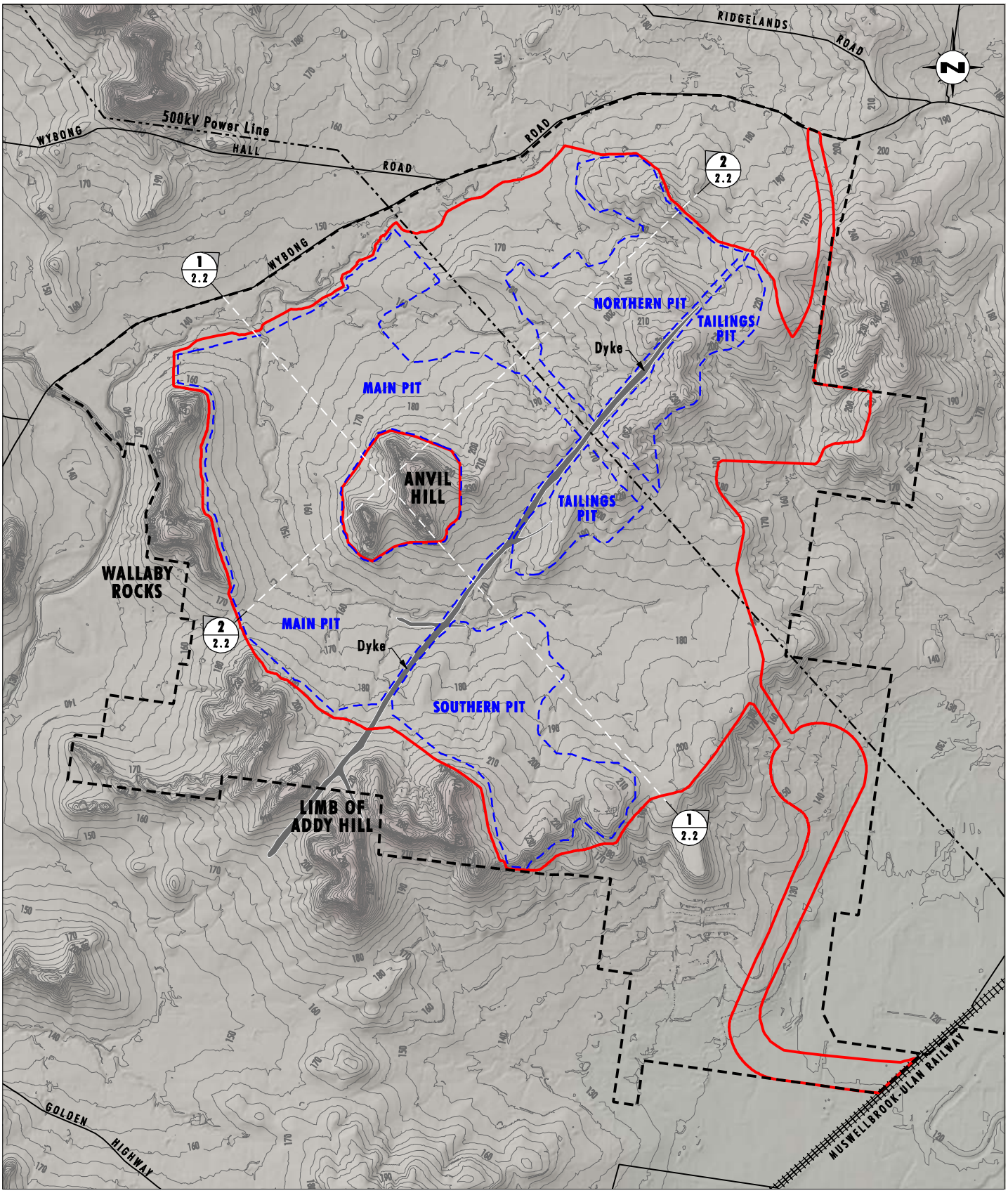
It is expected to take about one year after commencement of construction activities for the mine to be operational.

2.3 Mining Operations

2.3.1 Mine Layout

The conceptual mine layout and progression of mining operations at various stages is represented indicatively by Years 2, 5, 10, 15 and 20, as shown in **Figure 2.3** to **Figure 2.7**.

The two main features that influence the design of the mine and the equipment selection are the dyke that runs from the south-west to the north-east across the eastern side of the Project and the 500 kV powerline that runs at right angles to the dyke (**Figure 2.1**).



Source: Mine Consult (2005), Mackie Environmental Research (2006)
Base Map: Dept. of Lands (2006), Geospectrum (2004)
Note: 1. For section details, refer to Figure 2.2
2. Contour Interval 5m

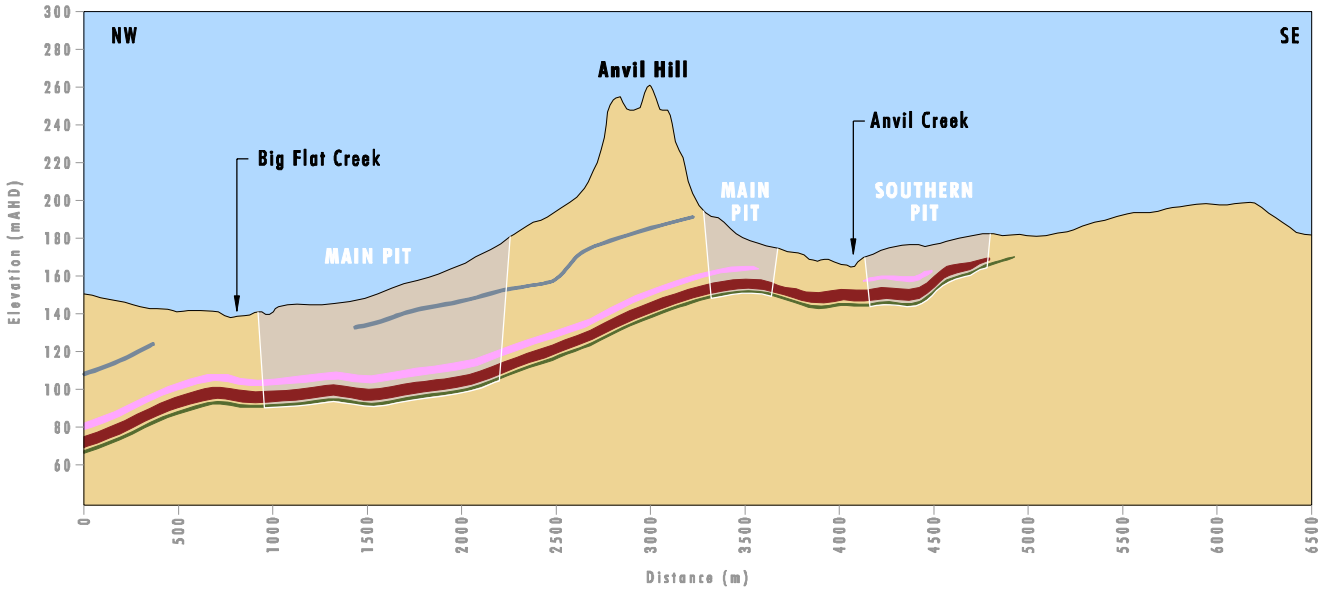
0 0.5 1.0 2km

Legend

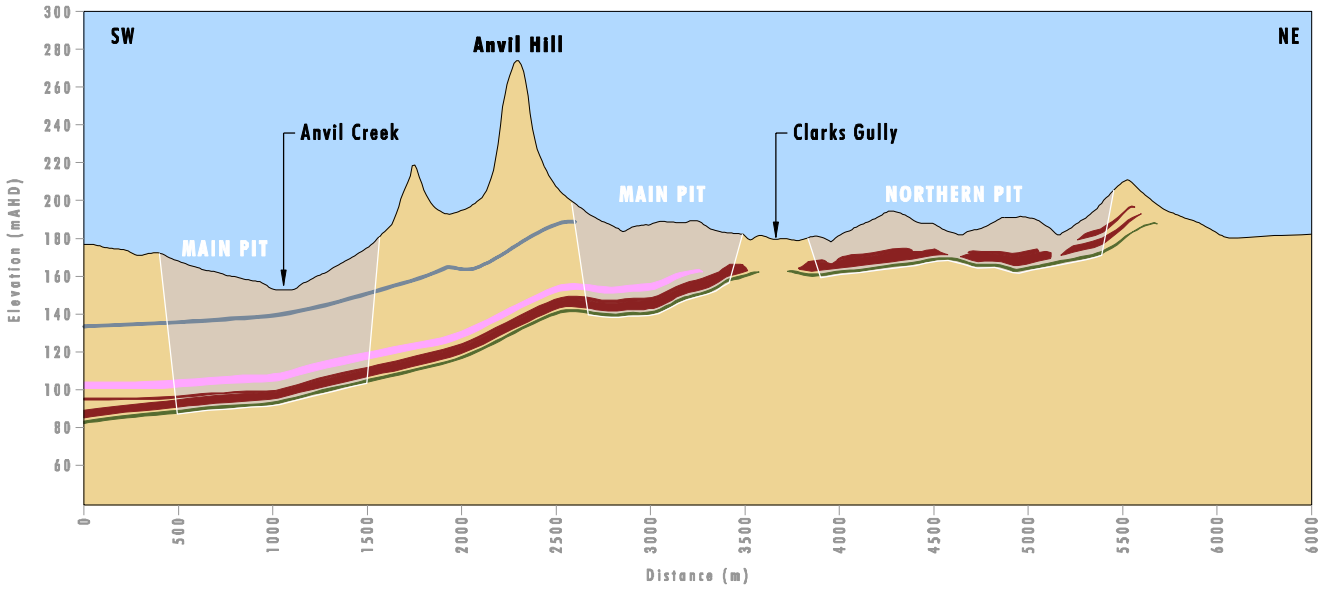
- Proposed Disturbance Area
- Project Area
- Proposed Mining Area

FIGURE 2.1

Coal Resource and Conceptual Pit Layout



Section 1



Section 2

Source: Mackie Environmental Research (2006)
Note: Vertical Exaggeration 1:10

0 100 200 400m
Vertical Scale

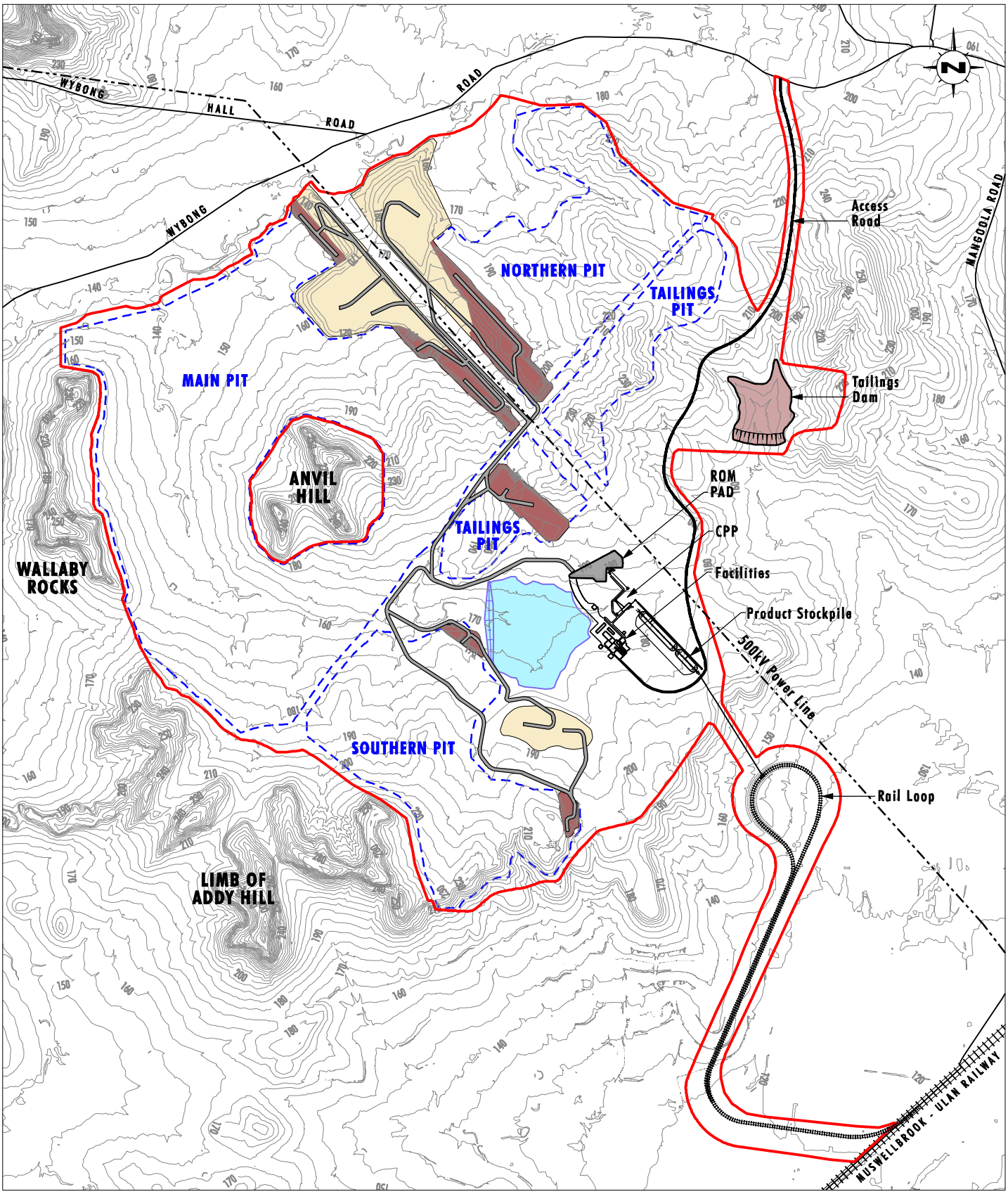
0 0.5 1.0 2.0km
Horizontal Scale

Legend

- Wallarah Seam
- Great Northern Seam
- Fossifern Seam
- Upper Pilot A Seam
- Pit Profile

FIGURE 2.2

Vertical Section across Proposed Disturbance Area



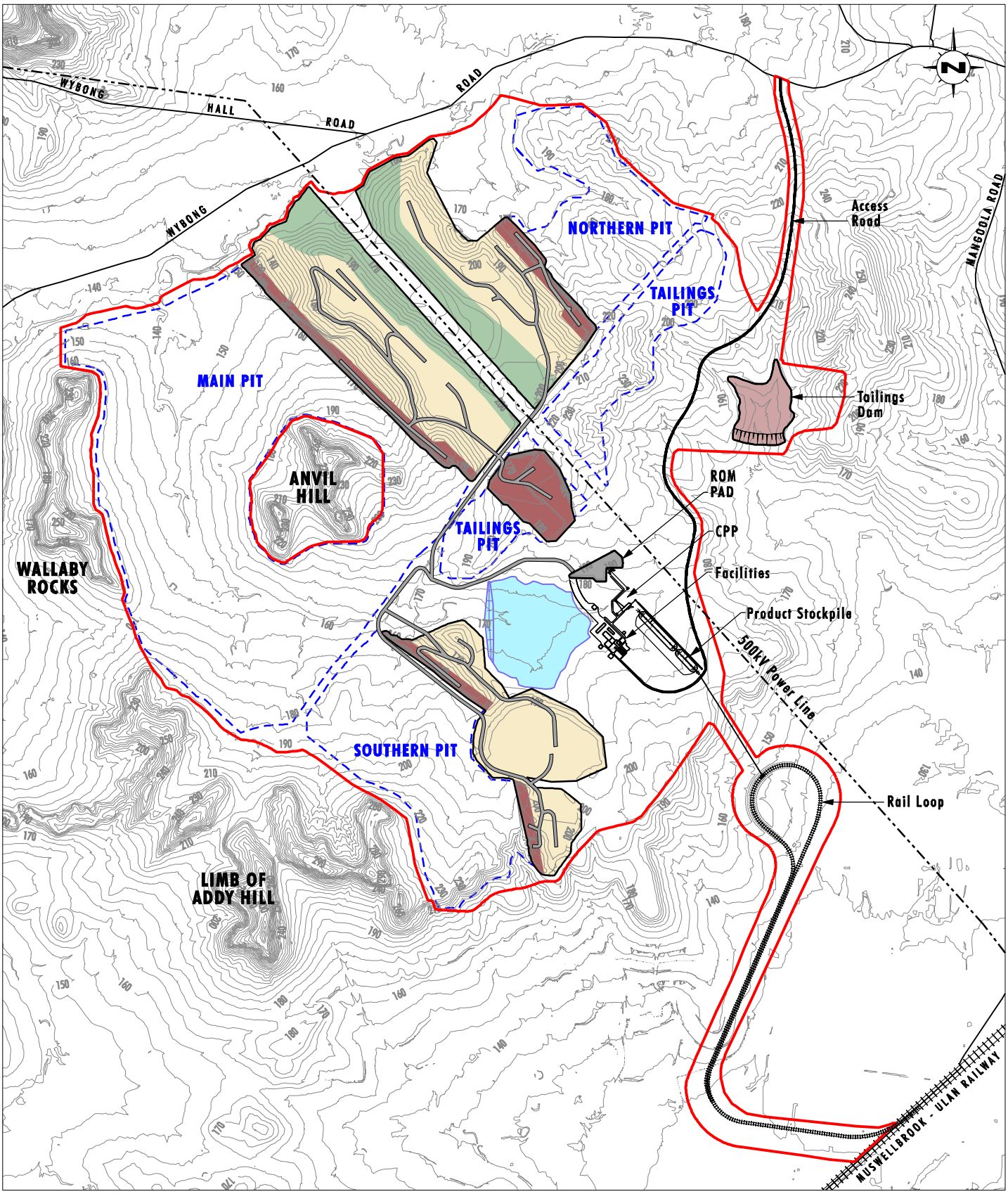
Source: Mine Consult (2005)
Base Map: Dept. of Lands (2003), Geospectrum (2004)

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Main Dam

FIGURE 2.3

Conceptual Progression of Mining Year 2



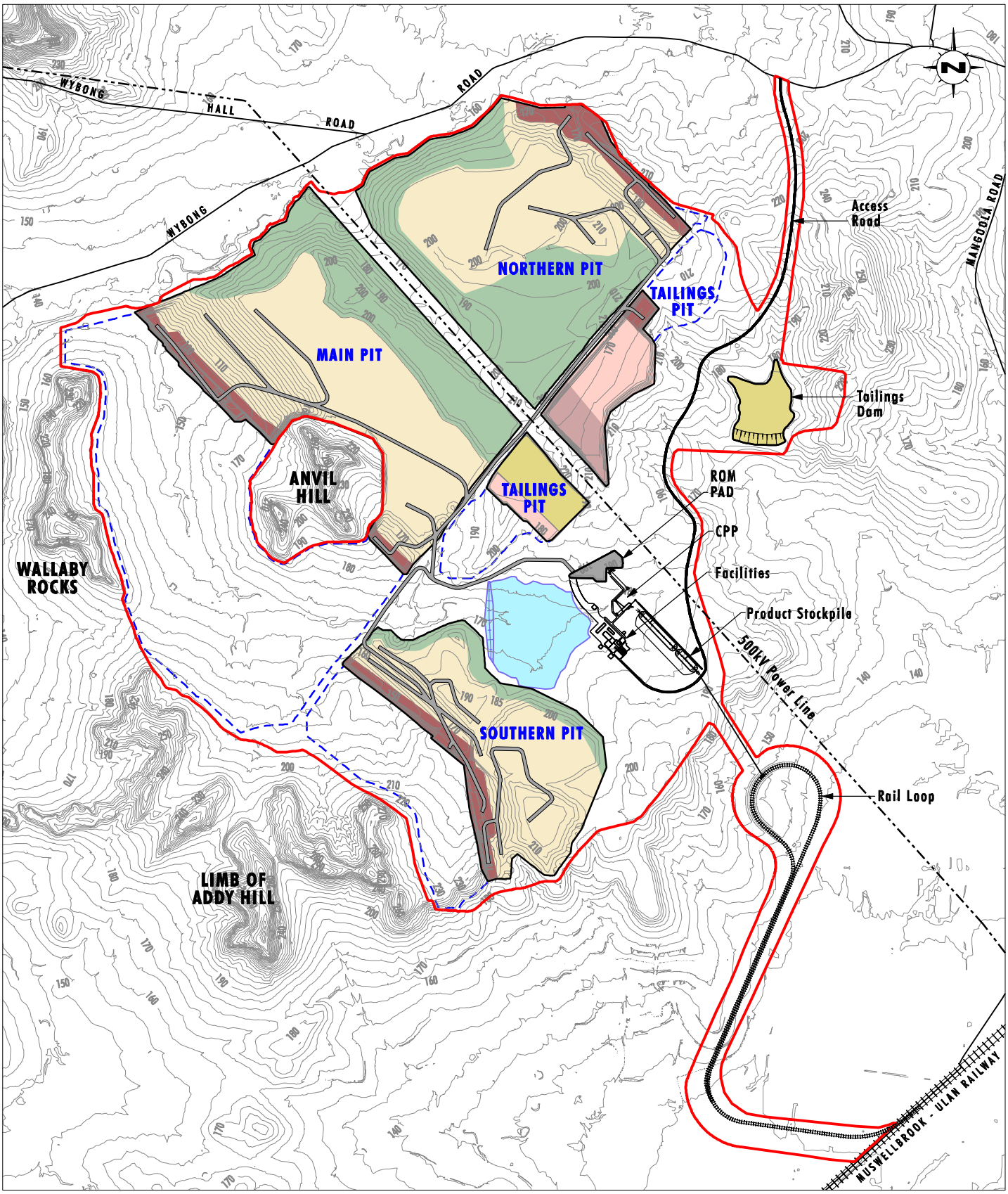
Source: Mine Consult (2005)
Base Map: Dept. of Lands (2003), Geospectrum (2004)

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Rehabilitation
- Main Dam

FIGURE 2.4

Conceptual Progression of Mining Year 5



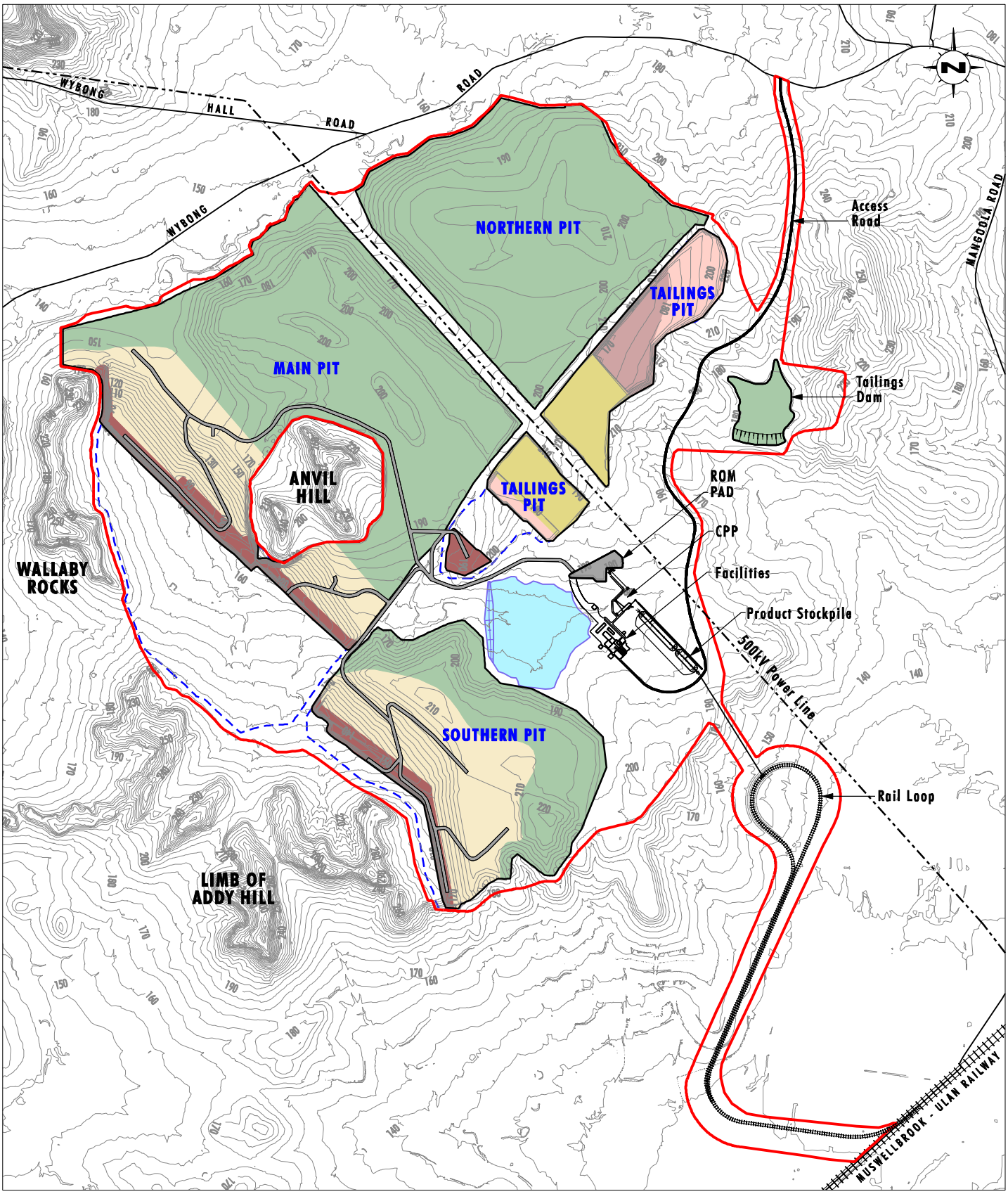
Source: Mine Consult (2005)
Base Map: Dept. of Lands (2003), Geospectrum (2004)

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Inactive Tailings
- Pit Floor
- Rehabilitation
- Main Dam

FIGURE 2.5

Conceptual Progression of Mining Year 10



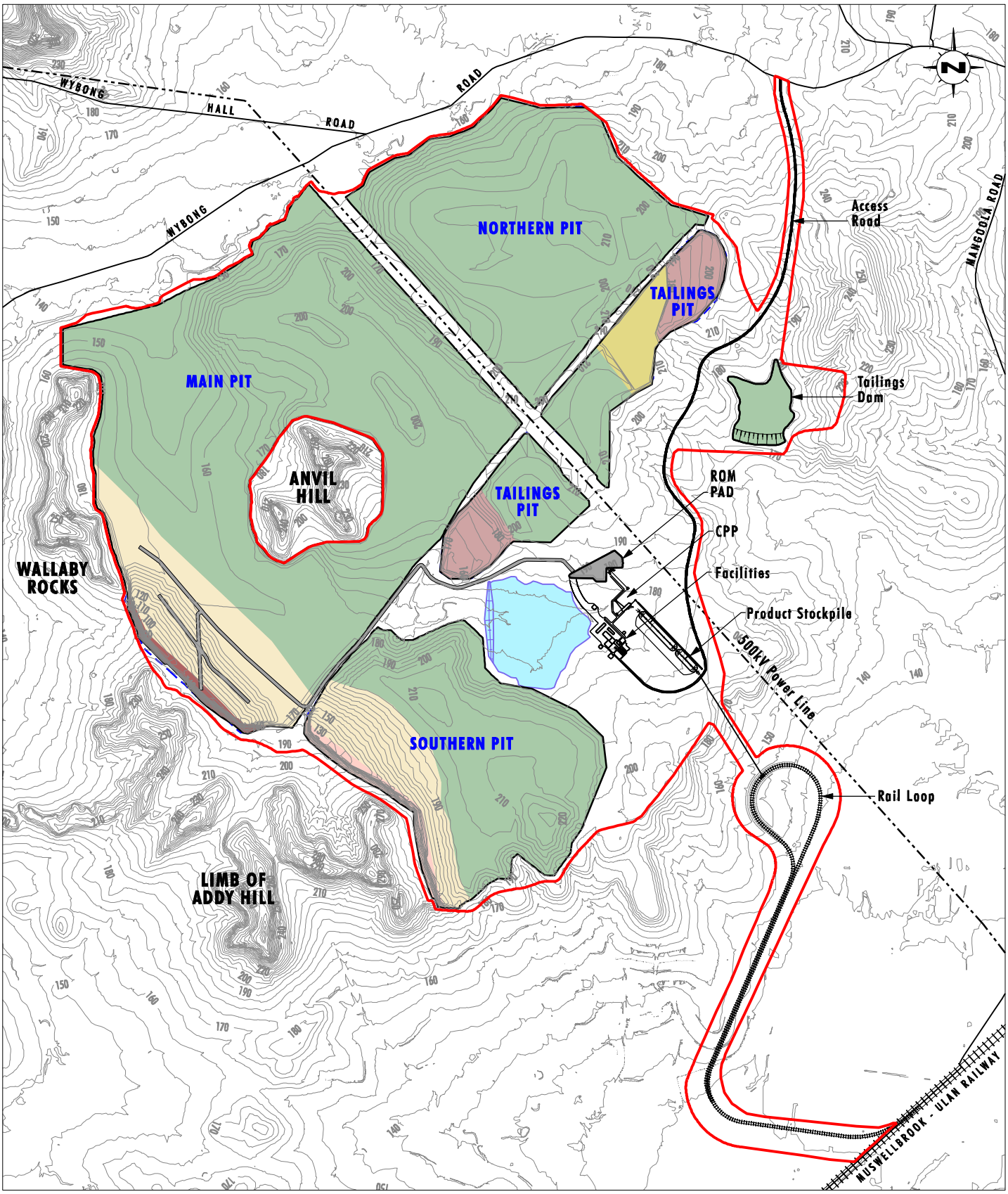
Source: Mine Consult (2005)
Base Map: Dept. of Lands (2003), Geospectrum (2004)

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Inactive Tailings
- Pit Flooor
- Rehabilitation
- Main Dam

FIGURE 2.6

Conceptual Progression of Mining Year 15



Source: Mine Consult (2005)
Base Map: Dept. of Lands (2003), Geospectrum (2004)

Legend

- Proposed Disturbance Area
- Proposed Mining Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Inactive Tailings
- Pit Floor
- Rehabilitation
- Main Dam

FIGURE 2.7

Conceptual Progression of Mining Year 20

These features effectively divide the open cut mining area into four active pits – Northern Pit, Main Pit, Tailings Pit and Southern Pit.

To achieve consistent coal quality for the life of the mine, scheduling has allowed for concurrent operation of these four pits for most of the mine life. Only one of these pits will mine coal at any one time with overburden movement being undertaken simultaneously in the other three pits.

2.3.2 Mining Method

The primary mining method will be by hydraulic excavators loading rear dump trucks, assisted by dozer push and cast blasting of overburden where appropriate. Dump trucks will haul ROM coal to the coal handling facilities along the haul roads. The general mining sequence will include the stripping of topsoil, removal of overburden, extraction of coal resource, in pit overburden emplacement and progressive rehabilitation. Clearing and topsoil stripping will be conducted progressively as the mine advances, minimising the extent of clearing to that required in advance of each mining strip.

With the exception of thin layers and some near-surface weathered material, it is expected that all overburden and coal will require drilling and blasting prior to excavation. Thin layers and weathered material will be ripped by bulldozer in preparation for loading.

Out-of-pit overburden emplacements will be necessary to provide for the development of working pit voids. The out-of-pit overburden emplacement areas are planned to be situated adjacent to the northern, main and southern pits and will ultimately merge with the backfilled pits to form the conceptual final landform (discussed further in **Section 5.1**).

2.4 Coal Processing

The coal handling facilities, CPP and other infrastructure are proposed to be located within a valley in the south-eastern portion of the Proposed Disturbance Area (refer to **Figure 2.3**). This location provides natural topographic screening from surrounding residences, is off the coal reserve area, and provides for efficient coal handling prior to rail loading.

The CPP contains the processing equipment which separates the raw coal into various products and rejects. This will include at least two products in addition to coarse rejects and fine tailings. The CPP will be designed to process up to 10.5 Mt of ROM coal per annum.

The ROM coal will be hauled to the coal handling facilities, where it will be crushed, prior to treatment in the CPP. A ROM coal surge stockpile will be situated prior to the crushing station and will be fitted with automatically activated dust control sprays. Buildings and structures within the infrastructure area will have a maximum height of approximately 35 metres.

2.5 Product Handling and Rail Load out

After washing, product coal will be stockpiled. The product stockpile area will have a nominal capacity in the order of 600,000 tonnes. Stockpile capacity will be optimised with the use of dozers. Automatic dust control sprays, activated during high wind periods, will be installed on the stockpiles.

The proposed rail loop is located in the south-east of the Project Area and joins the existing Muswellbrook to Ulan railway line. Coal will be transported from the product stockpile area to the rail load out bin via a conveyor.

The train loading facility is planned to be available for use 24 hours per day, 7 days per week. On average, four trains per day are expected to be handled through the facility.

2.6 Production Schedule

The ROM coal production will be a maximum of 10.5 Mtpa over the proposed 21 year duration of the Project. Coal production will vary depending on coal quality and markets.

Contingent upon gaining relevant government approvals, Centennial has contracted with Macquarie Generation to supply approximately 2.5 Mtpa of coal for its Bayswater and Liddell power stations for an initial 12 years commencing in 2008. The Project plan allows for the production of export coal and additional domestic coal.

2.7 Waste Management

Coarse rejects material will be conveyed from the CPP to a reject bin and from there it will be transported by truck for disposal with overburden.

Fine tailings will be thickened to a high density for maximum water recovery. The thickened tailings will be pumped to tailings emplacement areas to be further dewatered and consolidated by drainage and surface evaporation. When sufficiently consolidated, the tailings will be progressively covered by a layer of overburden and the area will be rehabilitated.

A surface tailings dam will be established in the eastern portion of the Proposed Disturbance Area (**Figure 2.3**) for the disposal of tailings for the early stage of mining operations. However, as mining progresses, one of the mining pits (Tailings Pit) will be backfilled with tailings. It is expected that the Tailings Pit will be available for tailings emplacement approximately five years following commencement of mining. This will minimise the additional surface area disturbed by tailings storage. The tailings dam and cells within the Tailings Pit are planned to be rehabilitated progressively throughout the life of the mine.

2.8 Other Surface Infrastructure

Ancillary surface infrastructure including the access road and intersection; workshop and refuelling facilities; administration and employee facilities; and associated services will be near the CPP and coal handling facility area. The location of the access road and facilities area is shown on the conceptual mine plans (**Figures 2.3** to **2.7**).

2.8.1 Access Road and Wybong Road Intersection

An access road is planned to be constructed from Wybong Road to the proposed facilities area, shown in **Figure 2.3**. This will involve the construction of a new intersection on Wybong Road and approximately 5 kilometres of internal sealed road access.

The location and design of the proposed access road intersection has been based on the assessment of the impacts of traffic flow and road safety along Wybong Road and is discussed further in **Section 5.10**. All access to the site during both construction and operational phases of the Project will be via Wybong Road.

Apart from the access road from Wybong Road to the site facilities, internal roads including haul roads and light vehicle roads will not be sealed.

2.8.2 Workshop and Refuelling Facility

A heavy vehicle workshop will be located in the facilities area and used for the maintenance of heavy vehicles on site. A heavy vehicle and light vehicle wash down bay, parking area and bunded area for hydrocarbons and similar will also be constructed near the workshop. Runoff and washdown water will be collected and treated before use as process or dust suppression water.

2.8.3 Administration and Employee Facilities

The office and administration building will be constructed as demountable style buildings to allow for flexibility in future use of this facility. The office and administration building will provide facilities for management, environmental and technical employees.

The bath house, first aid and emergency response facilities will be a similar construction to the office and administration centre.

An external car parking area for employees and site visitors will be provided within the facilities area.

2.8.4 Electrical and Power Reticulation

Electrical power for the Project is proposed to be sourced from a 66 kV electrical supply. A suitable connection to the existing power supply network will be constructed.

The proposed alignment of the powerline is being determined in consultation with Energy Australia. The impacts associated with the construction and operation of this powerline have not been assessed in the EA, and will be included as part of separate approval to be sought by Energy Australia under Part 5 of the EP&A Act.

2.8.5 Telecommunication Cables

Telecommunication infrastructure will be connected to the existing infrastructure and will follow existing easements and service lines where practicable. This will minimise the disturbance of land and the need to create additional easements. Where upgrades to existing and proposed telecommunication infrastructure are required, this will be undertaken in consultation with the telecommunication service provider.

2.8.6 Water Supply and Sewage Systems

Water supply for the Project will be sourced from a number of primary resources including water collected from the mine site and direct pumping of water from the Hunter River.

The majority of water will be utilised on site within the CPP, and for dust suppression. Other uses include drinking water, employee washing, fire control and equipment washing and maintenance. The water supply and management system has been designed to maximise water re-use efficiency, particularly in relation to tailings re-use, storm water harvesting and sewage treatment (refer to **Section 5.2**).

Sewage and wastewater generated from the office and administration building and employee bath house will be treated on site through a package treatment plant. Options for use of the treated wastewater include irrigation of landscaped areas or re-use in the CPP.

2.8.7 Lighting

Permanent lighting will be required in the mine infrastructure area due to the night time operation of the coal handling facilities, CPP and rail load out infrastructure.

There will also be mobile lighting required in active areas of the mine during night-time operations. This will be provided by mobile lighting plants and equipment headlights. The majority of this work will be undertaken in-pit which will provide screening from nearby residences.

Lighting will be kept to the minimum required for operational needs and safety. All permanent lights will have shields and all lighting will be directed down onto working areas to ensure that fugitive light emissions are limited.

2.8.8 Explosives Storage

An explosive storage facility will be located within a secure location, a sufficient distance from employee facilities and the public road system to satisfy appropriate safety standards.

2.9 Hours of Operation

Construction activities will generally be undertaken during daylight hours, up to seven days per week. Once established, mining operations, coal handling and washing, rail loadout and all associated activities are planned to operate on a 24 hours per day, seven days per week basis.

As discussed in **Section 5.6**, operations will be restricted at night to below the maximum elevation of the overburden dumps, in order to minimise noise impacts.

Blasting will typically be undertaken between the hours of 9.00 am and 3.00 pm Monday to Saturday. No blasts will be undertaken on Sundays or public holidays.

2.10 Alternatives Considered

Planning for the Project has been iterative since its inception in 1999. Considerations have included:

- an increasing understanding of the coal resource;
- changes in the commercial environment;
- an appreciation gained from background environmental monitoring and site investigations;
- issues raised in consultation with the community and relevant government agencies; and
- information gained from completion of detailed environmental studies for the Project.

The various opportunities and constraints for the Project have been analysed and considered in assessing alternatives, prior to the current conceptual mine plan being proposed for the Project. A summary of the alternatives considered is provided in **Table 2.2**.

Table 2.2 - Alternatives Considered

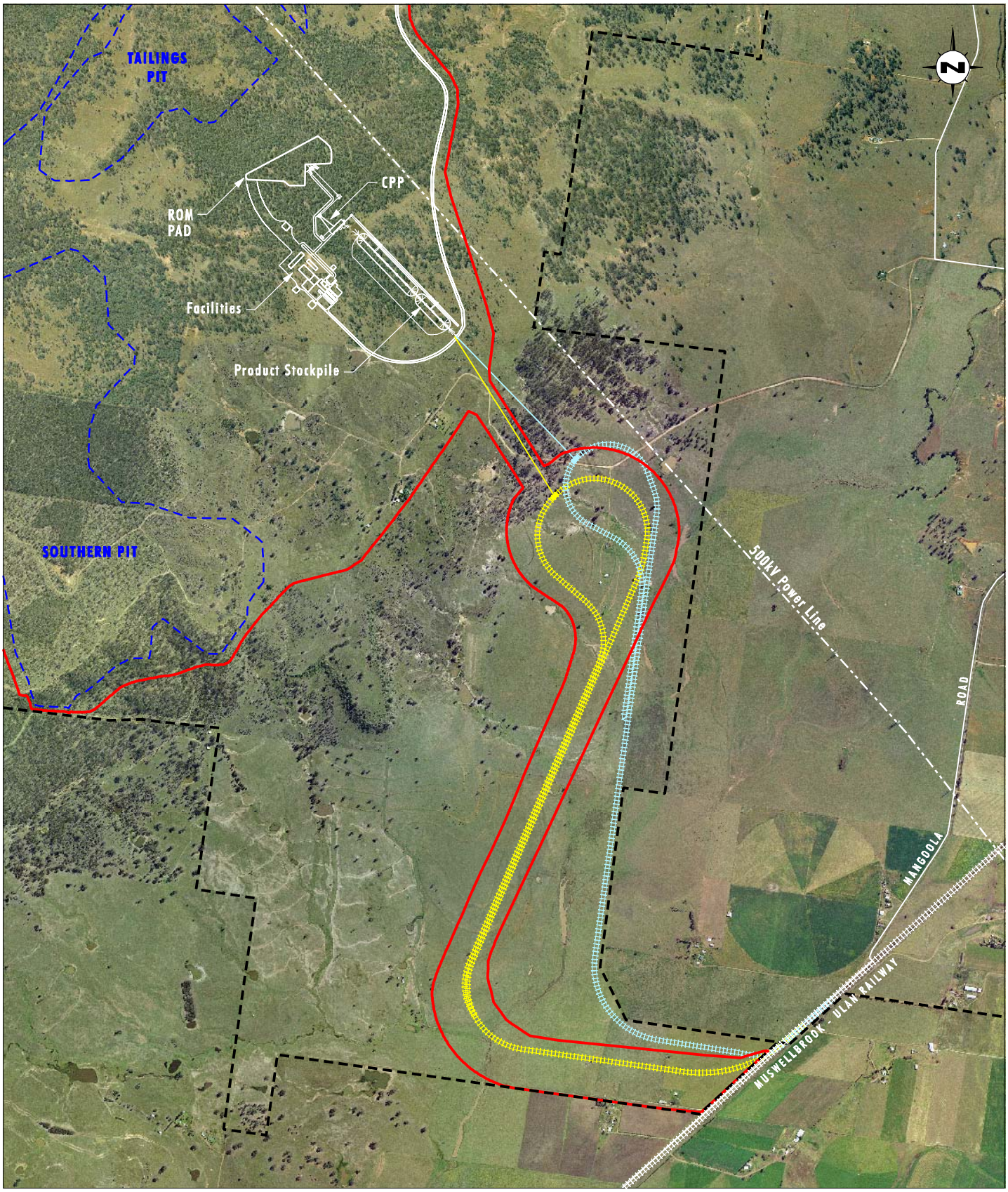
Issue	Alternative	Comment
Mining Method	Underground methods	The shallowness of much of the resource rules out underground mining due to safety and limits on resource recovery.
	Dragline, bucketwheel, large electric shovel	The 500 kV powerline, dyke, coal quality variability, lack of operational flexibility and long lead time to establish such equipment limit their application for the Anvil Hill Project. See also Mine Plan –Layout of Pits.
Coal Transport	Delivery by Conveyor	Delivery to Macquarie Generation by conveyor was considered. The method would be cost prohibitive and involve additional landholdings being disturbed. Delivery to other electricity generators or Port of Newcastle could not be achieved using this method.
	Delivery by Road	Given the long campaign to eliminate road haulage of coal in the Hunter Valley, this option was not seen to be sustainable.
Mine Plan	Extent of Mining: Anvil Hill	From an economic/mine planning perspective Anvil Hill could be mined. However, consideration of environmental issues outweighed the technical/economic advantages. Consequently, Anvil Hill is not proposed to be mined.
	Extent of Mining: Big Flat Creek	From an economic/mine planning perspective, coal from an area under Big Flat Creek was originally planned to be mined. On further consideration of environmental constraints, these outweighed technical/economic advantages. Consequently, Big Flat Creek is not proposed to be mined or diverted.
	Layout of pits	The layout of the pits is dictated by the 500 kV powerline, dyke, coal quality variability and preference to restrict the extent of any one area of out of pit overburden emplacement. The operation of the four pits concurrently for the majority of the mine life has been proposed to allow for management of coal quality variations. As with many coal deposits, some areas have intrinsically higher ash and therefore lower energy. Two other factors influence coal quality for the Project Area: – The presence of the dyke. The material forming the dyke was injected in a molten state after deposition of the coal, resulting in some adjacent coal being heat affected; – The shallowness of the deposit, particularly to the north, has allowed weathering to cause quality variations not only along the edges of the coal seams, but also on sections of the upper seam. The operation of the Tailings Pit as a separate mining area over the life of the mine allows for this area to be managed for efficient and safe tailings disposal and limits the requirement for further surface disturbance for tailings dams.
	Rate of Production	Various production rates have been considered. While lower production rates could be achieved with less equipment on site or more restricted operating hours, there is significant capital expenditure required even to achieve a reduced rate of production. The return on those funds is greatly diminished by restricting the rate of production, thus reducing the Project's ability to provide a long term stable operation for all its stakeholders. Further scaling up the operation has been investigated but is limited particularly by the balance with environmental impacts.

Issue	Alternative	Comment
	Operating Hours	As noted in **Section 2.9**, there will be some restriction of overburden dumping activities at night. Consideration was given to further restricting or stopping operations at night under adverse meteorological conditions. Potential noise impacts are greatest under strong temperature inversions. However, investigation of the occurrence of temperature inversions showed a very high frequency of such strong temperature inversions (refer to **Section 5.6**). Inversion strengths of 4° per 100 metres occur during 43% of summer nights and up to 85% of winter nights. Not operating for this amount of time would not be financially viable for the proposal.
	Final Void	An alternative of full void infill and reliance on evapotranspiration by trees and grass was considered. However, the current proposal is considered superior in the prevention of saline discharges (refer to **Section 5.3**) and cost of implementation.
Rail Loop	Various conceptual designs	Various conceptual designs for the rail loop were considered, including a siding parallel to the existing Muswellbrook-Ulan line. The current design is considered the most suitable in that it allows for the coal loading point to be close to the infrastructure area rather than residences outside the Proposed Disturbance Area. The rail loop alignment has been recently modified to minimise surface drainage (**Section 5.2**) and cultural heritage (**Section 5.8**) impacts. This is shown on **Figure 2.8**.
Washery	No washery	While the Anvil Hill coal resource was considered suitable for supply as unwashed product to domestic electricity generators, utilising a washery provides the opportunity to maximise the return on mining the resource with flexibility to produce coal suitable for export as well as local electricity generator use. This also provides for improved product coal quality control. This improves the Project's ability to achieve a long term stable operation for all its stakeholders. The "no washery" option would provide lower water requirements and some reduction to noise generation and power use.
	Reject and Tailings	Various co-disposal options have been investigated. These options require the use of additional chemicals and are not as well proven and reliable as the method proposed. The characteristics of the coal at this site are not well suited to co-disposal. Similarly, mechanical dewatering is not considered cost efficient or operationally effective.
Roads	Access Road	Various road transport corridors have been considered, including Mangoola Road and access off Wybong Road using Kyuga Road. The current proposal is seen to be the optimum solution, provided that the Bengalla Link Road is completed through to Wybong Road.

2.10.1 Need for the Project

The Project is focussed on timely recovery of state significant resource by a reputable and responsible Australian listed Company. The need for the Project is represented in the potential lost/missed opportunities of not proceeding with the Project.

The alternative of not proceeding with the Project would result in the loss of the environmental, economic and social benefits discussed in **Sections 5.0** and **7.0** of this EA. Some of the specific consequences are outlined below.



Source: GHD (2006)
Base Map: Department of Lands (2003), ortho-rectified by Plateau Images

0 0.5 1.0 1.5km

Legend

- Proposed Disturbance Area
- Project Area
- Proposed Mining Area
- Rail Loop Option A
- Rail Loop Option B

FIGURE 2.8

Alternative Rail Loop Alignments Considered

- The following economic benefits would be foregone:
  - Construction of the Project is anticipated to contribute between $19M and $21M in annual direct and indirect regional output or business turnover; between $9M and $10M in annual direct and indirect regional value added; between $5M and $6M in annual direct and indirect household income; and indirect and direct employment of approximately 121 to 143 people as an annual average during the construction period (refer to **Section 5.11.2**).
  - In the operational phase, it is estimated that the operation will contribute to the regional economy, between $212M and $224M in annual direct and indirect regional output or business turnover; between $115M and $121M in annual direct and indirect regional value added; between $25M and $28M in annual household income; and indirect and direct employment of between 343 and 449 direct and indirect jobs, as an annual average (refer to **Section 5.11.2**).
- The opportunity to secure long term protection of significant flora and fauna within the Proposed Offset Areas (refer to **Section 5.1**) through a rationalisation of land ownership and use of appropriate protection mechanisms would be lost.
- Development contributions towards improved and additional local community facilities would not be provided.
- Community uncertainty with regard to the future of the site and potential effects on surrounding land use and future development would remain.
- A major coal resource would remain undeveloped and Centennial would not have the benefit of a major open cut coal mine with long term reserves on which to continue to build its business in the NSW coal industry.

Further details regarding justification for the Project are provided in **Section 7.0**.

Statutory Provisions

Section 3.0

3.0 Statutory Provisions

The DGRs for the EA are provided in **Appendix 2** and require the "consideration of any relevant statutory provisions". The following identifies the relevant applicable State and Commonwealth legislation, including the relevant planning approval process, applicable to the Project.

3.1 New South Wales Legislation

3.1.1 Environmental Planning and Assessment Act 1979

Major Project

In accordance with the State Environmental Planning Policy (SEPP) (Major Projects) 2005, the Minister for Planning has formed the opinion that the Project, as a development for the purposes of coal mining in accordance with clause 5(1)(a) of Schedule 1 to the Major Projects SEPP, is a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) applies. Consequently, the Minister for Planning will determine the Project Application. In addition, the following provisions of the EP&A Act are relevant to the approvals process for this Major Project.

Application of Environmental Planning Instruments

The Project is located wholly within the area to which the Muswellbrook Local Environmental Plan 1985 (Muswellbrook LEP) and Hunter Regional Environmental Plan 1989 (Hunter REP) apply.

However, section 75R of the EP&A Act provides that environmental planning instruments, other than SEPPs, do not apply to Major Projects under Part 3A of the Act, other than as detailed below.

Permissibility

Muswellbrook LEP is relevant to the permissibility of the Project. Section 75J(3)(b) of the EP&A Act provides that the Minister cannot approve the carrying out of a project that would be wholly prohibited under an environmental planning instrument.

The land proposed to be affected by mining and associated infrastructure is located primarily within zone 1(a) (Rural "A" Zone), with a smaller portion of 7(d) (Environment Protection (Scenic) Zone). In addition, part of the rail loop forming part of the Project will be located on land zoned 7(L1) Environment Protection General (Alluvial Areas) and 5(b) Special Uses "B" (Railways).

Those parts of the Project located in zones 1(a), 5(b) and 7(L1) are development which is permissible with consent in those zones. Open cut mining is prohibited in zone 7(d). However, the Project is not wholly prohibited by Muswellbrook LEP and it is available to the Minister to grant project approval under section 75J of the EP&A Act.

Approvals legislation which does not apply

Under s75U of the EP&A Act if the Project is granted project approval under Part 3A of the EP&A Act, the following approvals, which may otherwise have been relevant, will not be required to carry out the Project.

Table 3.1 - Approvals Legislation which does not apply

Act	Approval
Fisheries Management Act, 1994	Permit for works or structures within a waterway.
Heritage Act 1977	Disturbance to an item listed on State Heritage Register or Interim Heritage Order; Excavation permit
National Parks & Wildlife Act 1974	Preliminary research permit; consent to destroy relics
Water Management Act 2000	Water use approval, water management work approval or activity approval

Approvals legislation to be applied consistently

If the Project is granted project approval under Part 3A of the EP&A Act, the following approvals, which will be required for the Project, must not be refused by the relevant approval authority and must be substantially consistent with the terms of the Project approval.

Table 3.2 - Approvals Legislation to be applied

Act	Approval	Authority
Mine Subsidence Compensation Act 1961	Development within Mine Subsidence District	Mine Subsidence Board (MSB)
Mining Act 1992	Mining Lease	Department of Primary Industries (Mineral Resources) (DPI)
Protection of the Environment Operations Act 1999	Environmental Protection Licence	Department of Environment and Conservation (DEC)
Roads Act 1993	Permit to impact on a public road	Local roads – Muswellbrook Shire Council

3.1.2 State Environmental Planning Policies (SEPPS)

In addition to the Major Projects SEPP, the following SEPPs are relevant considerations for the Project.

SEPP 44 - Koala Habitat Protection is applicable in the Muswellbrook LGA. An extensive ecological assessment has been conducted and found no core koala habitat within the Proposed Disturbance Area. Consequently, the requirement for preparation of a koala plan of management does not apply to the Project.

SEPP No. 11 – Traffic Generating Development requires that the Roads and Traffic Authority (RTA) is made aware of, and given the opportunity to make representations in respect of, developments listed in Schedule 1 of that SEPP. Mining activities are listed in Schedule 1 and therefore this SEPP is applicable to the Project. The RTA has been consulted in regard to this proposal and an assessment of the impact of the Project on roads and traffic is included in **Section 5.10**.

SEPP No. 33 – Hazardous and Offensive Development requires the consent authority to consider whether an industrial proposal is a potentially hazardous industry or a potentially offensive industry. A hazard assessment has been conducted for the Project (refer to **Appendix 5**) and has determined that the Project is not potentially hazardous or potentially offensive. Therefore SEPP 33 is not applicable.

3.1.3 Coal Mines Regulation Act 1982

An approval for Reject Emplacement Areas will be required under s126 of the *Coal Mines Regulation Act 1982*. An application will be made to DPI prior to establishment of these areas.

3.1.4 Dams Safety Act 1978

An approval under the *Dams Safety Act 1978* may be required for the dams constructed as part of the water management system. Consultation will occur with the Dams Safety Committee as the engineering designs progress.

3.1.5 Water Act 1912

The *Water Act 1912* applies to groundwater in the fractured rock aquifers and basement rocks within the Project area. The Project will require bore licences under Part 5 of the *Water Act 1912* for each of the open cut pits and other bores, such as water monitoring bores.

3.1.6 Water Management Act 2000

The Project is partly located within the area covered by the Water Sharing Plan for the Wybong Creek Water Source 2003. The Project also involves the extraction of water from the Hunter Regulated River Water Source which is subject to the Water Sharing Plan for the Hunter Regulated River Water Source 2003.

The licensing provisions of the *Water Management Act 2000* (Water Management Act) therefore apply to the Project to the extent that the Project involves the extraction of water from the Wybong Creek water source or the Hunter Regulated River Water Source.

The Project will not require approval under sections 89, 90 or 91 of the Water Management Act due to the operation of section 75U of the EP&A Act, as described in **Section 3.1.1**.

To the extent that the Project requires the extraction of water from a water source that is not covered by exemptions from the requirement to hold a water access licence under the Water Management Act and *Water Management Regulations 2004*, an allocation under a water access licence will be required.

The Minister for Natural Resources has declared an embargo on the grant of further units of water access licence share component in the Wybong Creek water source and Hunter Regulated River Water Source. To the extent an allocation of water or increased water access licence share component is required for the Project, it will be obtained from an existing holder.

3.2 Commonwealth Legislation

3.2.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and Heritage (DEH).

Under the EPBC Act, approval of the Commonwealth Minister for the Environment and Heritage is required for any action that may have a significant impact on matters of national environmental significance. The relevant provision of this legislation relates to potential impacts on migratory species, threatened species, or ecological communities listed in the EPBC Act.

No threatened ecological communities listed in the EPBC Act have been recorded, or are expected to occur in the Project Area. A number of migratory or threatened species listed under the EPBC Act have been recorded within the Project Area. The majority of these species will not be significantly impacted by the Project. The Project is likely to or may have a significant impact on two listed flora species, as discussed further in **Section 5.4**. The Project will be referred to the DEH to determine whether the Project is a controlled action under the EPBC Act.

Consultation and Identification of Environmental and Community Issues

Section 4.0

4.0 Consultation and Identification of Environmental and Community Issues

4.1 Consultation

4.1.1 Agency Consultation

There has been extensive consultation with government authorities throughout the assessment process including:

- initial briefings regarding Project details and the proposed environmental assessment approach;
- a Planning Focus Meeting with all key agencies which included an inspection of the Project Area;
- various meetings with relevant agencies to discuss assessment outcomes and specific issues relevant to the agency.

Following the Planning Focus Meeting, DoP requested all relevant government agencies to provide feedback for DoP's consideration in preparation of the DGRs. DoP provided a copy of this agency correspondence with the DGRs for the EA and this is included in **Appendix 2**.

A summary of the agency consultation during the EA preparation is provided in **Table 4.1** below.

Table 4.1 - Summary of Agency Consultation

Agency	Date	Purpose
Department of Planning (DoP)	7 April 2004	Initial Project briefing
	20 January 2005	General Project update
	17 March 2005	Planning Focus Meeting and site inspection
	2 November 2005	Preliminary ecological survey outcomes and proposed ecological condition assessment methodology
	2 May 2006	General Project update
	10 May 2006	Proposed ecological offset strategy
Department of Natural Resources (DNR)	21 January 2005	Proposed water management approach
	17 March 2005	Planning Focus Meeting and site inspection
	12 January 2006	Proposed approach for groundwater assessment and final voids
	19 May 2006	Surface water management
Department of Environment and Conservation (DEC)	19 November 2004	Overview of the Project, proposed Aboriginal archaeological survey strategy and schedule, proposed Aboriginal consultation program, and general approach to offset strategies.
	9-10 May 2005	Overview of ecology survey effort, preliminary discussion of results and site inspection.
	2 November 2005	Preliminary ecological survey outcomes and proposed ecological condition assessment methodology

Table 4.1 - Summary of Agency Consultation (cont)

Agency	Date	Purpose
	17 March 2005	Planning Focus Meeting and site inspection
	10 May 2006	Proposed ecological offset strategy
	11 May 2006	Outcomes of cultural heritage assessment
Department of Primary Industries (DPI)	9 November 2004	Presentation of the Conceptual Project Development Plan (CPDP) to technical representatives
	17 March 2005	Planning Focus Meeting and site inspection
	24 January 2006	General Project update
	10 May 2006	Proposed ecological offset strategy
Muswellbrook Shire Council (MSC)	25 November 2004	Initial Project briefing
	7 February 2005	Presentation to Councillors and Environment Committee on the proposed strategy for the environmental assessment
	17 March 2005	Planning Focus Meeting and site inspection
	2 April 2005	Presentation at the MSC Strategy Workshop regarding the general Project status
	14 January 2006	Proposed methodology for Historic Heritage assessment and discussion regarding heritage items within the locality.
	11 May 2006	General Project update and discussion regarding road usage and traffic impacts
Department of Lands	17 March 2005	Planning Focus Meeting and site inspection
	2 November 2005	Road closures
Australian Rail Track Corporation (ARTC)	8 December 2004	Project briefing
	17 March 2005	Planning Focus Meeting
Department of Environment and Heritage (DEH)	3 February 2006	Project overview, status of ecological assessment and EPBC Act Assessment

Note: Organisations that were sent the Planning Focus Document but did not attend the Planning Focus Meeting, included the Roads and Traffic Authority (RTA), NSW Heritage Office, Hunter - Central Rivers Catchment Management Authority (HCRCMA), Mine Subsidence Board (MSB).

In addition to the specific meetings shown in **Table 4.1**, there was extensive correspondence, telephone calls and discussions with numerous agencies throughout the assessment process.

4.1.2 Community Consultation

While a range of consultative processes have been utilised with regard to the Project since 1999, a more intensive program was undertaken during preparation of the EA. Coakes Consulting Pty Limited (Coakes) undertook the initial issues scoping consultation, participated in ongoing consultation and completed the Socio-Economic Assessment for the Project (refer to **Appendix 3**). Stakeholder involvement and understanding of community issues was an integral part of the Socio-Economic Assessment.

A range of consultative and assessment mechanisms were used to engage the community in relation to the Project. These are outlined below.

- Individual landholder meetings. This included over 100 interviews with residents and landholders in close proximity to the Project to identify issues and obtain baseline information early in the EA preparation process. Further consultation with landholders is being progressed to provide feedback on technical studies and to discuss proposed management measures.

- Community Presentations. These were provided to special interest groups with a particular interest in the Project at regional and local levels, including environmental groups, professional and trade associations, community organisations, and other industry groups. The majority of presentations were undertaken in April 2005 and were designed to provide information and obtain feedback about relevant issues for the EA. Further consultation will be conducted with interested community groups to provide feedback on technical studies and to discuss proposed management measures.

- Service Provision Review. This involved interviewing local service providers to assess the likely impact of the Project on service delivery within the region and identify areas of community need. This included education, health, accommodation and community service organisations.

- Broader Community Survey. A telephone survey of 400 randomly selected households in the Muswellbrook Shire was undertaken in April 2005 to gauge the views of the wider community on the Project. Further information on the outcomes of this survey is provided in **Section 5.11**.

- Open days. Information days were held in June 2006 at Wybong Hall and the Centennial Muswellbrook office, to provide feedback on the results of the environmental assessment and provide further opportunity for the local community to ask questions and discuss the Project, including proposed community and environment management. Over 100 community members attended on these two days.

- Community Information Sheets (CIS). There have been three CISs circulated during preparation of the EA and a copy of these is provided in **Appendix 4**. These were widely circulated to stakeholders in January 2005 to provide an overview of the Project and approvals process, and in July 2005 to provide feedback on the consultation process and a summary of the issues raised. A third CIS was circulated in June 2006 to provide feedback on the results of the environmental assessment.

- Anvil Hill Project newsletters. Prior to commencement of the EA process, Centennial regularly circulated a newsletter to relevant landholders and other stakeholders. This newsletter provides an update on status of exploration, mine planning, environmental investigations conducted in the Project Area, and the general status of EA preparation. More recently, this newsletter has also included feedback on issues discussed by the Community Consultative Committee. Eight newsletters have been circulated to stakeholders since July 2003.

- Community Consultative Committee (CCC). The CCC was established by the Minister for Mineral Resources early in the exploration phase of the Project. Presentations on the approvals process and the outcomes of the technical studies have been provided by Centennial and its consultants and feedback relating to the Project has been received from the Committee and members of the gallery. At times, there have been in the order of 50 people in the gallery during the CCC meetings and associated presentations. Centennial and its consultants responded to questions and comments from these attendees during the meetings and also were available to discuss issues following the meetings.

- Aboriginal Group Consultation. Eighteen Aboriginal groups (including the Local Aboriginal Land Council) were consulted during the Aboriginal Heritage Assessment. This included meetings, workshops, and field surveys. Further details of this consultation program are included in **Section 5.8.1**.

- General Consultation. A project office was established by Centennial in Muswellbrook in January 2003. This provided a point of contact within the LGA for stakeholders. General consultation co-ordinated from this office includes numerous letters, telephone conversations, and personal discussions with many community stakeholders throughout

the assessment process. In particular, letters were sent to all landowners within Assessment Lease 9 (AL9) in April 2005, regarding Centennial's Stakeholder Liaison Program and Property Acquisition Strategy. A letter was also sent in January 2006 to all landowners within the Project Area, informing them that a Project Application has been lodged with DoP.

- Other forums. These include Project information booths at the Muswellbrook Show on 31 March -1 April 2006, and the Upper Hunter Wine and Food Affair at Denman on 6 May 2006.

Interviews with landholders (refer to **Figure 4.1** for extent of consultation) focused on providing the context of the Project proposal and on identifying the landholders' issues relating to the Project. Details of the issues raised are included in the Socio-Economic Assessment contained in **Appendix 3**.

The issues perceived to be important to the wider community were identified through the presentations to community groups and telephone survey. The results of this survey are presented in **Appendix 3**.

The key issues identified throughout the consultation process are summarised in **Section 4.2**.

4.2 Identification of Key Environmental and Community Issues

Identification of key environmental and community issues for the EA for the Project is based on consideration of:

- The planning and environmental context for the locality (refer to **Sections 1.0** and **3.0**);
- An environmental risk analysis (refer to **Appendix 5**);
- Outcomes of the extensive community and authority consultation process (refer to **Section 4.1**); and
- Base-line studies completed as part of preparation of the EA.

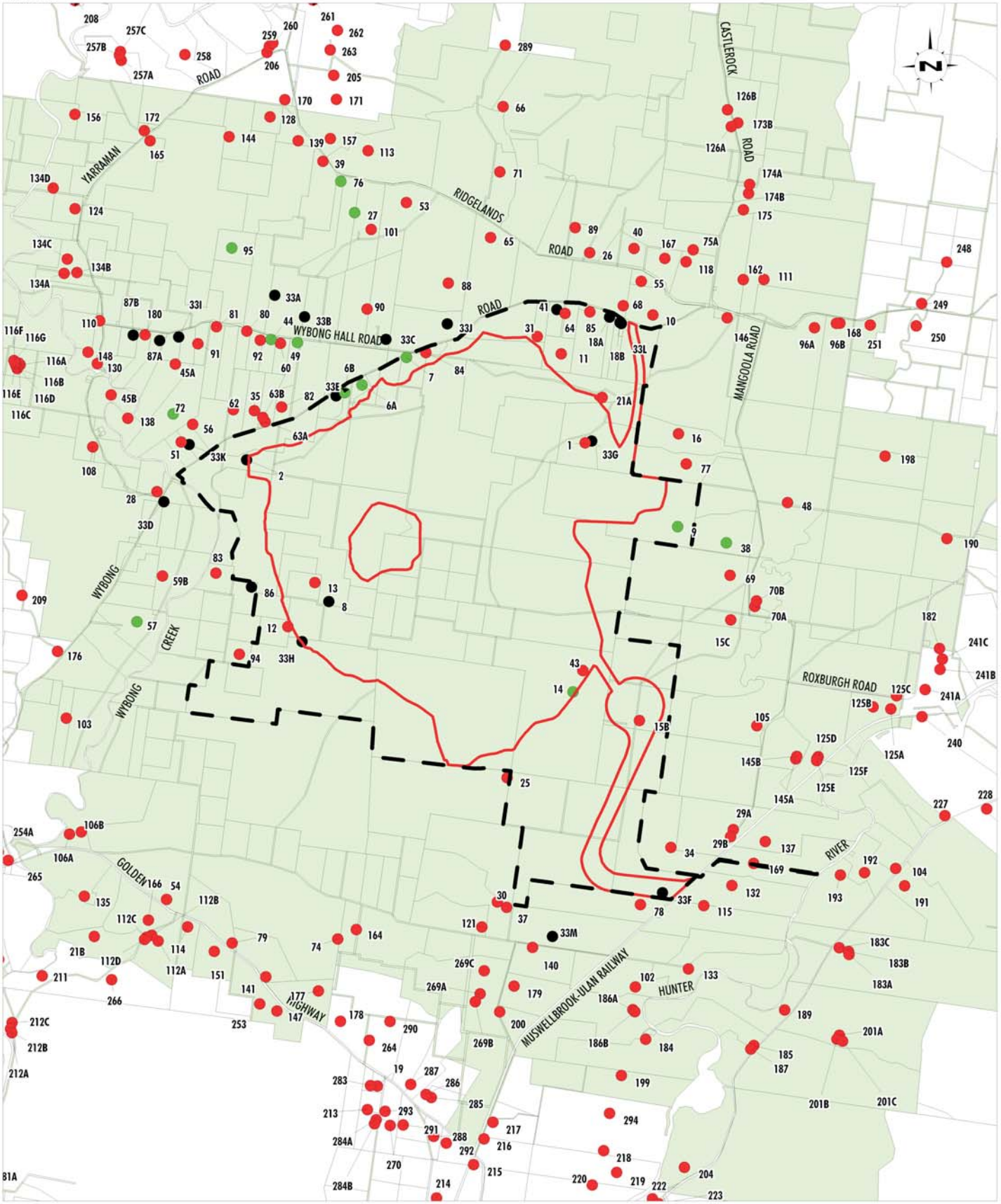
Table 4.2 provides a summary of the key issues identified through these processes and provides reference to the section of the EA in which these issues have been addressed.

Table 4.2 – Key Environmental and Community Issues

Issue	EA Reference
Groundwater	Section 5.3
Surface Water	Section 5.2
Ecology	Section 5.4
Aboriginal Heritage	Section 5.8.1
European Heritage (non-Aboriginal)	Section 5.8.2
Air Quality	Section 5.5
Noise Generation	Section 5.6
Blast Vibration	Section 5.7
Greenhouse Gas Emissions	Section 5.5.8

Table 4.2 – Key Environmental and Community Issues (cont)

Issue	EA Reference
Visual Amenity	Section 5.9
Transport, mine access and impacts on local roads	Section 5.10
Rehabilitation and impacts on land resources	Section 5.1
Socio-economic Impacts	Section 5.11



Source: Dept. of Lands (2003)

0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- Landholders Invited for Interview
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences

FIGURE 4.1

Geographic Extent Of Landholders Invited For Interview

Environmental and Social Assessment

Section 5.0

5.0 Environmental and Social Assessment

5.1 Land Resources, Rehabilitation and Decommissioning

The DGRs for the Project require a discussion of rehabilitation, final landform and final void management that includes:

- a justification of the proposed final land use for the site in relation to the strategic land use objectives for the Wybong area;
- a detailed description of how the site will be progressively rehabilitated and integrated into the surrounding landscape; and
- the measures which will be put in place for the long term management of the site (including biodiversity offset areas) following cessation of mining operations.

In order to address these requirements, this section provides an overview of existing land resources, existing land use, rehabilitation strategy for the Proposed Disturbance Area, proposed offset strategy, and mine closure considerations.

5.1.1 Existing Land Resources

5.1.1.1 Topography

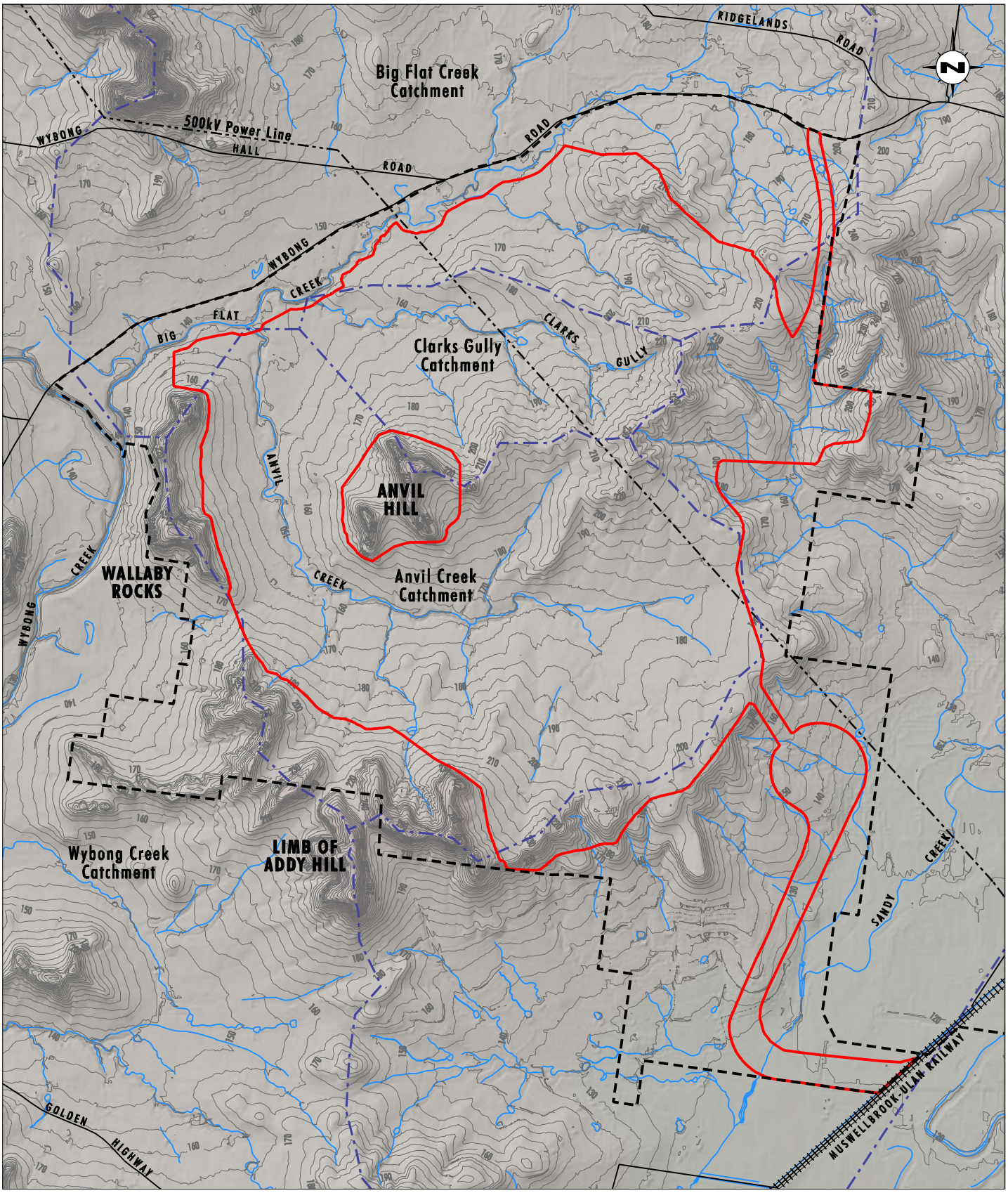
The topography of the Project Area (refer to **Figure 5.1**) varies from lower slopes towards the Hunter River, through undulating and hilly lands to rocky outcrops. The lower areas of the Proposed Disturbance Area are currently used for pastoral grazing and a 500 kV TransGrid powerline crosses the site in a south-east/north-west direction. A notable topographical feature within the Project Area is Anvil Hill itself which rises to a height of approximately 285 mAHD, which is 70 metres above the surrounding area. It is located at the centre of the proposed mining area and consists of two hills connected by a saddle. Anvil Hill is not within the Proposed Disturbance Area and is not proposed to be mined.

The topography of the area surrounding the Proposed Disturbance Area is dominated by a row of hills to the west and south. The hills to the west are not named, although they are known locally as “Wallaby Rocks”. Wallaby Rocks rise to a height of 264 mAHD, being approximately 100 metres above the surrounding area, and contain a visually dominant escarpment along the western side. The rocky area to the south known as Limb of Addy Hill rises to a height of 302 mAHD, which is also approximately 100 metres above the surrounding area.

5.1.1.2 Soils

A detailed soil survey was undertaken by GSS Environmental to determine the characteristics and extent of soil types within the Proposed Disturbance Area and the required soil management measures. The detailed soil assessment is included in **Appendix 6**.

The assessment of the soil types within the Proposed Disturbance Area involved a total of sixteen (16) soil profiles at sites chosen to represent the major soil types occurring within this area. Soil layers at each of the test pit sites were assessed based on grading, texture, structure, consistence, mottling and root presence (Elliot & Veness 1981). Soil samples were collected and sent for laboratory analysis to determine the geochemical suitability of the surface and near-surface soil horizons for use in top dressing and rehabilitation works.



Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

Legend

- Proposed Disturbance Area
- Project Area
- Catchment Boundary

FIGURE 5.1

Existing Topography

A total of seven (7) soil units were identified within the Proposed Disturbance Area as a result of the detailed soil assessment. **Table 5.1** outlines these major soil units in relation to the broad soil landscapes as described by Kovac and Lawrie (1991), and the distribution of the soil units within the Proposed Disturbance Area is shown in **Figure 5.2**.

Table 5.1 - Soil Landscapes and Soils Units within the Proposed Disturbance Area

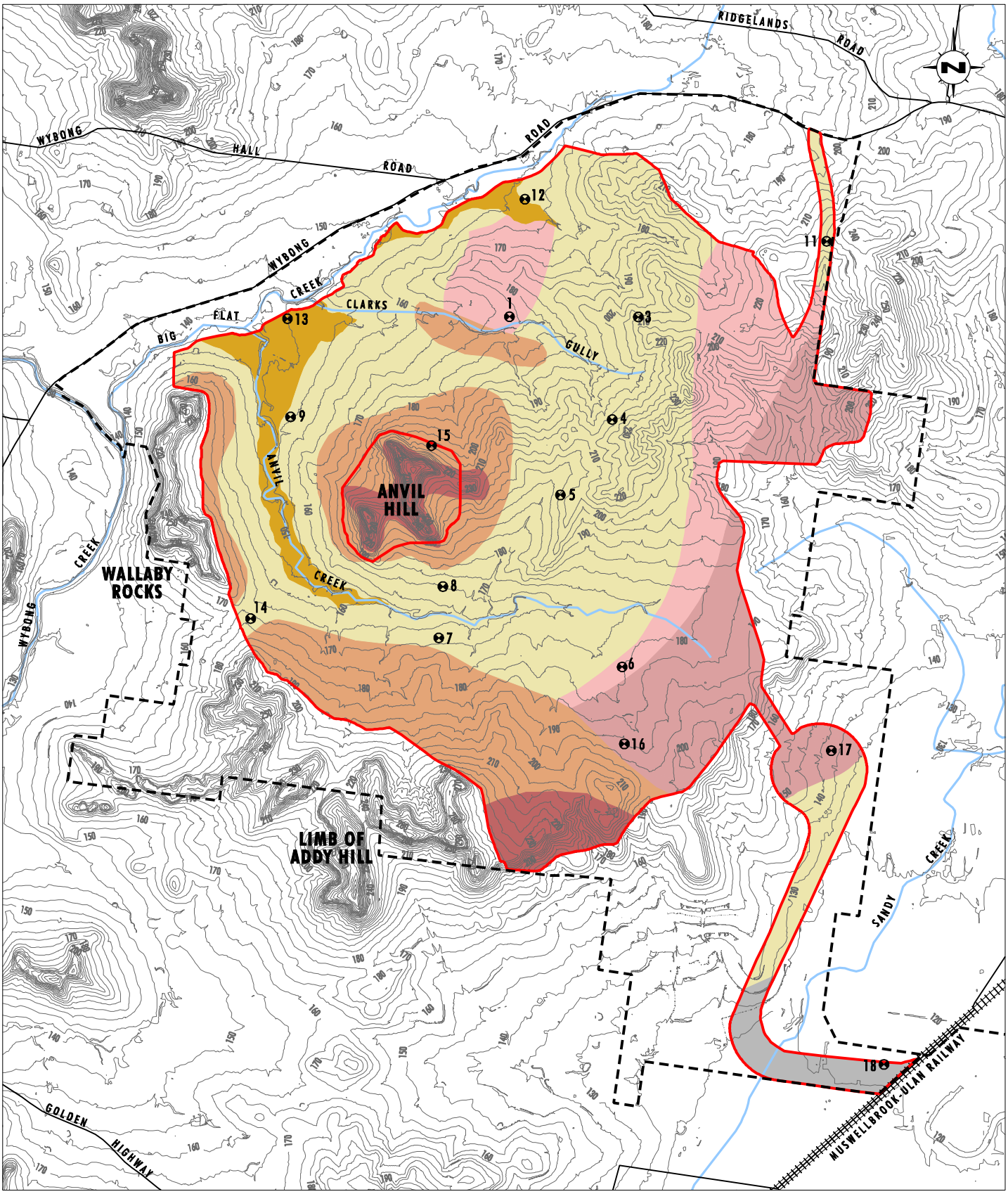
Soil Landscape	Location within Proposed Disturbance Area	Associated Soil Units
Sandy Hollow	Dominant soil landscape associated with drainage lines and gentle slopes throughout the Proposed Disturbance Area, except for the north-eastern corner and far south-eastern margins.	Yellow Solodics Brown Solodics Deep Sands Alluvial Soils
Castle Rock	Minor soil landscape associated with undulating low hills in north-eastern corner of Proposed Disturbance Area.	Yellow Solodics Brown Clay Alluvial Soils
Dartbrook	Minor soil landscape associated with the undulating slopes and low hills in the far eastern margin of the Proposed Disturbance Area.	Brown Clays
Lees Pinch	Minor soil landscape associated with steep outcropping sandstone hills in centre of Proposed Disturbance Area (Anvil Hill), along with far southern and western margins.	Shallow Sands (Siliceous)
Hunter	Minor soil landscape associated with flat alluvial plains of the Hunter River in the far south-eastern margins of the Proposed Disturbance Area.	Black Alluvial Clay

Source: GSS Environmental (2006) (refer to **Appendix 6**)

The Yellow Solodics, associated with the Sandy Hollow and Castle Rock soil landscapes, are the dominant soil unit and cover the majority of the Proposed Disturbance Area. Other soil units within the Proposed Disturbance Area are associated with major drainage lines, rocky outcrops and the alluvial plain of the Hunter River. Broad areas of intergrading occur between the dominant yellow solodic and other soil units including the alluvial soils associated with major drainage lines and Brown Clays within the eastern extent of the Proposed Disturbance Area.

5.1.1.3 Land Capability

Rural land capability classes for NSW have been developed by the former NSW Soil Conservation Service (now DNR). This classification divides land capability into eight classes based on the biophysical characteristics of the land and the extent to which these will limit a particular land use. The relevant capability classes for the Project are provided in **Table 5.2**.



Source: GSS Environmental (2006)
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

Legend

- Proposed Disturbance Area
- Project Area
- Soil Profile Site

Soil Units:

- Alluvial/Brown Solodic
- Black Alluvial Clay
- Brown Clay
- Deep Sand
- Shallow Sand
- Yellow Solodic
- Yellow Solodic/Brown Clay Intergrade

FIGURE 5.2

Soil Units within Proposed Disturbance Area

Table 5.2 – Relevant Land Capability Classes

Land Capability Class	Description
II	Usually gently sloping land suitable for a wide variety of agricultural uses. Has a high potential for production of crops on fertile soils similar to Class I, but increasing limitations to production due to site conditions. Includes "prime agricultural land".
VI	Productivity will vary due to the soil depth and the soil fertility. Comprises the less productive grazing lands.
VII	Generally comprises areas of steep slopes, shallow soils and/or rock outcrop. Adequate ground protection must be maintained by limiting grazing and minimising damage by fire. Destruction of trees is not generally recommended, but partial clearing for grazing purposes under strict management controls can be practised on small areas of low erosion hazard. Where clearing of these lands has occurred in the past, unstable soil and terrain sites should be returned to timber cover.
VIII	Land unusable for agricultural or pastoral uses. Recommended uses are those compatible with the preservation of the natural vegetation, namely: water supply catchments, wildlife refuges, national and state parks, and scenic areas.

The distribution of the land capability classes within the existing landscape is shown in **Figure 5.3**. The majority of the land within the Proposed Disturbance Area is Class VI land, which is generally suitable for grazing with intensive management measures. The existing landscape is not suitable for cultivation owing to a combination of limitations of slope, subsoil instability and potential for dispersion and gully erosion. The small area of Class VIII land within the Proposed Disturbance Area is associated with the rocky outcrops around Anvil Hill.

The Black Alluvial Clays and selected areas of the Brown Clays, in the south-east of the Proposed Disturbance Area within the area of the proposed rail loop, are classified as Class II land.

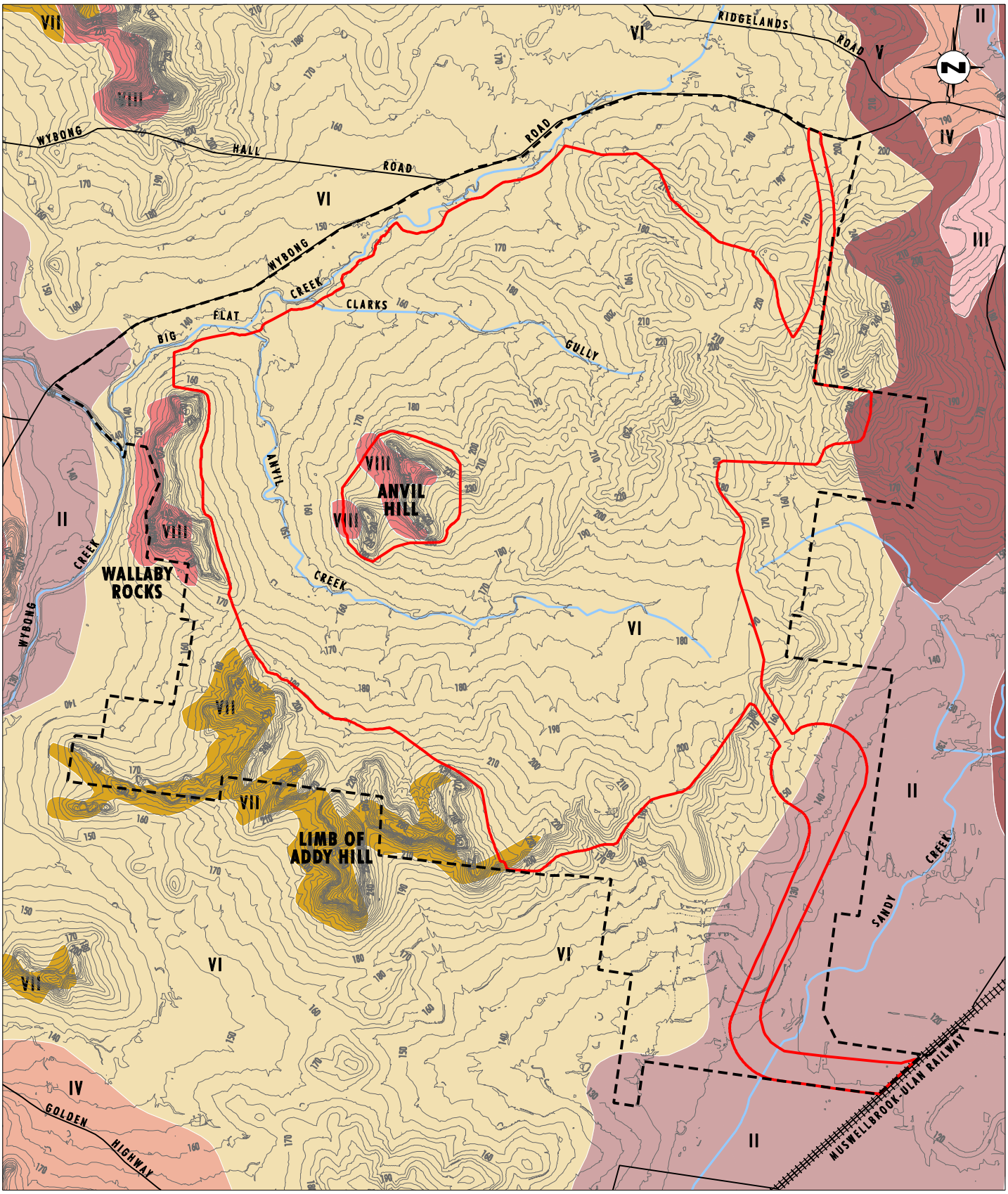
5.1.2 Existing Land Use

As shown in **Figure 5.4**, the majority of the Project Area is currently being used for low intensity grazing. This land use is primarily associated with low to moderate slope areas. Interspersed with the dominant grazing land use are areas of rural residential land use and areas of bushland associated with Anvil Hill. As discussed in **Section 1.2.2**, the majority of land within the Project Area is either owned by Centennial or Centennial has a contractual right to purchase.

Land use in the general area surrounding the Project is diverse and typical of the land use exhibited throughout much of the upper Hunter Valley and includes residential, tourism, agricultural and mining activities. Much of the higher and steeper land in the region has not been cleared and is used either for low intensity grazing or for conservation purposes.

Further afield, there are conservation reserves: the Wollemi National Park and the Manobalai Nature Reserve, 13 kilometres south-west and 7 kilometres north-west of the Project Area, respectively (refer to **Section 5.4**).

The predominant land uses within the vicinity of the Project include grazing, intensive agriculture, vineyards, olive plantations, rural residential, commercial land uses and quarrying. Other surrounding land uses include bushland, community uses and Commonwealth government land use. Further details of the surrounding land use are included below.



Source: GSS Environmental (2006)
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

0 0.5 1.0 2km

Legend

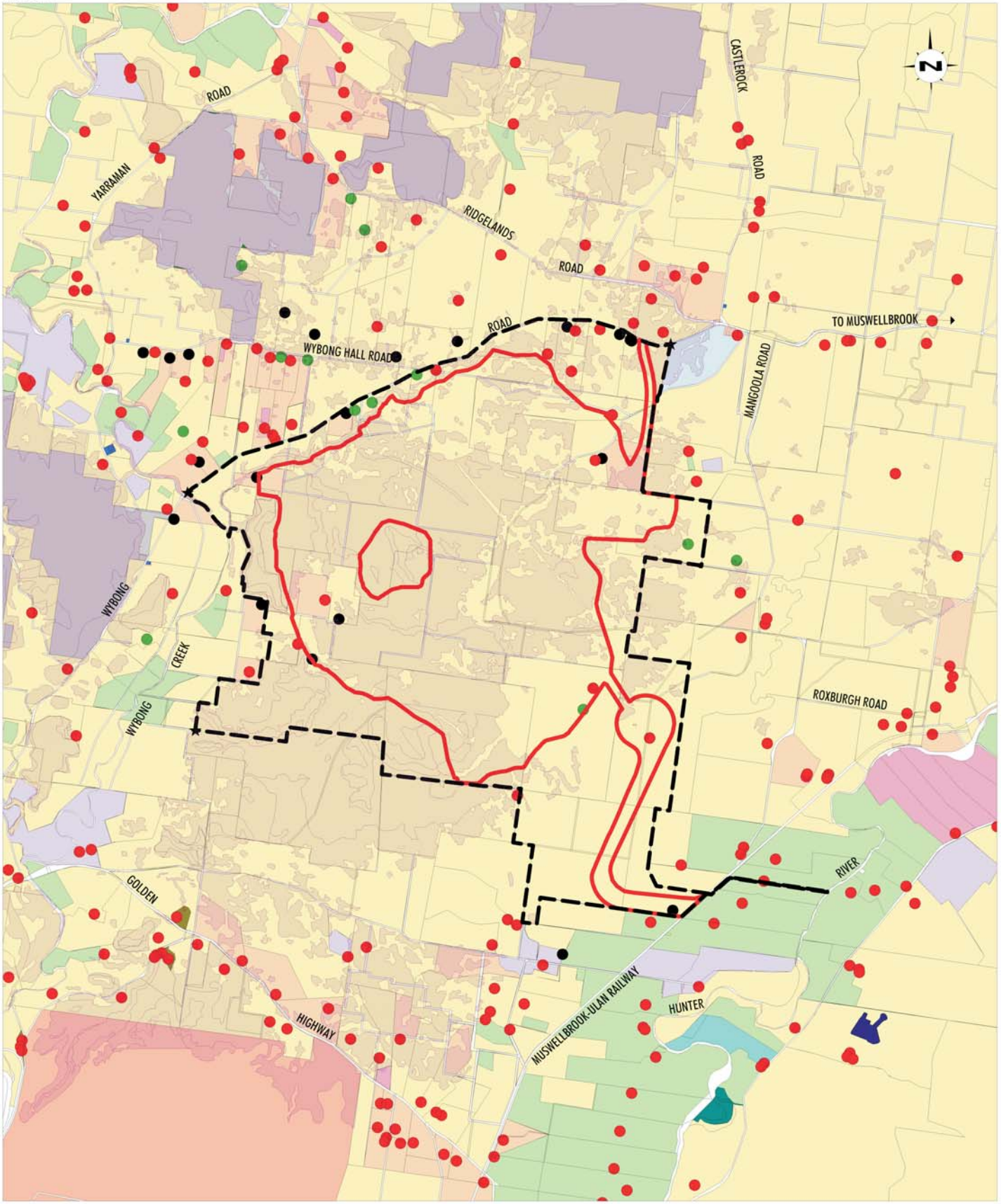
- Proposed Disturbance Area
- Project Area

Capability Classification:

- II Class 2
- III Class 3
- IV Class 4
- V Class 5
- VI Class 6
- VII Class 7
- VIII Class 8

FIGURE 5.3

Existing Land Capability



Base Map : Dept. Of Lands (2003)

0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- Existing Woodland
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences

- Aquaculture
- Commercial
- Community Use
- Crown
- Grazing
- Horse Stud
- Intensive Agriculture
- Myambat Military Installation
- Olive Plantation
- Quarry
- Rural Residential
- Travelling Stock Reserve
- Vineyard

FIGURE 5.4

Land Use

5.1.2.1 Grazing

Grazing is the most widespread land use within and surrounding the Project Area. Grazing land mapped on **Figure 5.4** includes properties utilised for agricultural purposes, other than for intensive agricultural operations, vineyards or olive plantations. Grazing land surrounding the Project Area is primarily utilised for pastoral grazing on unimproved pastures on areas of low to medium slope. This land has been largely cleared of vegetation, apart from isolated woodland fragments, and is generally subject to low intensity grazing.

5.1.2.2 Intensive Agriculture

Intensive agricultural land uses include a range of more intensive rural land uses including pastoral grazing on improved pasture, irrigated agriculture including lucerne, and dairying operations. These land uses are associated with the floodplain areas of major surface waters within the surrounding area, particularly the Hunter River to the south-east and Wybong Creek to the west and north-west of the Project. There is no intensive agriculture within the Project Area.

5.1.2.3 Vineyards

Vineyards mapped on **Figure 5.4** include areas under cultivation for grapes and any ancillary facilities such as winery and cellar door. Vineyards vary in size and are associated with the floodplain areas of Hunter River to the south-east of the Project Area, and with Wybong Creek to the west and north-west of the Project Area.

5.1.2.4 Olive Plantation

Olive plantations range in size from large scale operations with associated tasting facilities through to smaller scale plantations located in a sporadic pattern within the surrounding area. These smaller operations are generally associated with grazing, intensive agriculture or rural residential land uses.

5.1.2.5 Rural Residential

Rural residential land uses refer to land that is used primarily for residential occupation. Rural residential land use has been mapped on **Figure 5.4**. In some cases grazing may form a secondary land use although at a low intensity. In many cases rural residential land surrounding the Project is vegetated with natural bushland. The majority of rural residential land is located adjacent to Wybong Post Office Road, to the north-west of the Project Area. The location of residences within the area surrounding the site is shown on **Figure 5.4**.

Horse Stud

There is a horse stud in operation in the surrounding area, within the alluvial area of the Hunter River. The horse stud operation is located along Denman Road and is approximately 3.5 kilometres south-east of the Project Area.

5.1.2.6 Other Commercial

Other commercial land uses include areas that are used for tourist development including a number of farm stay and tourist cabins. Three tourist operations are shown on **Figure 5.4** and are located along the Golden Highway and Rosemount Road, 4 to 7 kilometres to the south of the Project Area. Each operation offers small scale tourist accommodation in the form of a number of separate cottages and/or cabins (up to five).

5.1.2.7 Quarrying

An active quarrying operation is located within the Hunter River floodplain, approximately 6 kilometres south-east of the Project Area. The quarrying operation extracts sand and soil from the alluvial area associated with the Hunter River. The operation offers a range of quarry products including sand, aggregates, topsoil and gravel.

Aquaculture

A commercial aquaculture operation is located on Denman Road, approximately 6 kilometres south-east of the Project Area. The operation produces a number of fish species, including golden and silver perch.

5.1.2.8 Community Use

Community uses within the surrounding area include two churches, a cemetery and Wybong Hall. A Catholic Church is located on Wybong Road, 2 kilometres west of the Project Area boundary, and is utilised on occasion for events such as baptisms and weddings. An Anglican Church is located approximately 1.5 kilometres north-east of the Project Area on Castlerock Road, and is currently utilised twice a month. A cemetery is located on Yarramon Road, approximately 1.5 kilometres north-west of the Project Area.

Wybong Hall is located on Wybong Hall Road approximately 2.5 kilometres north-west of the Project Area boundary. The hall is used on a daily basis for child care, arts and craft classes, community activities such as meetings and dances, and is also used for weddings and functions.

5.1.2.9 Government Land Uses

The Commonwealth of Australia operates the Myambat military installation located approximately 7 kilometres south of the Project Area. The military installation is primarily used as a munitions depot, with other ancillary uses including a commercial transport company.

There are a number of areas of Crown land surrounding the Project Area. This land corresponds primarily to forested land, some of which forms part of regional conservation reserves to the north and west of the Project Area.

A Travelling Stock Reserve is located on the north-eastern boundary of the Project Area and is managed by the NSW Rural Lands Protection Board.

5.1.3 Rehabilitation Strategy

5.1.3.1 Principles and Objectives

The primary objective of mine rehabilitation will be to create a stable final landform with acceptable post-mining land use capability. Rehabilitation of the overburden emplacement areas and backfilled pits will be conducted progressively over the life of the mine, as an integral component of mining operations. All rehabilitation works will be scheduled to occur progressively as soon as practicable after mining disturbance. Rehabilitation of infrastructure areas will occur as soon as practical following decommissioning of infrastructure. This approach will minimise the disturbed area at any time and hence reduce the environmental impact of the Project.

In recognition of the importance of vegetation corridors to regional biodiversity, the rehabilitation strategy has been designed to link rehabilitation areas to the proposed offset areas and existing remnant vegetation. Local provenance species will be used during rehabilitation unless conditions demand otherwise. For the purposes of this EA, “local

provenance" is defined as species whose genetic pool comes from within the upper Hunter Valley, bounded approximately by Singleton, Murrurundi, Merriwa and Denman.

5.1.3.2 Post Mining Landform

The Project will impact on existing topography of the Proposed Disturbance Area both by excavation as part of mining and the establishment of out of pit overburden emplacement areas. There will also be minor impacts on topography due to the construction of site infrastructure including CPP area, rail load out and rail loop facilities.

The conceptual final landform (refer to **Figure 5.5**) has been designed to maintain consistency with the local area and will predominantly consist of an undulating landform reflecting the dominant features of the existing environment. The conceptual final landform will also complement Anvil Hill, the most prominent topographical feature within the Project Area, through the establishment of ridgelines leading to this feature. Based on the conceptual mine planning, the proposed final landform is expected to be a maximum of approximately 45 metres above the pre-mining land surface.

The final landform of overburden emplacement areas will predominantly consist of slopes of 10 degrees and will increase to up to a maximum of 14 degrees in places, consistent with DPI guidelines. The final landform will be designed and constructed as a self draining landscape, with appropriate surface drainage and sediment control structures to be installed to manage surface runoff from rehabilitated areas.

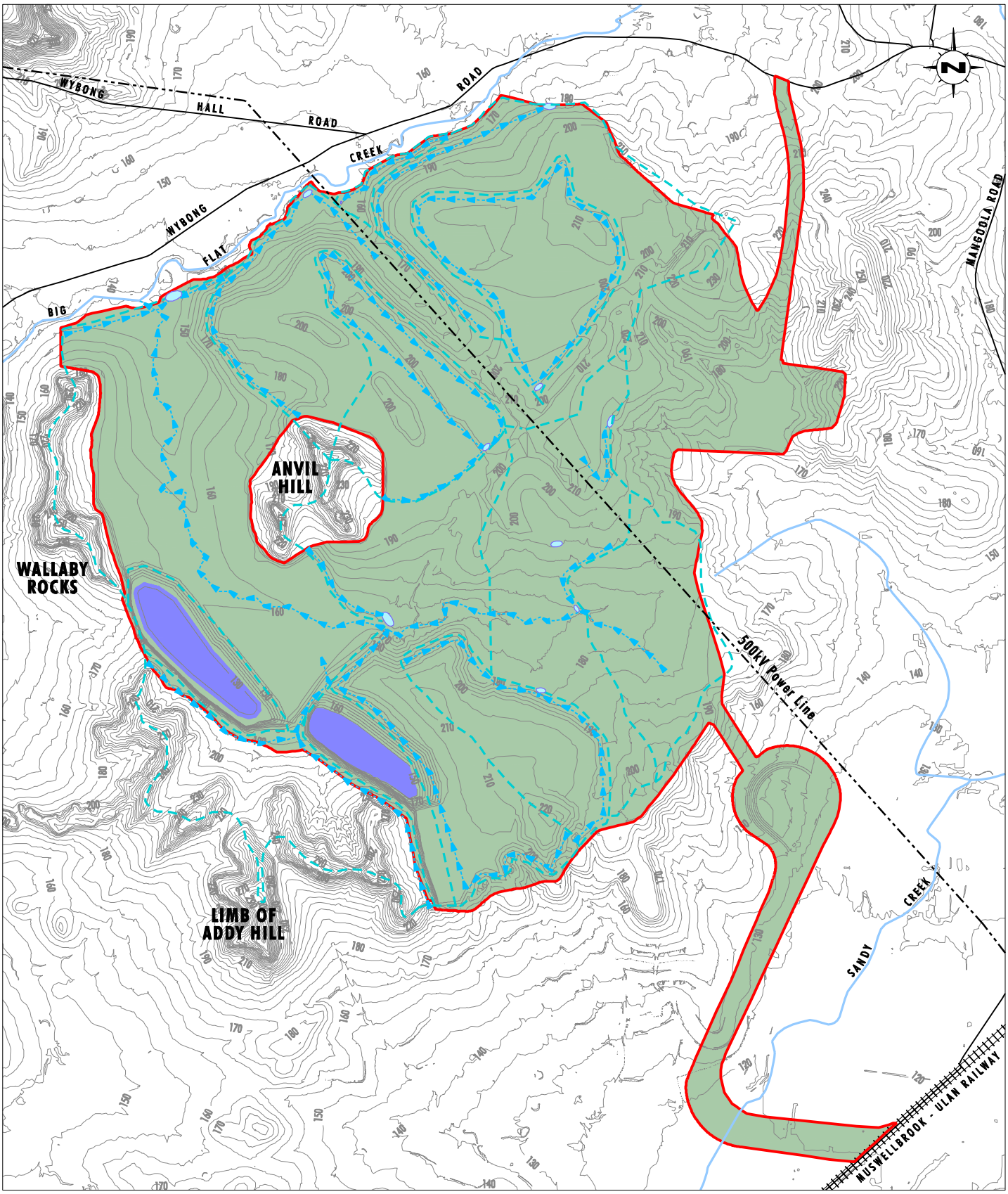
Two final voids are planned to remain in place at the completion of mining, located at the south-western end of the proposed mining area associated with the Main and Southern Pit workings (refer to **Figure 5.5**). The final voids are designed to capture groundwater inflow from the Main Pit and South Pit overburden emplacement areas and allow for the evaporation of accumulated water. In order to provide an appropriately sized evaporative surface, the two voids will have a combined area of approximately 50 hectares.

An assessment of the long term void water levels, water quality and required management, is included in **Section 5.3.2**. Proposed management strategies for the final voids will be developed in consultation with relevant authorities and will be included in the mine closure plan discussed in **Section 5.1.7**.

5.1.3.3 Post Mining Land Use

The majority of the Proposed Disturbance Area, including the open cut mining areas, overburden emplacement areas and infrastructure areas, will be progressively revegetated and regenerated to self-sustaining indigenous vegetation communities consisting of native and naturalised species. This aims to emulate the pre-mining environment, enhance local and regional ecological linkages and provide for a sustainable final land use option, given the inherently low land capability of the existing land (Class VI) across the majority of the Proposed Disturbance Area. Land within the south-eastern extent of the Proposed Disturbance Area (which contains the rail loop and load out facilities), is proposed to be predominantly rehabilitated to agricultural land with a land capability consistent with that which currently exists.

The DGRs for the Project require a justification of the proposed final land use for the site in relation to the strategic land use objectives for the Wybong area. There are no strategic land use objectives for this area apart from that expressed in the Muswellbrook LEP 1985. As discussed in **Section 3.1.1**, the majority of the Proposed Disturbance Area is located within zone 1(a) (Rural "A" Zone), with smaller portions within zone 7(d) Environment Protection (Scenic), zone 7(L1) Environment Protection General (Alluvial Areas) and zone 5(b) Special Uses "B" (Railways). **Table 5.3** shows a justification for the post mining land use for the Project in relation to the LEP.



Base Map: Mine Consult (2005), Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

Legend

- Proposed Disturbance Area
- Rehabilitation
- Final Voids
- Sediment Dam
- Catchment Boundary
- Major Catch/Diversion Drain

FIGURE 5.5

Conceptual Final Landform and Drainage

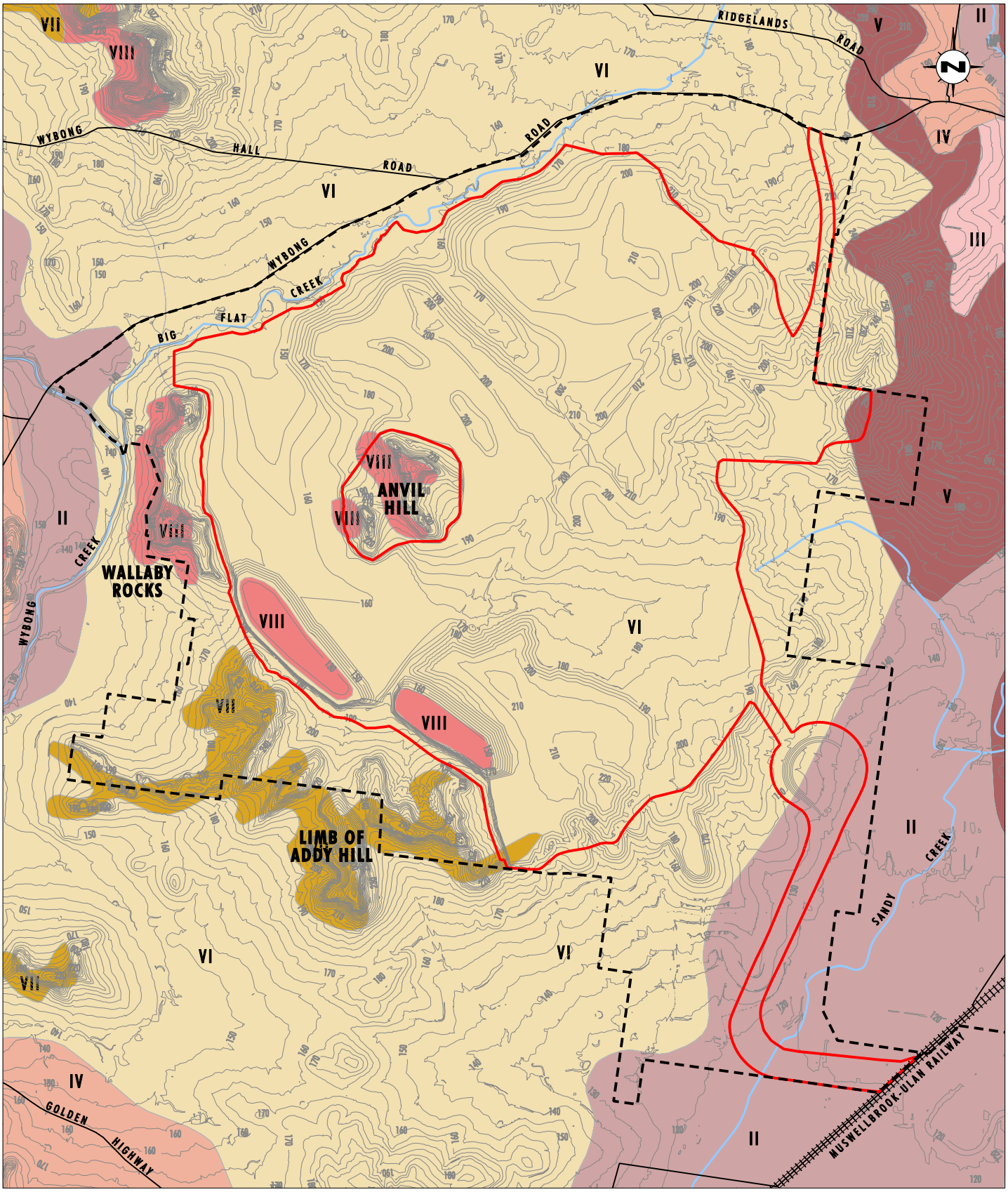
Table 5.3 – Justification for Post Mining Land Use

	Proposed Post Mining Land Use	
Muswellbrook LEP 1985 Zoning	**Self-sustaining Indigenous Vegetation Communities**	**Sustainable Agriculture**
Zone 1(a) - Rural "A" Zone	All disturbed land within Zone 1(a) proposed to have a post mining land use of Self-sustaining Indigenous Vegetation Communities has Class VI land capability. This is not suitable for intensive agricultural production or cultivation due to limitations such as slope, subsoil instability and potential for dispersion and gully erosion.	N/A - There is no disturbed land within Zone 1(a) that is proposed to have this post-mining land use.
Zone 7(d) - Environment Protection (Scenic) Zone	A post mining land use of Self-sustaining Indigenous Vegetation Communities is considered consistent with zone 7(d) which aims to "encourage the preservation of existing wooded hilltops, parts of river valley systems, major scenic corridors and other local features of scenic protection".	N/A - There is no disturbed land within Zone 7(d) that is proposed to have this post-mining land use.
Zone 7(L1) - Environment Protection General (Alluvial Areas) Zone	N/A - There is no disturbed land within Zone 7(L1) that is proposed to have this post-mining land use.	A post mining land use of Sustainable Agriculture is considered consistent with zone 7(L1) which aims to "ensure that prime alluvial land and irrigable land is preserved for agricultural use".
Zone 5(b) - Special Uses "B" (Railways) Zone	N/A - There is no disturbed land within Zone 5(b) that is proposed to have this post-mining land use.	Only a very small portion of the Proposed Disturbance Area is within Zone 5(b) and is associated with the Project rail spur from the Muswellbrook to Ulan railway.

Figure 5.6 shows the proposed post-mining land capability. A small increase in Class VIII land of approximately 50 hectares associated with the final voids is the only change to the pre-mining land capability classification and represents less than 3% of the Proposed Disturbance Area.

5.1.3.4 Post Mining Vegetation Communities

The progressive rehabilitation of previously mined areas within the Proposed Disturbance Area will be a major component of the overall mine plan. The progression of staged rehabilitation is shown on **Figure 5.7**. A detailed rehabilitation strategy has been developed and includes the re-establishment of a range of native vegetation communities, as discussed in **Section 5.4** and shown in **Table 5.4**. This strategy provides a suitable degree of diversity within the vegetation of the post-mining landscape, thus allowing for the re-establishment of a variety of vegetation types and formations. This approach will greatly increase the value of this rehabilitation for fauna species, particularly key threatened species.



Source: GSS Environmental (2006)
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

Legend

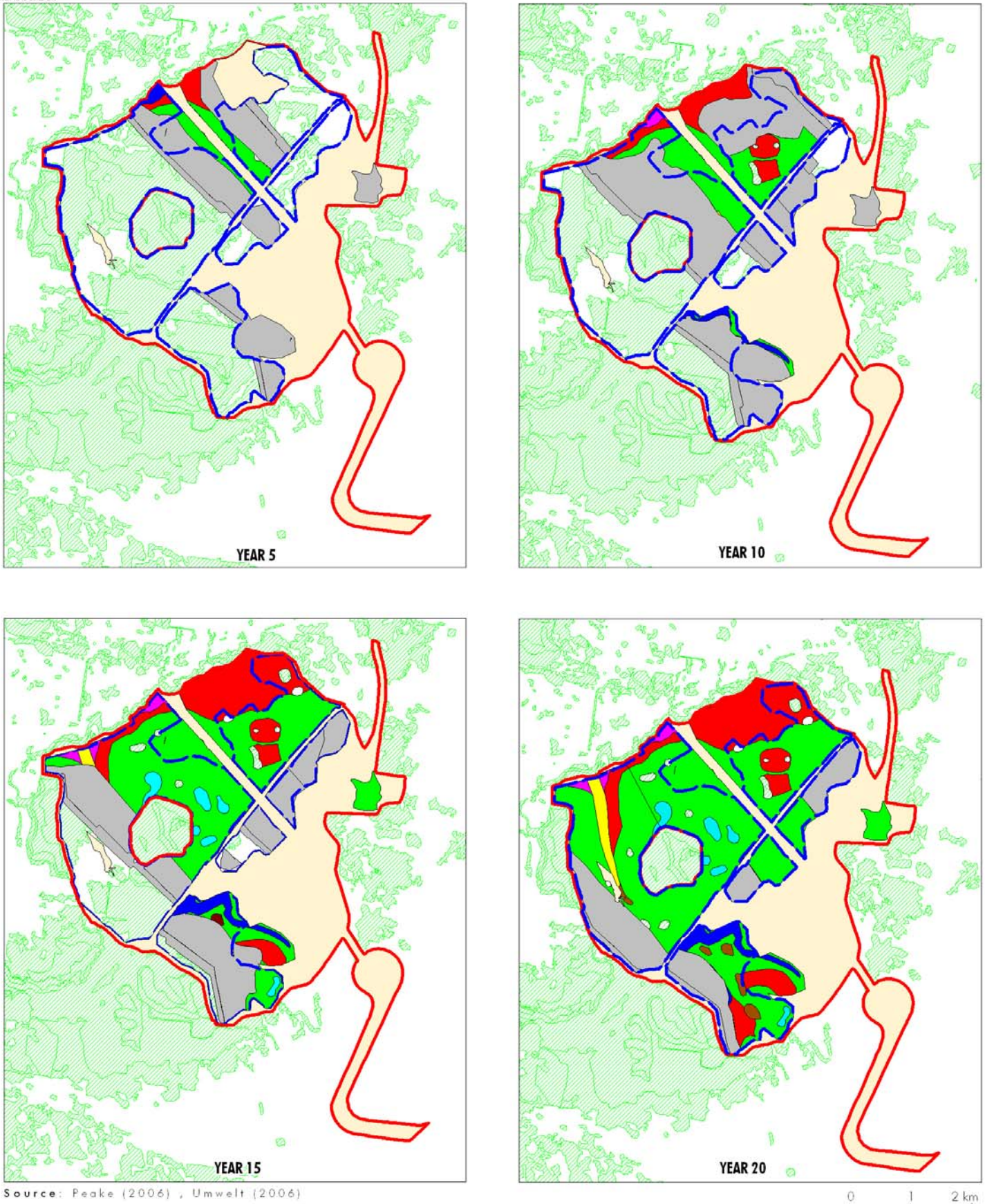
- Proposed Disturbance Area
- Project Area

Capability Classification:

- II Class 2
- III Class 3
- IV Class 4
- V Class 5
- VI Class 6
- VII Class 7
- VIII Class 8

FIGURE 5.6

Post Mining Land Capability



Source: Peake (2006), Umwelt (2006)

0 1 2 km

Legend

- Proposed Disturbance Area
- Proposed Mining Areas
- Existing Treed Vegetation
- Active Mining
- Infrastructure / Other Disturbance

- Slaty Box Woodland
- Ironbark Woodland Complex
- Sheltered Grey Gum Woodland
- Rough-barked Apple Woodland
- Forest Redgum Riparian Woodland
- Drooping Sheoak Woodland
- Paperbark Woodland
- Grassland

FIGURE 5.7

Staged Rehabilitation Strategy for Post-mining Areas

Table 5.4 – Conceptual Staged Rehabilitation Strategy for Proposed Disturbance Area

Community Name	Formation	Total Indicative Disturbance (ha)	Cumulative Area of Rehabilitation (ha)				Total Area at end of Project (ha)	Net Change in Area (ha)
			Year 5	Year 10	Year 15	Year 20		
Slaty Box Woodland	Woodland	245	20	80	214	253	309	+64
Ironbark Woodland Complex	Woodland	886	67	183	524	826	1526	+640
Bulloak Woodland	Woodland	100	0	0	0	0	0	-100
Sheltered Grey Gum Woodland	Woodland	0	0	13	30	36	117	+117
Drooping Sheoak Woodland	Woodland	1	0	<1	28	28	28	+27
Paperbark Woodland	Woodland	19	0	<1	3	17	23	+4
Forest Redgum Riparian Woodland	Riparian/ Floodplain	51	0	0	6	28	29	-22
Swamp Oak Riparian Forest	Riparian/ Floodplain	1	0	0	0	0	0	-1
Rough-barked Apple Woodland	Riparian/ Floodplain	0	6	7	16	16	24	+24
Weeping Myall Woodland	Shrubland	0	0	0	0	0	17	+17
Coast Myall Exposed Woodland	Shrubland	<1	0	0	0	0	0	-<1
Total Treed Communities		**1304**	**93**	**283**	**821**	**1204**	**2074**	**+770**
Grassland		**934**	**1**	**5**	**17**	**23**	**114**	**-820**
Final Void		**-**	**-**	**-**	**-**	**-**	**50**	**+50**
Total of All Communities		**2238**	**94**	**288**	**968**	**1227**	**2238**	**0**

As shown in **Table 5.4**, the post-mining vegetation community composition of the Proposed Disturbance Area will be different to the current composition. For example, the rehabilitation works will aim to increase the extent of regionally significant vegetation communities such as Rough-barked Apple Woodland, Paperbark Woodland and Weeping Myall Woodland, while decreasing the extent of Grassland within the post-mining landscape. Replacing large areas of Grassland with woodland and riparian communities will provide increased fauna habitat in the post-mining landscape. Further details of existing and proposed vegetation communities are provided in **Section 5.4**.

In total, rehabilitation will establish approximately 2074 hectares of treed vegetation in the Proposed Disturbance Area, representing an increase of approximately 770 hectares above the extent of existing treed vegetation in this area. For the purposes of this EA, “treed” vegetation consists of all vegetation communities occurring within the following formations: Woodland, Riparian/Floodplain and Shrubland. It specifically excludes Grassland vegetation.

5.1.3.5 Topsoil Management & Availability

As part of the Soil Survey and Land Resource Assessment (**Appendix 6**), the suitability of soils for re-use in rehabilitation works was determined by the geochemical and physical characteristics of the soils in relation to stability, water retention, water infiltration and root penetration of revegetation species. The soil analyses results were used in conjunction with the detailed field investigations to determine the appropriate stripping depths for soils to be respread and utilised as a surface cover in the rehabilitation of areas disturbed by the Project.

Topsoil stripping and handling will initially be undertaken in accordance with the stripping and handling procedures developed through the soil investigations (**Appendix 6**). Wherever practicable, topsoil will be spread directly onto areas prepared for rehabilitation at a nominal depth of 0.15 metres. Where direct spreading is not practicable, the stripped soil will be stockpiled and seeded with grasses to maintain soil viability prior to being re-spread, if it is to be stockpiled for greater than six months.

Any limit on the availability of topsoil does not pose a limitation to the achievement of the proposed final land use of self sustaining indigenous vegetation communities. The use of topsoil in rehabilitation works may favour competition of grasses and other weed species, limiting the establishment of indigenous vegetation (ACARP 2006).

5.1.3.6 Specific Rehabilitation Techniques

Mining and Infrastructure Areas

On completion of landform contouring, topsoiling and erosion and sediment control works, a vegetative cover will be applied as soon as practicable and in accordance with the final land use and rehabilitation strategy. Both seeding and direct planting techniques will be utilised for tree and shrub species. Seeding and planting activities will be scheduled to take into account seasonal factors.

Tailings Disposal Areas

Upon completion of the tailings emplacement, the tailings pits and surface tailings dam will be capped using appropriate overburden material to create a landform that is stable and can be rehabilitated in the same manner as the mining and infrastructure areas described above. Unless justified otherwise on the basis of tailings cover trials conducted during the life of the Project, a minimum 2 metre cover layer will be used to restrict oxygen and water ingress to underlying tailings and prevent salts from rising to the soil surface. Topsoil will then be spread on top of the capping material to an appropriate depth and the area will be seeded with a range of grass species and native trees consistent with the final land use and rehabilitation strategy.

The final cover design for the tailings disposal areas will be developed in consultation with the DPI.

5.1.3.7 Studies and Trials

Ongoing site specific trials and studies will be conducted to examine options and to optimise rehabilitation techniques. These trials and studies will be undertaken over the life of the Project and some examples are outlined below.

- Rehabilitation trials addressing plant species selection. Centennial has undertaken a local rehabilitation trial program in a disused quarry. Centennial has already established a 1 hectare direct seeding trial plot for Forest Red Gum (*Eucalyptus tereticornis*) using seeds collected from the southern part of the Project Area. The trial site is situated on

Centennial owned land to the north of the Project Area, in an area which has similar soil structure to the Proposed Disturbance Area.

- Tailings emplacement area capping trials to investigate appropriate capping mediums.
- Geochemical and physical evaluation of overburden characteristics that may influence plant growth.
- Trials of various growing mediums, such as spoil and differing soil mixes in conjunction with appropriate soil treatments such as use of bio solids. This approach will provide opportunities for further field trial sites to validate existing research on the establishment of native vegetation on a variety of mediums in the Hunter Valley.
- Examination of the application of fertilisers and herbicides during rehabilitation.
- Review of the depths, areas and approach to topsoil stripping as more detailed characteristics of the soil units become apparent throughout the operation of the Project.

The details and results of any trials and studies will be reported in the Annual Environmental Management Report (AEMR).

5.1.4 Proposed Offsets Strategy

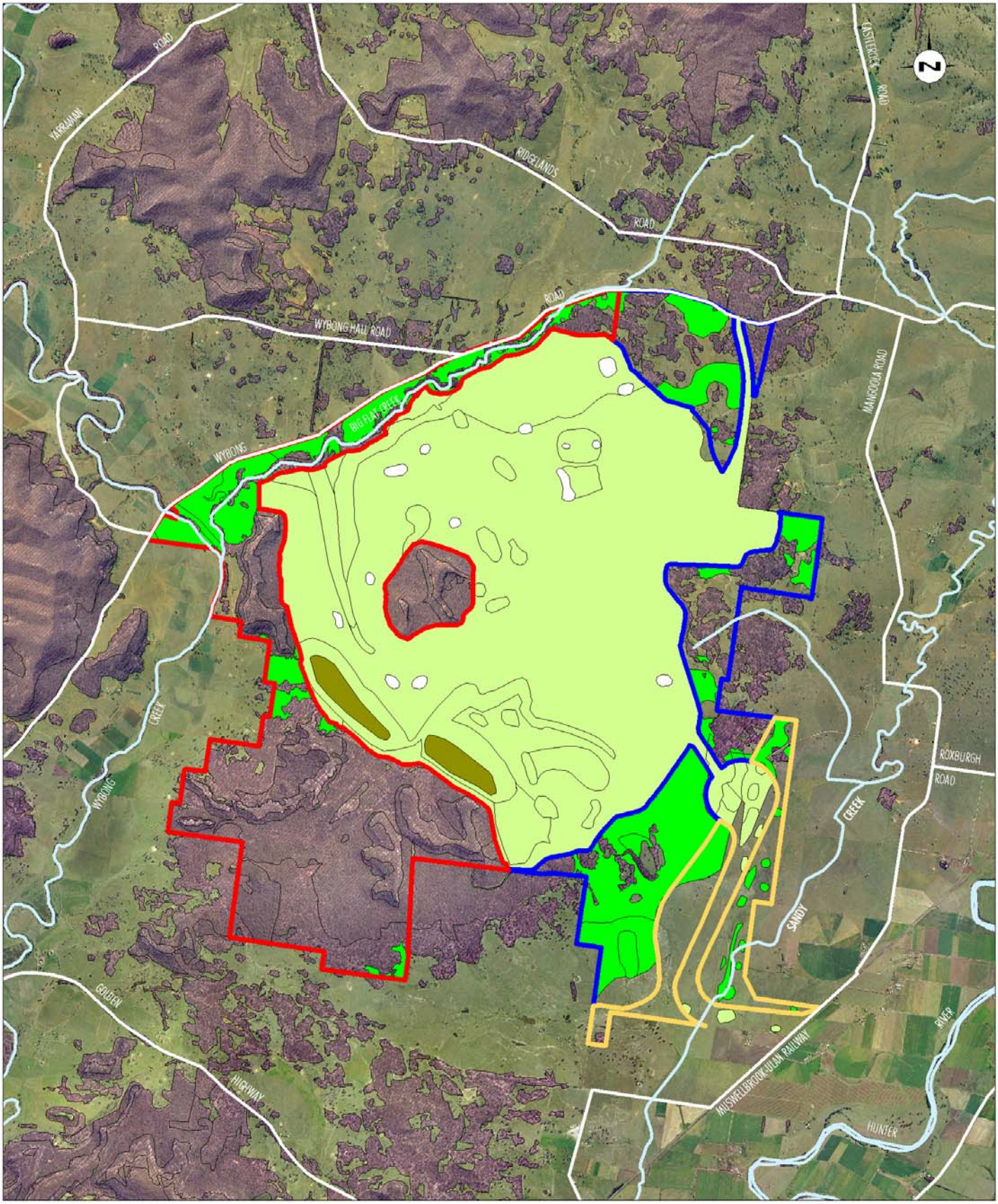
The proposed offsets strategy has been designed to offset the ecological and Aboriginal cultural heritage impacts of the Project. It will assist in the protection of a diverse range of threatened flora and fauna and significant Aboriginal archaeological sites, and provide improved connectivity between existing woodland remnants. Development of the offsets strategy has been undertaken in consultation with DoP and DEC (November 2005, May 2006) and with relevant Aboriginal stakeholder groups (March 2005, May 2006). Further details of relevant ecological and cultural heritage assessment are provided in **Sections 5.4** and **5.8.1**. This section provides an overview of the integrated strategy.

Centennial has already purchased the majority of the Proposed Offset Areas from various private landholders and has made an offer to purchase the remaining land. Conservation management of this land as one landholding will substantially improve biodiversity and cultural heritage values for this area.

The Proposed Offset Areas comprise 1924 hectares surrounding the Proposed Disturbance Area, of which 1038 hectares are currently covered by treed vegetation (**Figure 5.8**). The offset areas have been positioned to adjoin areas of existing remnant vegetation and rehabilitation areas, in order to increase, conserve and enhance areas with existing ecological values and the continuity of treed vegetation in the region.

The largest offsets area is south of the Proposed Disturbance Area around Limb of Addy Hill, which is predominantly covered by intact treed vegetation. Other significant treed areas include Anvil Hill and Wallaby Rocks, while areas around Big Flat Creek and in the north-east and east of the Proposed Disturbance Area are covered by fragmented woodlands. The Proposed Offset Area in the south-east has been extensively cleared, with only a few relatively small remnants remaining.

Approximately 516 hectares of additional treed vegetation will be established in the offset areas in the medium to long term. Enhancement of the offsets will be achieved by the implementation of appropriate land management practices such as fencing, weed and pest control, selective planting, bushfire management, and management of livestock access to encourage natural regeneration.



Source: Umwelt (2006)
Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images

Legend

- Conservation Offset Area
- Habitat Enhancement Offset
- Sustainable Agriculture Offset
- Existing Vegetation
- Proposed Treed Rehabilitation
- Proposed Regeneration & Revegetion
- Final Voids
- Grassland

FIGURE 5.8

Proposed Offset Areas

Portions of the offset areas are referred to as Conservation, Habitat Enhancement, and Sustainable Agriculture to reflect the primary purpose of each area. A description of the proposed management approach for these areas is discussed further below.

5.1.4.1 Conservation Areas

Approximately 1078 hectares of the Proposed Offset Areas (56%) to the west, north and south of the Proposed Disturbance Area and around Anvil Hill, is proposed to be protected and managed for ecological and Aboriginal cultural heritage conservation purposes. Centennial has already purchased the majority (78%) of this land from various private landholders. This area consists of predominantly intact treed vegetation and contains 9 threatened or significant flora species, 26 threatened or migratory fauna species and 98 Aboriginal cultural heritage sites, the majority of which have high scientific and cultural significance (refer to **Sections 5.4** and **5.8.1**).

Approximately 178 hectares of treed vegetation will be established in the conservation areas over the long-term through natural regeneration and selective planting. This will also include the revegetation of the banks of Big Flat Creek with a variety of riparian communities (Rough-Barked Apple Woodland, Forest Redgum Riparian Woodland, Swamp Oak Riparian Forest, River Redgum Floodplain Woodland) which will increase the quantity of riparian vegetation along the creek. Detailed revegetation design will be undertaken in accordance with relevant guidelines such as Rehabilitation Manual for Australian Streams (Land and Water Resources Research and Development Corporation, 2000).

For the purposes of this EA, “revegetation” refers to the use of methods such as planting of tubestock and direct seeding to return native vegetation to a particular area. Where areas of Aboriginal archaeological significance overlap with areas identified for revegetation, non-disruptive methods of revegetation will be used such as hand-planting to minimise the potential for disturbance. The term “regeneration” is used in this EA to identify areas where vegetation will be allowed to return naturally to a particular area, generally by removing existing impacts or physical disturbances such as grazing, slashing or soil compaction.

The areas proposed to be conserved as part of the offsets strategy will be secured and protected in the long term. The appropriate mechanism for achieving this will be determined in consultation with DoP and DEC.

5.1.4.2 Habitat Enhancement Areas

Approximately 629 hectares of the Proposed Offset Areas (33%), to the east of the Proposed Disturbance Area, is proposed to be managed to provide increased habitat for native flora and fauna. This area currently consists predominantly of fragmented woodlands and cleared grazing land and is known to contain six threatened or migratory fauna species and one site with high Aboriginal archaeological significance.

Approximately 293 hectares of treed vegetation will be established in the Habitat Enhancement Areas over the long-term through revegetation and regeneration. In general this area does not have high cultural heritage value so more intensive revegetation techniques could be used. These areas will be established as early as possible within the life of the Project to ensure that replanted vegetation will be mature enough to function as fauna habitat as early as possible.

5.1.4.3 Sustainable Agriculture Areas

In recognition of its higher land capability, approximately 217 hectares of the Proposed Offset Areas (11%) to south-east of the Project Area is proposed to be managed for sustainable agriculture. This will include grazing and other sustainable agricultural practices as

appropriate for the area. Approximately 45 hectares of treed vegetation will be established in this area over the long term through revegetation and natural regeneration.

5.1.4.4 Summary

Table 5.5 summarises the net increase in treed vegetation that will be achieved by the implementation of the rehabilitation and offset strategies. As indicated, these strategies will increase the total existing treed vegetation area by approximately 1286 hectares in the medium to long term.

Table 5.5 – Effect of the Rehabilitation and Offset Strategy on Treed Areas

	Area Disturbed by the Project (Ha)	Area of Existing Vegetation Immediately Protected (Ha)	Area of Vegetation to be Established (Ha)	Total Area of Vegetation at end of Project (Ha)	Net Change in Treed Vegetation Area (Ha)
Proposed Disturbance Area	1304	0	2074	2074	+770
Conservation Areas	0	869	178	1047	+178
Habitat Enhancement Areas	0	165	293	458	+293
Sustainable Agriculture Areas	0	3	45	48	+45
Total	**1304**	**1037**	**2590**	**3654**	**+1286**

5.1.5 Other Sustainability Initiatives

5.1.5.1 Wybong Uplands Land Management Strategy

Centennial proposes to establish a land management strategy which will achieve its corporate sustainability goals. The Strategy, "Wybong Uplands Land Management Strategy" (WULMS), will target sustainable land management across the broader landscape of the Wybong area. Land management within the Proposed Disturbance Area will complement the Strategy. The Strategy will be managed by a committee, the structure of which is yet to be determined. The committee is proposed to include members from the community, Centennial, relevant land management groups and/or agencies.

The aim of the Strategy is long term sustainable land management within the Wybong area. Actions to achieve this aim may include dryland salinity mitigation, drought proof farming, sustainable agriculture, demonstration farms, riparian zone management, and ecological corridors. Centennial will commit to funding for the Strategy of $100,000 per year for five years. WULMS may seek further funding through government environmental grants.

5.1.5.2 Corridor Strategy

In addition to the net increase in treed vegetation area shown in **Table 5.5**, a Conceptual Corridor Strategy has also been developed to address the reduction in movement opportunities for flora and fauna species as a consequence of the clearing associated with the mining process. This Strategy aims to identify existing corridors within the landscape and to retain this existing function wherever possible. Where this has not been possible, alternative corridor options have been provided to ensure adequate access and egress throughout the Project Area during the construction and operation of the mine, as well as in the post-mining landscape. The Conceptual Corridor Strategy is discussed further in **Section 5.4.6**.

5.1.6 Monitoring, Maintenance & Reporting

A monitoring program will be developed to assess the performance of the rehabilitation areas and offset areas. Specific details of the program including methods to be used, monitoring frequencies and locations will be included within a comprehensive Ecological Management Plan to be completed prior to commencement of clearing on the site. The aims of the ecological monitoring program will be to:

- document changes in retained vegetation within the Proposed Offset Areas and corridors, through comparison with baseline data;
- document changes in the structure, composition and condition of rehabilitation, revegetation or regeneration areas, through comparison with baseline data and control sites;
- determine if the impacts on key threatened species are consistent with predictions in this EA;
- assess progressive changes to flora and fauna species assemblages within the Proposed Disturbance Area, and Proposed Offset Areas as the mine progresses; and
- determine the need for any maintenance and/or contingency measures.

Monitoring will be undertaken on a regular basis and may need to be undertaken at different times, depending on the optimal detection period for each target species or group. Monitoring is likely to include the parameters listed below.

- Checking soil erosion status and the effectiveness of erosion and sediment control measures.
- Monitoring runoff water quality from overburden emplacement areas (as part of the surface water monitoring program).
- Monitoring establishment of vegetation and flora species diversity and abundance through visual inspections, photo monitoring points, and flora survey quadrats.
- Fauna monitoring including spotlighting, herpetological surveys, diurnal and nocturnal bird surveys, Anabat echolocation call detection, and the use of hair funnels to detect terrestrial and arboreal mammals. Fauna surveys will specifically target threatened species previously recorded, or with potential to occur, within the area.
- Identification of the presence of weeds or animal pests.
- Assessing the biogeochemical functioning of the landscape using Ecosystem Function Analysis (EFA) or a similar systems-based approach. EFA is a CSIRO developed method used to provide indicators of rehabilitation success and allows the assessment of ecosystem sustainability through the plotting of development trajectories. EFA aims to measure the progression of rehabilitation towards a self-sustaining ecosystem through the assessment of landscape function, vegetation dynamics and habitat complexity.

Based on the monitoring results, maintenance works/contingency measures may include:

- repair of erosion (such as re-grading of eroded areas);
- repair of drainage paths and de-silting of sediment control structures;
- re-seeding or re-planting;

- application of fertiliser;
- application of lime or gypsum to control pH and improve soil structure;
- implementation of weed and animal pest control measures.

The monitoring program, monitoring results, rehabilitation maintenance activities and rehabilitation and revegetation progress will be reported annually in the AEMR.

5.1.7 Mine Closure

At the end of the 21 year operational life of the Project, Centennial proposes to decommission all on site infrastructure and associated facilities as part of the mine closure process. Should it be considered feasible for mining operations to continue beyond the proposed 21 year mining period, under current legislation an application to extend the project life would have to be made and the decommissioning process would need to be revisited as part of any such Project Application.

On mine closure, Centennial will actively decommission all redundant plant and equipment, surface infrastructure, hazardous materials and tailings emplacement areas concurrently with the completion of site rehabilitation of mining and overburden emplacement areas. Roads that have no specific post-mining use will be ripped, topsoiled and revegetated. Some access roads may be retained post-mining to enable access for use in bushfire and other land management activities. Water management structures and sediment control structures will either be retained as water sources or decommissioned and rehabilitated.

A mine closure plan will be developed for the Project at least three years prior to anticipated mine closure, in consultation with DoP, DPI, Council, other relevant government agencies, and the local community. This plan will specifically address the major aspects of conceptual decommissioning and define future care and maintenance requirements for the site and ongoing monitoring and management. Centennial will also work with relevant agencies to investigate the amelioration of adverse socio-economic effects that may occur due to the loss of employment at Project closure.

Completion criteria, determined in consultation with the relevant agencies, will be utilised to demonstrate achievement of the Project rehabilitation and offsets strategy objectives.

Table 5.6 contains a set of conceptual completion criteria relevant to the Project. These criteria will be refined in consultation with relevant agencies, prior to and during the Project.

Table 5.6 - Conceptual Project Completion Criteria

Project Component	Completion Criteria
Final Landforms	Safe, stable, adequately drained post-mining landforms consistent with the local surrounding landscape.
Final Voids	Surface water inflows to the final voids have been minimised, and voids have been profiled for long term stability.
Rehabilitation and Offset Areas	The area of vegetation is equal to or greater than the pre-mining extent.
	Relevant areas are progressing toward self-sustaining indigenous vegetation communities as determined by Ecosystem Function Analysis (EFA) monitoring, or other appropriate monitoring technique.
	Vegetation communities will comprise appropriate representations of existing vegetation communities (where considered desirable) in similar proportions to the pre-mining extent, or to other agreed target levels.

Table 5.6 - Conceptual Project Completion Criteria (cont)

Project Component	Completion Criteria
Rehabilitation and Offset Areas (cont)	There are no significant weed infestations and weeds do not comprise a significant proportion of the species in any stratum.
	Vegetation communities provide habitat for a suite of fauna species similar to the pre-mining fauna communities.
	Flora species assemblages are characteristic of the desired native vegetation community.
	Ecological monitoring identifies no loss of native flora or fauna species diversity within areas of retained vegetation.
Ecological Corridors	Ecological corridors are shown to be successfully established and consistent with desired vegetation community compositions. Pest species (flora and fauna) are managed and controlled (where possible) within ecological corridors. Presence/absence monitoring of flora and fauna species identifies increasing levels of corridor function in terms of species movement.

The gradual achievement (or otherwise) of these completion criteria will be assessed and discussed in the annual documentation of monitoring results, which will include the identification of any failures of the criteria, and measures of addressing any such issue.

5.2 Surface Water

The potential impact on both surface water quality and quantity was also identified as a key issue for this project. The DGRs for the EA required detailed modelling of potential surface water impacts, a site water balance and a detailed description of any proposed creek diversions. Contingency measures to protect the supply of water to landowners and the environment in the region were also required.

Umwelt has completed a comprehensive surface water assessment, which is included in full in **Appendix 7** and summarised in this section.

5.2.1 Catchment Context

The Project Area is located within Clarks Gully, Anvil Creek and Big Flat Creek catchment areas (refer to **Figure 1.2**). Clarks Gully and Anvil Creek are tributaries of Big Flat Creek. Big Flat Creek is a tributary of Wybong Creek, which in turn is a tributary of the Goulburn River.

A small part of the Project Area is located in the Sandy Creek catchment. Sandy Creek is a tributary of the Hunter River, and flows into the Hunter River at the township of Denman. The Goulburn River flows into the Hunter River downstream of Denman.

The Proposed Disturbance Area covers approximately 42% of Big Flat Creek catchment, including the entire catchment of both Clarks Gully and Anvil Creek. The Project will disturb less than 3% of the Wybong Creek catchment, and 1% of the Sandy Creek catchment at any stage of mining.

The maximum extent of the subcatchment areas draining to the mine water management system is listed in **Table 5.7**.

Table 5.7 - Project Area Subcatchments

Creek	Catchment Area		
	Total Area (ha)	Maximum Area Draining to Mine Water Management System (ha)	Maximum Catchment Draining to Water Management System as % of Total Catchment Area
Anvil Creek	1404	1404	100%
Clarks Gully	365	365	100%
Big Flat Creek	5040	2055	41%
Wybong Creek	80,044	2055	2.6%
Sandy Creek	14,517	65	0.4%

Downstream of the Project Area there are no surface or groundwater extraction points on Big Flat Creek. There are 13 licensed surface water extraction points and 10 licensed groundwater extraction points on Wybong Creek.

5.2.1.1 Water Quality Monitoring

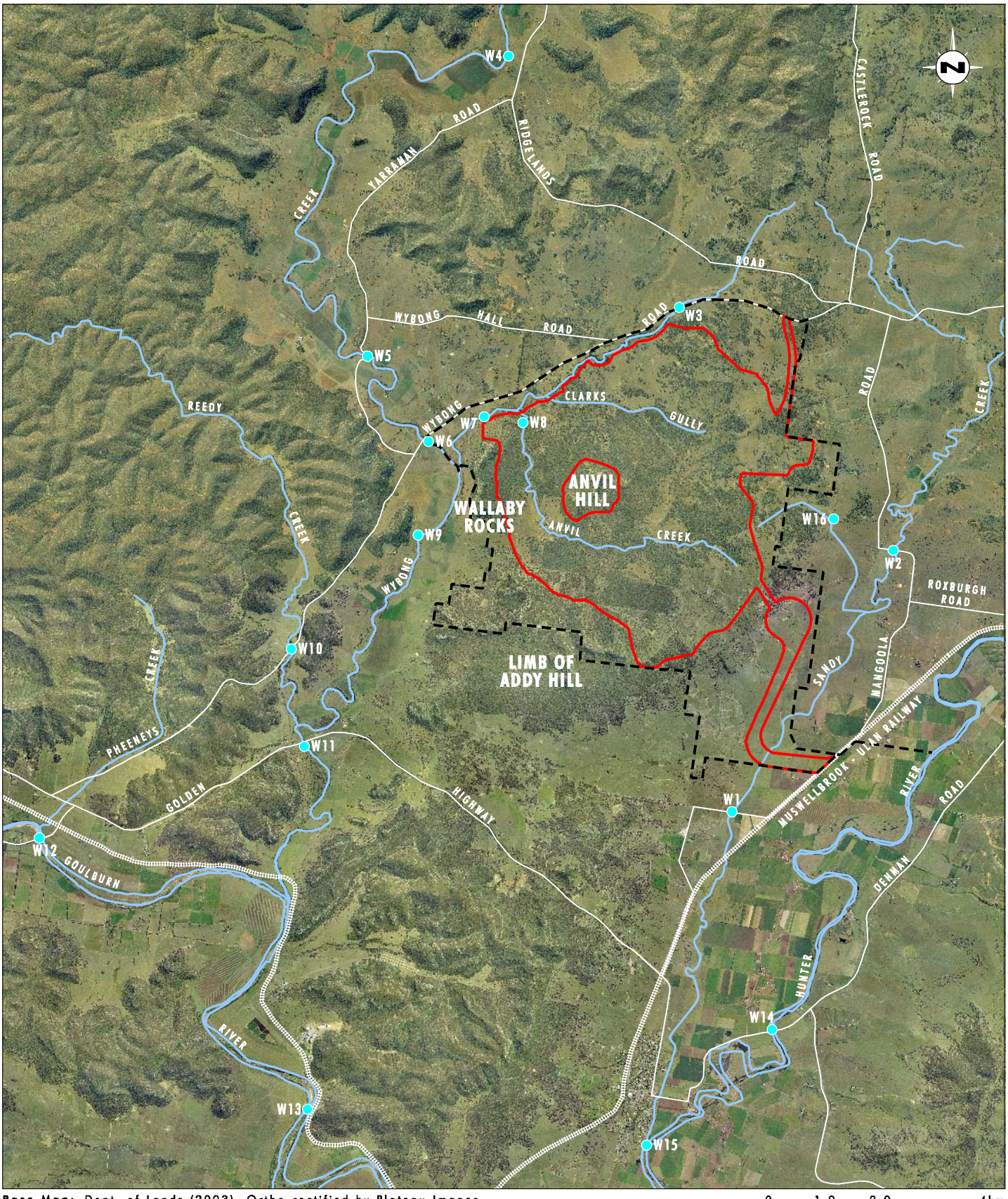
A surface water monitoring program has been in place since February 2002 which includes sampling sixteen monitoring locations on a monthly basis or after extended periods of rain (**Figure 5.9**). These monitoring locations are situated upstream, downstream and within the Project Area and include sites within Wybong Creek, Big Flat Creek, Anvil Creek, Sandy Creek, Goulburn River and the Hunter River. Samples are analysed for a range of parameters including pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS). Further analyses (including salts, heavy metals, nutrients, anions and cations) are undertaken after significant rain events.

The monitoring results show the variability of water quality in the local creeks. In overview, Big Flat Creek, just north of the proposed mining area, has high salinity, and Wybong Creek generally has much lower salinity levels both upstream and downstream of the Project Area. Further details on measured water quality are outlined below.

- Anvil Creek - pH ranged from slightly acid (5.0) to slightly alkaline (8.1). Electrical conductivity ranged from 98 µS/cm to 2400 µS/cm.

- Big Flat Creek – upstream reaches were neutral to alkaline with pH ranging from 6.9 to 9.1. Electrical conductivity ranged from 570 µS/cm to 50,500 µS/cm. Water quality in the downstream reaches of Big Flat Creek was neutral to slightly alkaline ranging from 7.4 to 8.8. Electrical conductivity at the downstream monitoring location ranged from 520 µS/cm to 48,500 µS/cm.

- Wybong Creek – water quality monitoring was conducted at five locations, three upstream of its confluence with Big Flat Creek, and two downstream of the confluence. Water quality in Wybong Creek upstream of its confluence with Big Flat Creek was neutral to slightly alkaline, ranging from 6.9 to 8.9. Electrical conductivity ranged from 450 µS/cm to 3770 µS/cm. Water quality in Wybong Creek immediately downstream of its confluence with Big Flat Creek was neutral to slightly alkaline, with pH ranging from 7.4 to 8.4. Electrical conductivity ranged from 500 µS/cm to 5460 µS/cm, indicating a significant contribution in salt loads from Big Flat Creek. Further downstream Reedy Creek flows into Wybong Creek. Downstream of Reedy Creek, conductivity reduces ranging from 460 µS/cm to 3730 µS/cm.



Base Map: Dept. of Lands (2003), Ortho-rectified by Plateau Images

0 1.0 2.0 4km

Legend

- Proposed Disturbance Area
- Project Area
- Water Monitoring Location

FIGURE 5.9

Surface Water Monitoring Locations

- Sandy Creek – the upstream reaches were neutral to slightly alkaline with pH ranging from 7.2 to 8.2. Electrical conductivity ranged from 839 µS/cm to 6990 µS/cm. Water quality in the downstream sections of Sandy Creek was neutral to slightly alkaline, with pH ranging from 6.8 to 8.6. Electrical conductivity ranged from 116 µS/cm to 1100 µS/cm.

Wybong Creek has been identified in the Catchment Blue Print as being a major salt contributor to the Goulburn and Hunter River systems. Water quality monitoring undertaken for the project indicates that Big Flat Creek catchment, which makes up approximately 6% of the Wybong Creek catchment is contributing up to 30% of the total salt load in the Wybong Creek system.

5.2.2 Proposed Water Management System

The proposed water management system for the Project includes a clean water system (runoff from areas not disturbed by mining operations), a saline water system (that is, water that has been in contact with coal) and a dirty water system (that is, runoff from other areas disturbed by mining operations). Components of the water management system over the life of the mine are shown on **Figure 5.10**.

The clean water system includes a series of dams located around the perimeter of the mining area. These dams include Anvil Creek Dam 1 which has an approximate capacity of 270 ML, Anvil Creek Dam 2 which has an approximate capacity of 30 ML and several smaller dams each with a capacity of less than 5 ML that will be constructed upslope of the open cut pits to prevent clean runoff flowing into the pits. Anvil Creek Dams 1 and 2 will be used to store clean water collected within the Project Area. This water will be either used to assist in meeting water demands on the site or diverted around the mine workings and discharged off site.

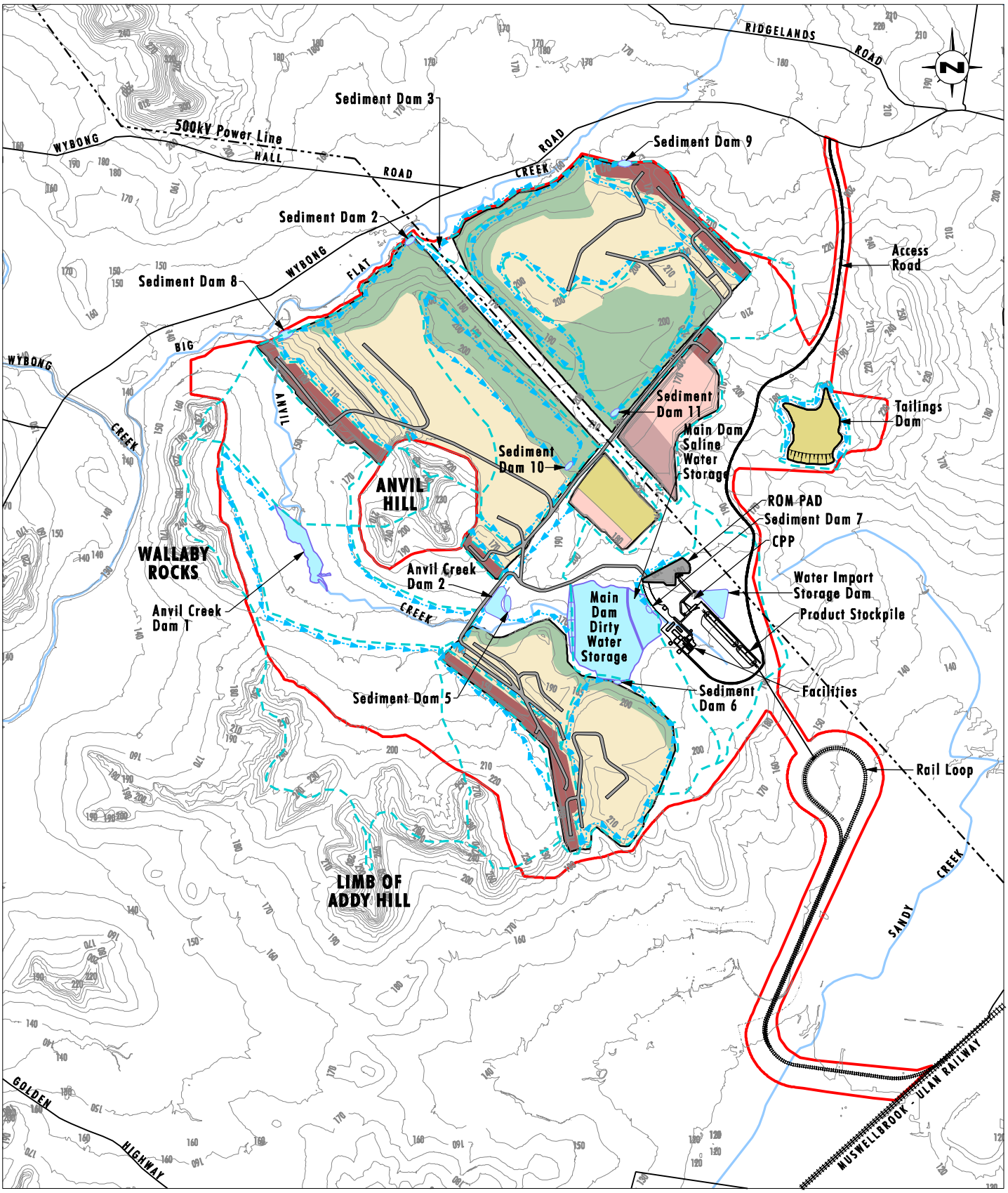
A clean water storage dam is proposed to be constructed near the CPP facilities area to contain water imported to the site from the Hunter River.

The water management system is also proposed to include a series of sediment and pollution control dams that are used to capture, contain and recirculate drainage runoff from disturbed or contaminated areas within the mining area.

These pollution control dams will be utilised as part of the saline water and dirty water management systems. These dams will include:

- Main Dam (approximately 2000 ML). This dam will be compartmentalised to have two storage areas, those being approximately 400 ML 'saline' water storage and 1600 ML dirty water storage. The saline water storage will be used to collect runoff from the CPP and coal stockpile areas. Groundwater inflows to in-pits sumps will also be pumped to the saline water storage. Water from this dam will be used to supply the CPP and for dust suppression of coal stockpiles. The 1600 ML dirty water storage will be used to store and recirculate runoff collected in the sediment dams. To minimise evaporation losses during dry periods, the dam will be constructed with a deep central section that will reduce the surface area to less than 5 hectares when the dam volume is less than 300 to 350 ML. Main Dam will be used to contain runoff collected from sediment dams (dirty water storage) and in-pit sumps (saline water storage) during wet periods where dirty runoff is in excess of CPP and dust suppression needs;

- in-pit sumps that form part of the saline water and dirty water systems. Surface runoff and groundwater inflow from the open cut pits will be collected in these sumps. Each sump will be fitted with a pump system capable of pumping up to 10 ML/day to Main Dam;



0 0.5 1.0 2km

Source: Umwelt (2006)
Base Map: Dept. of Lands (2003), Mine Consult (2005)
Note: Contour Interval 10m

Legend

- Proposed Disturbance Area
- Haul Road
- Active Pit
- Active Overburden Emplacement
- Active Tailings
- Rehabilitation
- Pit Floor
- Inactive Tailings
- Dam
- Catchment Boundary
- Major Catch/Diversion Drain

FIGURE 5.10

Surface Water Management System Year 10

File Name (A4): R12_V1/1858_498.dgn

- sediment dams that collect runoff from haul roads, overburden emplacement areas and rehabilitated areas. Runoff from rehabilitated areas will be captured and treated until such time as the area served by the dam has achieved a stable vegetative cover. Each of the sediment dams has been designed in accordance with the Blue Book (Landcom 2004) requirements for Type C soils to minimise surface area and therefore evaporation losses. Each of the sediment dams will be fitted with a pump system capable of pumping up to 10 ML/day to Main Dam. This will substantially increase the effective ability of the sediment dam system to prevent dirty water discharging from the site. Each of the sediment dams will be designed to overflow to the Big Flat Creek system when the capacity of the dams and the pump system is exceeded during extreme rainfall events. Overflow pathways will be designed to convey flows at non-erosive velocities and will be maintained in a stable and vegetated condition. The location of sediment dams will vary over the life of the Project to ensure that the most effective water quality control is achieved.

5.2.3 Detailed Water Balance

Water demand over the life of the Project will vary between approximately 1 ML and 4 ML per day for coal processing and dust suppression. This water will be collected from a variety of sources including the Hunter River, surface runoff from within disturbance areas and groundwater inflow into mining areas.

To assess likely water demands during the operation phase, a detailed daily water balance model has been developed for the project (refer to **Appendix 7**). The model takes into account rainfall runoff within the Project water management system, groundwater inflows, water use for coal processing and dust suppression and evaporation losses from dam surfaces.

Water balance modelling (refer to **Appendix 7**) indicates that it may be necessary to import up to 400 ML per year of water to the site during the construction phase and during prolonged dry periods to meet on-site water needs including dust suppression requirements. This water will be sourced from existing water licences on the Hunter River system and will be stored on site in a dam that will be constructed upslope of the CPP.

Main Dam has been sized to provide significant wet weather storage capacity for dirty water and saline water, however water balance modelling indicates that during prolonged wet periods (as have occurred in the past), there will be an excess of water on site. During these times it may be necessary to discharge some of this water off site. A range of contingency measures has been identified to minimise the volume of water discharged from the dirty water system and to provide appropriate water management and suitable protection for the quality of waters flowing into the downstream systems. Any surplus water will be managed in the following order of priority.

- Preferential use of pit-water (which is likely to have the highest salinity of all water sources on site) for dust suppression and use in the CPP. This water will be stored in Main Dam.

- Discharge off site of clean water collected in Anvil Creek Dams 1 and 2 that is in excess of the capacity of these dams, in the first instance. Up until approximately Year 7 this will be possible via the existing Anvil Creek channel. After this time it will be necessary to pipe the water from Anvil Creek Dam 1 to Big Flat Creek.

- The potential exists to utilise captured dirty water that is in excess of pollution control requirements for watering rehabilitation areas to promote plant growth, where practical. It will also be feasible to apply additional water to haul roads to increase evaporation losses and reduce the overall volume of dirty water stored on the site.

- In addition to Main Dam storage capacity, it will be possible to provide short term storage in pit.

- Analysis of the conductivity (salt concentrations) of surface runoff from the existing catchment within the Project Area indicates that during prolonged or high rainfall periods, runoff from overburden emplacement areas and reshaped landform is likely to have relatively low conductivity, with the main potential pollutant being suspended sediment. Provision will be made to transfer runoff from the sediment dams servicing emplacement areas to Sediment Dam 2 and Sediment Dam 5 during prolonged or high rainfall conditions. A water treatment system will be installed on Sediment Dams 2 and 5 to ensure that waters discharged from the dams have TSS concentrations of less than 50 mg/L. Overflows in excess of the design treatment capacity of Sediment Dams 2 and 5 may exceed this concentration under certain high rainfall events.

- It is also possible that during prolonged wet periods dirty water from Main Dam could be discharged to Big Flat Creek via the overflow system from Anvil Creek Dams 1 and 2 or via Sediment Dams 2 and 5. Any such discharges would be treated to ensure TSS concentrations in the discharge water of less than 50 mg/L.

- If necessary, approval will be sought in the future to discharge saline water from Main Dam to the Hunter River under the Hunter River Salinity Trading Scheme (HRSTS). A pipe system will facilitate such discharges. Based on current modelling, it is anticipated that there will be no requirement to discharge saline water from the site and this is raised only as a contingency measure.

5.2.4 Potential Surface Water Impacts

5.2.4.1 Surface Runoff Impacts

The water balance model has also been used to assess potential reduction in runoff to the Wybong Creek system that may occur as a result of the project. The analysis summarised in **Table 5.8** is based on the assumption that all water needs are met from on-site sources. Importation of water to the site from the Hunter River system would result in smaller reductions in runoff to the Wybong Creek system than those predicted in **Table 5.8**.

Table 5.8 - Predicted Changes in Runoff to the Wybong Creek System as a Result of the Anvil Hill Project

Mining Scenario Modelled	Area of Mine Water System (Ha)	Average Runoff From Mine Water System Area Pre-Mining (ML)[1]	Predicted Average Overflows from Water System (ML)[1]	Big Flat Creek Average Runoff (ML)[2]	Predicted Reduction in Average Runoff to Big Flat Creek System (ML)	Predicted Reduction in Average Runoff to Big Flat Creek System (%)[1]	Predicted Reduction in Average Runoff to Wybong Creek System (%)[1]
Year 2	1401	981	535	3525	446	13%	0.8
Year 5	1909	1336	587	3525	749	21%	1.3
Year 10	2120	1484	1080	3525	404	11%	0.7
Year 15	1522	1065	1123	3525	0	0	0
Year 20	1132	792	1567	3525	0	0	0

[1] Includes up to 335 ML of clean water that would have otherwise been collected under Harvestable Rights
[2] Average annual flows derived from DLWC 1999 of 0.07 ML/ha being 10% of average annual runoff.

As can be seen from **Table 5.8**, modelling indicates that the Project would result in approximately a 1.3% average reduction in the total runoff to the Wybong Creek system at Year 5, with average reductions of less than 1% being predicted for all other mining scenarios modelled.

With the proposed sediment and erosion control measures in place, the Project will not adversely impact on sediment levels in Big Flat Creek or downstream drainage systems. The Project will not increase total salt loads in the Big Flat Creek system.

5.2.4.2 Potential Flooding Impacts in Big Flat Creek

Detailed flood modelling of Big Flat Creek has also been undertaken to explore if the Project will adversely impact on flood levels or result in increased flow velocities that may cause a decrease in channel stability. Results of the modelling indicate that during all stages of the proposed development flood levels in Big Flat Creek adjacent to and upstream of the Project Area will not be adversely affected and that in channel flow velocities will not increase.

5.2.4.3 Channel Stability and Instream Habitat

The Project will result in the removal of Anvil Creek from approximately Year 10, with sections of the drainage line being re-established from approximately Year 16 onwards. As part of progressive rehabilitation it is proposed to shape the final landform to provide a free-draining broad vegetated drainage line along the approximate current alignment of Anvil Creek. This drainage line will be designed and constructed to provide a stable vegetated channel that is capable of conveying flows from the final landform to Big Flat Creek system. Native trees and shrubs will be planted along the drainage line alignment to enhance the long term stability of the drainage system and to provide suitable habitat for native fauna. It would also be possible to re-establish in-channel habitat in the final landform such as pools and riffles, similar to that existing in the current Anvil Creek system.

The project will result in the removal of Clarks Gully effectively from Year 1. Over the life of the Project, new drainage lines will be established to convey runoff from the Clarks Gully area to Big Flat Creek. These drainage lines will be designed and constructed to provide a stable vegetated channel that is capable of conveying flows to Big Flat Creek.

The Project will result in changes in the flow regime within Big Flat Creek as the mine water management system is developed and mining progresses. This will result in reduced annual flow volumes in the creek. The frequency and duration of flows within the creek system is not expected to be significantly changed by the project, however the magnitude of these flows will change. It is considered that sufficient flow volumes will be maintained in the creek system to fill the pools and holes along Big Flat Creek that sustain the current aquatic and riparian habitat characteristics of the creek system.

Flood modelling undertaken for the Project indicates that the proposed development will not significantly alter the flow regime in Wybong Creek in terms of peak discharges, flood levels or peak instream velocities. As a result, the Project is unlikely to adversely impact on channel stability or instream habitat of the Wybong Creek system.

The Project will occupy only a small section of Sandy Creek catchment with the proposed rail loop crossing Sandy Creek and a number of its minor tributaries. All crossings will be designed to safely convey a 1 in 100 year Average Recurrence Interval flood event.

5.2.5 Cumulative Impacts

The main potential cumulative impacts of the Project in terms of surface water relate to:

- the overall demand for water from the Hunter and Goulburn River systems;
- the potential for land use practices to result in greater sediment generation and deposition in the Wybong catchment; and

- the potential to increase salt loads in Wybong Creek, Goulburn River and Hunter River systems.

Water required to meet the operational and dust suppression needs of the Project will be largely drawn from runoff and inflows collected by the dirty water management system. As discussed, additional water may be required during the construction phase when the water management infrastructure is being established and during prolonged dry periods. This water will be sourced from existing water licences and hence will not have a cumulative impact on water supplies in the Hunter and Goulburn River catchments.

In terms of potential sediment generation, a range of sediment and erosion controls will be incorporated into the Project to minimise the potential for sediment export from the site.

In terms of salt loads, the Project is unlikely to increase salt loads in the existing Wybong Creek, Goulburn River and Hunter River systems. Comparison of surface water quality data for Anvil Creek (with a maximum recorded electrical conductivity of 2400 µS/cm) and the upstream sections of Big Flat Creek (which has a maximum electrical conductivity of 50500 µS/cm) indicates that the majority of the salt in the Big Flat Creek system is being generated upstream of the area serviced by the mine water management system.

Soil testing undertaken as part of the Project indicates that soils in the Project Area that are suitable to be used to topsoil reshaped landforms are typically non-saline and hence are unlikely to generate saline runoff or contribute significantly to existing salt loads in the Big Flat Creek system.

As a result, the project is unlikely to increase total salt loads in the Big Flat Creek system. Reductions in annual discharge as a result of the Project may, however, cause minor increases in salt concentrations but not the total salt load in discharges from Big Flat Creek. Salt concentrations in Big Flat Creek flows will continue to be substantially diluted by flows in the Wybong Creek system, which are on average approximately 15 times greater than Big Flat Creek flows.

5.2.6 Surface Water Management Commitments

Centennial acknowledges the importance of protection of local water resources and has committed to the following key measures to minimise surface water impacts from the Project:

- Surface water controls have been designed to ensure that clean runoff is separated from runoff within disturbed mining and infrastructure areas. Sediment and erosion controls have been designed to ensure any runoff from disturbed areas is appropriately treated.

- The Conceptual Mine Plan has been modified to avoid the need for any diversion of Big Flat Creek.

- The drainage lines to be constructed as part of the final landform where Anvil Creek now exists will be designed and constructed to provide a stable vegetated channel with a natural appearance that blends in with any adjoining riparian areas. Native trees and shrubs will be planted along the drainage alignment to enhance the long term stability of the drainage system and to provide suitable habitat for native fauna.

- A comprehensive water quality monitoring program will continue to monitor the surrounding surface water quality over the life of the operation.

Centennial is also committed to contributing to broader catchment management with the objective of improving water quality in the local area. In this regard, Centennial plans to conduct tree planting and other land management activities in association with relevant stakeholders, in order to address specific existing issues such as dryland salinity in Big Flat

Creek catchment. This commitment has been discussed in relation to the Wybong Uplands Land Management Strategy in **Section 5.1.5.1**.

5.3 Groundwater

A comprehensive assessment of potential groundwater impacts associated with the Project has been undertaken by Mackie Environmental Research Pty Ltd (MER). In accordance with the DGRs for the Project the groundwater assessment includes detailed modelling of potential groundwater impacts and mitigation measures to protect the supply of water to landowners and the environment in the region

The full assessment report is included in **Appendix 8**, with a summary provided in this section.

5.3.1 Existing Groundwater System

Groundwater levels were initially measured in June 2003 and regular groundwater monitoring of approximately 53 bores (**Figure 5.11**) has been undertaken on a bi-monthly basis since October 2004. These bores are routinely analysed for a range of parameters including groundwater level, pH, and Electrical Conductivity (EC). Further analyses (including salts, heavy metals, and major ions) have been undertaken from a selection of holes to characterise the groundwater resource in the area. In addition, data loggers have been installed at ten sites which record water table level every eight hours.

5.3.1.1 Regional Hydrogeology

The regional groundwater system comprises a shallow unconfined aquifer associated with alluvial deposits and weathered bedrock along the main drainages, and a deeper confined system associated with the coal seams.

The coal measures strata provide limited groundwater storage and transmission capacity, and the interburden and overburden lithologies possess very low hydraulic conductivities. Consequently, groundwater transmission characteristics are more likely governed by the occurrence and frequency of jointing than by intergranular flow.

5.3.1.2 Groundwater Levels and Gradient

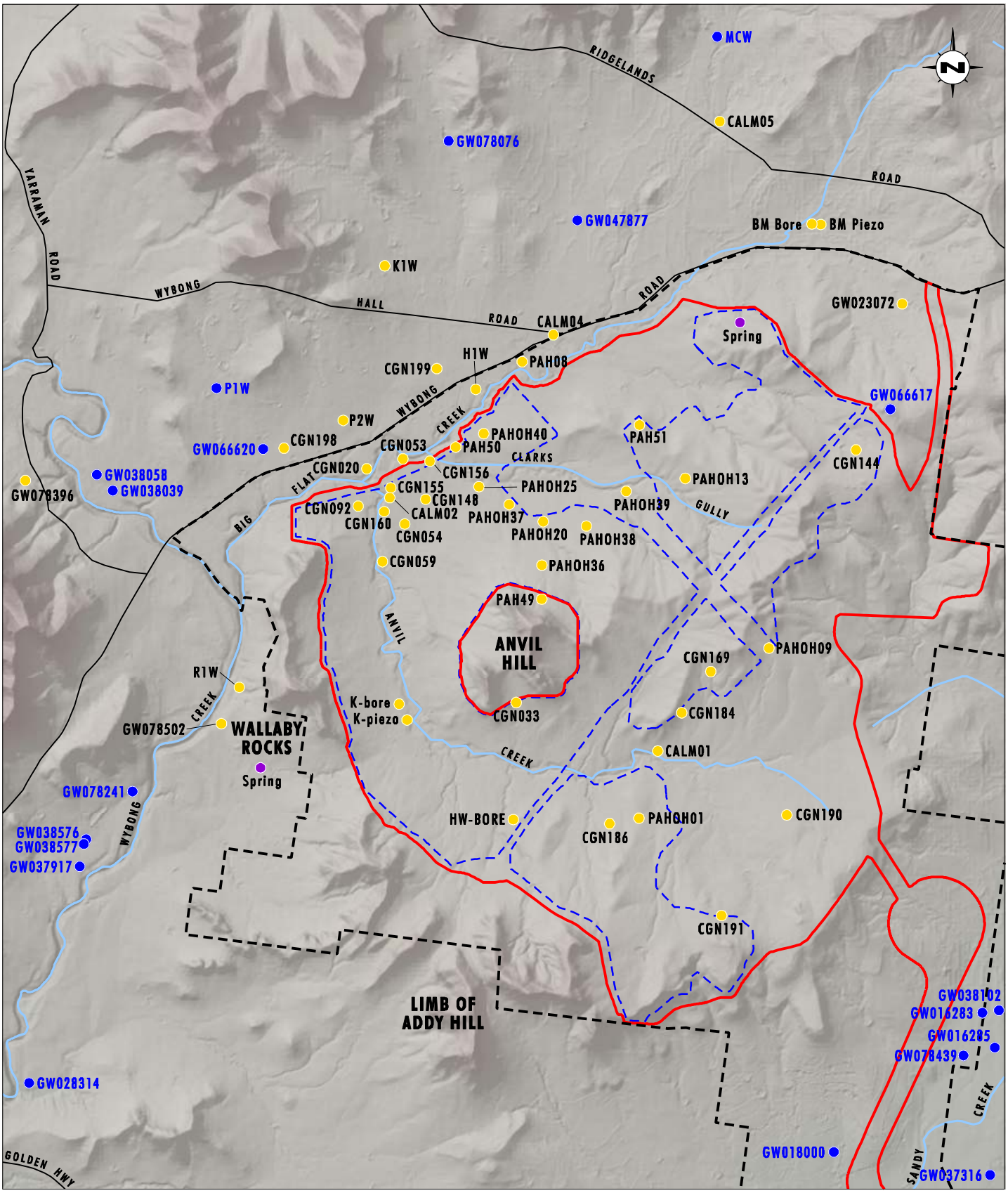
Figure 5.12 provides an indication of approximate groundwater levels and flow directions. The groundwater level is sustained by rainfall which infiltrates the alluvium and weathered rock then percolates downwards into the underlying consolidated rock mass.

Reference to **Figure 5.12** indicates a southward or south-westerly gradient in areas north of Big Flat Creek, a westward to north-westerly gradient in the central part of the Project Area, and a flow divide in the southern part of the Project Area.

5.3.1.3 Groundwater Quality

In general, poor quality brackish to saline waters occur within the coal measures and within the alluvium of Big Flat Creek and Anvil Creek. There are occasional exceptions where the shallow weathered bedrock may host relatively fresh water springs.

EC values range from 117 to 23,955 µS/cm with an average of 8425 µS/cm. The highest EC levels generally occur in the alluvium of Big Flat Creek. pH values range from 5.8 to 9.2 with an average of 7.1.



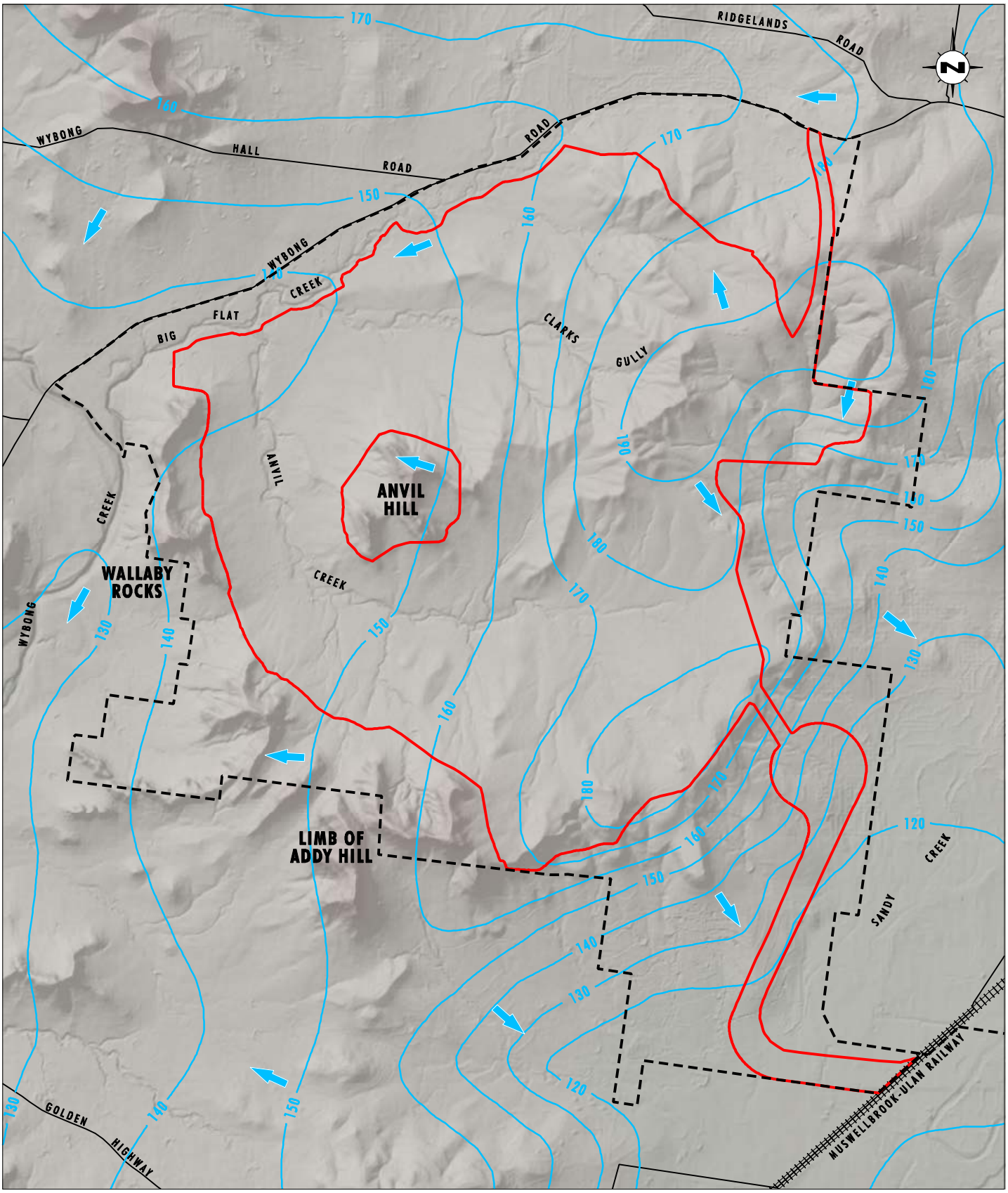
Source: Mackie Environmental Research (2006)
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Some private bore locations may be subject to location error

Legend

- Proposed Disturbance Area
- Project Area
- Proposed Mining Area
- Groundwater Monitoring Location
- Other DNR Registered Private Bore and Well
- Observed Spring

FIGURE 5.11

Groundwater Monitoring Locations and Registered Bores and Wells



Source: Mackie Environmental Research (2006)
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 10m

Legend
- Proposed Disturbance Area
- Project Area
- Groundwater Level (mAHD)
- Flow Direction

FIGURE 5.12

Approximate Groundwater Surface and Flow Directions

Established water quality guideline data is summarised in **Table 5.9** together with typical groundwaters sampled. The sampled groundwaters are shown in italics. Comparison of EC levels suggest groundwaters within the coal measures and many locations sampled within the alluvial deposits, have limited or no beneficial use due to high salinity.

Table 5.9 - Generalised water quality criteria and comparison with regional waters

TDS (mg/L)	Equivalent EC (µS/cm)	Beneficial use
131	202	*weathered bedrock spring*
1000 [1]	1540	Acceptable taste limit for humans
1300 [2]	2000	Approximate limit for lucerne on alluvial lands
1500	2300	General upper limit based on taste
3000 [2]	4600	Limit for poultry and pasture/fodder
3188	4904	*Typical Fassifern Seam groundwater*
4000 [2]	6100	Limit for dairy cattle
8250	12693	*Shallow alluvial groundwater*
9371	14417	*Deeper alluvial groundwater*
32500	50000	Sea water

Source: 1=ADWG - 1996, 2=ANZECC, 2000, Equivalent EC is approximate and depends on specific ions.

5.3.1.4 Existing Groundwater Users

The DNR retains a database of registered bores and wells in NSW. This database includes exploration/test wells which may not have been completed as permanent structures, observation/monitoring bores, and privately owned bores and wells currently in use or abandoned. **Figure 5.11** identifies bore/well locations situated in proximity to the Project. As shown in **Figure 5.11**, the nearest privately owned bores or wells are located in or adjacent to the alluvial lands associated with Big Flat Creek (north and south of Wybong Road) and Anvil Creek. Bores identified as GW078502, K-bore, GW066620, BM bore, GW023072 and GW066617 are either not in use or abandoned due to failure of equipment, failure of the bore structure, or saline water quality. The well identified as R1W is an old timber lined well currently not in use, while wells identified as P1W and H1W are used for stock or domestic purposes depending on water quality.

Further bores are located more than 3 kilometres beyond the proposed mining areas. A number of these are located within Wybong Creek alluvium to the west of the Project Area, and many are located within alluvial lands associated with Sandy Creek to the south-east.

5.3.2 Groundwater Impacts

5.3.2.1 Coal Measure Aquifers

Proposed mining within the Northern Pit and Tailings Pits in the east will be either above the regional groundwater level or only submerged below it in limited areas. Main Pit and Southern Pit in the west and south-west will progressively penetrate the groundwater table in a westerly and down dip direction. This will initiate groundwater depressurisation within the coal seams initially, and subsequently within overlying conglomerates and other strata.

A computer based aquifer model of the region has been developed in order to understand the groundwater flow processes that would evolve during mining. Simulation results indicate that mining would maintain inward draining hydraulic sinks around the mine pits for a distance of up to 500 metres beyond the eastern pits, and distances of approximately 1500 metres to the west and north of Main Pit. Depressurisation of the rock strata may induce minor leakage from the alluvium associated with Big Flat Creek and Wybong Creek (see

Section 5.3.2.2). However, coal measure pressure losses are not predicted to extend to Sandy Creek alluvium or the Hunter River alluvium in the south-east of the area.

While groundwater levels within the mine pits will recover, the long term water levels would not return to pre mining levels since the areas of mine development would exhibit different hydraulic properties to the pre mining conditions. The net effect would be a relatively flat water table over Main and Southern Pits at elevations of about 135 and 150 mAHD respectively due to final void(s) design. These levels are below the regional groundwater level, and hence would create an inward hydraulic sink with respect to the regional groundwater system. The influence of this groundwater sink post mining is estimated to extend up to 500 metres beyond the mined areas when long term equilibrium is attained.

5.3.2.2 Shallow alluvial aquifers

Anvil Creek alluvium would be progressively incised as Main Pit is developed in a westerly direction. Hydraulic testing of the alluvial materials supports low hydraulic conductivities consistent with observed silt and clay strata. Seepage contributions are therefore predicted to be low and manageable.

If necessary, Big Flat Creek alluvium is able to be isolated from Anvil Creek alluvium through the construction of a barrier cut off wall across Anvil Creek at the confluence of these two creeks. Such a wall would inhibit horizontal leakage of saline groundwaters associated with Big Flat Creek alluvium, into Main Pit. However vertical leakage may still occur in a downwards direction via underlying conglomerates and subcropping seams. The rate of this component of leakage is predicted to be low and in the order of 0.027 to 0.054 litres per day per square metre of alluvium in the potentially affected area. Since Big Flat Creek groundwaters are generally saline with no identifiable beneficial use, leakage impacts are considered to be small.

The maximum rate of leakage from Wybong Creek alluvium is also predicted to be low and of the order of 0.009 to 0.019 litres per day per square metre of alluvium within the potentially affected area, and would be reduced to a negligible rate when water levels in the final voids equilibrate.

5.3.2.3 Potential Impacts on Groundwater Users

There are only two identified boreholes (GW066620 and GW078502) located within the coal measures that may be 'yield affected' within the predicted cone of depressurisation that would surround the mine pits (**Appendix 8**). Bore GW066620 located a short distance to the north-east of Main Pit is decommissioned while bore GW078502 is unequipped and encountered poor yield and poor water quality.

It is possible (but unlikely) that two wells located within or close to Big Flat Creek alluvium may be impacted (H1W, P2W). Yield at these locations may only be affected if leakage from the alluvium is significant and drought conditions prevail. Otherwise rainfall recharge is expected to maintain existing well yields.

Weathered bedrock seeps that are accessed by wells in areas north of Big Flat Creek are unlikely to be affected unless specific hydraulically transmissive structural features (for example, faults), provide direct conduits to strata within the proposed mine pit(s). No such structures have been identified to date. Wells and bores located within Wybong Creek alluvium to the west or in Sandy Creek alluvium to the south-east, will not be impacted.

5.3.2.4 Impacts on Groundwater Quality

Groundwater quality within the coal measures and the alluvial lands would not be impaired by mining operations. Indeed it is possible that in some areas, the slow leakage of saline

water from the strata and in particular the alluvial lands, may lead to partial flushing and replacement by improved quality groundwater in the long term.

In addition, mine final void water is expected to remain largely isolated from the regional coal measures and alluvials through the maintenance of inward hydraulic gradients during the recovery process and an evaporative sink condition that would continue to attract groundwater flow to the voids (at low rates) in the long term. Regional water quality impacts are therefore considered to be minimal.

5.3.2.5 Mine Water Make and Quality

Total seepage entering the mine pits for average rainfall recharge conditions is predicted to rise from a rate of less than 0.5 ML per day during the first year of mining to a maximum rate of about 1.8 ML per day in Year 10, declining thereafter to a rate of about 0.9 ML per day at the completion of mining in Year 21.

The quality of groundwater entering the mine pits is expected to reflect an average of water quality for the coal measures (excluding Big Flat Creek alluvium). Salinity levels are expected to fall in the range 853 to 12,508 µS/cm with a likely average value of 4904 µS/cm (Total Dissolved Solids (TDS) of 3200 mg/L) determined from coal measure water samples.

Based on a salt load estimate generated through leachate trials on interburden core samples, the final void water salinity is estimated to fall in the range 3250 to 5650 mg/L. Acid forming characteristics of spoils have been examined and all samples (used in leachate trials) have been found to be non acid forming. Consequently, pH of the final void water is predicted to be in the range 6.5 to 9.0.

5.3.2.6 Potential Cumulative Impacts

As stated in **Section 5.3.2.1** above, the inward draining hydraulic sinks around the mine pits are predicted to be a maximum of approximately 1500 metres during mining, and 500 metres when long term equilibrium is attained. The nearest mining operation to the Project is Bengalla Mine which is located approximately 12 kilometres to the east. Therefore, no cumulative groundwater impacts are predicted.

5.3.3 Groundwater Management and Monitoring Commitments

Centennial acknowledges the importance of protection of local water resources and has committed to the measures outlined below to minimise groundwater impacts from the Project. These measures focus on monitoring and contingency measures to protect the supply of water to landowners and the environment in the region.

- The existing groundwater monitoring bore locations will be maintained and a number of additional bores will be constructed at new locations beyond the mine pit areas, and in spoils following reshaping. Locations for these piezometers will be subject to consultation and agreement with DNR. These bores will be monitored every two months for a range of parameters including water table level, pH, and EC and further analyses every six months for TDS, major ions, and heavy metals. Daily monitoring of water levels by automatic data loggers at existing piezometers and in selected new piezometers will continue. Analyses of this data will include comparison against model predictions, establishment of triggers for remedial action, expert review as required, and reporting to regulatory agencies at appropriate intervals.

- As discussed in **Section 5.3.2.3**, it is possible (but unlikely) that two existing groundwater wells not owned by Centennial may be affected by the Project. If the data obtained from the groundwater monitoring program indicates that the Project is having an adverse effect on these groundwater users (that is, reduced groundwater yield from existing wells), then

the water supply would be reinstated by Centennial either by deepening the existing well, construction of a new well or by providing an alternate water supply.

- If monitoring indicates it is required, a barrier cut off wall within the alluvium associated with Big Flat Creek will be constructed to limit groundwater seepage into the mine.

- Final voids have been designed to intercept leachate from overburden emplacement areas and minimise discharge of saline groundwater. These have been sized to ensure they do not overflow. Final void design will be reviewed at least three years prior to anticipated mine closure.

- Analyses of the monitoring data will include comparison against model predictions, establishment of triggers for remedial action, expert review as required, and reporting to regulatory agencies at appropriate intervals. The monitoring results and the analyses will be compiled into the AEMR for review by the relevant government agencies. The AEMR will also be publicly available for review by the local community and any other interested parties.

5.4 Flora and Fauna Assessment

During the consultation process, the clearing of land for development of the Project and impacts on native flora and fauna were raised as key issues. The DGRs for the Project seek a Flora and Fauna assessment that includes:

- assessment of impacts on critical habitats, threatened species, populations, ecological communities and native vegetation; and

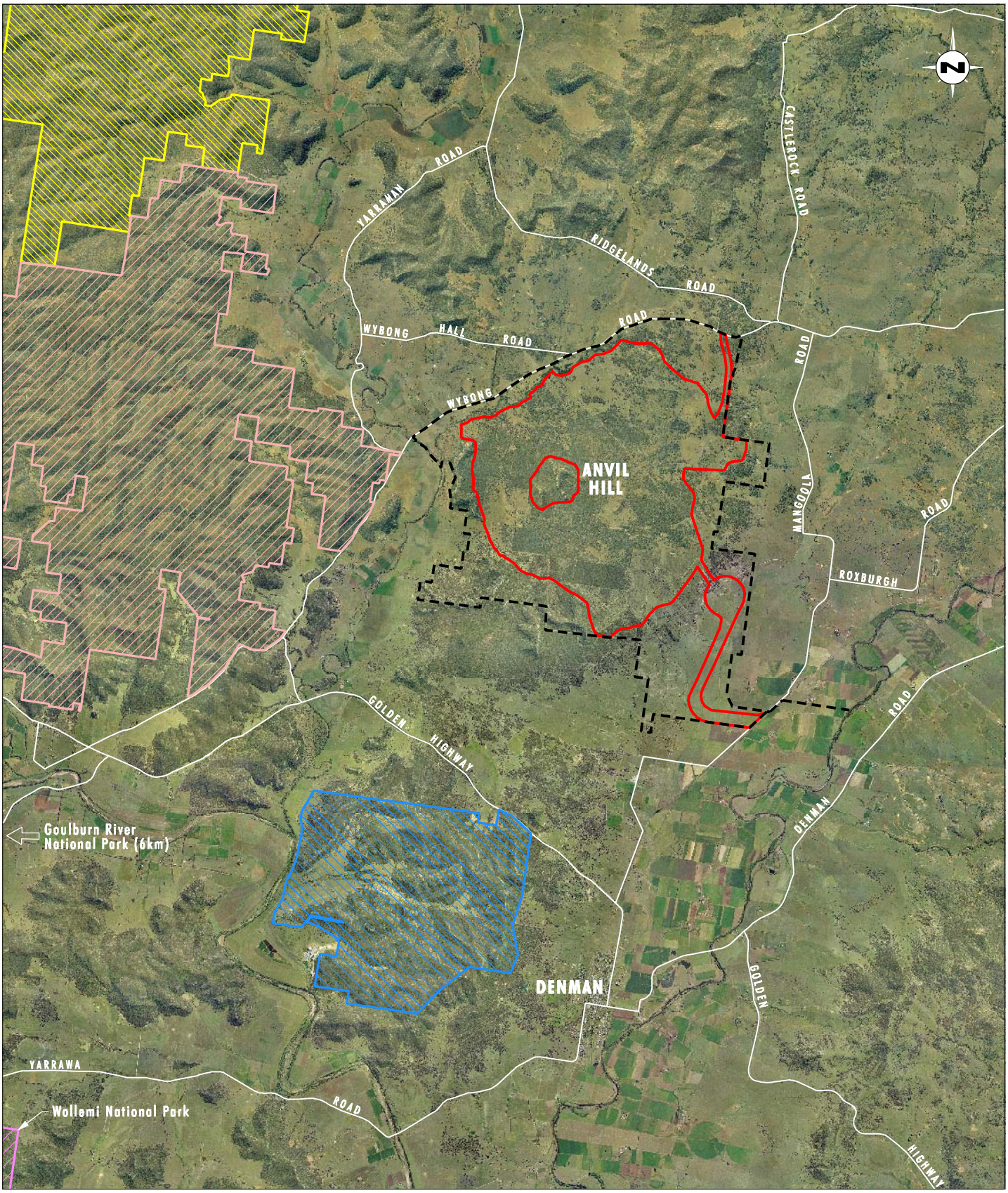
- a comprehensive offset strategy as part of the mitigation measures to ensure that there is no net loss of flora and fauna values in the area in the medium to long term.

A comprehensive Ecological Assessment was undertaken by Umwelt over three years and throughout all seasons to assess the impact of the Project on native flora and fauna. A full copy of the assessment is included in **Appendix 9** and it is summarised in this section.

5.4.1 Background

The Ecological Assessment included extensive field work to identify the major vegetation communities and flora and fauna species both within the Proposed Disturbance Area and surrounding areas. The study area for the ecological assessment comprises 4142 hectares with approximately 2238 hectares of this area proposed to be disturbed by the Project (Proposed Disturbance Area). The remaining area (1904 hectares) occurs within land that was considered to have potential to be managed for conservation as an offset for ecological impacts from the Project (Proposed Offset Areas).

The study area is located in the upper Hunter Valley, on the margin of the valley floor. The areas surrounding the study area are predominantly composed of two broad vegetation types: rugged escarpment woodlands and heaths; and valley floor woodlands and derived pastures. These in turn support the broad fauna habitat types of grassland, riparian, woodland, aquatic and escarpment habitat. Two national parks and one nature reserve lie within 10 kilometres of the Project Area, and Myambat Military Area, which supports a diverse array of native plants and animals, is situated about 3 kilometres to the south (refer to **Figure 5.13**). Existing “stepping stone” corridors connect the study area to Myambat Military Area, as well as to extensive areas of Crown land to the north.



Source: Peake (2006), Umwelt (2006)
Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images

0 1 2.5 5km

Legend

- Proposed Disturbance Area
- Project Area
- Myambat Military Area
- Manobalai Nature Reserve
- Bell (1997) Manobalai Study Area

FIGURE 5.13

Regional Area and Existing Conservation Areas

The study area has been extensively used for agriculture since the 1800s and is dominated by undulating grazing land with remnant and regrowth woodland. An aerial photo showing the extent of clearing in 1930 is shown in **Figure 5.14**. There has been extensive regrowth on the site, as shown by comparison with **Figure 1.2**, which shows a more recent aerial photograph of the site.

Travis Peake (2006) has recently completed a study on behalf of the Hunter-Central Rivers Catchment Management Authority (HCRCMA), referred to as the Hunter Remnant Vegetation Project. That study covered 315,000 hectares stretching from Scone in the north to Denman in the south-west and Branxton in the south-east, and included the land now included in the Project Area. Peake (2006) found that approximately 65% of all remnant vegetation on the Hunter Valley floor occurs within a few remnants that are over 100 hectares, with the largest, at Myambat Military Area near Denman, being approximately 2250 hectares. The second-largest remnant mapped was in an area referred to as the Wybong Uplands which covers 2067 hectares and includes vegetation within the Project Area.

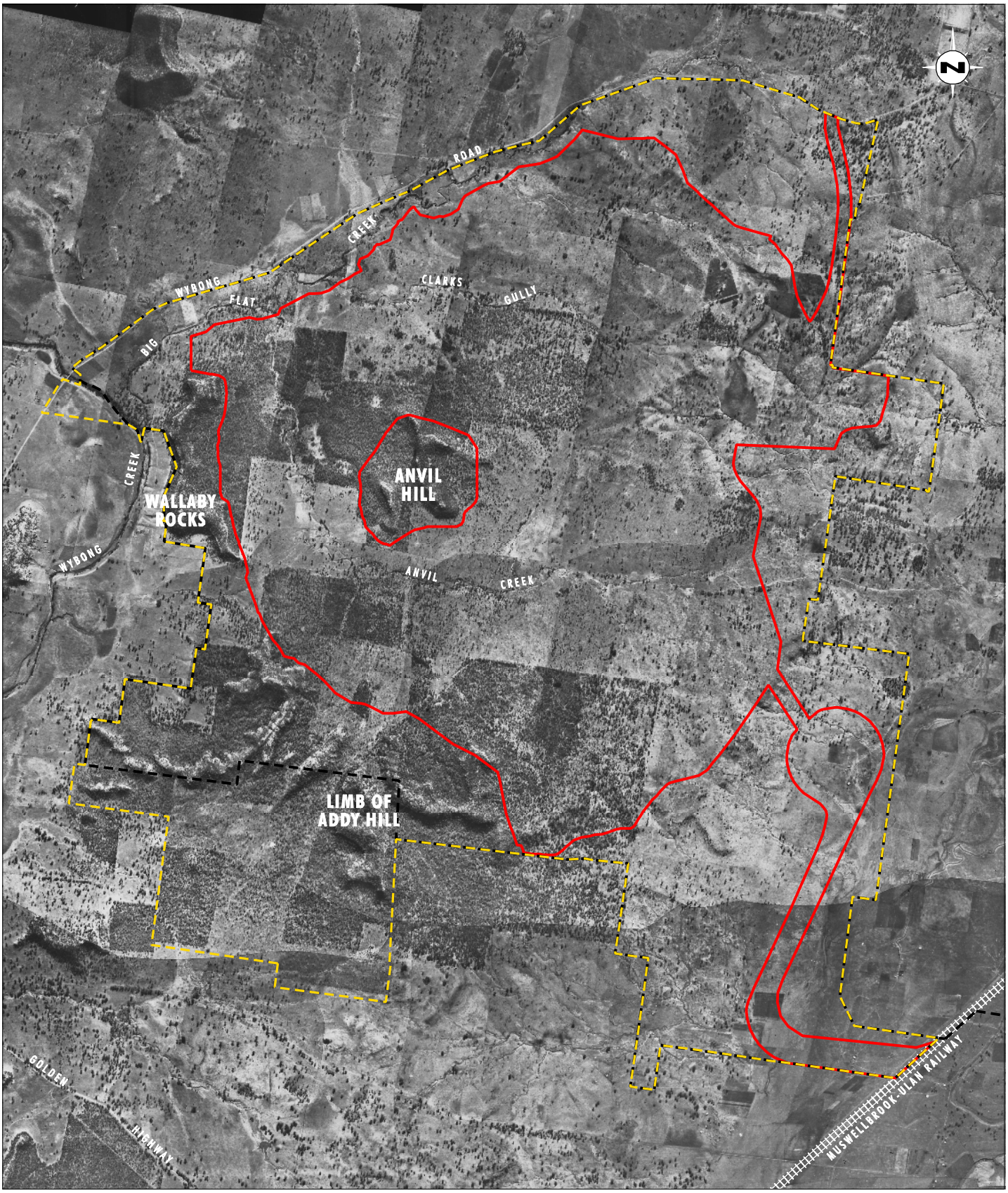
5.4.2 Methods

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the study area. The survey strategy was developed in consultation with DoP and DEC, and covered the entire study area, including both the Proposed Disturbance Area and Proposed Offset Areas. The methods commenced with a detailed literature review, including searches of all relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design an extensive field survey program to map and survey vegetation communities, and to target threatened species, endangered populations, endangered ecological communities (EECs), or their habitats, including aquatic features. A similar level of survey effort was undertaken across both the Proposed Disturbance Area and Proposed Offset Areas as part of this field program.

Vegetation mapping was initially based on the regional mapping undertaken by the HCRCMA to ensure consistency with regional data, and refined through floristic sampling and extensive ground-truthing.

The flora survey program included extensive plot-based sampling at 141 sites, and 73 kilometres of targeted threatened flora walking transects. Flora surveys were conducted in all seasons and in all months except January, August and November. The fauna survey program was undertaken in all seasons, and included the use of all standard survey techniques, including terrestrial and arboreal trapping and hair tube sampling, harp trapping, pitfall trapping, spotlighting, call playback, Anabat echolocation call detection and analysis, reptile searches, amphibian searches, bird searches, and analysis of scats, scratches, tracks and characteristic calls. Koala habitat was assessed at 158 sites. Surveys of the aquatic environments were undertaken at 22 sites through the use of dip nets, baited fish traps, habitat assessments and aquatic flora sampling.

A rigorous ecological condition assessment was also conducted across the study area to assist in the development of the comprehensive Biodiversity Offsets Strategy. This condition assessment was designed to enable the direct comparison of habitat types and overall ecological condition between the Proposed Disturbance Area and Proposed Offset Areas. Sampling was directed towards the collection of data relevant to the habitat requirements of key threatened species. Eighty-five sites were sampled, as well as 34 farm dams.



Base Map: United Photos (2006), ortho-rectified by Umwelt

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Project Area
- Ecology Study Area

FIGURE 5.14

1930s Aerial Photograph of Project Area and Surrounds

5.4.3 Flora Results

5.4.3.1 Plant Species

In total, 597 plant species were recorded in the study area from all surveys. These comprised trees, tree mallees, shrubs, forbs, grasses, sedges, rushes, reeds, ferns, lithophytes, epiphytes, mistletoes, vines and twiners. Of the plants recorded, 95 (15.9%) were not native to the study area. Six noxious weed species (1% of the flora of the study area), were recorded.

5.4.3.2 Native Vegetation Communities

Seventeen vegetation communities were recorded in the study area (see **Figure 5.15**):

- eight woodland vegetation communities;
- five riparian and floodplain vegetation communities;
- three shrubland vegetation communities; and
- one grassland community.

Grassland (934 hectares) and two woodland vegetation communities (Ironbark Woodland Complex (886 hectares) and Slaty Box Woodland (245 hectares)) cover most of the study area. Most other vegetation communities occur in specific landscape positions, such as floodplains, rocky ridges or steep, sheltered slopes, which are small, restricted locations.

Approximately 1304 hectares of treed vegetation communities are located in the Proposed Disturbance Area, as shown on **Figure 5.15**, whilst approximately 1037 hectares of treed vegetation communities are located in the Proposed Offset Areas.

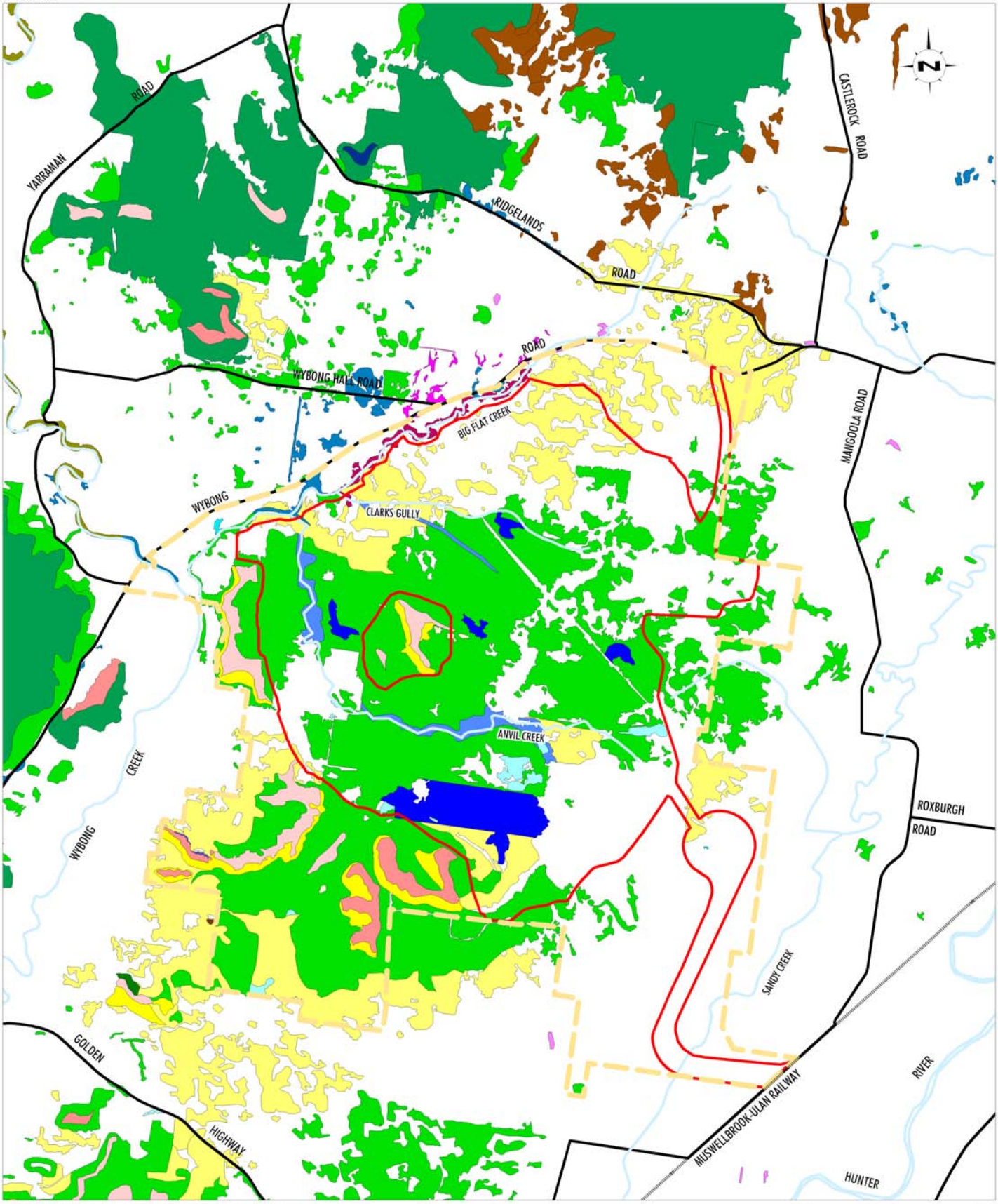
An analysis of aerial photographs dating back to 1967 and to the 1930s (refer to **Figure 5.14**) shows that the vegetation of the study area has been extensively cleared and modified. Some areas, such as the core of woodland vegetation that was present in the 1930s, still exist around Anvil Hill, Wallaby Rocks, Limb of Addy and the Western Rocks. For the most part, however, the vegetation is regrowth that has occurred since extensive clearing.

5.4.3.3 Threatened and Ecologically Significant Vegetation

A total of six flora species, two endangered populations and one EEC listed under the *Threatened Species Conservation Act* 1995 (TSC Act) were recorded in the study area. Of these, five species are also listed as threatened under the *Environment Planning and Biodiversity Conservation Act* 1999 (EPBC Act).

Of these, the majority of species and records occur within the more intact Proposed Offset Areas to the south of the Proposed Disturbance Area. Only one of the six threatened species, narrow goodenia (*Goodenia macbarronii*), occurs extensively within the Proposed Disturbance Area (refer to **Figure 5.16**).

The one EEC, Weeping Myall Woodland, occurs mainly within the Proposed Offset Areas, with an isolated occurrence in the centre of the proposed rail loop.



Source: Peake (2006), Umwelt (2006)

0 1 2 km

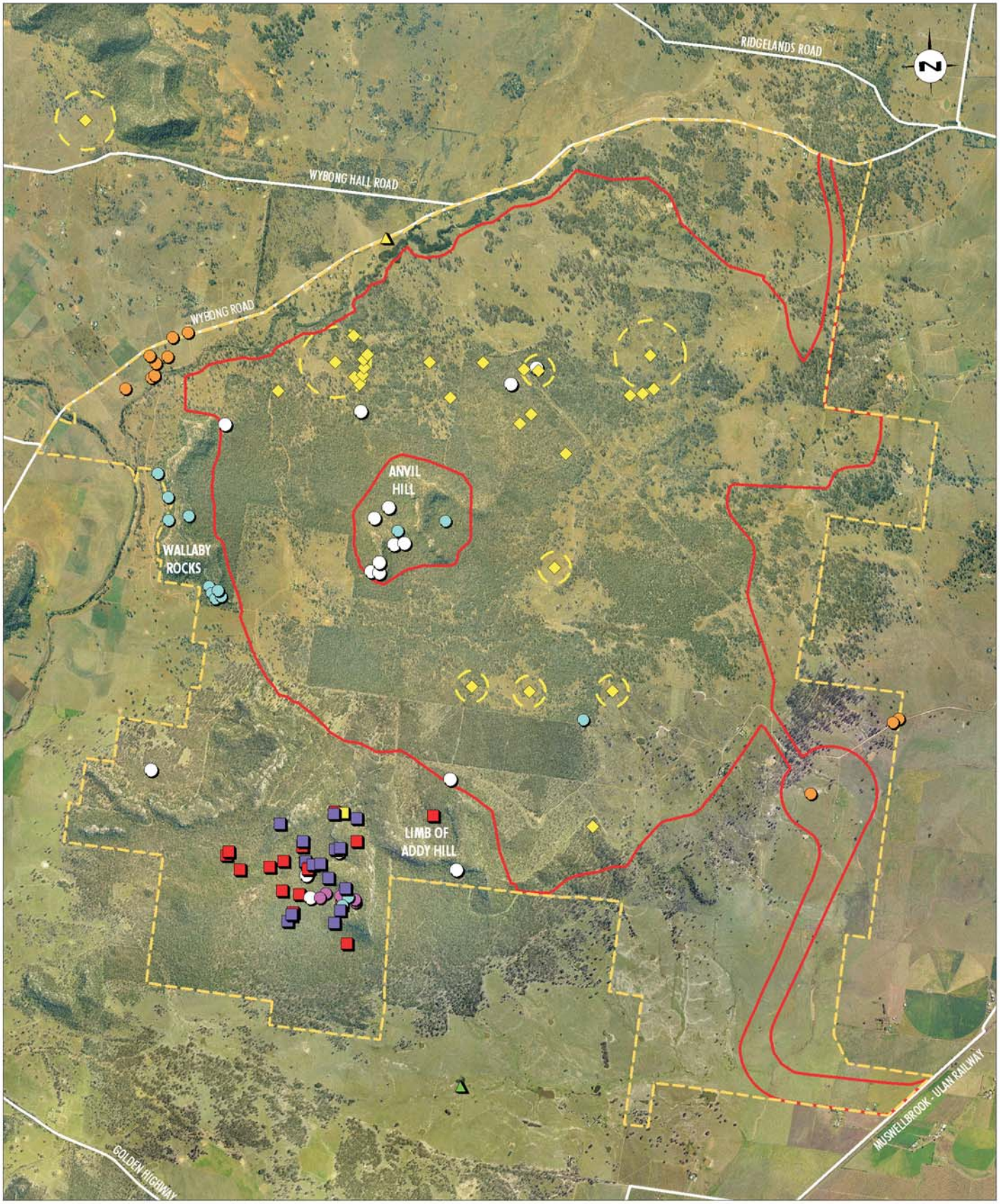
Legend

- Proposed Disturbance Area
- Ecology Study Area

- Slaty Box Woodland
- Ironbark Woodland Complex
- Bulloak Woodland
- Exotic Rushland
- Sheltered Grey Gum Woodland
- Weeping Myall Woodland
- Spotted Gum Open Forest
- Ironbark-Wattle Low Exposed Woodland Complex
- Red Ash Sheltered Forest
- Swamp Oak Riparian Forest
- Disturbed Grassland
- River Oak Riparian Forest
- Rough-barked Apple Woodland
- Tall Mixed Shrubland Complex
- Coast Myall Exposed Woodland
- Forest Red Gum Riparian Woodland
- Mixed Species Revegetation/ Plantation
- Drooping Sheoak Woodland
- Paperbark Woodland
- Cypress Pine Woodland
- Low Shrubland
- Currawang Tall Woodland

FIGURE 5.15

Vegetation Distribution



Source: DEC Atlas of NSW Wildlife (2006), National Herbarium of NSW (2006), Umwelt (2006), HLA Envirosciences (2003)

Base Map :Dept. Of Lands (2003), ortho-rectified by Plateau Images

0 1 2 km

Legend

- Proposed Disturbance Area
- Ecology Study Area

- *Acacia pendula*
- *Bothriochloa biloba*
- *Commersonia rosea*
- *Cymbidium canaliculatum*
- *Diuris tricolor*
- *Goodenia macbarronii* (areas)
- *Goodenia macbarronii sites*
- *Grevillea montana*
- *Pomaderris queenslandica*
- *Lasiopetalum longistamineum*
- *Pomaderris reperta*

FIGURE 5.16

Threatened and Significant Flora Locations

5.4.4 Fauna Results

A total of 188 fauna species were recorded in the study area, with 166 of these species being recorded within the Proposed Disturbance Area, and 179 of these species being recorded in the Proposed Offset Areas. The total species count comprised 122 bird species, 13 reptiles, 9 amphibians and 44 mammals.

5.4.4.1 Threatened and Significant Fauna

A total of 19 fauna species listed as threatened under the TSC Act were recorded in the study area (refer to **Figure 5.17**), including two species listed as Vulnerable under the EPBC Act. In addition to this, four migratory species as listed under the EPBC Act were recorded within the study area. Of the threatened species, nine were birds, seven were micro-bats and three were other mammals. The latter includes the brush-tailed rock-wallaby (*Petrogale penicillata*), which was recorded in the Proposed Offset Areas through the presence of old scats, but is now regarded as being locally extinct in the study area. No koalas (*Phascolarctos cinereus*) or koala scats were identified in any part of the Proposed Disturbance Area despite a significant level of survey effort, however koala scats were recorded from one site in the Proposed Offset Areas. As a result, the Proposed Disturbance Area is not considered to provide koala habitat.

The condition assessment showed that, apart from riparian areas, there is in general higher quality of habitat present for most of the key threatened fauna species in the Proposed Offset Areas.

Aquatic Fauna

A total of 24 aquatic fauna species were recorded during the aquatic survey of the study area and adjoining areas, comprising three vertebrate and 21 invertebrate species. No threatened aquatic species were recorded during the assessment and none are expected to occur.

5.4.5 Impacts

5.4.5.1 Avoidance of Impacts

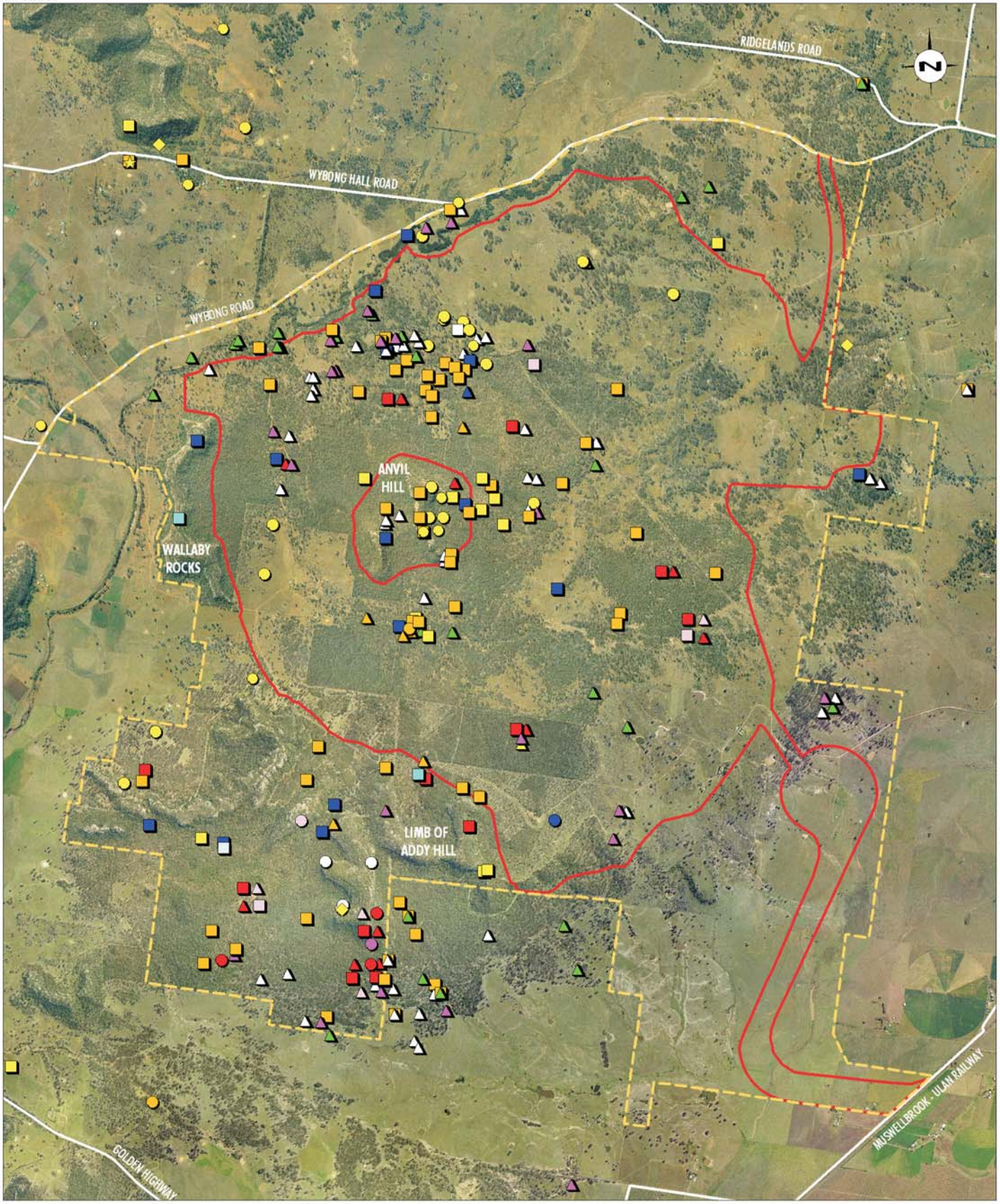
During the planning phase of the project, a number of refinements were made in order to reduce the overall impact on particular threatened species and ecological features. These included:

- the increased protection of a stand of drooping sheoak (*Allocasuarina verticillata*), which is an important feed tree for the threatened glossy black-cockatoo (*Calyptorhynchus lathami*);

- the reduction of the Proposed Disturbance Area boundary around the base of Anvil Hill in order to reduce potential for blasting impacts on potential roosting areas for cave-dependent micro-bats;

- reduction in the Proposed Disturbance Area boundary along the floodplain of Big Flat Creek, which assisted in the protection of the associated floodplain vegetation communities, a number of which are considered to be regionally significant, and also allowed for the retention of an important internal ecological corridor;

- agreement to protect significant ecological features within the Proposed Offset Areas, such as a number of small populations of weeping myall (*Acacia pendula*), which is an endangered population and an EEC; and



Source: Birds Australia (2006), DEC Atlas Of NSW Wildlife (2006), HCRCMA (1999), Umwelt (2006), HLA Environsciences (2003), Australian Museum (2006)

Base Map :Dept. Of Lands (2003), ortho-rectified by Plateau Images

0 1 2 km

Legend

- Proposed Disturbance Area
- Ecology Study Area

- Babbler nest
- Brown treecreeper
- Diamond firetail
- Glossy black-cockatoo
- Grey-crowned babbler
- Hooded robin
- Masked owl
- Painted honeyeater
- Powerful owl
- Rainbow bee-eater
- Satin flycatcher
- Speckled warbler
- Turquoise parrot
- White-bellied sea eagle
- White - throated needletail
- Brush-tailed rock-wallaby scat
- Koala scats
- Squirrel glider
- Eastern bentwing-bat
- Eastern cave bat
- Eastern freetail-bat
- Eastern false pipistrelle
- Greater broad-nosed bat
- Large-eared pied bat
- Large-footed myotis

FIGURE 5.17

Threatened and Migratory Fauna Locations

- facilitation of a survey of *Pomaderris reperta* by the Pomaderris Study Group from the Royal Botanic Gardens Melbourne for consideration of a conservation program for this species in the Proposed Offset Areas.

5.4.5.2 Impacts without Mitigation

Without mitigation, the Project has the potential to result in a variety of impacts on the ecological features of the study area. The majority of these impacts will be direct impacts from the establishment and construction of the mine, however there are also likely to be ongoing impacts as a result of the operation of the mine.

It was assumed for the purpose of this assessment that all vegetation within the Proposed Disturbance Area will be removed during the life of the mine, totalling 1304 hectares. The dominant vegetation formation within the Proposed Disturbance Area is Woodland, and there will be a gradual removal of this vegetation over each of the mine stages, as discussed in **Section 5.1.3**.

Based on assessment without mitigation, the Project is likely to or could possibly have a significant impact on two threatened plant species, painted diuris (*Diuris tricolor*) and narrow goodenia. The latter species is subject to a current nomination for de-listing. The remaining plant species, endangered populations and EEC are not expected to be significantly impacted by the Project, as they are not considered likely to occur in the Proposed Disturbance Area or, if likely to be present, will only be impacted to a minor level.

It is considered that the Project is likely to or could possibly have a significant impact on 13 threatened fauna species, comprising the brown treecreeper (*Climacteris picumnus victoriae*), speckled warbler (*Pyrrholaemus sagittata*), hooded robin (*Melanodryas cucullata cucullata*), grey-crowned babbler (*Pomatostomus temporalis temporalis*), diamond firetail (*Stagonopleura guttata*), squirrel glider, eastern freetail-bat (*Mormopterus norfolkensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), eastern false pipistrelle (*Falsistrellis tasmaniensis*), large-eared pied bat (*Chalinolobus dwyeri*), large-footed myotis (*Myotis adversus*), greater broad-nosed bat (*Scoteanax rueppellii*) and eastern cave bat (*Vespadelus troughtoni*).

A detailed assessment and justification for these determinations is included in **Appendix 9**.

5.4.6 Ecological Management Commitments

5.4.6.1 Biodiversity Offset Strategy

In order to address the overall goal of no net loss of flora and fauna values in the study area in the medium to long term, Centennial is committed to a range of impact mitigation strategies, developed to minimise the overall impact of the Project on threatened species, endangered populations, EECs or their habitats. Specifically, a Biodiversity Offset Strategy is proposed to reduce the severity of the predicted impacts on key threatened species within the study area, such that the level of impact over time will be negligible or may indeed be positive. The Biodiversity Offset Strategy consists of a number of components that collectively aim to:

- replace habitat removed from the Proposed Disturbance Area;
- increase the quality of habitat within the Proposed Offset Area; and
- provide access/egress into and out of the study area through a network of ecological corridors.

The protection of the Proposed Offset Areas is proposed as an immediate ecological outcome to offset the impacts of the Project. It will assist in the protection of a diverse range of threatened flora and fauna species, two endangered populations and one EEC, and will link in with the Conceptual Corridor Strategy, habitat augmentation and Ecological Management Plan to provide for the continued viability of the biodiversity of the local area. The Proposed Offset Areas cover an area of 1924 hectares, of which 1037 hectares are covered by treed vegetation. The largest area is the southern Proposed Offset Area around Limb of Addy Hill, which is for the most part covered by intact treed vegetation.

Other significant treed areas occur at Anvil Hill and Wallaby Rocks, while the Proposed Offset Areas around Big Flat Creek and in the north-east and east of the study area are covered by fragmented woodlands. The Proposed Offset Area in the south-east has been extensively cleared, with only a few relatively small remnants remaining.

It is proposed that most of the Proposed Offset Areas will be protected and managed in the long-term for biodiversity conservation. A small area in the south-east will be managed for agricultural purposes, due to the presence of areas of high land capability that will support agricultural production. This will enable continued agricultural activity to take place in the area.

Of the twelve natural vegetation communities that will be entirely, or mostly, protected within the Proposed Offset Areas, four are of botanical significance, including one EEC. Five threatened flora species occur within the Proposed Offset Areas, as well as one ROTAP species. In particular, *Commersonia rosea* is a recently-described species previously known from only four sub-populations in the Sandy Hollow district. Its protection in the Proposed Offset Areas represents a significant conservation opportunity. Two endangered plant populations occur within the Proposed Offset Areas: weeping myall (*Acacia pendula*) and tiger orchid (*Cymbidium canaliculatum*).

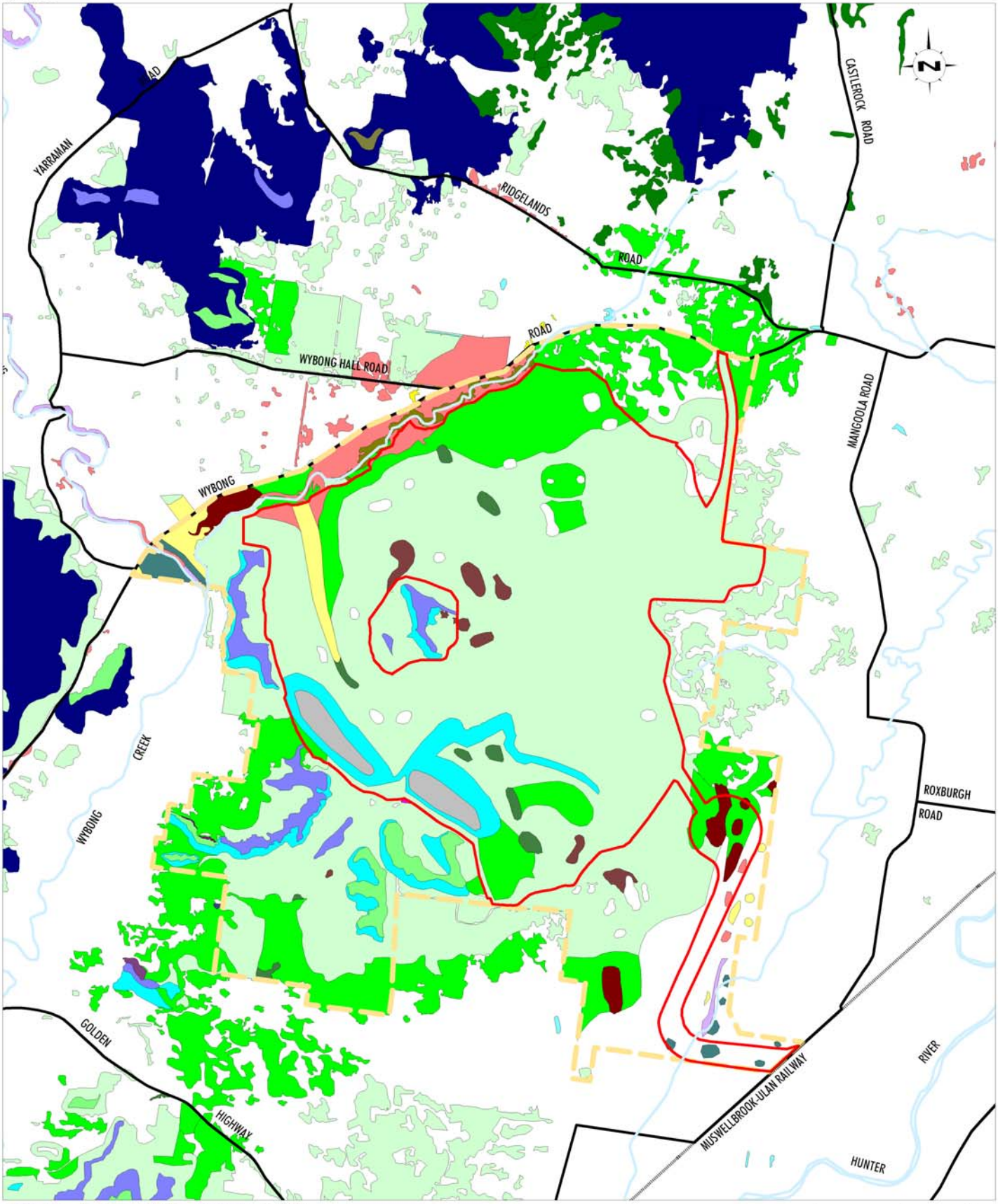
The Proposed Offset Areas comprise a diverse array of fauna habitats, and include representation of all four vegetation formations mapped in the study area. Despite the more restricted extent of fauna habitat available in the Proposed Offset Areas, these areas generally contain higher quality habitat for most of the key threatened fauna species. Nineteen threatened fauna species were recorded in the study area, of which 17 occur in the Proposed Offset Areas. Finally, the Proposed Offset Areas support significant aquatic habitat in Big Flat Creek.

The details of the proposed Conservation and Enhancement Areas are also discussed in **Section 5.1**.

5.4.7 Other Management Commitments

These components will be detailed in an Ecological Management Plan, and include:

- the progressive revegetation of the post-mining area based on target native vegetation communities (refer to **Figure 5.18**);
- immediate protection and enhancement of existing vegetation in the Proposed Conservation and Enhancement Areas;
- regeneration or revegetation of other areas in the Conservation and Enhancement Areas;
- establishment of internal ecological corridors and external ecological corridors connecting the study area to substantial nearby areas of Crown land and, indirectly, with a national park and a nature reserve;



Source: Peake (2006), Umwelt (2006)

0 1 2 km

Legend

- Proposed Disturbance Area
- Ecology Study Area

- Slaty Box Woodland
- Ironbark Woodland Complex
- Bulloak Woodland
- Exotic Rushland
- Sheltered Grey Gum Woodland
- Weeping Myall Woodland
- Spotted Gum Open Forest
- Ironbark-Wattle Low Exposed Woodland Complex
- Red Ash Sheltered Forest
- Swamp Oak Riparian Forest
- River Oak Riparian Forest
- Rough-barked Apple Woodland
- Tall Mixed Shrubland Complex
- Coast Myall Exposed Woodland
- Forest Redgum Riparian Woodland
- Mixed Species Revegetation/Plantation
- Drooping Sheoak Woodland
- Paperbark Woodland
- Cypress Pine Woodland
- Low Shrubland
- Currawang Tall Woodland
- River Red Gum Floodplain Woodland
- Disturbed Grassland
- Final Void

FIGURE 5.18

Conceptual Revegetation Strategy

- augmentation of existing habitat (including the erection of substantial numbers of nest boxes, and the salvage and repositioning of habitat features such as hollows, boulders and hollow logs);

- impact softening strategies such as the development and application of tree clearing procedures which minimise the risk of directly impacting fauna species, including the use of progressive clearing approaches to reduce the area of impact as much as possible at any one time, which will result in clearing only occurring when and where necessary; and

- the development of an integrated community-based catchment approach to local and regional land use management and activities through a substantial funding package, referred to as the Wybong Uplands Land Management Strategy (refer to **Section 5.1.5**).

5.4.8 Ecological Monitoring

A comprehensive ecological monitoring program is proposed with the aim of monitoring the success of the mitigation measures and includes:

- the collection of systematic floristic data from permanent plots;

- photo-monitoring at permanent plots;

- assessment of flora and fauna species diversity and abundance;

- assessment of habitat losses or gains, incidence of weeds and feral animals, the security of protected areas, the ongoing revegetation and regeneration of vegetation communities, the resilience of ecosystems; and

- landscape function analysis to assess the biogeochemical functioning of the landscape.

The ecological monitoring program will be in action across the study area and external corridors before mining and during its progress, including rehabilitation.

A detailed set of completion criteria will be developed in order to provide an assessment framework for the success of the ecological and rehabilitation management measures. These criteria will relate to the objectives of the retention of existing vegetation, revegetation and regeneration activities, fauna habitat, habitat augmentation and landscape function analysis.

The monitoring program will be detailed as part of the Ecological Management Plan.

5.4.9 Key Outcomes

In conclusion, the ecological survey identified the presence of a diversity of threatened flora and fauna species, two endangered plant populations and one EEC. These occur variously within the Proposed Disturbance Area, Proposed Offset Areas, or both. A high diversity of vegetation communities and both highly intact and highly fragmented fauna habitats were recorded.

Without the application of mitigation measures it is possible or likely that two threatened flora and thirteen threatened fauna species would be significantly impacted by the Project. A comprehensive Biodiversity Offsets Strategy is proposed to mitigate the possible impacts on threatened species, through long-term protection and life-of-mine management of habitat, revegetation, habitat augmentation and the establishment of a network of corridors. Based on the measures proposed to mitigate impacts, it is expected that there will be no net loss of flora and fauna value in the area in the medium to long term.

5.5 Air Quality

A comprehensive Air Quality Impact Assessment has been undertaken by Holmes Air Sciences in accordance with the DGRs for the EA and relevant DEC guidelines. The assessment report is included in **Appendix 10**, with an overview of the assessment provided in this section. A Greenhouse Assessment has also been completed by SEE Sustainability Consulting, as discussed in **Section 5.5.8** and provided in **Appendix 11**.

5.5.1 Climate and Meteorology

5.5.1.1 Monitoring Stations

Two meteorological stations were installed by Centennial in the vicinity of the Project Area in April 2002. The sites are referred to as Wybong Road (WS1) and Coolabah Road (WS2).

The Wybong Road site provides information every 10 minutes on temperature, relative humidity, rainfall, wind speed, wind direction and sigma-theta (the standard deviation of horizontal wind direction).

Ten-minute meteorological data is also collected at the Coolabah Road site, which, in addition to the parameters measured by the Wybong Road site, collects barometric pressure. Sigma-theta, which is commonly used for the determination of atmospheric stability, is not recorded by this station. An examination of the data collected at this site indicated that the 10-minute wind direction data were rounded to the nearest wind sector, assuming there are 16 wind sectors. The resolution of this data was not considered to be sufficient for the purposes of air quality and noise assessments, and there were also a substantial number of hours missing from the datasets. For these reasons, data from the Wybong Road site has been used in the air quality assessment and noise assessment (**Section 5.6**), while the Coolabah Road data has been used for comparative purposes.

5.5.1.2 Wind Speed and Direction

Figure 5.19 shows annual and seasonal windroses prepared from the Wybong Road wind data for 2003.

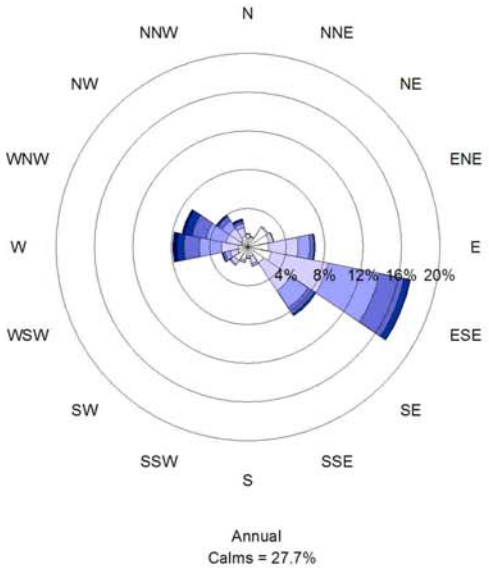
Winds in the central to upper Hunter Valley are commonly aligned along a north-west-south-east axis. It can be seen from **Figure 5.19** that the wind data collected at the Wybong Road site generally follow this pattern albeit rotated anti-clockwise slightly. The steep topography surrounding this site is likely to be the main reason for the wind direction deviation from other sites in the Hunter Valley.

In summer, winds are generally from east-south-east. The pattern of winds in winter shows that the east-south-east winds reduce and are replaced by winds from the west-north-west. Winds in autumn and spring exhibit a combination of summer and winter patterns.

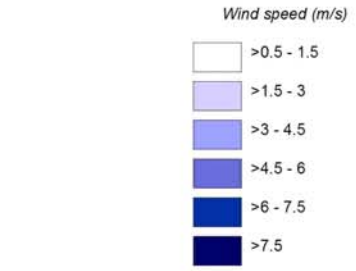
The annual average wind speed in 2003 at Wybong Road was 2.1 m/s and the percentage of hours that wind speeds exceeded 5.4 m/s was 6%.

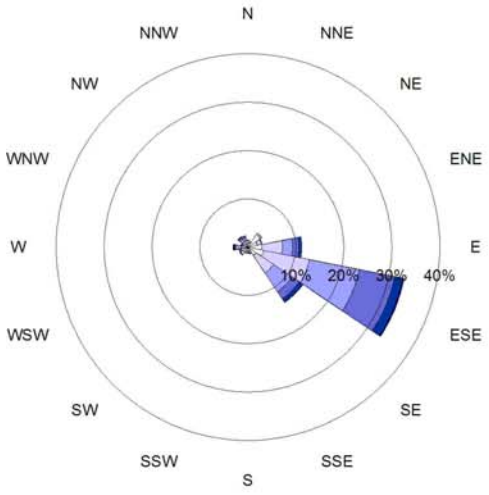
5.5.2 Air Quality Goals

In its guidelines, *Approved Methods and Guidance for the Modelling of Air Pollutants in NSW* (EPA, 2001), the EPA (now DEC) specifies air quality assessment criteria relevant for assessing impacts from mining activities. These criteria relate to dust deposition and dust concentration.

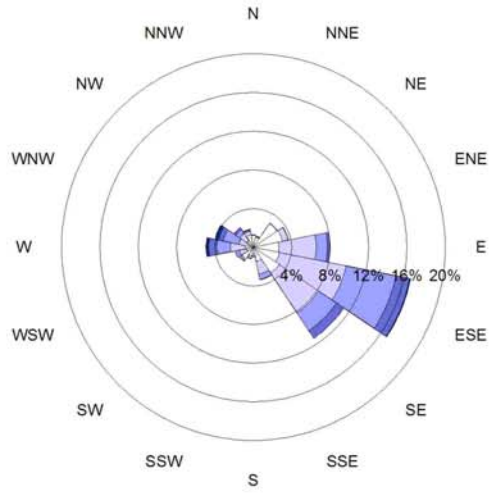


Annual
Calms = 27.7%

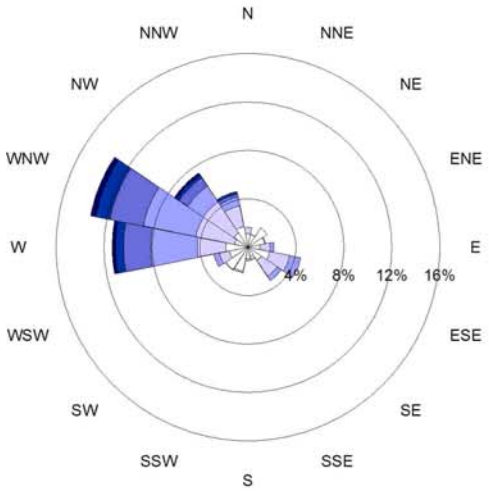




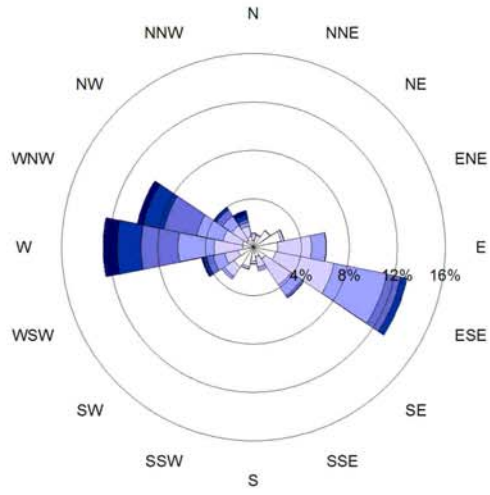
Summer
Calms = 15.2%



Autumn
Calms = 32.1%



Winter
Calms = 37.7%



Spring
Calms = 26.9%

FIGURE 5.19

2003 Annual and Seasonal Windroses for Wybong Road (WS1)

Source: Holmes Air Sciences (2006)

5.5.2.1 Dust Deposition

Dust deposition levels refer to the quantity of dust particles that settle out of the air as measured in grams per square metre per month (g/m²/month) at a particular location. These emissions have the potential to cause nuisance impacts by depositing on surfaces.

DEC expresses dust deposition criteria in terms of an acceptable increase in dust deposition over the existing background levels and a total allowable cumulative level. The maximum allowable increase in the mean annual rate of dust deposition is 2 g/m^2/month due to the Project considered alone, with a total allowable cumulative dust deposition of 4 g/m^2/month due to the Project and other sources.

5.5.2.2 Dust Concentration

Dust concentration refers to airborne dust and is measured in micrograms per cubic metre (µg/m³). Relevant criteria for dust concentration are defined in terms of two classes, total suspended particulates (TSP) and PM_{10}.

TSP relates to all suspended particles which are usually in the size range of zero to 50 micrometres (µm). Particle sizes larger than 50 µm are typically measured in dust deposition levels. The human respiratory system has in-built defensive systems that prevent particles larger than approximately 10 µm from reaching the more sensitive parts of the respiratory system. PM_{10} refers to particulate matter with a diameter less than 10 µm.

Goals for dust concentration are referred to as long term (annual average) and short term (24 hour maximum) goals. Relevant goals for TSP and PM_{10} are outlined in **Table 5.10** in relation to both Project specific and cumulative goals applied at a regional level. The TSP and PM_{10} annual average goals relate to the total dust in the air and ***not*** just the dust from the Project. Therefore, background levels need to be considered when using these goals to assess impacts.

Table 5.10 - Goals for Dust Concentration

Pollutant	Standard/ Goal	Averaging Period	Agency
Total suspended particulate matter (TSP)	90 $\mu g/m^3$	Annual mean	National Health & Medical Research Council
Particulate matter < 10 µm (PM_{10})	50 $\mu g/m^3$	24-hour maximum	DEC
	30 $\mu g/m^3$	Annual mean	DEC
	50 $\mu g/m^3$	(24-hour average, 5 exceedances permitted per year)	National Environment Protection Council

5.5.2.3 Other Emissions

Other emissions from mining activities include sulphur from the combustion of fuel. The sulphur content of Australian diesel is considered to be too low and mining equipment is too widely dispersed over mine sites to cause sulphur dioxide (SO_2) goals to be exceeded, even in mines that use large quantities of diesel. For this reason, a detailed study is not required to demonstrate that emissions of SO_2 from the mine will not significantly affect ambient SO_2 concentrations. Similarly, the potential nitrous oxides (NO_x) and carbon monoxide (CO) emissions are considered too small and too widely dispersed to require a detailed modelling assessment.

5.5.3 Existing Air Quality

5.5.3.1 Dust Deposition

Dust deposition data has been collected in the Project Area and surrounds since March 2002 using a network of 20 dust gauges. The location of these gauges is shown in **Figure 5.20**.

Annual average calculations indicate dust deposition levels typically range between 1 and 2 g/m^2/month. There appears to be little spatial variation for the annual averages although in 2004 and 2005 gauge DG14 to the west-north-west of the Project Area experienced considerably higher levels, on average, than the other established sites. This is likely to be caused by contamination due to bird droppings and cultivation in the areas surrounding the gauge. This gauge has recently been relocated as it is not considered representative of the existing air quality in the area.

5.5.3.2 Dust Concentration

Dust concentration has been monitored by one TSP and two PM_{10} high volume air samplers (HVASs) at two representative locations since October 2004. The HVASs measure the 24 hour concentration of suspended particulates every six days. The location of these monitors (PM10-1, PM10-2, and TSP1) is shown in **Figure 5.20**.

The measured dust deposition and dust concentration levels in the area surrounding the Project are considered typical of a rural area remote from industrial emission sources. Air quality in the area is largely determined by emissions from natural sources, road traffic, residential activities such as use of wood-burning heaters, and agricultural activities. From time to time particulate matter levels would be expected to be affected by smoke from bushfires and dust from regional dust storms.

From the available monitoring data, the following background concentrations have been applied at the nearest residences for impact assessment purposes:

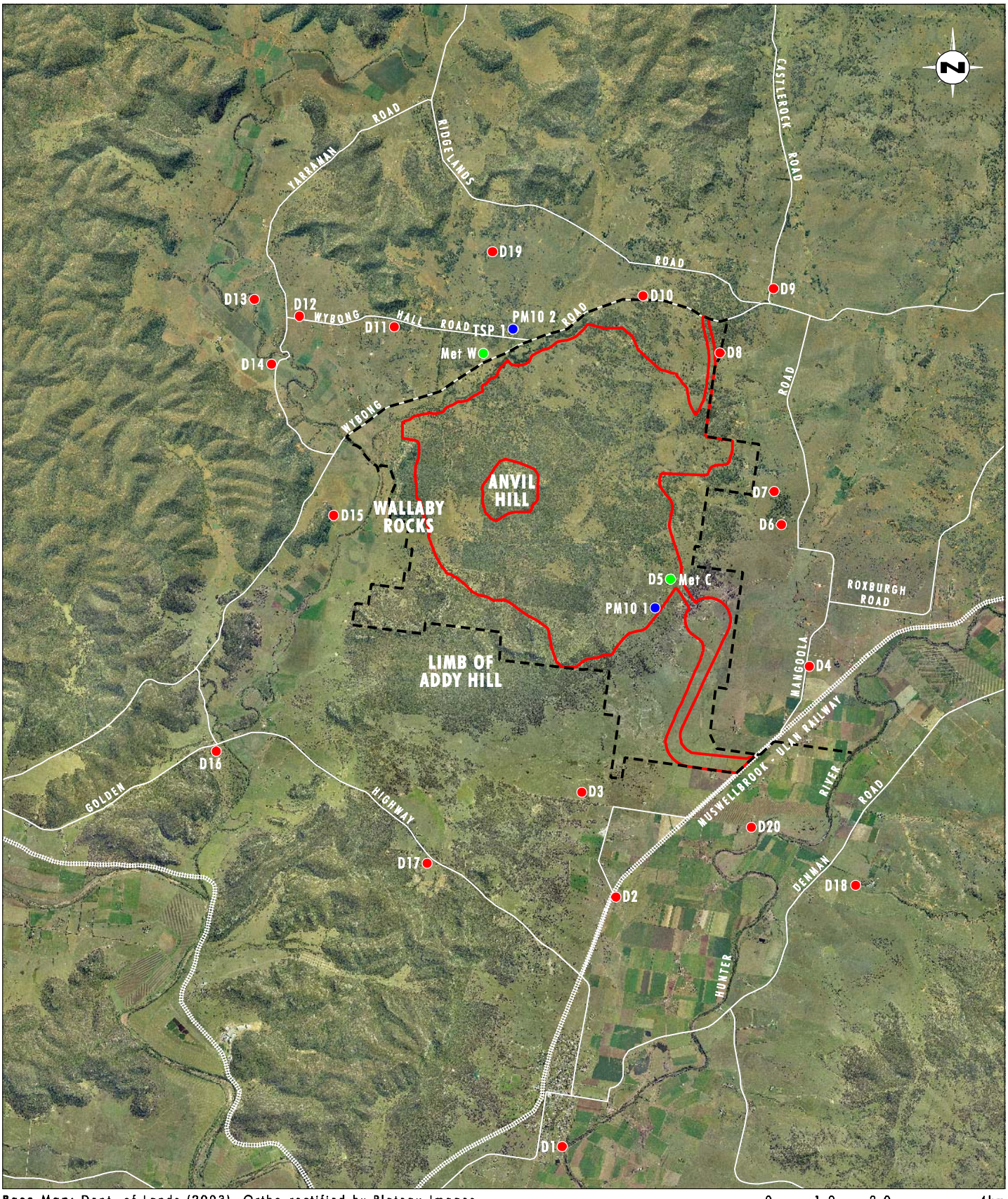
- Annual average TSP of 35 µg/m^3;
- Annual average PM10 of 15 µg/m^3; and
- Annual average dust deposition of 1.5 g/m^2/month.

5.5.4 Air Quality Impact Assessment

5.5.4.1 Assessment Methodology

The Air Quality Assessment (see **Appendix 10**) is based on a conventional approach following the procedures outlined in the document titled *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005).

The assessment uses a computer-based dispersion model (ISCST3) to predict off-site dust concentration and dust deposition levels, due to the potential dust generating activities associated with the Project. The dispersion modelling takes account of the local meteorology and terrain information and uses dust emission estimates to predict the air quality impacts for five indicative mine stages over the planned life of the Project. The stages (Year 2, 5, 10, 15 and 20) were selected to represent a range of mine production levels and active pit locations.



Base Map: Dept. of Lands (2003), Ortho-rectified by Plateau Images

Legend

- Proposed Disturbance Area
- Project Area
- Dust Monitoring Location
- HVAS Monitoring Location
- Met Station Monitoring Location

FIGURE 5.20

Air Quality Monitoring Network

The calculated emissions take account of proposed air pollution controls and mitigation strategies including passive controls such as those built into the mine plan (for example stockpile size and alignment, and length of haul roads) and active controls which include the intensity of watering and extent of rehabilitation. These mitigation strategies are further discussed in **Section 5.5.6**.

5.5.4.2 Predicted Dust Impacts

For each of the operational scenarios selected, dust impacts were predicted in the form of single point calculations at private residences. Dust contours have been derived from these results to approximate air quality impacts over a defined area and to determine impacts on privately owned vacant land. A vacant property is considered to be potentially dust affected if greater than 25% of that property is predicted to be impacted above the relevant criteria.

The results for each operational scenario are included in **Appendix 10**, including representative worst-case dust contours for each DEC criteria for all indicative mine stages. **Figure 5.21** considers all modelled years to produce the worst-case envelopes for the entire project life.

A comparison of the model predictions with the air quality goals discussed in **Section 5.5.2** indicates the following:

- Based on maximum 24-hour average PM_{10} predictions, there are 23 private residences (5 of which are subject to agreement with Centennial) and 9 vacant properties (6 of which are subject to agreement with Centennial) where concentrations are above the 50 $\mu g/m^3$ goal at some stage during the Project.

- Based on annual average PM_{10} predictions, there are 18 private residences (3 of which are subject to agreement with Centennial) and 10 vacant properties (6 of which are subject to agreement with Centennial) where concentrations are above the 30 $\mu g/m^3$ goal at some stage during the Project.

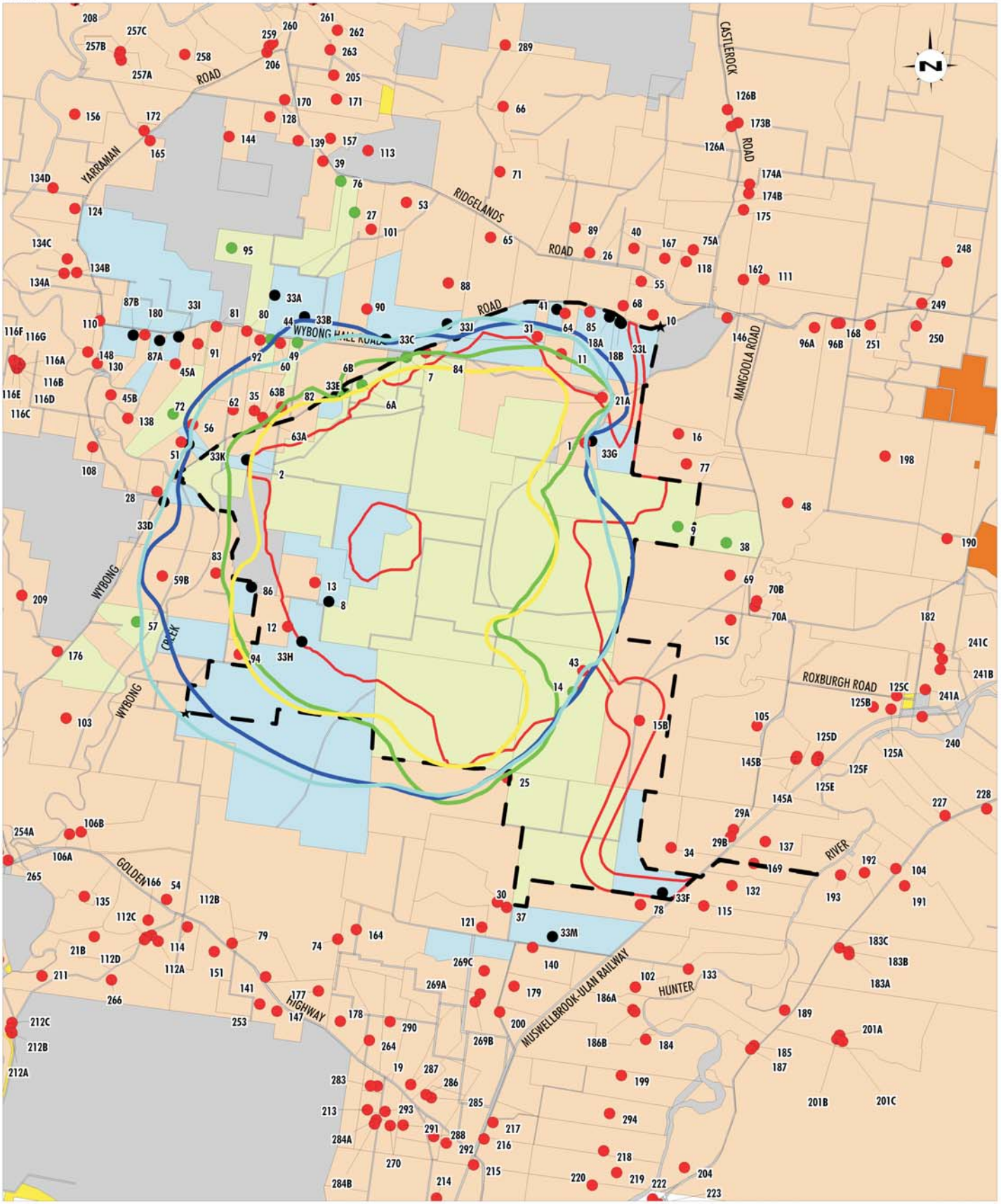
- Based on annual average TSP predictions, there are 2 private residences and 5 vacant properties (4 of which are subject to agreement with Centennial) where concentrations are above the 90 $\mu g/m^3$ goal at some stage during the Project.

- Based on annual average dust deposition predictions, there are 5 private residences (2 of which are subject to agreement with Centennial) and 6 vacant properties (4 of which are subject to agreement with Centennial) where concentrations are above either the 2 g/m^2/month (Project only) or 4 g/m^2/month (cumulative) goals at some stage during the Project.

Overall, the modelling predicts that up to 23 private residences (5 of which are subject to agreement with Centennial) and 10 vacant properties (6 of which are subject to agreement with Centennial) are likely to be subject to adverse air quality impacts, above the DEC air quality criteria, at some stage during the life of the Project. Twenty one of these residences and 9 of these vacant properties are also predicted to be affected by noise impacts.

DEC assessment criteria would not be exceeded at the remaining properties as a result of emissions from the Project. However, based on results from existing air quality monitoring, exceedances of the DEC's 24-hour PM_{10} criterion may still be observed from time to time due to emissions from other sources of particulate matter, such as agriculture, dust storms and bush fires.

As discussed in **Section 2.2**, a number of construction activities are proposed as part of the Project. These activities are not expected to generate significant quantities of dust, and dust emissions would be readily controlled using water trucks and standard dust control measures used on construction sites.



Source: Dept. of Lands (2003), Holmes Air Sciences (2006)

0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- PM 10 - 24 hr
- PM 10 - Annual
- Dust Deposition Annual
- TSP Annual
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 5.21

Worst Case Dust Contours (All Years)

5.5.4.3 Odour and Spontaneous Combustion

Odour emissions from coal mines are typically limited to emissions resulting from the uncontrolled self-heating of coal. Self-heating gives rise to smouldering fires in stockpiles or the coal seam, which can lead to significant emissions of smoke and odour.

As indicated in **Section 2.1**, preliminary assessment has indicated that the coal resource has a medium high to high propensity for spontaneous combustion. However, the inherent propensity to spontaneously combust is only one factor in a complex chain of conditions that can create spontaneous combustion in coal mines. Many mines with coals that are inherently prone to spontaneous combustion operate safely without incident and others with coals of much lower propensity have major problems (SIMTARS, 2003).

It is recommended by SIMTARS that care be taken where broken coal exists, particularly on overburden, ROM stockpiles and clean coal stockpiles. This includes careful design of the stockpiles, particularly for the aspects of height, compaction, slope angle, separation and the orientation of these stockpiles to the prevailing wind directions(s). In addition, as discussed in **Section 2.7**, Centennial will place coarse reject within the overburden emplacement areas to minimise the opportunity for spontaneous combustion from this source.

5.5.5 Cumulative Emissions

The effect of existing dust emissions from the other operational mines in the area has been captured by the existing air quality monitoring program and is already included in the background concentrations referred to in **Section 5.5.3**. Due to dispersion effects, this contribution to background air quality levels in the Project Area is estimated to be very low (less than 1 $\mu g/m^3$ for annual average TSP and PM_{10}, and 0.1 g/m^2/month for dust deposition).

The potential cumulative effects of dust emissions from the nearest approved (but not operational) mining operations were also considered as part of the air quality impact assessment (**Appendix 10**). This included the Mount Pleasant Mine located approximately 9 kilometres to the north-east, which was assumed to be operating at its maximum approved level, based on its existing development consent.

It was concluded that the cumulative effects of emissions from other approved mines to the east are considered to be small (less than 1 $\mu g/m^3$ for PM_{10} and TSP, and 0.1 g/m^2/month for deposition). Therefore, there would be no additional properties where exceedances of air quality criteria are predicted based on cumulative impacts.

5.5.6 Air Quality Management Commitments

Centennial is committed to implementing all feasible measures to reduce the extent of dust impact on the local community. For this reason, the key management commitments listed below have been incorporated into the Project.

- The CPP, coal stockpiles and associated infrastructure will be located near the eastern boundary of the Proposed Disturbance Area, within the valley that forms the upper reach of Anvil Creek. This area provides natural topographic shielding which will reduce dust impacts on surrounding areas.

- Water sprays will be used at coal handling transfer points and on stockpile areas that are capable of generating dust.

- All active roads will be clearly defined and the development of minor roads will be limited. Minor roads used regularly for access will be constructed so as to minimise dust

generation (for example, by using well-compacted select material) and will be watered as required.

- Speed limits will apply and be enforced on all roads on the mine site.
- Water carts will be used on active haul roads and unsealed working areas. Surface moisture levels on all haul roads will be maintained at suitably elevated levels and/or chemical treatments will be applied to achieve 90% dust suppression.
- Only the minimum area necessary for mining operations will be disturbed at any time.
- Reshaping and rehabilitation of mining and overburden emplacement areas, and obsolete roads will be undertaken as soon as practicable.
- Drills will be fitted with dust suppressant measures.
- Blasting design and operation will be managed to achieve optimum material breakage and movement to facilitate efficient mining while minimising the explosives used to achieve this outcome. This includes consideration of material and explosives characteristics, excavating equipment specifications, hole spacing and stemming material specification, accurate placement and drilling of holes, accurate explosives loading and well-managed stemming of blast holes. These measures will assist with minimising dust generation in the blasting process.
- Cover crops will be established on any topsoil and subsoil stockpiles that are not planned to be used in less than six months.
- Meteorological conditions will be monitored and weather data will be considered in the timing of blasts to assist with minimising the impacts of blast generated dust.
- Dust control measures to be employed during construction will include use of water carts, defining of trafficked areas, imposition of vehicle speed limits and constraints on work under extreme unfavourable weather conditions.
- A spontaneous combustion management strategy will be developed for the Project in consultation with the DPI and will include coal stockpile and reject emplacement management measures, monitoring potential causes of spontaneous combustion events, and actions that can be implemented in the event of spontaneous combustion.
- Mine personnel will be provided with training in dust controls during induction for mine operations.

In addition to the controls described above, Centennial will liaise with the local community regarding relevant mitigation strategies, such as installation of filters on rainwater tanks. Centennial has also offered to enter purchase arrangements which, subject to the Project gaining approval, provide each owner of a property predicted to experience dust impacts above the relevant DEC criteria at some stage during the life of the Project, with an option to trigger sale to Centennial (or for Centennial to trigger purchase).

5.5.7 Air Quality Monitoring

As discussed in **Section 5.5.3**, Centennial maintains an extensive air quality monitoring network, including dust deposition, and HVAS. Centennial is committed to continue to monitor dust deposition and dust concentration levels within the area surrounding the Project over the life of the operation to verify that predicted impact criteria are not exceeded and dust controls are effective. The monitoring program will incorporate mechanisms for responding to dust-related complaints and reporting of results to relevant stakeholders.

5.5.8 Greenhouse Gas Emissions and Energy Consumption

5.5.8.1 Assessment Context

Potential greenhouse gas emissions from the Project was raised as a key issue during the community consultation process (refer to **Section 4.0**), and in the DGRs. Consequently, a detailed greenhouse gas and energy assessment for the Project was undertaken by SEE Sustainability (refer to **Appendix 11**).

The assessment addressed energy and greenhouse gas emissions from the Project in accordance with DoP requirements, specifically the *NSW Energy and Greenhouse Guidelines for Environmental Impact Assessment* (2002). Energy consumption and greenhouse gas emissions were calculated for various operational scenarios, and relevant management controls identified that can be utilised to minimise energy use and greenhouse gas emissions.

The greenhouse gas and energy consumption inventory was based on proposed production rates, equipment numbers, energy consumption and methane levels in the ROM coal. It should be noted that due to the shallow coal resource, the level of methane in the coal seams proposed to be mined by the Project is quite low, ranging from 0.30 to 0.72 m^3 per tonne. This is lower than typically found in other operations with deeper coal resources.

5.5.8.2 Key Findings

The key findings in relation to the generation of greenhouse gases and energy consumption for the Project are presented below.

- The average annual greenhouse emissions for the Project are estimated at 167,574 tonnes CO2 equivalent (TCO2e). The greenhouse index of 0.031 TCO2e per tonne of saleable coal is less than the Australian open cut black coal mining industry average of 0.05 TCO2e per tonne. (AGSO, 2000)

- Average greenhouse emissions estimated for the Project are dominated by energy use with diesel at 39% and electricity at 36% of the total. Emissions from methane make up 23% of the total and explosive use at 2% makes up the remainder of the inventory.

- The estimated energy usage for the Project is dominated by diesel usage with the remaining consisting of electrical energy. This is due to the reliance on diesel powered mining equipment, with no plan to use a dragline or electric shovels. The energy index of 0.226 GJ per tonne of saleable coal is less than the Australian open cut black coal mining industry average of 0.29 GJ per tonne. (AGSO, 2000)

5.5.8.3 Greenhouse Gas Management and Monitoring Commitments

Due to the nature of open cut coal mining and the low levels of methane contained in the coal seams to be mined at the Project, there is no means of capturing and combusting methane. As such, the key greenhouse mitigation measures are largely focused upon energy management and energy efficiency.

Centennial will assess the viability of the following approaches to improving energy efficiency and reducing greenhouse emissions from the Project:

- use of energy management systems;

- seeking continuous improvement in energy efficiency in the mining fleet, stationary equipment, mining processes and coal preparation;

- the use of some proportion of biodiesel in the mining fleet;

- use of electric boosted solar hot water; and
- small scale planting for carbon sequestration.

Centennial will continue to assess and implement energy and greenhouse management initiatives during the Project design, operation and decommissioning.

5.6 Noise Assessment

In accordance with the DGRs for the Project, a comprehensive noise impact assessment has been undertaken by Wilkinson Murray Pty Limited. This assessment provides details of existing noise levels within the Project Area and surrounds, determines the noise impact assessment criteria based on existing noise levels and the relevant DEC guidelines, predicts noise levels that are expected to result from the Project and provides an assessment of these noise levels against the relevant criteria. An overview of the noise assessment findings is provided in this section, with the full report included in **Appendix 12**.

The potential for noise impacts was identified early in the assessment process. Consequently, extensive iterative modelling was conducted to determine potential noise impacts, and identify additional noise management measures or design modifications required to reduce Project noise emissions. The range of potential project modifications and noise mitigation measures considered during this iterative process are discussed in further detail in **Appendix 12**.

5.6.1 Existing Noise Environment

The existing noise environment around the Project Area has been monitored on several occasions, both by means of unattended noise logging, and by attended measurements. Four unattended noise surveys were carried out by HLA Envirosciences Pty Ltd in 2002 and 2003. The surveys involved establishing environmental noise loggers at eight representative residential locations surrounding the Project, N1 to N8, shown in **Figure 5.22**.

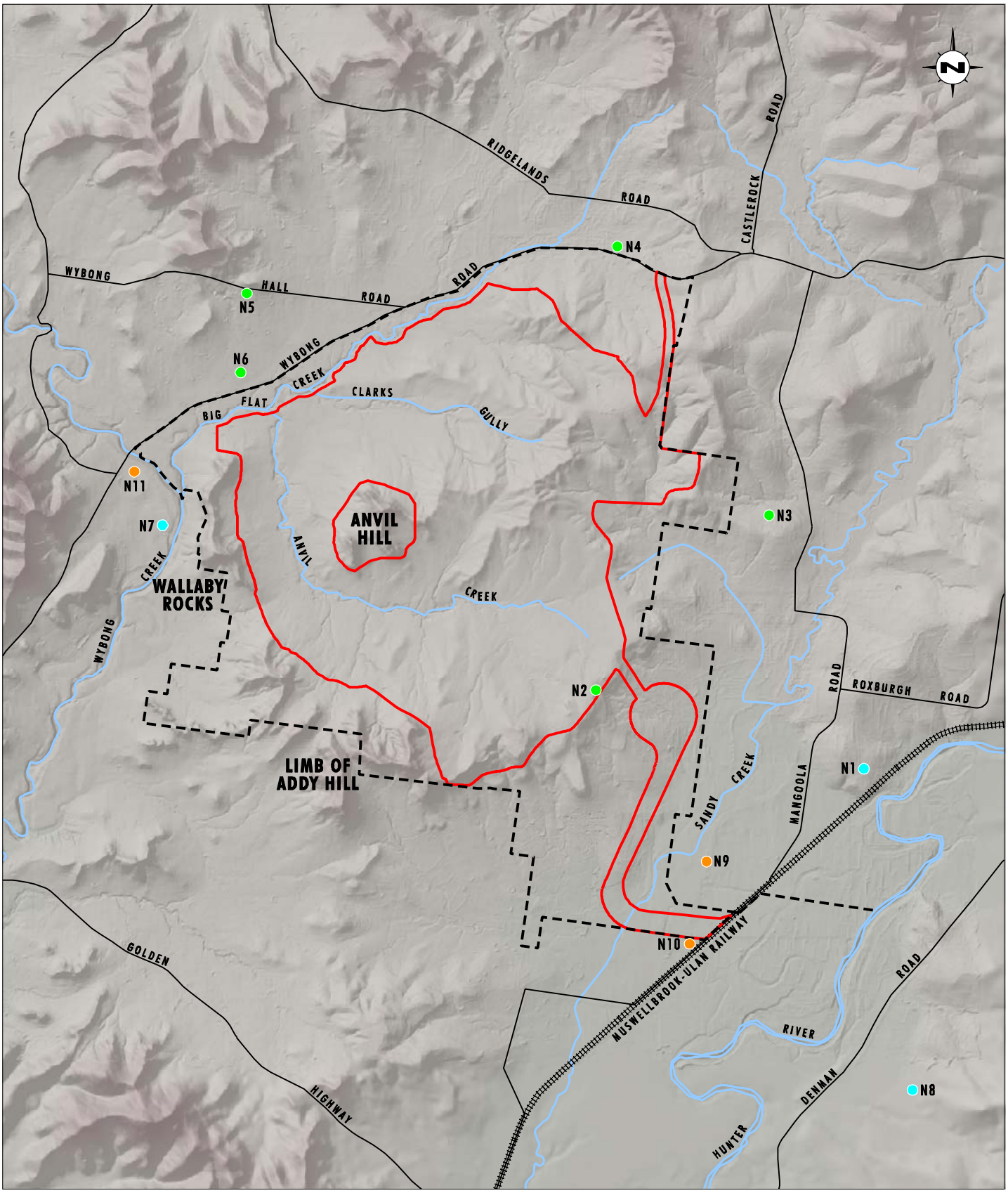
Further attended noise measurements were conducted by Wilkinson Murray in December 2004. Eight residences were chosen for short-term attended noise monitoring, five of which were the same as those at which unattended monitoring was carried out. The monitoring consisted of measuring noise levels using a calibrated hand held sound level meter for 15 minute periods at each location. The additional locations, N9, N10 and N11, are also shown in **Figure 5.22**.

No existing industrial noise sources were detected at any of the measurement locations. Noise levels were dominated by insects and other wildlife and were typical of a quiet rural environment, generally less than 30 dBA for all periods (day, evening and night).

5.6.2 Operational Noise Impacts

5.6.2.1 Noise Criteria

The operational noise impacts for the Project have been assessed in accordance with DEC's Industrial Noise Policy (INP) (DEC 2000). The INP addresses industrial noise only; it does not address construction or transportation noise other than movements of vehicles and equipment on site.



Source: Wilkinson Murray Pty Limited (2006), HLA Environsciences (2004)
Base Map: Dept. of Lands (2003), Geospectrum (2004)

0 1 2 3km

Legend

- Proposed Disturbance Area
- Project Area
- Attended Noise Monitoring Location
- Unattended Noise Monitoring Location
- Attended and Unattended Noise Monitoring Location

FIGURE 5.22

Noise Monitoring Locations

The assessment of industrial noise sources in accordance with the INP has two components, assessment of intrusive noise impacts and assessment of noise amenity levels. The intrusiveness and amenity limits applied to a Project are derived independently. The intrusiveness criteria is aimed at controlling noise sources such that the impact of the noise from the industrial operation does not exceed the existing background noise levels by more than 5 dBA, whereas the amenity criteria is designed to limit continuing increases in noise levels in an area from new industrial noise sources. These amenity and intrusiveness criteria are then compared to determine the Project's specific operational noise goal which reflects the most stringent noise level requirement from either criterion.

The amenity and intrusiveness criteria for all residences surrounding the Project are summarised in **Table 5.11**. The intrusiveness criterion is the more stringent in all time periods, and is therefore the adopted criterion for this assessment. As discussed in **Section 5.6.1**, the background noise levels around the Project are generally below 30 dBA. The INP specifies that in such circumstances 30 dBA should be adopted as the rating background noise level (RBL) for setting noise goals for proposed development.

Table 5.11 - Summary of Operational Noise Criteria

Location	Period	RBL (dBA)	Criterion (dBA)	
			Intrusiveness	Amenity
ALL	Day	30	35	50
	Evening	30	35	45
	Night	30	35	40

In those cases where the INP Project-specific assessment criteria in **Table 5.11** are exceeded, it does not automatically follow that all people exposed to the noise would find the noise noticeable or unacceptable. In subjective terms, exceedances of the criteria can be generally described as follows:

- negligible noise level increase (less than 1 dBA) (not noticeable by all people);
- marginal noise level increase (between 1 dBA and 2 dBA) (not noticeable by most people);
- moderate noise level increase (between 3 dBA and 5 dBA) (not noticeable by some people and may be noticeable by others); and
- appreciable noise level increase (greater than 5 dBA) (noticeable by most people).

It should be noted that the INP does not set mandatory limits, but requires operations to seek to achieve the criteria. Where INP criteria cannot be achieved by applying feasible and cost-effective measures, there is scope to apply alternative criteria.

Recent mining project development consents have required that any landholders with a residence or greater than 25% of vacant land that is predicted to experience exceedance of the INP criteria by more than 5 dBA (>40 dBA in this case), are offered the opportunity to sell their properties to the mining company.

For the purposes of assessing potential noise impacts for the Project, receivers that experience exceedance of the criteria have been described as marginally affected (36-37 dBA), moderately affected (38-40 dBA) and significantly affected (> 40 dBA).

5.6.2.2 Assessment Methodology

Operational noise levels at residences were calculated using the Environmental Noise Model (ENM). This model has been endorsed by DEC for environmental noise assessment. ENM takes account of noise attenuation due to geometric spreading, atmospheric absorption, shielding and the effect of acoustically soft ground. It can also be used to predict noise levels under various meteorological conditions, defined by a combination of temperature gradient, wind speed and wind direction.

The model uses mobile equipment and plant sound power level data as measured at other operations, and accounts for topography and equipment positioning for each conceptual mine stage plan. Data from the Wybong Road and Bengalla weather stations (**Section 5.5.1**) was used to derive the various meteorological conditions used in the model.

Noise levels have been calculated under a total of 41 meteorological conditions for 10 operational scenarios (day and night for five mine stages) at all residences up to 8 kilometres from the Project area. For Years 2, 5, 10, 15 and 20 a typical "worst-case" scenario was modelled, with equipment operating in locations that were likely to generate the highest noise levels at nearby residences. Where equipment could be operating in more than one position around the Project, noise levels have been calculated at a range of possible positions, and the highest noise level used as the worst-case.

An important atmospheric factor that influences noise impacts is temperature inversion. This results from variations in temperature occurring in layers in the atmosphere that can increase noise impacts. The INP includes a methodology for estimating the effect of inversions, however the noise modelling for the Project has considered existing temperature inversion conditions. As a result, the calculated noise levels are higher than would have been predicted using standard INP methods, more closely representing expected actual conditions.

5.6.2.3 Operational Noise Results

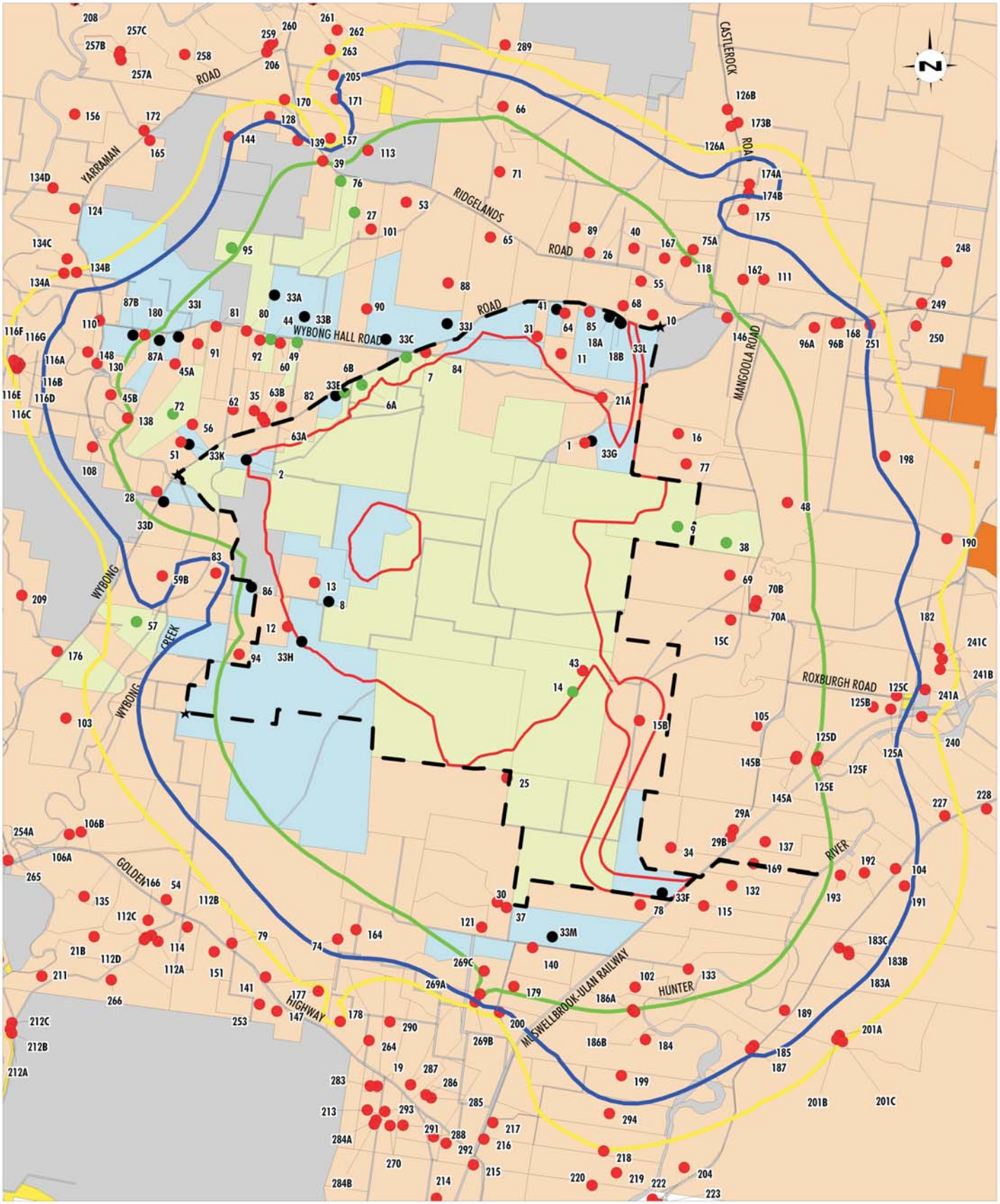
The noise modelling results for each operational scenario are included in **Appendix 12**, and are summarised in **Table 5.12**. Based on the noise modelling results for each residence, noise contours have been developed which approximate the noise impacts over a defined area. **Figure 5.23** shows the worst-case 35 dBA, 37 dBA and 40 dBA noise contours based on the maximum envelope for all modelled stages.

Table 5.12 - Summary of Operational Noise Impacts

Stage of Operation	Number of Private Residences			Number of Vacant Private Properties Significantly Affected > 40 dBA
	Marginally Affected 36-37 dBA	Moderately Affected 38-40 dBA	Significantly Affected > 40 dBA	
Year 2	20 (0)	41 (3)	57 (9)	19 (7)
Year 5	26 (1)	30 (2)	70 (10)	21 (7)
Year 10	36 (1)	34 (1)	78 (11)	23 (7)
Year 15	39 (1)	24 (2)	56 (9)	19 (7)
Year 20	25 (4)	23 (4)	30 (4)	15 (6)
All Years	**37 (1)**	**36 (1)**	**82 (11)**	**24 (7)**

Note:

- In accordance with recent DoP consent conditions, a vacant property (defined as contiguous land parcels owned by the same person or entity) has been considered noise affected if greater than 25% of that property will be impacted above the criteria for significant affectation, defined as more than 5 dBA above the Project Specific Noise Design goal, in this case 40 dBA.
- These details are current as at 8 August 2006. Centennial is progressing discussion with affected private landholders to seek agreement in relation to purchase of these properties and consequently these numbers may decrease during this process.
- Numbers in brackets indicate the number of private residences or vacant private properties that are subject to agreement with Centennial.



Source: Dept of Lands (2003) , Wilkinson Murray Pty Limited (2006)

0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- 40 dBa Noise Contour
- 37 dBa Noise Contour
- 35 dBa Noise Contour
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 5.23

Worst Case Noise Contours (All Years)

As shown in **Table 5.12**, a comparison of the worst case model predictions with the noise criteria discussed in **Section 5.6.2.1** indicates the following:

- There are 37 private residences (1 of which is subject to agreement with Centennial) which will be marginally affected by noise at some stage during the Project.

- There are 36 private residences (1 of which is subject to agreement with Centennial) which will be moderately affected by noise at some stage during the Project.

- There are 82 private residences (11 of which are subject to agreement with Centennial) and 24 vacant properties (7 of which are subject to agreement with Centennial) which will be significantly affected at some stage during the Project. Twenty one of these residences and 9 of these vacant properties are also predicted to be affected by dust impacts.

Appendix 1 includes a schedule of the specific properties and landowners predicted to be significantly affected by noise impacts. Centennial has made an offer to each of these private landholders to purchase their property, or to negotiate an appropriate outcome for the landowner.

Noise levels at two churches near the Project (Catholic Church on Wybong Road and Anglican Church on Castlerock Road) have also been estimated from the worst-case noise contours. Both locations have predicted worst-case noise levels within the relevant noise level criterion (refer to **Appendix 12**).

5.6.3 Construction Noise Impacts

5.6.3.1 Construction Noise Criteria

As discussed in **Section 2.2**, the construction period for the Project is expected to be in the order of 12 months. There are no criteria within either the INP or DEC's Environmental Noise Control Manual (ENCM) that apply to construction activities that are expected to last for longer than 26 weeks.

Therefore, construction activities have been assessed as being a phase of the general operations for the Project, and the criteria for operational noise outlined in **Section 5.6.2.1** have also been used to assess construction noise. This methodology will result in more stringent criteria than would have applied had the construction period been shorter.

5.6.3.2 Construction Noise Results

The potential impacts from construction were assessed under daytime meteorological conditions using ENM, as no construction activities are proposed at night.

The modelling results indicate that noise levels at residences during the construction of infrastructure and rail facilities are predicted to be lower than those levels predicted for operational noise, and as such no additional impacts are expected.

5.6.4 Road Traffic Noise Impacts

5.6.4.1 Road Traffic Noise Criteria

Criteria for assessment of noise from traffic on public roads are set out in the *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999). The relevant criteria are shown in **Table 5.13**. In terms of the ECRTN road classifications, Denman Road is considered a "collector" road, and both Wybong Road and Bengalla Link Road are considered "local" roads.

Table 5.13 - Criteria for Traffic Noise – Residences

Type of Development	Noise Level Criterion		Where Criteria are already Exceeded
	Daytime (7.00 am-10.00 pm)	Night Time (10.00 pm-7.00 am)	
Land use developments with potential to create additional traffic on collector roads	$L_{Aeq,5hr}$ 60 dBA	$L_{Aeq,1hr}$ 55 dBA	In all cases, the development should be designed so as not to increase existing noise levels by more than 2 dBA.
Land use developments with potential to create additional traffic on local roads	$L_{Aeq,5hr}$ 55 dBA	$L_{Aeq,1hr}$ 50 dBA	

These criteria have been used to assess the traffic noise impacts during both Project construction and operation.

5.6.4.2 Operational Road Traffic Noise Impacts

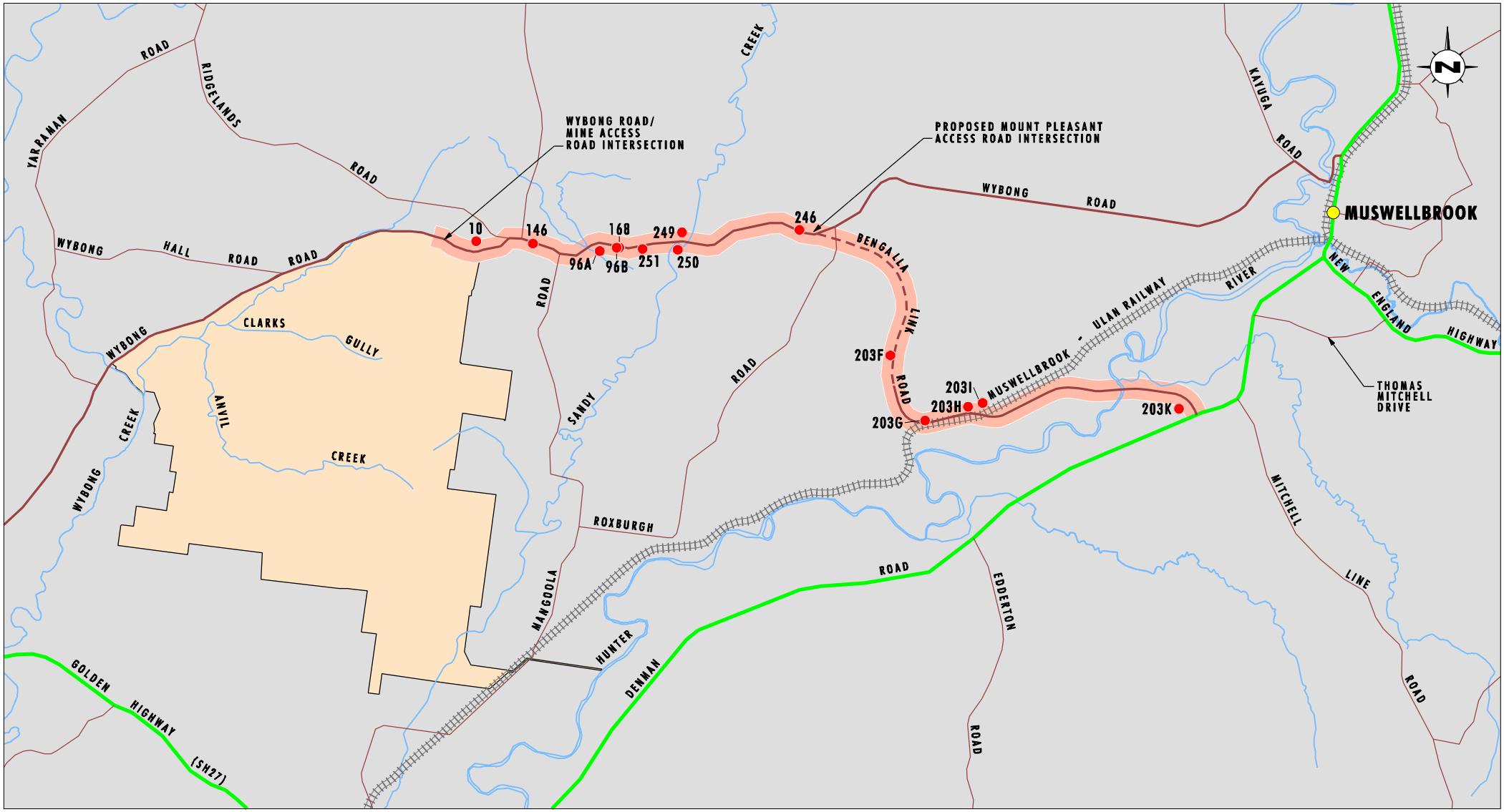
The Project has potential to generate additional traffic on public roads as a result of employee arrivals and departures, and also from heavy vehicle deliveries. As discussed in **Section 5.10**, the proposed access route to the site is via Bengalla Link Road and then Wybong Road.

It is proposed to operate with two 12 hour shifts, with changeovers at 7.30 am and 7.30 pm. After allowing for numbers for peak employees, visitors and heavy vehicles, car sharing, expected working hours and likely times for vehicle movements, the peak morning traffic flow is predicted to occur at shift changeover (7.00 am – 8.00 am) with a total of 125 vehicle movements to and from site. The peak evening traffic flow is also predicted to occur at shift changeover (7.00 pm – 8.00 pm), with a total of 106 vehicle movements (refer to **Section 5.10**).

Preliminary analysis of noise impacts from existing and proposed traffic flows was assessed against the daytime ECRTN criteria in **Section 5.6.4.1**.

Results indicate that the increase in noise levels due to traffic generated by the Project is within the ECRTN allowance criterion for residences on Denman Road at all times. However, the predicted increase in traffic noise levels on Wybong Road and Bengalla Link Road (7-11 dBA) warranted further detailed investigation. Consequently, noise levels from existing and proposed traffic on these roads was calculated at individual residences using procedures based on the CoRTN (Calculation of Road Traffic Noise UK DoE Traffic Noise Prediction Method 1988) prediction algorithms.

Table 5.14 shows the predicted noise levels for residences within 250 metres of either Wybong Road or Bengalla Link Road between the proposed mine access road and the intersection with Denman Road. These residences and the modelled section of each road are shown in **Figure 5.24**.



Source: Wilkinson Murray Pty Limited (2006)
Base Map: Dept. of Lands (2003)

0 1.0 2.0 4km

Legend

- Project Area
- Major Road
- Proposed Road
- Modelled Section of Road
- Residence Locations

FIGURE 5.24

Residences and Roads Modelled for Road Traffic Noise

Table 5.14 - Summary of Operational Road Traffic Impacts

Residence ID	Nearest Road	Distance from Road (m)	Ownership	$L_{Aeq, 1\ hour}$ Noise Level (dBA)	
				Peak Morning (7 am – 8 am)	Peak Evening (7 pm – 8 pm)
10	Wybong	175	Private	52.0	50.5
146	Wybong	100	Private	55.0	53.5
168	Wybong	80	Private	**56.5**	54.5
246	Wybong	75	Private	**56.0**	54.0
249	Wybong	80	Private	**55.5**	54.0
250	Wybong	250	Private	50.5	49.0
251	Wybong	120	Private	53.0	51.5
96A	Wybong	200	Private	53.0	51.0
96B	Wybong	90	Private	**56.0**	54.0
203F	Bengalla Link	65	Other mine owned	54.5	53.5
203G	Bengalla Link	50	Other mine owned	**56.5**	55.0
203H	Bengalla Link	120	Other mine owned	51.5	50.0
203I	Bengalla Link	220	Other mine owned	49.0	48.0
203K	Bengalla Link	210	Other mine owned	49.0	47.5

As indicated in **Table 5.14**, the calculated noise levels show there are four private residences on Wybong Road and one mine owned residence on Bengalla Link Road that marginally exceed the ECRTN criterion of 55 dBA by up to 1.5 dBA for the period 7.00 am - 8.00 am. In terms of impacts at residences, there would be a noticeable change in the acoustic environment for that hour. During the period 7.00 pm – 8.00 pm, all residences have calculated noise levels that meet the ECRTN criteria.

5.6.4.3 Construction Road Traffic Noise Impacts

Based on overall traffic volumes, the highest traffic noise levels at residences during the construction period would be expected to be 2-3 dBA higher than the highest hourly day time operational traffic noise levels shown in **Table 5.14**. This would mean that seven private residences on Wybong Road (146, 168, 246, 249, 251, 96A, 96B) and two mine owned residences on Bengalla Link Road (203F, 203G) would exceed the daytime criterion for construction traffic noise by up to 4.5 dBA. However, construction traffic is likely to be at a peak for only 2-3 months during the 12 month construction period and any impacts at residences can be considered short term.

5.6.5 Rail Traffic Noise Impacts

5.6.5.1 Rail Traffic Noise Criteria

The Australian Rail Track Corporation (ARTC) operates the Muswellbrook to Ulan railway. Noise emissions from railways operated by ARTC are regulated via their Environmental Protection Licence EPL 3142. This does not nominate specific environmental noise limits but specifies that the licensee must work towards the goals of 65 dBA L_{Aeq} (daytime), 60 DBA L_{Aeq} (night time) and 85 dBA 24 hour maximum pass-by noise, at 1 metre from the façade of

affected residential properties. Consequently, the following noise criteria have been adopted for rail transport for the Project:

- $L_{Aeq,9hr}$ = 60 dBA
- $L_{Aeq,15hr}$ = 65 dBA
- L_{Amax} = 85 dBA

5.6.5.2 Rail Traffic Impacts

Rail noise impacts are from train movements associated with the transportation of coal on the Muswellbrook to Ulan line. Rail noise impacts from trains on the proposed Project rail loop are considered part of the overall operational noise impact discussed in **Section 5.6.2**.

The noise impact of the proposed three peak daytime return trips and two peak night time trips from the Project on rail traffic flow on the Muswellbrook to Ulan Railway was assessed. This included consideration of existing average movements from Cobar Mine, Ulan Mine and Bengalla Mine, and the approved average movements from the Wilpinjong and Mount Pleasant operations.

The results indicate that there will be no change in L_{Amax} levels at residences as freight trains already run on the Muswellbrook to Ulan line. However, the distance from the rail line at which the other ARTC criteria is met increased by a maximum of 5 metres for peak daytime freight movements and 20 metres for peak night time freight movements as a result of the Project. This resulted in an extra two residences that are modelled to have noise levels that exceed the ARTC criteria.

5.6.6 Cumulative Noise Impact Assessment

5.6.6.1 Cumulative Operational Noise Impacts

As discussed in **Section 5.6.1**, no existing industrial noise sources were identified at residences during attended monitoring undertaken near the Project Area. However, potential cumulative impacts from the nearest mining operations were considered in the assessment included in **Appendix 12**. Given the distance to nearest mining operations (approximately 12 kilometres to the east), it was concluded that if any residences to the east of the Project have exposure to existing industrial noise, it is unlikely that noise levels from the Project would be high enough at such locations to cause an exceedance of the relevant INP amenity criterion outlined in **Section 5.6.2**.

5.6.6.2 Cumulative Traffic Noise Impacts

The Mount Pleasant Mine was approved in December 1999 and whilst timing of commencement of operations is not publicly available, it has been assumed for assessment purposes that this may occur before operations commence for the Anvil Hill Project. Based on information in the Mount Pleasant Environmental Impact Statement (EIS), traffic from the mine would share some of the same road network as traffic generated by the Anvil Hill Project, that being Bengalla Link Road and Denman Road as shown in **Figure 5.24**.

Whilst the Mount Pleasant EIS did not specify shift start and finish times, there is a possibility that the operation could have the same shift cycle as the Anvil Hill Project. The cumulative noise impact of both mines operating with the same shift cycle has been assessed.

Preliminary analysis indicated that the increase in noise levels due to cumulative traffic generated by both operations is within the ECRTN allowance criterion for residences on Denman Road at all times. However, the predicted increase in traffic noise levels of between 4.5-8 dBA on Wybong Road and 2.5-3 dBA on Bengalla Link Road warranted further detailed investigation. Consequently, noise levels from existing and proposed traffic on these roads was calculated at individual residences using the methodology outlined in **Section 5.6.4.2**.

Results indicate that the future traffic noise levels at residences on Wybong Road are generally the same as when the Anvil Hill Project was considered in isolation (**Table 5.14**). Noise levels on Bengalla Link Road increase by up to 3.5 dBA from those levels shown in **Table 5.14**, however higher existing noise levels mean that some residences have an ECRTN allowance criteria. Consequently, there is one mine owned residence (203F) that is predicted to exceed the day time criterion by up to 0.5 dBA.

5.6.7 Noise Management and Monitoring Commitments

The noise modelling has been refined through a series of changes to enable consideration of the feasibility and effect of a range of potential control measures. As a result, Centennial has committed to incorporation of the following project design considerations and key controls as part of the Project.

- The CPP, coal stockpiles and associated infrastructure will be located near the eastern boundary of the Proposed Disturbance Area, within the valley that forms the upper reach of Anvil Creek. This area provides natural topographic shielding which will reduce noise impacts on surrounding areas.

- The CPP, rejects bin, and crushers will have noise enclosures and shielding will be installed for conveyors.

- The rail loop will be located to use natural topography for shielding as much as possible. In addition, a 4 metre high noise barrier will be constructed on parts of the track that are exposed to nearby residences.

- At night, trucks will be restricted to operate below the maximum elevation of the overburden emplacement areas.

Exposure to noise levels greater than 5 dBA above Project-specific criteria may be considered unacceptable by some landowners. Consequently, Centennial has offered to enter purchase agreements which, subject to the Project gaining approval, provide each owner of a property predicted to experience noise levels above 40 dBA at some stage during the life of the Project, with an option to trigger sale to Centennial (or for Centennial to trigger purchase). For those residences that are moderately affected, Centennial proposes to conduct regular noise monitoring to confirm noise levels at locations representative of those residences, and to undertake reasonable and feasible residence specific measures to reduce noise impacts at these locations, such as installation of double glazed windows or air conditioning.

Monitoring of traffic noise levels will be conducted at residences predicted to exceed ECTRN criteria to assess compliance. If measured noise levels are found to exceed the criteria, then appropriate noise mitigation measures will be offered to private landowners including the installation of double glazed windows or provision of air conditioning to allow windows to be kept closed.

In addition to the regular noise and blast monitoring to assess compliance, Centennial has committed to the use of a real-time noise monitoring system, as a means to monitor and refine operational performance, as necessary.

5.7 Blast Assessment

In accordance with the DGRs for the EA, Wilkinson Murray Pty Limited undertook a detailed blast impact assessment, which is included in **Appendix 12**. A summary of the key findings are provided below.

5.7.1 Proposed Blasting Practices

Explosives are used in mining in order to dislodge overburden and coal to enable the extraction of the resource. To achieve this, holes are drilled in a designed pattern giving strict attention to their angle, depth and spacing. These holes are then filled with an explosive and the charge is initiated with the aid of primers and detonators. The detonation of each hole is delayed in a pre-designed sequence to ensure that each hole is fired individually in close succession. This delayed firing technique improves the efficiency of the blast and also reduces its environmental impacts.

The design of a blast depends on its location, geological structures in that area, volume of resource in the target area and any limiting factors in relation to potentially sensitive locations (including residences and infrastructure). Blast design is therefore completed on a blast by blast basis, ensuring that all these factors are considered to achieve blast levels within acceptable limits. The conceptual blast designs used for the assessment are included in **Appendix 12**. These blast designs will be refined during detailed mine planning, with technological advances and as further site specific knowledge becomes available, as mining progresses.

5.7.2 Blast Assessment Criteria

5.7.2.1 Annoyance and Discomfort

For assessment of annoyance due to blasting, DEC adopts guidelines produced by the Australian and New Zealand Environment and Conservation Council (ANZECC 1990). The fundamental criteria are that at any residence or other sensitive location:

- the maximum overpressure due to blasting should not exceed 115 dB for more than 5% of blasts in any year, and should not exceed 120 dB for any blast; and

- the maximum peak particle ground velocity should not exceed 5 mm/s for more than 5% of blasts in any year, and should not exceed 10 mm/s for any blast.

5.7.2.2 Structural Damage

At sufficiently high levels, blast overpressure may in itself cause structural damage to some building elements such as windows. However, this occurs at peak overpressure levels of approximately 133 dB and above, well in excess of criteria for annoyance.

For assessment of damage due to ground vibration, Australian Standard *AS2187.2 1993 Explosives – Storage, Transport and Use* specifies levels for peak particle vibration velocity (PPVV) to protect typical buildings from damage. These levels range from 5 mm/s to 25 mm/s PPVV according to building type and use. The criteria for residences is 10 mm/s. One heritage site has been identified which may be susceptible to damage from blast vibration (**Section 5.8.2**) and the 5 mm/s criterion has been adopted at this site.

5.7.2.3 500 kV Power Transmission Line

As shown in **Figure 1.2**, a 500 kV TransGrid power transmission line runs through the Project Area. TransGrid has specified that the vibration effects at the transmission line structures should be limited to 50 mm/s, and that care should be taken to ensure that flyrock from blasting operations do not damage the transmission line, conductors, insulators or structures.

5.7.2.4 Rock Formations and Shelters

A number of rock shelters and two rock formations (referred to as Anvil Rock and “The Book” rock formation) are located within the Project Area, as discussed in **Section 5.8.1**. Impact

from blasting on these structures has been raised by the community during the consultation process. There are no regulatory criteria nominated in Australia for the assessment of damage to archaeological/geological structures from vibration. A geotechnical investigation was undertaken by RCA Australia, which is included as an appendix to the Aboriginal Archaeological Assessment in **Appendix 13**, to assess the potential impact of blasting, and to determine appropriate vibration limits for these rock structures. The estimated significant damage vibration threshold for each rock shelter was typically 220 – 270 mm/s, with a few rockshelters having a threshold as high as 270 mm/s to 340 mm/s. The threshold levels for Anvil Rock and 'The Book' rock formation were 90 mm/s and 100 mm/s respectively, after allowing for a conservative safety factor.

5.7.3 Blast Impacts

Figure 5.25 shows the 5 mm/s vibration contour and 115 dB overpressure contour based on the conceptual blast design included in **Appendix 12**.

5.7.3.1 Private Residences and Vacant Land

All private residences with potential blast impacts above the relevant vibration and overpressure limits are located within the area significantly affected by noise and dust impacts. These landholders have therefore been approached by Centennial with offers to purchase, as discussed in **Sections 5.5** and **5.6**. **Table 5.15** shows a summary of the blast impacts on private residences and vacant land.

Table 5.15 – Summary of Blast Impacts

	Exceedances of Annoyance Criteria	
	No. of Private Residences	**No. of Vacant Properties**
Overpressure (115 dBA)	25 (4)	11 (5)
Vibration (5 mm/s)	28 (5)	11 (6)
Total	**28 (5)**	**11 (6)**

Note:

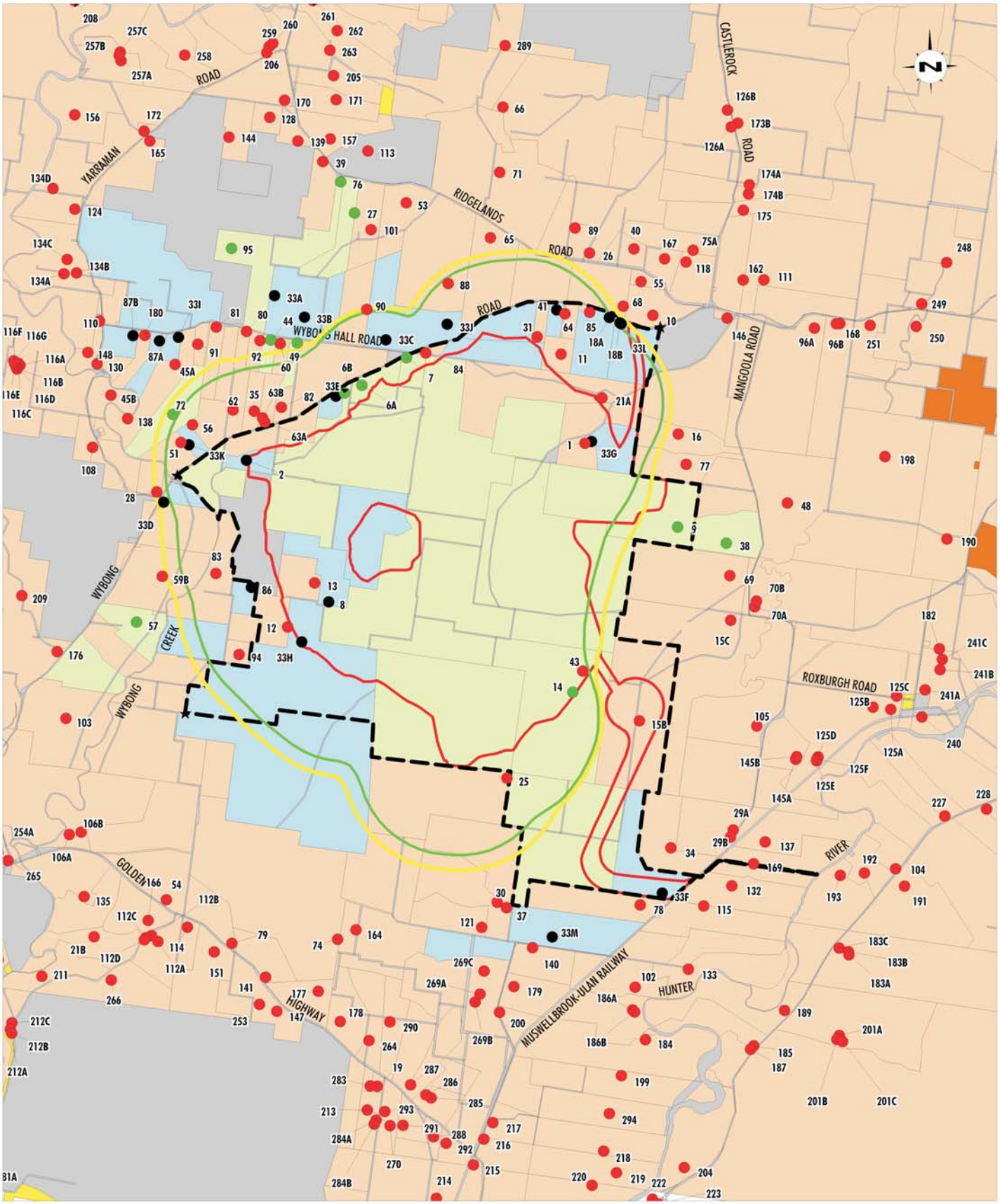
- In accordance with recent DoP consent conditions, a vacant property (defined as contiguous land parcels owned by the same person or entity) has been considered blast affected if greater than 25% of that property will be impacted above the relevant criteria.
- These details are current as at 8 August 2006. Centennial is progressing discussion with affected private landholders to seek agreement in relation to purchase of these properties and consequently these numbers may decrease during this process.
- Numbers in brackets indicate private residences or vacant private properties that are subject to agreement with Centennial.

5.7.3.2 500 kV Transmission Line

Blast predictions indicate that there is some potential to exceed the relevant criteria for the 500 kV transmission line during initial mining in the Main and Northern Pit and during mining in the Tailings Pit. As outlined in **Section 5.7.4**, there is a range of measures available to further refine blasting and Centennial has committed to achieving the relevant criteria at each of the 500 kV pylons by such measures determined during detailed mine planning and as mining progresses.

5.7.3.3 Rock Formations

Blast predictions have been conducted for each of the rockshelters considered to have Aboriginal cultural value, as outlined in **Section 5.8.1**. These predictions indicate that the appropriate criteria to protect these rockshelters from significant damage (refer to **Section 5.7.2.4**) can be met at most rockshelters with standard blasting practice. As mining progresses to the west and by Year 15, it is predicted that more specific, refined blast design



Source: Dept. Of Lands (2003) , Wilkinson Murray Pty Limited (2006)

0 1 2km

Legend

- Proposed Disturbance Area
- Project Area
- Overpressure (115 dB)
- Vibration Level (5mm/s)
- Property Boundaries
- 284A Residence ID Number
- Centennial Owned Residences
- Centennial Agreement Residences
- Private Residences
- Centennial Agreement
- Centennial Owned
- Crown + State + Commonwealth
- Private
- Not Known
- Other Mine Owned

FIGURE 5.25

Blast Vibration and Overpressure Criteria

and monitoring will be required to ensure protection of the rockshelters on Wallaby Rocks, particularly Site BFC12, on the northern end of Wallaby Rocks.

Predicted vibration levels for Anvil Rock and 'The Book' formations are generally within the damage threshold for each structure. However, in the later stages of the Project (after Year 15), more specific, refined blast design and monitoring will be required to ensure protection of these formations.

Techniques to minimise blast impacts will be employed as necessary to ensure compliance with relevant criteria. This may include blast initiation using electronic detonation techniques, limiting blast MIC, consideration of wind speed and direction prior to blasting, use of adequate stemming, implementing a delay detonation system, and careful drilling and hole loading to ensure that the required blast design is implemented.

5.7.3.4 Heritage Structures

Castle Hill (a slab hut) is considered to have high local heritage value (refer to **Section 5.8.2**) and is predicted to experience blast impacts above 5 mm/s from Year 10, based on standard blasting practice. Centennial will undertake further refinement of blast design and monitoring prior to that time and either restrict blasting to achieve the relevant criteria for protection of the structural integrity of the slab hut, or will undertake a full archival recording, monitoring and maintenance program to mitigate the impacts of blasting on this structure. Blast impact assessment and management for other historical heritage sites of low to moderate local heritage value are discussed in **Section 5.8.2**.

5.7.4 Blast Management and Monitoring Commitments

Blast modelling has been conducted iteratively to enable consideration of the feasibility and effect of a range of potential control measures. As a result, Centennial has committed to incorporation of the following key controls as part of the Project.

- Centennial will design and undertake blasts to ensure the relevant vibration and blast overpressure criteria are met at the 500 kV transmission line, Anvil Rock and rockshelters on Wallaby Rocks, Limb of Addy Hill and Western Rocks that are considered to be of significant Aboriginal cultural value.

- Techniques to minimise blast impacts will be employed as necessary to ensure compliance with relevant criteria. This may include blast initiation using electronic detonation techniques, limiting blast MIC, consideration of wind speed and direction prior to blasting, use of adequate stemming, implementing a delay detonation system, and careful drilling and hole loading to ensure that the required blast design is implemented.

- Blasting will typically be undertaken between the hours of 9.00 am and 3.00 pm Monday to Saturday. No blasts will be undertaken on Sundays or public holidays.

- Consideration of potential flyrock impacts will be incorporated into the blast design, particularly in regard to stemming length and bench spacing. Wybong Road will be temporarily closed during blast events within 500 metres of the road to reduce potential impacts from flyrock. In addition, arrangements will be made with any residents that may potentially be subject to flyrock impacts, to temporarily vacate their residences during blasting operations that are within the area of potential flyrock impact.

- Centennial will consult with residents surrounding the Project Area prior to the first blast on site and identify those residents that may wish to be notified of blasting times on an ongoing basis. Should any residents wish to be notified of blasting dates and times on an ongoing basis, Centennial will determine in consultation with these residents an appropriate mechanism for undertaking this notification.

- All relevant personnel will be trained on environmental obligations in relation to blasting controls.

- The date, location of blast holes and quantity of explosive used each day will be documented.

- Monitoring will be undertaken at locations representative of surrounding nearest private residences and other sensitive locations to verify compliance with relevant vibration and blast overpressure criteria, and appropriate further blast refinement or management.

- Blast management procedures will be periodically reviewed to evaluate performance and identify corrective action, if required.

- Blast monitoring results will be reported in the AEMR.

5.8 Heritage Assessment

During the consultation process, both Aboriginal and non-Aboriginal heritage were raised as relevant issues for the Project. The DGRs for the EA identify heritage as a key issue for detailed consideration. Detailed assessments for Aboriginal and non-Aboriginal heritage have been completed by Umwelt and are provided in **Appendices 13** and **14**. An overview of the key outcomes of these assessments and proposed management commitments is provided below.

5.8.1 Aboriginal Heritage

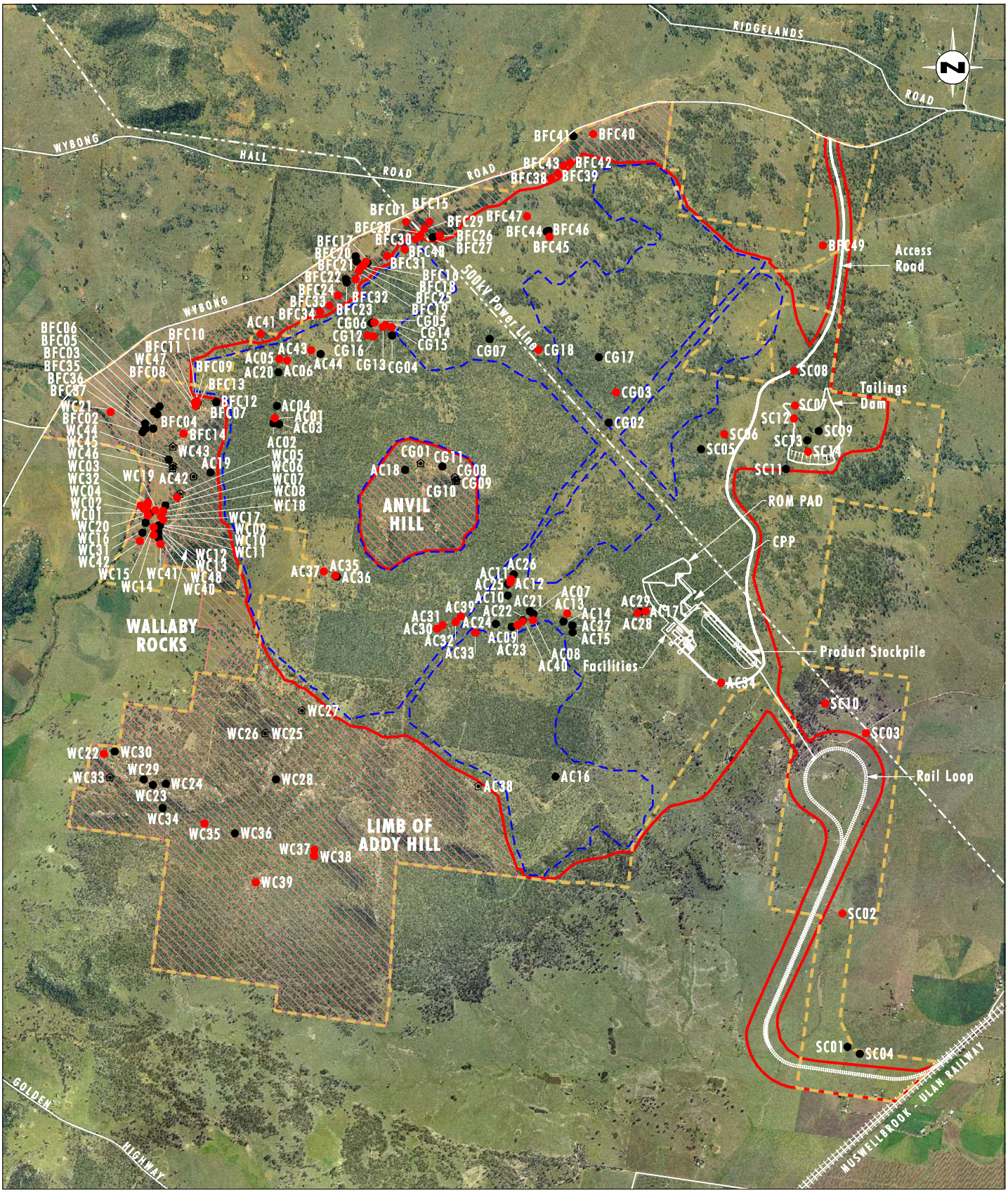
Umwelt prepared the Aboriginal Heritage Assessment in consultation with the local Aboriginal community (refer to **Appendix 13**). The purpose of the assessment was to gain an understanding of Aboriginal occupation and site distribution in the Proposed Disturbance Area and in adjacent areas which were considered to have potential as offsets for the Project (Proposed Offset Areas). The Proposed Offset Areas include Anvil Hill itself, Wallaby Rocks and the adjacent slopes leading to Wybong Creek, Limb of Addy Hill, Western Rocks and sections of Big Flat Creek (refer to **Figure 5.26**).

5.8.1.1 Consultation Process

Aboriginal community involvement is an essential component of the Aboriginal heritage assessment process. There were 16 Aboriginal stakeholder groups that registered interest in consultation for the Project following the advertisement and notification process. The Aboriginal stakeholder groups included Aboriginal Native Title Consultants, Giwiirr, Hunter Valley Aboriginal Corporation, Hunter Valley Cultural Consultants, Lower Wonnarua Tribal Consultancy Pty Limited, Ungooroo Aboriginal Corporation, Upper Hunter Heritage Consultants, Upper Hunter Wonnarua Council Inc, Valley Culture, Wanaruah Custodians, Wanaruah Local Aboriginal Land Council, Wattaka Wonnarua CC Service, Wonnarua Culture Heritage, Wonnarua Elders Corporation, Wonnarua Nation Aboriginal Corporation and Yarrawalk.

A survey strategy was developed in consultation with the 16 Aboriginal stakeholder groups and DEC. The survey strategy included investigation of the Proposed Disturbance Area and the areas considered to have potential for conservation offsets (Proposed Offset Areas).

Centennial provided the opportunity for all 16 Aboriginal community groups to participate in the survey and 14 chose to take part over two periods from 4 May to 25 May 2005 and 29 November to 7 December 2005 (22 days in total). A further two groups, Muswellbrook Cultural Consultants and Mingga Consultants, informed Centennial of their interest in the Project after the survey had commenced. These groups were not involved in the fieldwork but were included in all consultation following their notification of interest in the project.



Source: Umwelt (2006)
Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images 2005

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Archaeological Survey Area
- Proposed Mining Area
- Proposed Offset Area
- Artefact Scatter (Open Camp Site)
- Isolated Find
- Shelter with PAD

FIGURE 5.26

Aboriginal Sites and Cultural Heritage Offsets

5.8.1.2 Survey Results

The survey covered the Proposed Disturbance Area and Proposed Offset Areas. The survey identified 173 Aboriginal sites within the total survey area, including 69 sites in the Proposed Disturbance Area and 98 sites in the Proposed Offset Areas, and a further 6 sites outside both of these areas (refer to **Figure 5.26**).

These sites were primarily artefact scatters (88 sites) and isolated finds (69 sites) with mudstone and silcrete flakes dominating the assemblages. The majority of these sites (98) were identified on creek banks or within 30 metres of watercourses, and some of the sites were associated with potential archaeological deposit (PAD).

Sixteen rockshelter sites with surface evidence of Aboriginal occupation (including stone artefacts and in some cases calcined bone, shell and worked shell) and PAD were also recorded. The rockshelter sites are all within the Proposed Offset Areas (Anvil Hill had four rockshelter sites; Wallaby Rocks seven rockshelter sites; Limb of Addy Hill one rockshelter site and Western Rocks four rockshelter sites).

Observations of the landscape within the Proposed Disturbance Area indicate prior land use included cultivation, quarrying, clearing of mature trees by ringbarking and ripping, pastoralism and the establishment of farm infrastructure and utilities. This has led to the high levels of erosion of topsoil and the degradation of sites and PADs. Observations of the landscape within the Proposed Offset Areas indicate similar levels of disturbance within the cleared areas of the slopes and along the main watercourses, but an overall more intact soil profile within those areas associated with Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks.

The survey results indicate that evidence for repeated and long term Aboriginal occupation was related to the location of reliable water. Within the Proposed Disturbance Area the highest concentration of artefacts and sites is at creek confluences or associated with former chains of ponds (refer to **Figure 5.26**). Within the Proposed Offset Areas the higher density of archaeological artefacts and sites is located in areas such as the confluence of Wybong Creek and Big Flat Creek and from the base of Wallaby Rocks downslope to Wybong Creek. It is also reflected in the greater evidence for occupation of the rockshelter sites on the northern and western sides of Wallaby Rocks and the rockshelter at the western end of the Western Rocks (WC33), which are closest to, and face Wybong Creek.

5.8.1.3 Aboriginal Heritage Impacts

The significance of the sites and PADs located within the Proposed Disturbance Area and Proposed Offset Areas was assessed in relation to Aboriginal cultural heritage value and archaeological research potential. Information in relation to Aboriginal cultural heritage value was provided by the Aboriginal stakeholder groups throughout the survey period and following review of the draft assessment report. The majority of groups indicated that all sites are of value to the Aboriginal community.

In relation to archaeological values, the research potential of sites in the Proposed Disturbance Area and Proposed Offset Areas is summarised in **Table 5.16**.

Table 5.16 - Aboriginal Heritage Research Potential

Research potential	No of Sites		
	Proposed Disturbance Area	Outside Proposed Disturbance Area	Proposed Offset Areas
Low	65	5	75
Low to Moderate	3	-	5
Moderate	-	1	4
Moderate to High	-	-	4
High	1	-	10
	69	**6**	**98**

Of the 173 sites identified during the assessment process, 69 sites are proposed to be impacted by the Project. The majority of sites are of low research potential, with only one site (Site AC13) having high research potential. As noted in **Section 5.8.1.4**, it is proposed to salvage surface artefacts in advance of proposed disturbance and to conduct detailed sub-surface investigation of Site AC13 in order to minimise these impacts.

In addition, Site SC10 located on Sandy Creek, and in an area initially targeted for a rail corridor, was assessed as having high Aboriginal heritage value and moderate archaeological research potential. The design of the rail corridor has been modified to enable this site to be conserved and used for educational purposes.

Centennial recognised early in the project, that the impacts on cultural heritage would require offsetting in order to minimise cumulative impacts on cultural heritage of the region. The Proposed Offset Areas include 98 identified sites, with 14 of these sites having a moderate to high, or high archaeological value. The Aboriginal community has indicated general support for the proposed approach to Aboriginal heritage conservation and management and are particularly interested in the ongoing management of the significant rockshelters within the Proposed Offset Areas. As discussed in **Section 5.7**, specific blast monitoring and management is proposed in order to minimise potential blast impacts on the rockshelters.

5.8.1.4 Aboriginal Heritage Management Commitments

The draft management strategy was reviewed by the Aboriginal stakeholder groups and the majority of the groups generally agree with the proposed approach to Aboriginal heritage management. This includes:

- a combination of surface collection, grader scrapes and excavation of the 69 sites in the Proposed Disturbance Area; and

- conservation management for the 98 sites in the Proposed Offset Areas, including 16 rockshelters.

These management commitments are outlined in further detail below.

Site Management in Proposed Disturbance Area

- A combination of surface collection for 68 of the sites in addition to grader scrapes within parts of the Proposed Disturbance Area associated with Clarks Gully, Sandy Creek, Anvil Creek and Big Flat Creek. This approach targets artefact scatters and isolated finds within the Proposed Disturbance Area that have low to moderate research potential. It also appropriately tests the riparian corridor archaeological terrain unit which is assessed as having high research potential and Aboriginal and archaeological sensitivity. Manual

excavation will be undertaken in areas where the grader scrapes reveal features such as hearths, heat treatment pits, knapping floors or significant artefact concentrations.

- Site AC13, located on Anvil Creek and within an area targeted for mine infrastructure, was assessed as having a high archaeological research potential. This site will be subject to a detailed geomorphic investigation, a sub-surface test pitting program, large area manual excavation and grader scrapes.

- As noted above, Site SC10 located on Sandy Creek was initially targeted for a rail corridor. Due to the high Aboriginal heritage value and moderate archaeological research potential, this site will not be disturbed by Centennial and will be managed for use by the Aboriginal community for teaching and educational purposes.

Conservation Management

- The Proposed Offset Areas are shown on **Figure 5.8** and provide for conservation of archaeological terrain units evaluated as having equal or greater overall significance than in the Proposed Disturbance Area. Centennial is committed to conserving all 98 identified sites and the landscapes in which they occur, within the Proposed Offset Areas. This represents 98 of the 173 Aboriginal sites identified during fieldwork in the Study Area.

  The conserved sites include:

  - 16 rockshelters with artefacts and PAD,
  - 37 isolated finds and
  - 45 artefact scatters.

  The Proposed Offset Areas will conserve all the rockshelter sites within Wallaby Rocks, Limb of Addy Hill, Western Rocks and Anvil Hill. Anvil Hill rockshelter sites (four sites), however, may be affected by the indirect impacts of blasting. This impact will be mitigated and management strategies for the rockshelters on Anvil Hill are discussed in **Appendix 13**.

  The Proposed Offset Areas conserve the archaeological terrain units within the survey area which are assessed as having the highest Aboriginal heritage value and archaeological research potential. The Proposed Offset Areas provide an extensive area that Aboriginal stakeholders, archaeologists and the general community can access for teaching and educational purposes throughout the life of the mine and into the future. The Anvil Hill area will be isolated for the majority of the life of the mine, however, it will not be directly impacted by mining and will be available for organised access.

- An Aboriginal Heritage Management Plan will be prepared for the Project, including the Proposed Offset Areas. The Plan will be formulated in consultation with the Aboriginal stakeholder groups and DEC. This management plan will include appropriate ongoing monitoring of conserved sites and necessary measures to achieve appropriate conservation management of sites in the Proposed Offset Areas, including ongoing monitoring. As the Proposed Offset Areas are also important from an ecological perspective, there will be integration of the management approach.

5.8.2 Historic Heritage

The Historical or Non-Aboriginal Heritage Assessment was conducted by Umwelt to gain an understanding of the history and historical heritage values in the area proposed for direct impact and potential off-site impacts associated with blasting. A full copy of the assessment is included in **Appendix 14** and it is summarised below.

5.8.2.1 Consultation Process

Community involvement is an essential component of the historical heritage assessment process. As part of the historical heritage assessment, interviews were conducted with local families identified by the Muswellbrook Local and Family History Society (MLFHS) as having long connections with the Wybong area.

MSC was also consulted regarding the heritage assessment.

5.8.2.2 Methodology and Results

A literature review of the relevant historical context was conducted prior to the site inspection. There are no items listed on the relevant National or State Heritage Register within the area potentially affected by the Project. In addition, the current LEP does not list any sites of heritage significance within the study area.

MSC advised that some sites of local heritage value occur within the study area and are being considered as part of the draft LEP preparation. Full location details were not available for all of these sites but, where available, these details were considered during the assessment process.

The site inspection was undertaken by a heritage architect and an archaeologist to assess the built heritage and archaeology of the study area. The identified historical heritage items generally related to the early settlement of the locality during the late nineteenth to early twentieth century, and the land uses of dairying and grazing. Nine sites of local historic value were identified within the Proposed Disturbance Area including the ruins of a collapsed cottage with associated dam, pig pen, well, sheds and a hut, a rock spillway, a test shaft for exploratory coal mining, the ruins of a slab house and nearby dairy, the ruins of a weatherboard two room cottage and ruined dairy, shed and stockyards, two intact Victorian cottages, two quarries and one windmill and associated dam. These were rated of moderate and low local heritage significance.

Two historical heritage sites within the Proposed Disturbance Area were assessed as having high local heritage significance. These included the Ham House 1 and associated ruined Creamery and the ruins of Ham House 2 and associated ruined dairy and structures including the meat shed.

One property within the broader study area was assessed as having high local heritage significance. The remaining heritage items inspected were assessed as having moderate to low local heritage significance.

5.8.2.3 Heritage Impacts

All sites within the Proposed Disturbance Area will be destroyed at some stage during the Project life. As discussed in **Section 5.8.2.4**, it is proposed to record all of these sites prior to destruction, in order to maintain an appropriate record of these local heritage values. It is recognised that a number of families have lived in the Wybong area for a few generations and that knowledge of the local history may potentially be lost if these families relocate. For this reason, Centennial has committed to compilation of a community based historical study, as noted in **Section 5.8.2.4**.

Most historic heritage sites are either located a sufficient distance from the mining area where predicted levels are well below the relevant criteria, or are only of low to moderate local heritage value.

Castle Hill (refer to **Section 5.7.3**) is predicted to experience blast impacts above 5 mm/s from Year 10, based on standard blasting practice. Centennial will undertake further refinement of blast design and monitoring prior to that time and either restrict blasting to

achieve the relevant criteria for protection of the structural integrity of the slab hut, or will undertake a full archival recording, monitoring and maintenance program to mitigate the impacts of blasting on this structure.

5.8.2.4 Non-Aboriginal Heritage Management Commitments

In order to mitigate impacts on the local heritage values of the area, Centennial is committed to the following heritage management measures:

- the compilation of a community based oral history to document the local history of Wybong and to mitigate against the impact of the Project on the historical knowledge within the local community, as families that have resided in the area for many generations potentially move from the area;

- archival recording for all items of heritage value identified within the Proposed Disturbance Area to the standards of local heritage significance as specified by the guidelines of the NSW Heritage Office;

- the surface collection and salvage of Ham House 1 and Ham House 2 and associated dairies, creamery and structures. Both of these heritage sites require a surface collection of artefacts that are scattered throughout the two sites. No sub-surface investigation is considered warranted due to the lack of topsoil within these sites;

- further monitoring of Castle Hill and consideration of the blast design to confirm whether structural impacts will occur at this location, prior to measured blast levels reaching 5 mm/s at this site. This will enable further quantification of the impacts of blasting on this structure and any necessary remediation works as mining progresses. If blasting impacts are confirmed, a detailed archival recording to the standard of local heritage significance and a site specific historical investigation will be conducted;

- potential further sites of local heritage value located within the area predicted to be impacted by blasting that exceeds the relevant vibration criteria will be inspected, subject to landowner permission for access, and appropriately recorded prior to blasting. This will include assessing the structural status and identifying appropriate ameliorative measures, where relevant.

5.9 Visual Assessment

Potential visual impacts were identified as a key environmental issue during the consultation and in the DGRs for this Project. Consequently, a detailed Visual Assessment has been completed by O'Hanlon Design Pty Ltd and is included in full in **Appendix 15**. An overview of this assessment is provided in this section.

5.9.1 Existing Visual Amenity

5.9.1.1 Regional Scenic Character

The land use character of the regional area is discussed in **Section 5.1**. In addition, there are a number of sub regional landscape elements that form significant features within the landscape and contribute to the overall visual character of the areas surrounding the Project. These elements include:

- Ridgeline and Upper Woodland Slopes – this landscape unit forms a visually prominent backdrop to the northern, western and eastern extent of the Project Area. This landscape unit is characterised by steep slopes, rocky outcrops and dense vegetation, which strongly contrast with the surrounding landscape;

- Undulating Foothills (vegetated and cleared) – this landscape unit forms a consistent landscape within the area and contributes significantly to the character of the local area;

- Alluvial Floodplain Areas – this landscape unit is primarily associated with the Hunter River to the south-east of the Project Area;

- Water Bodies – including the Hunter River, Goulburn River, Wybong Creek and associated tributaries; and

- Infrastructure – the Muswellbrook to Ulan rail line, 500 kV powerline and local roads are the most significant infrastructure elements in the landscape.

The scenic quality of the landscape across the Project Area has been assessed through the detailed Visual Assessment (refer to **Appendix 15**). The rating of scenic quality was based on criteria that value topographical ruggedness, proximity to water, diversity in landscape patterns and increased natural and agricultural landscapes. The scenic quality rating for the Project Area ranges from moderately high for ridgelines and rocky outcrop landscape units through to moderate to low for undulating terrain and alluvial landscape units.

The existing night time character of the Project Area and surrounding landscape is rural with scattered residences, predominantly along roads, and small concentrations of light in more densely populated areas. The impacts of existing lighting patterns within the night time landscape are considered to be low and do not form prominent features.

5.9.2 Visibility of the Project

The visually dominant features of the Project include the conceptual mining areas, overburden emplacement areas, site infrastructure areas including the CPP, tailings dam and the rail load out and rail loop infrastructure. These features of the Project will be visible from a number of locations within the surrounding area as outlined below.

Independent of the stage of the Project, the surface infrastructure areas will remain constant in the landscape, however mining areas and overburden emplacement areas will present different degrees of visibility based on the progression of the mining operation. In addition, due to the proposed mining within four separate mining areas, each mining area will be visible to differing degrees during the life of the Project.

Visually prominent features of the Project in the night landscape will be the use of lighting for infrastructure areas including the CPP, lights associated with mobile plant travelling along the haul roads and overburden emplacement areas, and lighting associated with active mining operations within the mining areas.

5.9.3 Viewing Points and Assessment Methodology

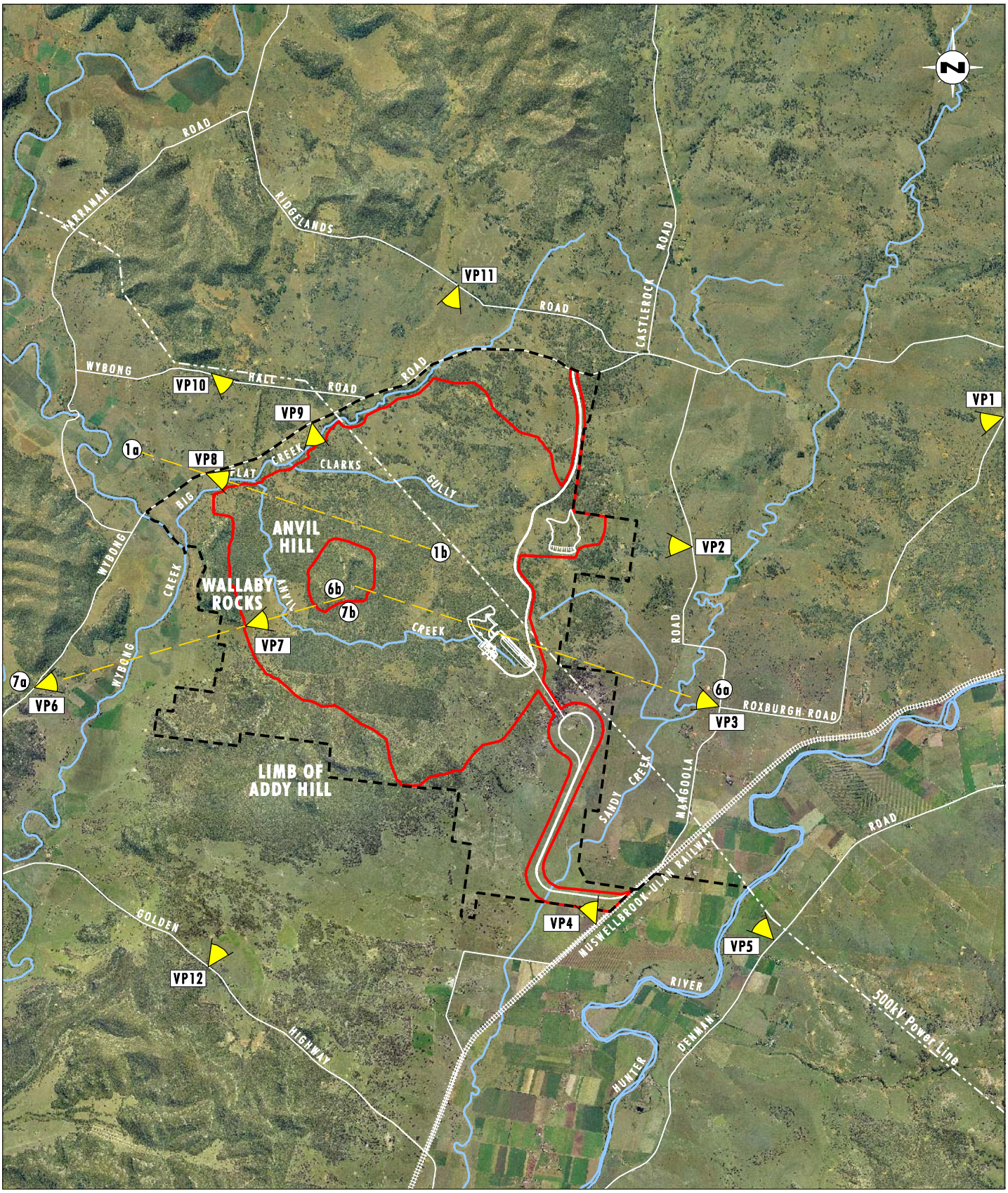
The detailed visual assessment (refer to **Appendix 15**) identified surrounding areas where views of the Project may be possible and necessary mitigation measures. The public viewpoints utilised for the detailed visual assessment are shown on **Figure 5.27** and are briefly described as follows:

VP 1 - Roxburgh Road approximately 1500 metres from Wybong Road intersection: RL 265

VP 2 - Mangoola Road approximately 3000 metres north of Roxburgh Road: RL 150

VP 3 - Corner of Mangoola Road and Roxburgh Road: RL 180

VP 4 - Mangoola Road 1200 metres north of Bells Lane: RL 180



Source: O'Hanlon Design (2006)
Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images
Note: For section details, refer to Figures 5.28

Legend

- Proposed Disturbance Area
- Project Area
- Viewpoint
- Transect Location
- 7a Transect Number
- VP6 Viewpoint Number

FIGURE 5.27

Visual Assessment Locations

VP 5 - Denman Road: RL 140

VP 6 - Wybong Road 1900 metres north of the Reedy Creek Road Junction: RL 165-170

VP 7 - End of Anvil Right of Way (ROW) adjacent to Bellevue: RL 180

VP 8 - Wybong Road 1200 metres north of Wybong Bridge: RL 145

VP 9 - Wybong Road 1100 metres south of Wybong Post Office Road: RL 145

VP 10 - Wybong Post Office Road: RL 200

VP 11 - Ridgelands Road adjacent to bridge: RL 180

VP 12 - Merriwa Road 1500 metres east of the Rosemount road intersection: RL 175.

The selection of the assessment points was based on elevation, angle and distance to the Project Area. The assessment of visual impact at each of the assessment locations was undertaken in accordance with established frameworks that consider the characteristics of the existing landscape, sensitivity of viewers and the nature of impacting activities.

The assessment of lighting impacts from the Project was based on direct views into lighted areas from the viewpoints and the degree of sky glow impacts associated with the Project.

5.9.4 Visual Impacts

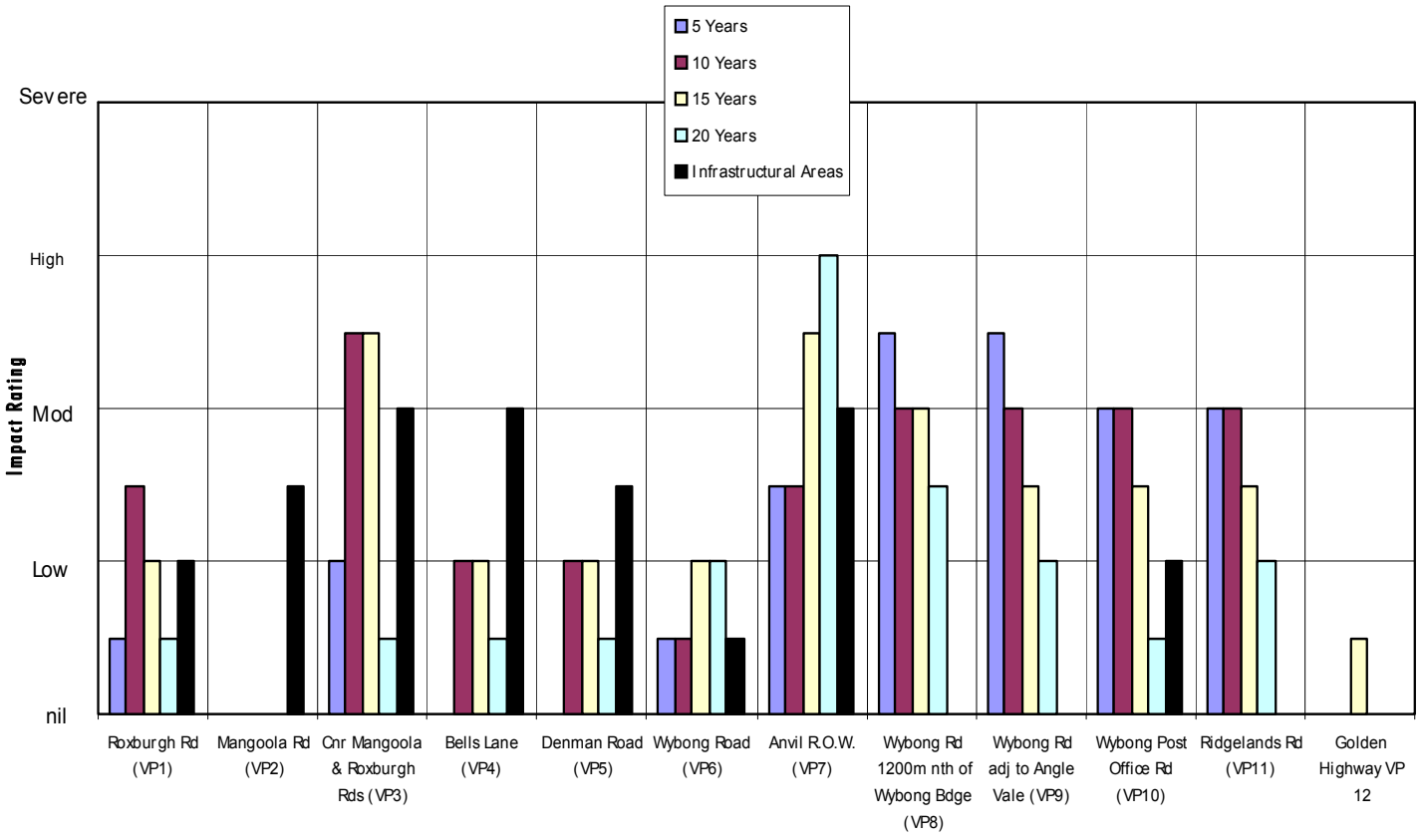
Overall, the design of the Project in terms of the location of infrastructure areas and pit layouts takes advantage of the shielding provided by the existing topography in order to minimise visual impacts where possible. The infrastructure area is located within the valley formed by the Anvil Creek catchment with a prominent ridgeline along the eastern extent of the Project Area providing screening to the east and south. In addition, the realignment of the Northern Pit boundary to be set back approximately 250 metres to 350 metres from Wybong Road decreased the prominence of the proposed mining area and also increased the area where screening can be maintained and enhanced by native vegetation.

The detailed visual assessment (refer to **Appendix 15**) rated the extent of visual impacts, ranging from nil impact through to very high, for each of the visual assessment points over the life of the Project (refer to **Figure 5.28**). As indicated in **Figure 5.28**, the visual impacts on the viewpoints ranged from nil impact to moderately high impacts based on the location in the surrounding area and the stage of the Project.

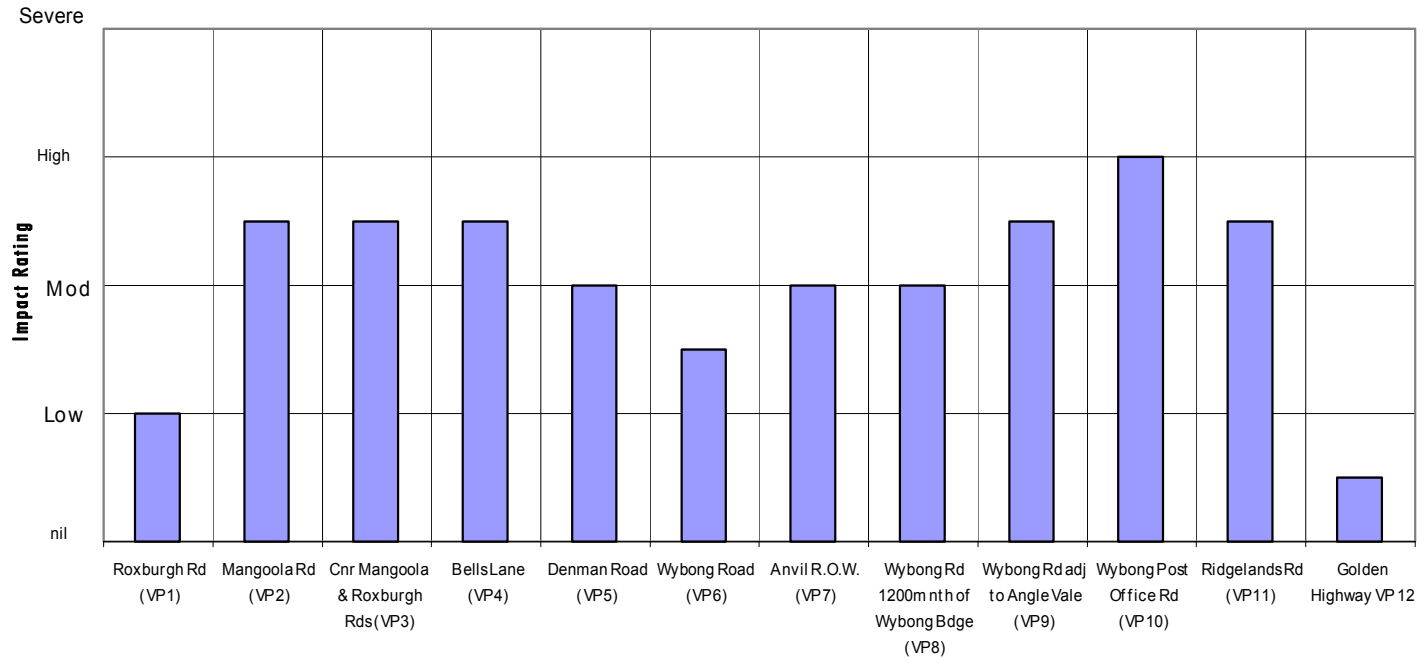
The largest visual impacts occurred at VP 7, located to the west of the Project Area, during Year 15 and 20 operations. This assessment point is located along Anvil ROW within the Project Area. As such, it is considered that the impacts from this viewpoint are not indicative of the visual impacts on surrounding private residences.

Within the surrounding area, the highest visual impacts occur at VP 3, located to the east of the Project Area, and at a number of viewpoints located to the north-west of the Project Area (VP 8 – VP 11). The extent of impacts at these locations varies over the life of the Project, with VP 3 experiencing highest visual impacts during Year 10 and Year 15 operations, whilst the areas to the north-west experience the greatest visual impacts during Year 5 and Year 10 operations.

A similar rating system has been used in the detailed Visual Assessment to assess the degree of impacts associated with lighting from the Project in the surrounding area (refer to **Figure 5.28**). Similarly to the visual impacts associated with the Project, the degree of night



Visual Impacts at selected years of the Project life



Nightlighting Impacts

Source: O'Hanlon Design Pty Ltd

FIGURE 5.28

Summary of Visual Impact Assessment

lighting impacts is dependent on the location of receivers in the surrounding area. As indicated in **Figure 5.28** the night lighting impacts associated with the Project have been assessed as being predominantly moderate to high. Higher levels of impact will be experienced at locations to the east (VP 2 – VP 4) and north-west of the Project Area (VP 9 – VP 11). The greater extent of impacts within areas to the east of the Project Area is associated with the increased visibility of surface infrastructure from these areas. Elevated lighting impacts within areas to the north-west of the Project Area are associated with increased potential for views in these areas, largely as result of the higher elevation.

Visual transects documenting the relationship between local topography, visible aspects of the Project and the surrounding area have been developed for a number of viewpoints, to provide additional detail of the potential visual impacts (refer to **Figure 5.27** and **Figure 5.29**). The transects provide perspectives of the static visual elements, such as the proposed infrastructure area, over the life of the mine. Perspectives of dynamic visual elements, including the proposed mining and overburden emplacement areas, are provided for a number of years of the project life to assist in understanding the changing nature of potential visual impacts.

Each transect represents a view along one section only, and does not provide a representation of the view with the naked eye, nor an indication of the complete impact from that point at that time. As such, the visual transects presented in **Figure 5.27** and **Figure 5.29** should be viewed in conjunction with the detailed Visual Assessment in **Appendix 15**.

5.9.4.1 Individual Residences

The detailed Visual Assessment also assessed the visual impacts of the Project at a number of selected individual residences between Wybong Road and Wybong Hall Road west of VP 8 (refer to **Figure 5.27**). The individual residences assessed will generally have greater potential for views to the Project Area relative to the surrounding area, than VP 1 to VP 12, due to their elevated locations.

Due to their elevated locations, these residences have views into the Project Area, in particular the progression of Main and Northern Pits and associated overburden emplacement areas, over the life of the Project. In addition, views of the CPP, infrastructure areas and coal stockpile areas will also be possible from the northern most residences close to Wybong Hall Road.

The visual impacts on these residences will be similar to VP 8 for the first five years of operation. However, with the progression of mining decreasing the distance between these residences and the mining operation, the visual impacts will range from moderate to high for the remaining years of the Project.

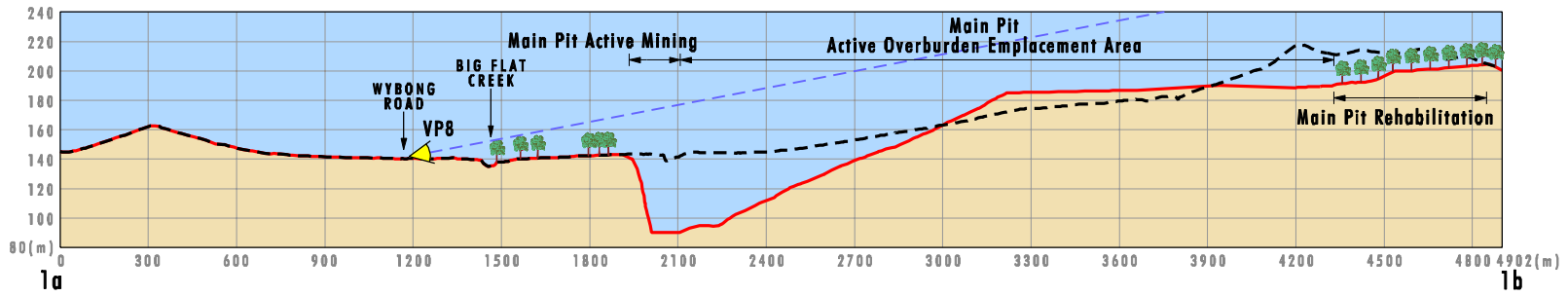
5.9.5 Visual Management Commitments

In order to minimise visual impacts associated with the Project, Centennial has committed to mitigation strategies outlined below.

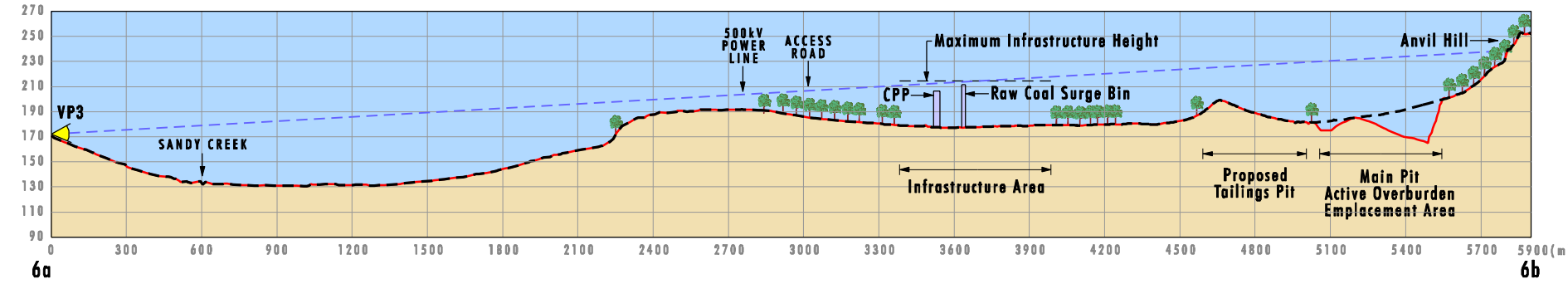
Vegetative Screenings

- Vegetative screens will be planted along the lower sections of Mangoola Road from Roxburgh Road to the new rail loop intersection and along the ridge extending west from Limb of Addy Hill.

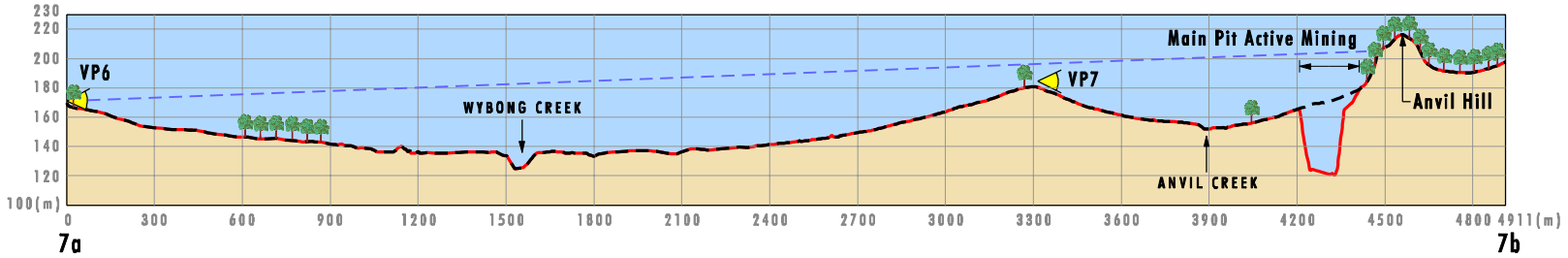
- Final revegetation of disturbed areas will consider the reduction of visual impacts.



Transect 1 - Year 10



Transect 6 - Year 10



Transect 7 - Year 15

Source: Infrastructure elements are diagramattic and locational only due to the vertical exaggeration distortion

Legend

- Existing Surface
- Post-Mining Surface
- Line of Sight
- Viewpoint
- Tree

Vertical Exaggeration 1:5

0 50 100 200m
Vertical Scale

0 250 500 1000m
Horizontal Scale

FIGURE 5.29

Visual Transects

File Name (A4): R12_V1/1858_517.dgn

Earthworks and Final Landforms

- Final bulk earthworks and shaping of the overburden emplacement areas associated with Main, Northern and Southern Pits will be designed to ensure:
    - minimisation of straight edges and use of curved faces, where possible, to greater create relief along the faces of the Northern and Main Pit overburden emplacement areas and vary ridge heights when viewed from Wybong Road; and
    - the shape and line of the base of each overburden emplacement area that is located parallel to the 500 kV line will reduce visual convergence when viewed from Wybong Road.

Infrastructure

- The link road from the CPP to the Tailings Dam will be relocated to avoid the knoll 500 metres east of the product stockpile. This will ensure existing vegetation on the knoll shields views of the CPP and stockpile from VP 2.
- The colour of building roofs and walls will be selected to differentiate elements and reduce visual mass.
- The spur on the north-east edge of Anvil Hill at RL 220 will be recreated as part of the overburden emplacement areas to assist screening of the CPP from Years 10 to 20 when viewed from the north around VP 10.
- The north, east and south sides of the workshop and CPP will be clad.
- All floodlights in the open cut area will be shielded to the maximum extent practicable.
- Workshop doors will be orientated south or south-west, where possible, to reduce light spill.
- Where safe to do so, trucks on access roads will make use of portable visual edge markers to increase drivers' visibility of road edges when driving with dipped headlamps.

Operational Measures

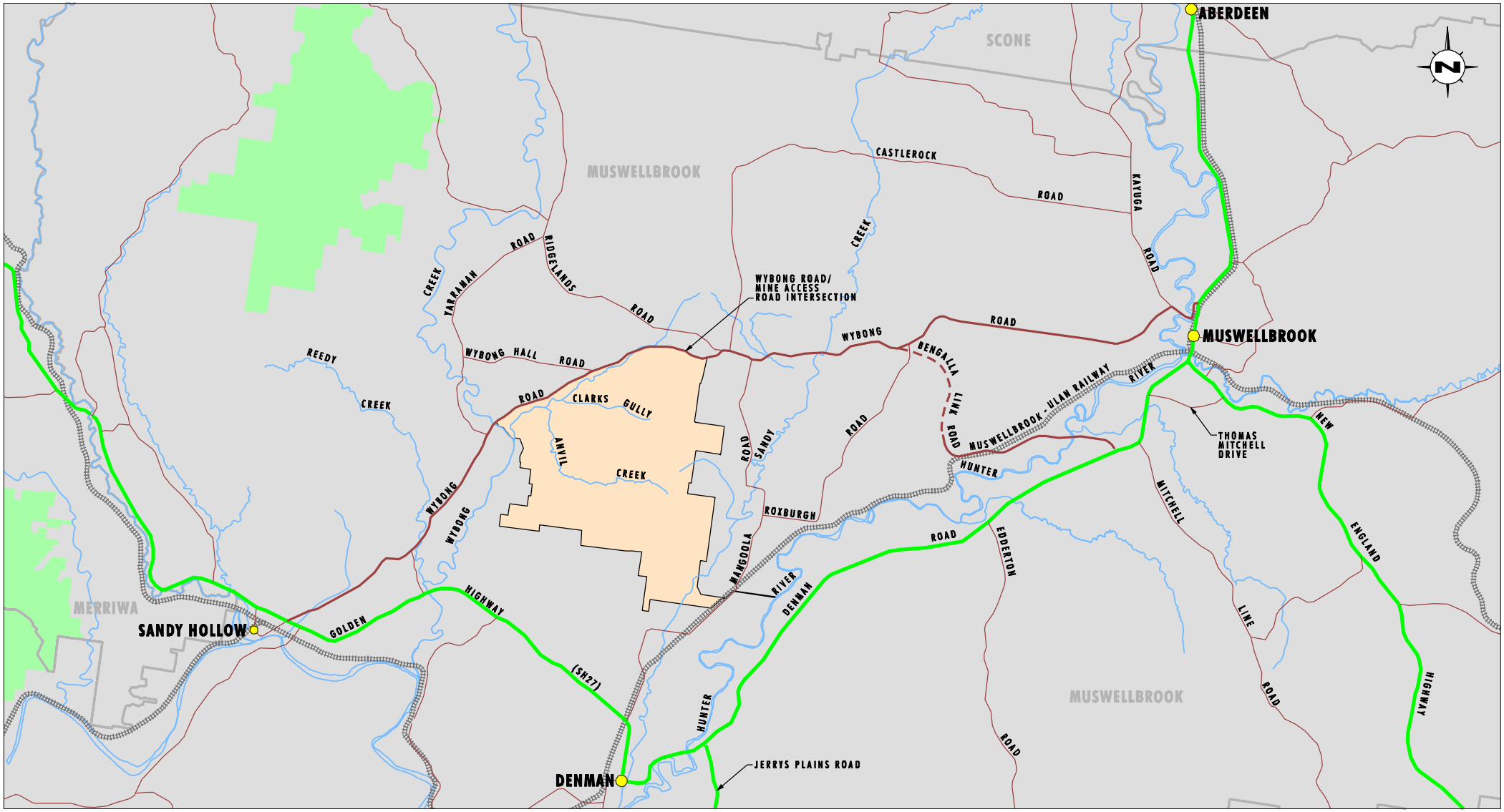
- At night, work will be restricted to lower levels on the overburden emplacement areas to reduce noise impacts which will also reduce potential direct lighting effects from random elements such as truck headlights and flashing beacons.

5.10 Traffic and Transport

The DGRs for the EA required detailed assessment of traffic and transport, and potential impacts on the local road system and safety for road users was a key issue raised during the consultation process. A detailed road traffic impact assessment has been conducted by TPK and Associates Pty Ltd. A complete copy of this report is included in **Appendix 16** and the key findings are outlined in **Section 5.10.1**. Details of rail infrastructure and the cumulative impacts of rail transport are provided in **Section 5.10.3**.

5.10.1 Existing Road Network

The existing road network surrounding the Project Area is shown in **Figure 5.30** and a brief description of the relevant roads is provided below.



Source: TPK & Associates Pty Ltd (2006)
Base Map: Dept. of Lands (2003)

Legend

- Project Area
- National Parks
- Local Government Boundary
- Major Road
- Proposed Road
- Creek
- Railway Line

FIGURE 5.30

Existing Road Network

Wybong Road

Wybong Road is a local road that facilitates a transport link between Muswellbrook and Sandy Hollow to the west. Wybong Road extends from the intersection with the Golden Highway at Sandy Hollow through to the intersection with Kayuga Road in the east (refer to **Figure 5.30**). Consultation with MSC has indicated that the portion of Wybong Road extending east from Roxburgh Road is planned to be closed once an alternative route is established via the planned extension of the Bengalla Link Road. Traffic counts undertaken for the Project (**Appendix 16**) indicate an existing Average Daily Traffic (ADT) of 500 vehicles per day (vpd) and an hourly peak flow of 50 vehicles per hour (vph) along Wybong Road.

Bengalla Link Road

Bengalla Link Road was constructed in 1997 as part of the development of the Bengalla Mine. The road extends north from Denman Road where it crosses the Hunter River and currently terminates at the Bengalla Mine access road. Part of the development consent for the Bengalla Mine requires the extension of the Link Road to connect with Wybong Road at the intersection with Roxburgh Road (refer to **Figure 5.30**). It is understood through consultation with MSC that the extension of Bengalla Link Road is planned to be completed as part of the MSC Western Road Strategy prior to the commencement of the Project. On this basis, this assessment has assumed that the Bengalla Link Road will form the primary access route to the site.

Traffic counts indicate an existing ADT of approximately 1500 vpd along Bengalla Link Road.

Denman Road (MR 219)

Denman Road is an RTA funded road which extends east from Denman and connects with the New England Highway at South Muswellbrook. Denman Road primarily consists of a two lane rural highway that provides the main connection between the township of Denman and Muswellbrook. Based on Traffic Volume Data 2004 (RTA 2004), the Annual Average Daily Traffic (AADT) for Denman Road is 4000 vpd on the section approaching Bengalla Link Road.

Golden Highway (SH 27)

The Golden Highway is an RTA funded road and is part of the major transport link between Dubbo and Newcastle. The Golden Highway passes through Denman en route to intersecting with the New England Highway to the south of Singleton. The AADT for the Golden Highway is 2343 vpd just north of Denman.

New England Highway

New England Highway is an RTA funded road which is a major transport route between Newcastle and Brisbane, and passes through the regional centres of Singleton and Muswellbrook. The AADT for the New England Highway south of Sydney Street in Muswellbrook is 16,253 vpd.

Rural Roads and Crown Roads

There are a number of rural roads both within and surrounding the Project Area. These roads, including Mangoola Road and Roxburgh Road, are generally narrow sealed roads that provide access to private properties within the surrounding area. In addition, there are a number of Crown Roads within the Proposed Disturbance Area. As outlined in **Section 1.2.2**, Centennial will be seeking approval from the Department of Lands for the closure of a number of these roads prior to the commencement of the Project.

5.10.2 Construction and Operational Traffic Impacts

Project related traffic, including employee movements, will be restricted to the use of the extension of the Bengalla Link Road to access the Project Area via Wybong Road. This restriction will ensure that no Project related traffic will use Mangoola Road and Roxburgh Road, minimising any potential impacts on the integrity and safety of these roads.

Construction Traffic

The expected daily peak traffic numbers during the construction period was estimated to be associated with vehicle movements from 200 contractors, 20 visitors and 12 heavy vehicles (refer to **Appendix 16**). After allowing for car sharing, expected working hours, and likely times for vehicle movements, the worst case hour is estimated to have a total of 191 vehicle movements.

The predicted construction related traffic movements represent a considerable increase in peak hourly traffic flows, particularly along Wybong Road. However, construction traffic is likely to be at a peak for only 2-3 months during the 12 month construction period and any impacts can be considered short term.

Operational Traffic

The *Upper Hunter Mining Industry and Employee Survey Report* (Coakes Consulting 1999) provides an assessment of the typical employment catchment areas that are most relevant to this Project. Based on this assessment, it is likely that the majority of Project related traffic will originate from Muswellbrook, with contributions from the Denman, Scone and Singleton areas. Coupled with the restrictions on transport route, the majority of Project related traffic will be generated along the New England Highway, Golden Highway, Thomas Mitchell Drive, Denman Road, Bengalla Link Road and Wybong Road (refer to **Figure 5.30**).

The detailed traffic impact assessment undertaken for the Project (refer to **Appendix 16**) focussed on the assessment of Project related traffic generation along this primary road transport route in relation to condition and safety of the relevant roads and main intersections. In addition, allowance has been made for the projected Mount Pleasant mine employee numbers as outlined in the Mt Pleasant Mine EIS Volume 1 (ERM Mitchell McCotter 1997).

Peak project related hourly traffic movements relate to shift changes, with the highest of 125 movements per hour expected to occur during the morning shift change. The average Project related traffic movements are expected to be approximately 300 to 340 vpd. Based on the projected traffic flows, the existing road infrastructure is considered to provide an adequate level of service for both existing and projected traffic movements.

An audit of the current condition of Wybong Road was undertaken as part of the detailed traffic impact assessment (refer to **Appendix 16**). This audit highlighted a number of issues that are to be addressed in order to maintain the integrity and safety of Wybong Road. Major issues include the expansion of the existing carriageway width, suitable line marking and safety signage.

The traffic assessment also included the modelling of traffic flow of the major intersections along the primary road transport route. Given the primary access route to the Project Area for Project related traffic, the critical intersection is the Denman Road and Bengalla Link Road intersection. The detailed traffic assessment modelled traffic impacts on this intersection based on the existing traffic flows, inbound and outbound morning and evening peak movements and the cumulative impact of the corresponding peak movements of the approved Mt Pleasant Project. The modelling indicated that the intersection performed satisfactorily within the existing infrastructure for all ten modelled scenarios.

The performance of intersections was assessed and demonstrates that Project related traffic at the Denman Road and New England Highway, and Denman Road and Jerrys Plains Road intersections will not impact on the physical condition and safety of the existing intersections. An evaluation of the Denman Road and Thomas Mitchell Drive, and the future Wybong Road and Bengalla Link Road intersections also indicated satisfactory performance for projected Project related traffic.

Following modelling of projected traffic flows for the proposed Wybong Road and Mine Access Road intersection, it is proposed to construct this intersection to a Type B rural layout with a left turn auxiliary lane from Wybong Road into the proposed access road. The proposed location of the mine access road has been selected to provide adequate Safe Intersection Sight Distance (SISD) to provide for the safe operation of the proposed intersection. Modelling of the performance of this proposed intersection layout for projected peak traffic movements indicated that the proposed intersection geometry will manage potential traffic impacts and have minimal impact on Wybong Road.

5.10.3 Rail Infrastructure

5.10.3.1 The Rail Network

As outlined in **Section 2.5**, all product coal produced by the Project will be transported to both domestic users and Port of Newcastle via a purpose built rail loop connected to the Muswellbrook to Ulan rail line. The Muswellbrook to Ulan line extends from the Ulan Junction located approximately 435 kilometres west of Muswellbrook, and passes through the township of Denman for connection to the Main Northern Line at Muswellbrook. The Main Northern Line passes through Muswellbrook to the Port of Newcastle and provides the primary transport infrastructure for the movement of coal produced in the Hunter Coalfield to markets.

The primary users of the Muswellbrook to Ulan rail line include ore freight, wheat freight and a number of existing and approved coal mining operations. Existing coal operations connected to the rail line include Ulan Coal, located west of the Project, and Bengalla Mine to the east. A number of recently approved coal mining operations, including the Wilpinjong Project and Mt Pleasant Mine, propose to connect to the rail line for movement of product coal to domestic and export markets.

5.10.3.2 Rail Loop and Rail Movements

A purpose built rail loop and loading facility is proposed, able to cater for transport of all of the Project product coal. The proposed rail loop is located in the south-eastern extent of the Project Area, and will connect to the Muswellbrook to Ulan rail line.

The train loading facility is planned to be available for use 24 hours per day, 7 days per week. On average four trains per day are expected to be handled through the facility throughout the duration of the Project, with a maximum of five trains per day.

5.10.3.3 Cumulative Impact on Existing Rail Network

The potential cumulative impacts on the existing rail network from proposed Project related rail movements on the Muswellbrook to Ulan Rail line and the subsequent movement along the Main Northern Line have been assessed. The assessment of potential cumulative noise impacts from train movements along the Muswellbrook to Ulan Rail line have also been assessed and are included in **Section 5.6.5.1** and **Appendix 12**.

Muswellbrook to Ulan Rail line

The existing, approved and proposed train movements along the Muswellbrook to Ulan rail line in terms of average and peak daily movements are provided in **Table 5.17** and **Table** 5.18.

Table 5.17 – Average Daily Movements Muswellbrook to Ulan Rail line

Operation	Existing / Approved Movements (avg/day)*		Proposed (Avg/day)		Total Movements / Operation
	Day	Night	Day	Night	
Cobar Ore Freight	3[a]	1[a]			**4**
Ulan Coal	8[a]	4[a]			**12**
Bengalla Mine	4[b]	2[b]			**6**
Wilpinjong Coal Project	6[c]	2[c]			**8**
Mt Pleasant Mine	4[d]	2[d]			**6**
Anvil Hill Project			6	2	**8**
Total Rail Movements	**25**	**11**	**6**	**2**	**44**

Table 5.18 - Peak Daily Movements Muswellbrook to Ulan Rail line

Operation	Existing / Approved Movements (peak/day)*		Proposed (Peak/day)		Total Movements / Operation
	Day	Night	Day	Night	
Cobar Ore Freight	5[a]	1[a]			**6**
Ulan Coal	8[a]	4[a]			**12**
Bengalla Mine	4[b]	2[b]			**6**
Wilpinjong Coal Project	8[c]	4[c]			**12**
Mt Pleasant Mine	4[d]	2[d]			**6**
Wheat Freight	2[e]	0			**2**
Anvil Hill Project			6	4	**10**
Total Rail Movements	**31**	**13**	**6**	**4**	**54**

* A movement is defined as a pass by along the rail line - that is, a train needs to go out and back from the operation along the rail line - 1 train = 2 movements

a Source from Richard Heggie & Associates 2005, Wilpinjong Coal Project Construction, Operation and Transportation Noise Impact and Blasting Assessment

b Source from Envirosciences 1993, Bengalla Coal Mine Environmental Impact Statement Volume 1

c Source from Richard Heggie & Associates 2005, Wilpinjong Coal Project Construction, Operation and Transportation Noise Impact and Blasting Assessment

d Source from ERM Mitchell McCotter 1997, Mt Pleasant Mine Environmental Impact Statement Volume 1

e Source from ARTC (J Tyne pers comm. 13 April 2006) is based on semi regular movements of 2-3 trains per week

As indicated in **Table 5.17** and **Table 5.18** the Project proposes to increase average train movements by up to eight per day and peak train movements by up to ten per day. The proposed Project related train movements represent an increase of approximately 20% of the existing and approved average and peak rail movements along the Muswellbrook to Ulan rail line.

The potential for increases in rail movements along the Muswellbrook to Ulan rail line has been acknowledged in the *Hunter Valley Corridor Capacity Improvement Strategy* (ARTC 2005). This strategy provides a five year plan for the improvement of rail movements within the Hunter Valley, which includes a number of specific measures to increase the capacity of the Muswellbrook to Ulan rail line.

The proposed improvements to the line aim to increase the capacity of the rail line to accommodate the existing, approved and proposed train movements along the line. ARTC (2005) state that the installation of Centralised Traffic Control (CTC) remote signaling and the construction of a number of passing loops along the rail line will increase the capacity of the line to meet projected demand within the short term, with completion of remaining strategies by 2009. The Project is scheduled to be commissioned in 2008, at which time the majority of planned improvements will have been completed.

Main Northern Line

The present capacity of the Main Northern Line system into the Port of Newcastle is approximately 85 Mtpa, with industry forecasts indicating a projected increase in demand to approximately 138 Mtpa by 2009 (ARTC 2005). ARTC 2005 specifies a number of specific strategies to enhance the capacity, safety and reliability of the rail system to meet projected demand. Specific strategies include works to address junction conflicts and increased congestion along the rail system south of Wittingham, which will improve train movements and ultimately increase the capacity of the rail network in the short to medium term.

The proposed infrastructure improvement strategy proposed by the ARTC is underlain by a $270M Commonwealth funding package to enhance the capacity of the existing rail system.

On the basis of the proposed improvements to both the Muswellbrook to Ulan rail lines and Main Northern Line south of Muswellbrook, the rail system can accommodate the additional coal to be transported as a result of the Project.

5.10.4 Traffic and Transport Management Commitments

In order to effectively manage any impacts from Project related road traffic, Centennial has committed to the following traffic management strategies.

- On the basis that the Bengalla Link Road extension is completed prior to being required for access for this Project, all Project related traffic, including employee movements, will be restricted to the use of the extension of the Bengalla Link Road to Wybong Road to minimise impacts on Mangoola and Roxburgh Roads.

- Confirmation of the capacity of the intersection of Thomas Mitchell Drive and Denman Road will be undertaken in consultation with MSC.

- Wybong Road will be upgraded in association with MSC, from the intersection with Bengalla Link Road to the proposed mine access road. This includes an upgrade to a sealed carriageway minimum 6.5 metres wide, road marked centreline to relevant standards, enhancement of safety and advisory signage, and upgrade of sections to ensure safe operation of school bus zones and stops. All works will be undertaken in consultation with MSC and to the standards recommended in the detailed traffic assessment in **Appendix 16**.

- The intersection of Wybong Road and the mine access road will be a Type B rural layout with a left turn auxiliary lane from Wybong Road into the proposed access road.

- As noted in **Section 3.1.1**, Centennial will require a Section 138 approval under the *Roads Act 1993*, from MSC, prior to the conduct of these works on Wybong Road.

5.11 Socio-Economic Assessment

The DGRs require that a social and economic assessment is undertaken for the Project. A comprehensive Socio-Economic Assessment has been completed by Coakes Consulting and is included as **Appendix 3**. Gillespie Economics has completed the economic assessment which is included as **Appendix 17**. A summary of the key findings of these assessments is provided in this section.

5.11.1 Methodology

Socio-economic assessment assesses and predicts the likely consequences of a proposed action in both social and economic terms. While economic assessment emphasises the monetary effects of an action or proposal, socio-economic assessment is concerned with assessing benefits and costs in non-monetary terms. This involves understanding impacts from the perspectives of those involved in a personal, community, social or cultural sense. Social and economic assessment processes work together to provide a complete picture of impacts and their meaning.

The socio-economic impact assessment process has a number of phases, including:

- assessment and evaluation of issues, which includes profiling to understand the community, and scoping to identify stakeholder issues;
- prediction of the likely effects of the Project;
- mitigation or working with the community to develop appropriate strategies; and,
- monitoring and management of the issues throughout the life of the Project.

The process has employed a range of consultative and assessment mechanisms appropriate to the stakeholder group and assessment phase, as discussed in **Section 4.1**. The process has also involved a range of stakeholders including local residents/landholders/tenants, government agencies and political representatives, special interest groups, service providers and functional groups, and the wider community in general.

5.11.2 Socio-Economic Assessment

The assessment has predicted a number of social impact variables that may be associated with the Project. These include:

- population impacts caused by the inflow of employees associated with the construction and operational phases of the Project and cumulative issues associated with other developments in the area;
- community/institutional arrangements, including the emergence of interest groups with specific views and attitudes towards the Project;
- changes in the nature of the community, resulting from relocation of households and perceived impacts of the Project;
- individual, family and community level impacts including the perceived environmental and social impacts associated with the Project such as dust, noise, visual impacts, traffic, and disruption to sense of community;
- community infrastructure needs which includes flow-on effects of the Project to infrastructure and social service provision.

Each of these impacts is discussed further below.

5.11.2.1 Population Impacts

The social assessment has predicted the potential impacts of the Project on the Muswellbrook Shire community. Given a peak predicted construction workforce of 200 employees and a peak operational workforce of 240 employees, it is projected that 192 employees will potentially relocate into the area with approximately 109 workers located in the Muswellbrook Shire specifically. This yields a family size impact of approximately 381 family members.

5.11.2.2 Community Infrastructure and Services

A review of local services such as temporary accommodation, education, health and housing has indicated that there will be sufficient temporary accommodation to cope with the population impacts associated with the construction workforce. However, the potential relocation of the additional 109 operational employees and their families, has the potential to place pressure on the health services within the Shire. In contrast, the education and housing sectors should have sufficient capacity to manage the influx of population associated with the Project.

Should the Project be approved, in order to maximise the benefits of the Project, it is recognised, at both a local government and general community level, that further education and training is required to increase the employability of local residents in line with development potential. It is noted that the region is currently experiencing a skills shortage, and attraction and retention of population is a key issue. Consequently opportunities exist for the company to work proactively with the local Shire and relevant stakeholders to facilitate new community opportunities and enhancement initiatives. These are discussed further in **Section 5.11.4**.

The Project appears to be in line with the Shire's strategic plan, which identifies the need to facilitate economic development and to ensure the establishment of complementary business ventures within the LGA. It has also been suggested that economic growth in the area is related to further expansion and development of coal mining.

5.11.2.3 Community Attitudes

In relation to the impact of the Project on community/institutional arrangements, it is evident from the assessment that a high level of community concern exists in relation to the Project, particularly among those landholders who reside in proximity to the Project.

To assess the attitudes towards the Project among the broader Muswellbrook LGA community, a random telephone survey of 400 households was conducted. After being presented with information that described the Project, approximately 46% of respondents indicated that they either strongly approved or approved of the Project. A further 24% expressed no opinion either way, while 29% either disapproved or strongly disapproved of the Project.

When community attitudes were further assessed across townships (that is, Muswellbrook and Denman), approximately 50% of respondents in both townships approved of the Project. However, the attitudes of residents in the Denman area (the closest town to the Project) were more polarised than the attitudes of Muswellbrook residents, that is, Denman residents were more likely to either approve or disapprove of the Project compared to Muswellbrook residents who were more ambivalent in their response.

At the broader community level, the potential benefits of the Project included employment, support for the local economy, including small business, and the opportunity to develop further community infrastructure and services in the area. Even among those who

disapproved of the Project, 49% believed that the Project would provide employment benefits for the area.

In regard to the disadvantages associated with the Project, the most significant disadvantages identified related to a perceived 'increase in dust from the mine', 'an increase in noise from the mine' and 'an increase in respiratory conditions'. These three issues were also found to be the primary reasons why the majority of respondents disapproved of the Project.

Comparisons in relation to the perceived disadvantages of the Project were also made amongst residents of the town of Muswellbrook, those in the Denman area and landholders in proximity to the mine site. While respondents across all three groups ranked the increase in dust from mining operations as an important issue, landholders in proximity to the proposed mine site were more likely to report 'changes in how the area looks' and 'a change in people's lifestyles' as important impacts.

5.11.2.4 Individual, Family and Community Level Impacts

A range of potential Impacts at individual, family and community level have also been identified as part of the assessment process. Consultation with local landholders, both within and outside of the Project Area, has indicated a high level of concern around the proposed development, with almost 50% of landholders surveyed expressing extreme concern in regard to the Project. Perceived individual and community level concerns of landholders in proximity to the Project related largely to changes in lifestyle, dust from the mine, visual aesthetics (impact on how the area looks), noise from the mine, potential reduction in property values, increase in traffic, and blasting.

Impacts of perceived lifestyle changes included uncertainty associated with Project approval and impacts, a decline in sense of community and individual and community concerns relating to possible relocation of households from the area. A key concern related to visual impacts, given the perceived beauty of the region and Anvil Hill itself. Mining development was considered by many landholders to be inconsistent with existing land uses and other regional economic development activities, for example agriculture and viticulture. Issues relating to the increase in noise from operations, particularly at night, and blasting were also raised, particularly in light of cumulative issues associated with mining within the region.

For landholders located outside the Project Area, issues of water quality and increased traffic (noise and safety implications) were also identified. These issues were also identified by a number of community groups within the area.

The Wybong area has been used for agriculture since the 1800s and there are a number of key families with strong generational ties to the community. This, the size of the community, its demographic composition, and its geographic nature (that is, separation from the townships of Denman and Muswellbrook) has contributed to the development of a strong 'sense of community'. Consequently, a further social impact area highlighted in the assessment relates to the change in the nature of the Wybong community, given that the Project has the potential to result in the relocation of a number of households.

5.11.2.5 Cumulative Impacts

Other developments in the region have the potential to add pressure on community infrastructure, services and housing. As part of the socio-economic assessment, the potential cumulative impacts of the approved (but not operational) Mount Pleasant Mine were considered.

Although there is sufficient capacity within the LGA to manage the temporary and permanent population impacts of the Project, further analysis reveals a critical level of population impact from the cumulative impact of the Project and Mount Pleasant which could result in an influx

of approximately 1130 new family members. Given the current and predicted service levels, this type of impact would place pressure on key community services within the LGA.

5.11.3 Economic Impact Assessment

Regional economic impact assessment is primarily concerned with the effect of a development on an economy in terms of a number of specific indicators, such as employment, income, gross regional product and gross regional output.

5.11.3.1 Overview of the Regional Economy

The comparative distribution of various industry sectors to the gross regional product (GRP), employment and output earnings for the local region (LGAs of Muswellbrook, Singleton and Scone) and for the state of NSW are presented in **Table 5.19**.

Table 5.19 - Local Regional Contributions to GRP, Employment and Output by Industry Sector (2001)

Sector	Total Employment (%)		Contribution to GRP (%)		Contribution to Output (%)	
	Hunter Region	NSW	Hunter Region	NSW	Hunter Region	NSW
Agriculture/Forestry and Fishing	10	4	4	2	4	2
Mining	19	1	42	2	41	2
Manufacturing	8	12	7	13	17	29
Utilities	3	1	8	2	7	2
Building	6	7	2	4	3	4
Services	54	76	30	67	28	61

Table 5.19 reveals that the agriculture, forestry and fishing sector, mining sector and the utilities sector in the regional economy are of greater relative importance than they are to the NSW economy.

In terms of all the regional economic indicators, gross regional output, value added contributions, employment, income, imports and exports, the coal mining sector is by far the most significant sector of the regional economy.

5.11.3.2 Regional Economic Impact

From an economic perspective, both the construction and operational phases of the Project will deliver benefits to the local, regional and state economy. Construction of the Project is anticipated to contribute between $19M and $21M in annual direct and indirect regional output or business turnover; between $9M and $10M in annual direct and indirect regional value added; between $5M and $6M in annual direct and indirect household income; and indirect and direct employment of approximately 121 to 143 people, on an average annual basis over the construction period.

In the operational phase, it is estimated that the operation will contribute to the regional economy between $212M and $224M in annual direct and indirect regional output or business turnover; between $115M and $121M in annual direct and indirect regional value added; between $25M and $28M in annual household income; and indirect and direct employment of between 343 and 449 people, on an average annual basis.

The economic assessment has also indicated that economic flow on effects from both the construction and operational phases of the Project are likely to positively affect and

contribute to a range of sectors including wholesale and retail trade, accommodation, cafes, restaurants, rail and road transport, agricultural and mining machinery manufacturing sector, fabricated metal products, electricity supply, other property services, community services, and scientific research.

Royalties for the life of the Project are estimated to be approximately $380M.

5.11.3.3 Cost Benefit Analysis

Economic analysis is primarily concerned with weighing up the potential economic benefits and costs of a Project to the community (that is, consideration of economic efficiency). This includes the benefits and costs to the environment. The main technique that is used to evaluate proposals with respect to economic efficiency is benefit cost analysis. As part of the Economic Assessment presented in **Appendix 17**, a benefit cost analysis was performed for the Project.

Identification of the "base case" or "without" Project option is required in order to facilitate the identification and measurement of the incremental economic benefits and costs of the Project. In this study, the "without" Project involves:

- continuation of the cattle grazing of open grasslands; and
- continuation of low intensity grazing and conservation of steeper land and areas of native vegetation.

The benefit cost analysis identified a range of incremental economic benefits and costs of the Project and placed indicative values on the production benefits and costs. External economic benefits and costs of the Project were identified and discussed. The analysis indicated that the incremental net production benefits of the Project (after full incorporation of greenhouse gas effects, air quality impacts, noise and blast vibration, agricultural impacts, traffic impacts, and partial internalisation of visual impacts, flora and fauna impacts, Aboriginal heritage impacts and historic heritage impacts) would be in the order of $480M.

This net benefit is distributed amongst a range of stakeholders including:

- Company shareholders;
- the NSW Government via royalties and payroll tax;
- the Commonwealth Government in the form of Company tax;
- the local community via Centennial's Community Enhancement Program (**Section 5.11.4.1**) and proposed conservation and heritage offsets.

The estimated net production benefit of the Project represents the opportunity cost to society of not proceeding with the Project. Put another way, any environmental costs of the Project, after mitigation by Centennial, would need to be costed at greater than $480M to make the Project questionable from an economic efficiency (net community welfare) perspective.

This is equivalent to each household in the Muswellbrook LGA having a willingness to pay $85,000 to avoid any of the residual environmental impacts of the Project, after mitigation by Centennial. The equivalent figure for the Muswellbrook, Singleton and Scone region is $27,000 and the figure for NSW households is $190.

5.11.4 Socio-Economic Management Commitments

5.11.4.1 Community Enhancement Program

Centennial has committed to provide opportunities for the community to benefit from the Project through the establishment of a Community Enhancement Program (CEP). The key elements of the CEP are summarised in **Table 5.20**. The CEP has been developed based on an assessment of community need in the local Wybong and broader Muswellbrook community, through consultation with MSC as well as approximately 60 service providers and the extensive consultation that has been engaged in with local landowners and community members. The consultation identified priority areas of community need and opportunities for potential community contributions and partnerships across a broad range of community sectors.

Table 5.20 – Community Enhancement Program

Issue of Concern	Detail	Mechanism/Contribution
Community Projects	For ongoing community projects, to be distributed with community input	1 cent per saleable tonne of coal produced
Local Environmental Management	External to the mine site Wybong Uplands Land Management Strategy (refer to **Section 5.1**)	$100,000 per annum for 5 years
Education and Training	Sponsorship of TAFE courses, apprenticeships, traineeships	$200,000 per annum for 3 years
Local Employment	To work with the local Council to facilitate local employment and residential opportunities within the Muswellbrook Shire	To be confirmed through consultation with key stakeholders
Community Infrastructure	Focus on Denman and Wybong, for example sporting and recreation facilities	$500,000

The 'Community Projects' component of the CEP will be based on the contribution of 1 cent per tonne of saleable product by Centennial. It is envisaged that if the Project is approved, the evaluation of community projects and distribution of these funds will be undertaken with community input, based on principles of partnership, representative-ness and mutual benefit.

Centennial has outlined that environmental management, education, training and local employment will be attributed particular priority to reflect identified stakeholder issues and expectations and will be addressed through two mechanisms - the Wybong Uplands Land Management Strategy (an annual contribution of $100,000 for five years) directed to support programs such as salinity management, riparian zone repair, demonstration farming, education, etc; and the Education, Training and Employment Strategy (annual contribution estimated at $200,000 for three years), aimed at addressing multiple methods of increasing local employment, such as sponsorship of TAFE courses, apprenticeships and traineeships. This strategy will also focus on increasing opportunities for education, training and employment amongst Indigenous members of the community.

In addition, an upfront contribution to the value of $500,000 will be directed towards the Denman and Wybong communities in consultation with key stakeholders.

5.11.4.2 Cumulative Impacts

Given the uncertainty of the timing or nature of any cumulative employment, population and housing demand in the local area, Centennial will consult with MSC, DoP and other mine operators to plan for and assist with facilitation of measures to manage cumulative issues, should they arise.

5.11.4.3 Mine Closure

As noted in **Section 5.1.7**, Centennial will develop a mine closure plan at least three years prior to mine closure, in consultation with regulatory agencies and the community. The mine closure plan will include consideration of the amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure, in consultation with the relevant Councils at that time.

5.11.4.4 Property Value and Acquisition

For some time, Centennial has had available an offer to purchase any property within its Coal Tenements Area at rural market value. Further to this, following studies predicting that some properties would have significant noise and dust impacts above the relevant criteria if the project proceeds, Centennial has offered the owners of such properties an option to sell arrangement. Centennial believes this arrangement properly accounts for the potential impact situation and provides an improved degree of certainty for the landholder and Centennial during the assessment of the Project Application. This offer includes a contribution to independent legal advice.

All reasonable attempts will be made by Centennial to reach a negotiated agreement with affected land owners regarding compensation and/or acquisition. Should negotiations fail to reach agreement, Centennial will readily participate in any mediation processes as deemed necessary by DoP.

The acquisition of numerous private properties by Centennial within the Wybong area could alter the dynamics of the rural community in this area. It is anticipated that the majority of land acquired by Centennial will continue to be leased for rural purposes, in order to provide for ongoing, responsible land management, and to assist to maintain the rural character and dynamics of the area.

5.11.4.5 Ongoing Community Consultation and Involvement

A key aspect of any socio-economic assessment is the identification of specific mechanisms and indicators that can be implemented to monitor any potential impacts associated with the development over time. Centennial is committed to an ongoing Community Involvement Plan and the development of an appropriate social and community monitoring program. Such a program needs to identify any deviations from the impacts predicted and would document any unanticipated impacts that may arise in relation to the Project. A summary of potential social impact variables that could be measured and assessed is provided in **Appendix 3**.

Should the Project be approved, Centennial will continue to engage the community in consultation for the purposes of providing the community with information relating to the Project and operations in general. This will also enable the community to provide feedback to Centennial and raise any issues or concerns. It is currently anticipated that consultation will include the following:

- circulation of information relating to the commencement of construction and/or mining;
- distribution of a community newsletter as appropriate and on at least a six monthly basis;
- operation of a 24 hour community hotline for receipt of community complaints. Centennial undertakes to respond to community complaints within 24 hours of receipt. All complaints will be investigated and the results of the investigation reported to the complainant in a timely manner;

- a Community Consultative Committee, as considered appropriate by DoP;
- community information days to be held periodically at the Project site.

Draft Statement of Commitments

Section 6.0

6.0 Draft Statement of Commitments

If Project Approval for the Project is granted and acted upon, Centennial will commit to the following operational controls and environmental management measures.

6.1 Production and Life of Operation

6.1.1 Apart from the commitments relating to the Rehabilitation and Landscape Management Plan, the life of the Project will be 21 years after the grant of a Mining Lease for the Project.

Note: Centennial is committed to completion of rehabilitation following mine closure, in accordance with the completion criteria which will be determined in consultation with the relevant government agencies, to the satisfaction of the Director-General of DoP in consultation with the DPI.

6.1.2 No more than 10.5 Mt of ROM coal per year will be extracted and processed at the site.

6.1.3 All coal will be transported from the site by rail. There will be no coal haulage on public roads.

6.2 Community Enhancement Program

6.2.1 The following Community Enhancement Program is proposed to be implemented as part of a Voluntary Planning Agreement:

Community Enhancement Program

Issue of Concern	Detail	Mechanism/Contribution
Community Projects	For ongoing community projects, to be distributed with community input	1 cent per saleable tonne of coal produced
Local Environmental Management	External to the mine site Wybong Uplands Land Management Strategy (refer to **Section 5.1.5.1**)	$100,000 per annum for 5 years
Education and Training	Sponsorship of TAFE courses, apprenticeships, traineeships	$200,000 per annum for 3 years
Local Employment	To work with the local Council to facilitate local employment and residential opportunities within the Muswellbrook Shire	To be confirmed through consultation with key stakeholders
Community Infrastructure	Focus on Denman and Wybong, for example sporting and recreation facilities	$500,000

6.3 Acquisition upon Request

6.3.1 There are a number of properties predicted to experience dust and noise levels above the relevant criteria for significant affectation (refer to **Sections 5.5** and **5.6**), at some stage during the mine life. Upon receiving a written request for acquisition from the landowner of the land listed in Tables 4 and 5 in **Appendix 1**, Centennial will acquire the land in accordance with the procedures set out by DoP in the Planning Approval.

6.4 Noise

Noise Impact Assessment Criteria

6.4.1 Noise emissions from the Project, when measured within 30 metres of a private residence, will not exceed the predicted worst case noise levels set out in Appendix C of **Appendix 12** (Noise and Vibration Assessment) unless a specific agreement is reached with the landholder in regard to noise impacts at a residence.

If Centennial has negotiated a written noise agreement with any landowner, and a copy of this agreement has been forwarded to DoP and DEC, then noise levels from the Project may exceed the noise limits in Appendix C of **Appendix 12** in accordance with the agreement.

Land Acquisition Criteria

6.4.2 If the noise generated by the Project exceeds LAeq noise level of 40 dBA, Centennial will, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures set out by DoP in the Planning Approval.

Noise Mitigation Measures

The following noise control measures will be employed throughout the life of the Project unless otherwise agreed in writing by DoP:

6.4.3 The CPP, coal stockpiles and associated infrastructure will be located near the eastern boundary of the Proposed Disturbance Area, within the valley that forms the upper reach of Anvil Creek. This area provides natural topographic shielding which will reduce noise impacts on surrounding areas.

6.4.4 The CPP and crushers will have noise enclosures, and shielding will be installed for conveyors.

6.4.5 The rail loop will be located to use natural topography for shielding as much as possible. In addition, a 4 metre high noise barrier will be constructed on parts of the track that are exposed to nearby residences.

6.4.6 At night, trucks will be restricted to operate below the maximum elevation of the overburden emplacement areas.

Additional Noise Mitigation Measures

6.4.7 Upon receiving a written request from:

- a landowner of the land listed in Tables 4 and 5 of **Appendix 1** (unless the landowner has requested acquisition); or
- the owner of any residence in existence at the date of Project Approval where subsequent noise monitoring shows the noise generated by the Project is greater than, or equal to, L_{Aeq} 38 dB(A) (except where a negotiated noise agreement is in place);

Centennial will implement additional reasonable and feasible noise mitigation measures such as double glazing, insulation, and/or air conditioning at any residence on the land in consultation with the landowner. If, within three months of receiving this request from the landowner, Centennial and the landowner cannot agree on the measures to be implemented, or there is a dispute about the

implementation of these measures, then the matter will be referred to the Director-General for resolution.

Noise Monitoring

6.4.8 Prior to carrying out any development, Centennial will implement a Noise Monitoring Program for the Project. The Noise Monitoring Program will include a combination of real-time and supplementary attended monitoring measures, and a noise monitoring protocol for evaluating compliance with the noise impact assessment and land acquisition criteria in the Project Approval.

6.5 Blasting and Vibration

Blasting Hours

6.5.1 Blasting will be undertaken Monday to Saturday inclusive, with blasts being detonated between the hours of 9.00 am and 3.00 pm except under exceptional circumstances where safety issues require blasting outside of these times. No blasting will be undertaken on Sundays or public holidays without the written approval of DEC.

Airblast Overpressure and Ground Vibration Criteria

6.5.2 Airblast overpressure from any blast will not exceed 120 dBL at a residence in existence at the date of the Project Approval, and 95% of all blasts over a 12 month period will not exceed 115 dBL at any such residence, unless specific agreement is reached with the landholder;

6.5.3 Ground vibration from any blast will not exceed 10 mm/s at a residence and 95% of all blasts over a 12 month period will not exceed 5 mm/s at the residence;

Road Closure

6.5.4 Prior to carrying out any blasting within 500 metres of Wybong Road, Centennial will prepare and implement a road closure management plan, in consultation with Council and DPI, and to the satisfaction of DoP.

Public Notice

6.5.5 During the life of the Project, Centennial will:

(a) operate a Blasting Hotline, or alternate system agreed to by the Director-General, to enable the public to get up-to-date information on the blasting schedule at the Project; and

(b) advertise the blasting hotline number in a local newspaper at least four times each year.

Blast Controls

6.5.6 Centennial will design and undertake blasts to ensure the relevant vibration and blast overpressure criteria are met at the 500 kV transmission line, Anvil Rock and rockshelters on Wallaby Rocks, Limb of Addy Hill and Western Rocks that are considered to be of significant Aboriginal cultural value.

6.5.7 Techniques to minimise blast impacts will be employed as necessary to ensure compliance with relevant criteria. This may include blast initiation using electronic

detonation techniques, limiting blast MIC, consideration of wind speed and direction prior to blasting, use of adequate stemming, implementing a delay detonation system, and careful drilling and hole loading to ensure that the required blast design is implemented.

6.5.8 The Mine Manager or delegate will undertake a pre-blasting review of weather conditions to identify any conditions which may significantly increase blasting impact or dust impacts. When weather conditions are suitable or if safety requirements dictate at other times, the Mine Manager or delegate will issue a blast clearance prior to each blast proceeding.

6.5.9 Wybong Road will be temporarily closed during blast events within 500 metres of the road.

6.5.10 Centennial will consult with residents surrounding the Project Area prior to the first blast on site and identify those residents that may wish to be notified on an ongoing basis of blasting times. Should any residents wish to be notified of blasting dates and times on an ongoing basis, Centennial will determine in consultation with these residents an appropriate mechanism for undertaking this notification.

6.5.11 All relevant personnel will be trained on environmental obligations in relation to blasting controls.

6.5.12 The date, location of blast holes and quantity of explosive used each day will be documented.

6.5.13 Monitoring will be undertaken at locations representative of surrounding nearest private residences and other sensitive locations to verify compliance with relevant vibration and blast overpressure criteria, and identify appropriate further blast refinement or management.

6.5.14 Blast management procedures will be periodically reviewed to evaluate performance and identify corrective action, if required.

6.5.15 Blast monitoring results will be reported in the AEMR.

6.6 Air Quality

Land Acquisition Criteria

6.6.1 As noted in **Section 6.3**, if the dust emissions generated by the Project exceed the criteria in **Tables 6.1**, **6.2**, and **6.3** at any residence, or on more than 25% of any privately owned vacant land, Centennial will, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures set out in the Planning Approval.

Table 6.1 - Long term land acquisition criteria for particulate matter

Pollutant	Averaging period	Criterion
Total suspended particulate (TSP) matter	Annual	90 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	30 µg/m^3

Table 6.2 - Short term land acquisition criteria for particulate matter

Pollutant	Averaging period	Criterion	Percentile[a]	Basis
Particulate matter < 10 µm (PM_{10})	24 hour	150 µg/m^3	99[b]	Total[c]
Particulate matter < 10 µm (PM_{10})	24 hour	50 µg/m^3	98.6	Increment[d]

a Based on the number of block 24 hour averages in an annual period.
b Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by DoP in consultation with DEC.
c Background PM_{10} concentrations due to all other sources plus the incremental increase in PM_{10} concentrations due to the mine alone.
d Incremental increase in PM_{10} concentrations due to the mine alone.

Table 6.3 - Long term land acquisition criteria for deposited dust

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

Note: Deposited dust is assessed as insoluble solids as defined by Standards Australia, 1991, AS 3580.10.1-1991: Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method.

Air Quality Controls

6.6.2 The CPP, coal stockpiles and associated infrastructure will be located near the eastern boundary of the Proposed Disturbance Area, within the valley that forms the upper reach of Anvil Creek. This area provides natural topographic shielding which will reduce dust impacts on surrounding areas.

6.6.3 Water sprays will be used at coal handling transfer points and on stockpile areas that are capable of generating dust.

6.6.4 All active roads will be clearly defined and the development of minor roads will be limited. Minor roads used regularly for access will be constructed so as to minimise dust generation (for example, by using well-compacted select material) and will be watered as required.

6.6.5 Speed limits will apply and be enforced on all roads on the mine site.

6.6.6 Water carts will be used on active haul roads and unsealed working areas. Surface moisture levels on all haul roads will be maintained at suitably elevated levels and/or chemical treatments will be applied to achieve 90% dust suppression.

6.6.7 Only the minimum area necessary for mining operations will be disturbed at any time.

6.6.8 Reshaping and rehabilitation of mining and overburden emplacement areas, and obsolete roads, will be undertaken as soon as practicable.

6.6.9 Drills will be fitted with dust suppressant measures.

6.6.10 Blasting design and operation will be managed to achieve optimum material breakage and movement to facilitate efficient mining while minimising the explosives used to achieve this outcome. This includes consideration of material and explosives characteristics, excavating equipment specifications, hole spacing and

stemming material specification, accurate placement and drilling of holes, accurate explosives loading and well-managed stemming of blast holes. These measures will assist with minimising dust generation in the blasting process.

6.6.11 Cover crops will be established on any topsoil and subsoil stockpiles that are not planned to be used in less than six months.

6.6.12 Meteorological conditions will be monitored and weather data will be considered in the timing of blasts to assist with minimising the impacts of blast generated dust.

6.6.13 Dust control measures to be employed during construction will include use of water carts, defining of trafficked areas, imposition of vehicle speed limits and constraints on work under extreme unfavourable weather conditions.

6.6.14 A spontaneous combustion management strategy will be developed for the Project in consultation with the DPI and will include coal stockpile and reject emplacement management measures, monitoring potential causes of spontaneous combustion events, and actions that can be implemented in the event of spontaneous combustion.

6.6.15 Mine personnel will be provided with training in dust controls during induction for mine operations.

Monitoring

6.6.16 Prior to carrying out any development, Centennial will implement a detailed Air Quality Monitoring Program. The Air Quality Monitoring Program will include a combination of high volume samplers and dust deposition gauges to monitor the dust emissions of the Project; and an air quality monitoring protocol for evaluating compliance with the air quality impact assessment and land acquisition criteria in the Project Approval.

Meteorological Monitoring

6.6.17 Centennial will continue monitoring at a suitable meteorological station operating in the vicinity of the Project in accordance with the requirements in *Approved Methods for Sampling of Air Pollutants in New South Wales*.

6.7 Water Management

6.7.1 Conceptual surface water controls have been designed to ensure that clean runoff is separated from runoff within disturbed mining and infrastructure areas. Conceptual sediment and erosion controls have been designed to ensure any runoff from disturbed areas is appropriately treated.

6.7.2 The Conceptual Mine Plan has been modified to avoid the need for any diversion of Big Flat Creek.

6.7.3 The drainage lines to be constructed as part of the final landform where Anvil Creek now exists will be designed and constructed to provide a stable vegetated channel with a natural appearance that blends in with any adjoining riparian areas. Native trees and shrubs will be planted along the drainage alignment to enhance the long term stability of the drainage system and to provide suitable habitat for native fauna.

6.7.4 A comprehensive water quality monitoring program will continue to monitor the surrounding surface water quality over the life of the operation.

Groundwater

6.7.5 The existing groundwater monitoring bore locations will be maintained and a number of additional bores will be constructed at new locations beyond the mine pit areas, and in spoils following reshaping. Locations for these piezometers will be subject to consultation and agreement with DNR. These bores will be monitored every two months for a range of parameters including water table level, pH, and EC and further analyses every six months for total dissolved solids (TDS), major ions, and heavy metals. Daily monitoring of water levels by automatic data loggers at existing piezometers and in selected new piezometers will continue. Analyses of this data will include comparison against model predictions, establishment of triggers for remedial action, expert review as required, and reporting to regulatory agencies at appropriate intervals.

6.7.6 As discussed in **Section 5.3.2.3**, it is possible (but unlikely) that two existing groundwater wells not owned by Centennial may be affected by the Project. If the data obtained from the groundwater monitoring program indicates that the Project is having an adverse effect on these groundwater users (that is, reduced groundwater yield from existing wells), then the water supply would be reinstated by Centennial either by deepening the existing well, construction of a new well or by providing an alternate water supply.

6.7.7 If monitoring indicates it is required, a barrier cut off wall within the alluvium associated with Big Flat Creek will be constructed to limit groundwater seepage into the mine.

6.7.8 Final voids have been designed to intercept leachate from overburden emplacement areas and minimise discharge of saline groundwater. These have been sized to ensure they do not overflow. Final void design will be reviewed at least three years prior to anticipated mine closure.

6.7.9 Analyses of the monitoring data will include comparison against model predictions, establishment of triggers for remedial action, expert review as required, and reporting to regulatory agencies at appropriate intervals. The monitoring results and the analyses will also be compiled into the AEMR for review by the relevant government agencies. The AEMR will also be publicly available for review by the local community and any other interested parties.

Site Water Management Plan

6.7.10 Prior to carrying out any development, Centennial will prepare a Site Water Management Plan for the mine. This plan may be prepared in stages, to address specific periods of proposed mining. This plan will include:

a) an Erosion and Sediment Control Plan;

b) a Surface Water Management and Monitoring Plan; and

c) a Ground Water Monitoring Program.

6.8 Ecological Management and Site Rehabilitation

6.8.1 Centennial will implement the Rehabilitation Strategy, Proposed Offset Strategy, and other ecological management and monitoring measures described in **Sections 5.1.3** to **5.1.6** and **Sections 5.4.6** to **5.4.8**. The Proposed Offset Strategy includes the conservation and long term protection of the areas summarised in **Table 6.4**. The

appropriate mechanism for achieving this long term protection will be determined in consultation with DoP and DEC.

Table 6.4 - Offset Strategy

Area	Size
Conservation Area	1078
Enhancement Area	629

6.8.2 Centennial will progressively rehabilitate the site as described in **Section 5.1**.

Mine Closure Plan

6.8.3 At least three years prior to anticipated mine closure, Centennial will prepare a Mine Closure Plan in consultation with relevant agencies.

The Mine Closure Plan will:

- define the objectives and criteria for mine closure;
- investigate options for the future use of the site, including any final void/s;
- describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the Project; and
- describe how the performance of these measures would be monitored over time.

6.9 Aboriginal Cultural Management

Site Management in Proposed Disturbance Area

6.9.1 A combination of surface collection for 68 of the sites in addition to grader scrapes within parts of the Proposed Disturbance Area associated with Clarks Gully, Sandy Creek, Anvil Creek and Big Flat Creek. This approach targets artefact scatters and isolated finds within the Proposed Disturbance Area that have low to moderate research potential. It also appropriately tests the riparian corridor archaeological terrain unit which is assessed as having high research potential and Aboriginal and archaeological sensitivity. Manual excavation will be undertaken in areas where the grader scrapes reveal features such as hearths, heat treatment pits, knapping floors or significant artefact concentrations.

6.9.2 Site AC13, located on Anvil Creek and within an area targeted for mine infrastructure, was assessed as having a high archaeological research potential. This site will be subject to a detailed geomorphic investigation, a sub-surface test pitting program, large area manual excavation and grader scrapes.

6.9.3 Site SC10 located on Sandy Creek was initially targeted for a rail corridor. Due to the high Aboriginal heritage value and moderate archaeological research potential, this site will not be disturbed by Centennial and will be managed for use by the Aboriginal community for teaching and educational purposes.

Conservation Management

6.9.4 The Proposed Offset Areas shown on **Figure 5.8** provide for conservation of archaeological terrain units evaluated as having equal or greater overall significance

than in the Proposed Disturbance Area. Centennial is committed to conserving all 98 identified sites and the landscapes in which they occur, within the Proposed Offset Areas. The Proposed Offset Areas will conserve all the rockshelter sites within Wallaby Rocks, Limb of Addy Hill, Western Rocks and Anvil Hill. Anvil Hill rockshelter sites (four sites), however, may be affected by the indirect impacts of blasting. This impact will be mitigated and management strategies for the rockshelters on Anvil Hill are discussed in **Appendix 13**.

Aboriginal Cultural Heritage Management Plan

6.9.5 Prior to carrying out any development, Centennial will prepare (and following approval implement) an Aboriginal Cultural Heritage Management Plan, in consultation with DEC and the relevant Aboriginal stakeholder groups. The plan will include:

a) details of the surface salvage program for the Project and planned sub-surface investigation works, as described in **Appendix 13**;

b) a description of the measures that would be implemented to protect Aboriginal sites outside the Proposed Disturbance Area;

c) a detailed monitoring and management program for Aboriginal sites within the Conservation Area;

d) a description of the measures that would be implemented if any new Aboriginal objects or skeletal remains are discovered during the Project; and

e) a protocol for the ongoing consultation and involvement of the Aboriginal communities in the conservation and management of Aboriginal cultural heritage on the site.

6.10 Heritage

6.10.1 Compilation of a community based oral history to document the local history of Wybong and to mitigate against the impact of the proposal on the historical knowledge within the local community, as families that have resided in the area for many generations potentially move from the area.

6.10.2 Archival recording for all heritage items identified within the Proposed Disturbance Area, prior to disturbance of such sites, to the standards of local heritage significance as specified by the guidelines of the NSW Heritage Office.

6.10.3 The surface collection and salvage of Ham House 1 and Ham House 2 and associated dairies, creamery and structures. Both of these heritage sites require a surface collection of artefacts that are scattered throughout the two sites. No sub-surface investigation is considered warranted due to the lack of topsoil within these sites.

6.10.4 Further monitoring of Castle Hill and consideration of the blast design to confirm whether structural impacts will occur at this location, prior to measured blast levels reaching 5 mm/s at this site. This will enable further quantification of the impacts of blasting on this structure and any necessary remediation works as mining progresses. If blasting impacts are confirmed, a detailed archival recording to the standard of local heritage significance and a site specific historical investigation will be conducted.

6.10.5 Potential further sites of local heritage value located within the area predicted to be impacted by blasting that exceeds the relevant vibration criteria will be inspected, subject to landowner permission for access, and appropriately recorded prior to blasting. This will include assessing the structural status and identifying appropriate ameliorative measures, where relevant.

6.11 Traffic and Transport

6.11.1 On the basis that the Bengalla Link Road extension is completed prior to being required for access for this Project, all Project related traffic, including employee movements, will be restricted to the use of the extension of the Bengalla Link Road to Wybong Road to minimise impacts on Mangoola and Roxburgh Roads.

6.11.2 Wybong Road will be upgraded in association with MSC, from the intersection with Bengalla Link Road to the proposed mine access road. This includes an upgrade to a sealed carriageway minimum 6.5 metres wide, road marked centreline to relevant standards, enhancement of safety and advisory signage, and upgrade of sections to ensure safe operation of school bus zones and stops. All works will be undertaken in consultation with MSC and to the standards recommended in the detailed traffic assessment in **Appendix 16**.

6.11.3 The intersection of Wybong Road and the mine access road will be a Type B rural layout with a left turn auxiliary lane from Wybong Road into the proposed access road.

6.11.4 Centennial will require a Section 138 approval under the *Roads Act 1993*, from MSC, prior to the conduct of these works on Wybong Road.

6.12 Greenhouse Gas

6.12.1 Centennial will assess the viability of the following approaches to improving energy efficiency and reducing greenhouse emissions from the Project:

- use of energy management systems;
- seeking continuous improvement in energy efficiency in the mining fleet, stationary equipment, mining processes and coal preparation;
- the use of some proportion of biodiesel in the mining fleet;
- use of electric boosted solar hot water; and
- small scale planting for carbon sequestration.

Centennial will continue to assess and implement energy and greenhouse management initiatives during the Project design, operation and decommissioning.

6.13 Visual Controls

Vegetative Screenings

6.13.1 Vegetative screens will be planted along the lower sections of Mangoola Road from Roxburgh Road to the new rail loop intersection and along the ridge extending west from Limb of Addy Hill.

6.13.2 Final revegetation of disturbed areas will consider the reduction of visual impacts.

Earthworks and Final Landforms

6.13.3 Final bulk earthworks and shaping of the overburden emplacement areas associated with Main, Northern and Southern Pits will be designed to ensure:

- minimisation of straight edges and use of curved faces, where possible, to greater create relief along the faces of the Northern and Main Pit overburden emplacement areas and vary ridge heights when viewed from Wybong Road; and

- the shape and line of the base of each overburden emplacement area that is located parallel to the 500 kV line reduces visual convergence when viewed from Wybong Road.

Infrastructure

6.13.4 The link road from the CPP to the Tailings Dam will be relocated to avoid the knoll 500 metres east of the product stockpile. This will ensure existing vegetation on the knoll shields views of the CPP and stockpile from VP 2.

6.13.5 The colour of building roofs and walls will be selected to differentiate elements and reduce visual mass.

6.13.6 The spur on the north-east edge of Anvil Hill at RL 220 will be recreated as part of the overburden emplacement areas to assist screening of the CPP from Years 10 to 20 when viewed from the north around VP 10.

6.13.7 The north, east and south sides of the workshop and CPP will be clad.

6.13.8 All floodlights in the open cut area will be shielded to the maximum extent practicable.

6.13.9 Workshop doors will be orientated south or south-west, where possible, to reduce light spill.

6.13.10 Where safe to do so, trucks on access roads will make use of portable visual edge markers to increase drivers' visibility of road edges when driving with dipped headlamps.

Operational Measures

6.13.11 At night, work will be restricted to lower levels on the overburden emplacement areas to reduce noise impacts which will also reduce potential direct lighting effects from random elements such as truck headlights and flashing beacons.

6.14 General Environmental Management, Monitoring, Auditing and Reporting

Environmental Monitoring Program

6.14.1 Within six months of Project approval, Centennial will prepare an Environmental Monitoring Program for the Project in consultation with relevant agencies. This

program will consolidate the various monitoring requirements of this approval into a single document.

Annual Reporting

6.14.2 Centennial will prepare an Annual Environmental Management Report (AEMR).

Independent Environmental Audit

6.14.3 Two years after commencement of development, and every three years thereafter, Centennial will commission and pay the full cost of an Independent Environmental Audit of the Project.

Community Consultative Committee

6.14.4 Within three months of this approval, Centennial will establish a Community Consultative Committee (CCC) in consultation with DoP and Council, and in accordance with relevant DoP guidelines.

Conclusion

Section 7.0

7.0 Conclusion

The DGRs seek a conclusion justifying the Project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and whether or not the Project is in the public interest. These elements are addressed in this section.

7.1 Site Suitability

The Project contains one of the largest remaining economic open cut coal resources in the Hunter Valley. The Hunter Coalfield is the largest coal-producing region in NSW, with an annual ROM coal production in 2003-2004 of approximately 103 Mt (DPI, 2005). A DPI strategic study (DPI 2005) predicted that up to 10 mines will close in the Hunter and Newcastle Coalfields over the next 10 years, due to depletion of reserves. Significant reliance on production from new projects and mine extensions is expected in order to compensate for the loss in production capacities due to mine closures and to take advantage of expected market opportunities. The study further predicted that by 2012-2013, approximately 50% of production will be from new mines and mine extensions.

Existing land uses and land use planning forms a major constraint to coal mine development in the Hunter Valley. The development of a coal mine and associated infrastructure is limited, by its nature, to the location of the coal resource. To the extent the individual elements of associated infrastructure comprising the Project are able to be preferentially located within the Project Area, these have been sited to minimise adverse environmental impacts, as described in **Sections 2.0** and **5.0**.

The existing land uses of the Project Area are described in **Section 5.1**. A detailed analysis of potential off-site impacts is provided in **Section 5.0** and an overview of environmental impacts is provided in **Section 7.2**. Extensive management, mitigation and offset measures have been incorporated into the Project to minimise impacts, including land use impacts. As described in **Section 5.1**, the approach to site rehabilitation and the extensive revegetation and conservation program is consistent with the strategic land use objectives outlined in the LEP for the area.

As discussed in **Appendix 17**, the use of this land for coal mining purposes is by far the highest value use of the land on a total project life cycle.

7.2 Overview of Environmental Impacts

As detailed in **Section 4.0** the environmental impacts of the Project have been identified and the subject of a detailed environmental assessment based on:

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

- expert technical assessment.

The key issues identified, including those specified in the DGRs, were the subject of the comprehensive specialist assessments of the potential impacts of the Project on the existing environment which are detailed in **Section 5.0** and the Appendices to this document.

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

Table 7.1 – Broad Overview of Environment and Community Impacts

Environmental/ Social Issue	Overview of Key Outcomes (After proposed Management, Mitigation, Offsets)
European Heritage	• No items of State or National Heritage Significance will be impacted. • Local heritage values will be protected by archival recording, monitoring and compilation of a community based oral history.
Ecology	• 1304 hectares of treed vegetation impacts by the Project. • No significant impacts on endangered ecological communities or populations. • To offset impacts on threatened species, a comprehensive offset and rehabilitation strategy is proposed, resulting in total area of treed vegetation being 3654 hectares at the end of the mine life. • With proposed mitigation and offset measures, there will be no net loss of flora and fauna values in the medium to long term.
Cultural Heritage	• 69 sites to be salvaged prior to disturbance. • 98 sites, including 16 rockshelters, to be conserved in offset area.
Surface Water and Groundwater	• Comprehensive water management ensures no significant off-site impacts. • Any water taken from the Hunter River will be a result of transfer of existing licences.
Dust Generation	• 18 private residences and 4 vacant private properties (that are not subject to agreement with Centennial) are likely to be subject to significant air quality impacts. • The majority of these will also be noise affected. • Centennial has made an offer for Agreement to Purchase to all significantly affected landowners if the Project is approved.
Noise Generation	• 71 private residences and 17 vacant private properties (that are not subject to agreement with Centennial) are predicted to be subject to significant noise impacts. • Centennial has made an offer for Agreement to Purchase to all significantly affected landowners if the Project is approved.
Blast Vibration and Overpressure	• All private residences with potential blast impacts above the relevant limits are located within the area affected by dust and noise impacts.
Visual Amenity	• Potential views to the Project are highly variable and have been minimised by Project design aspects and visual controls.
Greenhouse Gas	• Projected greenhouse emissions are less than industry average. • A range of energy management initiatives will be investigated for this Project.
Roads and Traffic	• Detailed assessment and proposed road works ensure that relevant road safety guidelines are met by the Project.
Social Impacts	• Estimated population impacts on service provision within the LGA is manageable. The potential loss of sense of community is being addressed by Centennial's upfront offer for purchase agreement to significantly affected landowners. Other community enhancement programs are discussed in **Section 7.3** below.

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

- obtaining a detailed understanding of the issues and impacts by extensive scientific evaluation and community consultation;
- a realistic consideration of alternatives;
- proactive and appropriate strategies to avoid, minimise, mitigate, offset or manage;
- the temporary nature of mining in the landscape, but with long-term benefits to future land use and catchment quality; and
- a thorough Statement of Commitments (refer to **Section 6.0**).

7.3 Benefits of the Project

The Economic Assessment (refer to **Appendix 17**) describes a range of positive benefits from the Project that will result at a local, regional and State level. The revenue, expenditure and employment associated with the construction and operation of the Project will stimulate economic activity for the regional economy, as well as for the broader NSW economy. There are benefits from both the construction phase and operational phase. The benefits from the operational phase include:

Regional Economy – Operational Phase

- $212M to $224M in annual direct and indirect regional output or business turnover;
- $115M to $121M in annual direct and indirect regional value added;
- $25M to $28M in annual household income; and
- 343 to 449 direct and indirect jobs.

NSW Economy – Operational Phase

- $275M to $324M in annual direct and indirect regional output or business turnover;
- $133M to $158M in annual direct and indirect regional value added;
- $33M to $43M in annual household income; and
- 531 to 809 direct and indirect jobs.

The Economic Assessment also considers the economic cost of the impact to the environment. It concludes that for the Project to be questionable on economic efficiency (net community welfare) grounds, the residual environmental cost would need to exceed $480M. In other words, to forego the opportunities presented by the Project and to avoid any residual environmental impact, there must be a community willingness to pay an equivalent of:

- $85,000 per household in the Muswellbrook LGA;
- $27,000 per household in the Muswellbrook, Singleton and Scone region; or
- $190 per household in NSW.

Other benefits include the value of conservation offsets and enhancement and community enhancement proposals that are described in **Section 5.0** and summarised in **Table 7.2**.

Table 7.2 – Offset and Enhancement Proposals

Issue of Concern	Contribution	Detail
Conservation Offsets		
Biodiversity and ecological values	Long term protection of 1078 hectares of Conservation Area	Conservation of area of existing biodiversity value.
Aboriginal cultural values	Long term protection of 98 sites, including 16 culturally significant rockshelters in proposed Conservation Area	Conservation of area of existing high cultural heritage value.
Habitat Enhancement		
Biodiversity and ecological values	629 hectares of Habitat Enhancement Area	Further regeneration and revegetation in addition to Conservation Area to enhance existing values
Sustainable agricultural opportunities	217 hectares of Sustainable Agriculture	Specific management of prime land for sustainable agriculture, including components of habitat enhancement
Community Enhancement		
Community Projects	1 cent per Saleable Tonne of coal produced	For ongoing community projects, to be distributed with community input
Local Environmental Management	$100,000 per annum for 5 years	External to the mine site environmental management - Wybong Uplands Land Management Strategy
Education and Training	$200,000 per annum for 3 years	Sponsorship of TAFE courses, apprenticeships, traineeships
Community Infrastructure	$500,000	Focus on Denman and Wybong, suggest sporting and recreation facilities

Public Interest

Centennial is committed to establishing and maintaining a long term position in the Australian coal industry. The Project is well within the Company's design, environmental, financial and management capabilities.

The Project is consistent with relevant objectives of the EP&A Act. The Minister for Planning will determine whether or not the Project is in the public interest. On considering the balance of environment and community impacts, it would be reasonable for the Minister to conclude that the State, regional and local benefits of the Project outweigh the adverse impacts.

Checklist of Director General's Requirements

Section 8.0

8.0 Checklist of Director-General's Requirements

The DGRs are included in full in **Appendix 2** and a checklist of where each requirement is addressed in the EA, is provided below.

Requirement	Section of EA
General Requirements	
The Environmental Assessment (EA) must include	
• An executive summary	Executive Summary
• A detailed description of the project including the:	Section 2.0
– Need for the project;	Section 2.10.1
– Alternatives considered; and	Section 2.10
– Various components and stages of the project;	Section 2.0
• Consideration of any relevant statutory provisions	Section 3.0
• An overview of the environmental impacts of the project (including an environmental risk analysis) which takes into consideration the issues raised during consultation	Section 4.0 & Appendix 5
• A detailed assessment of the key issues specified below and any other significant issues identified in the environmental risk analysis, which includes:	
– A description of the existing environment	Section 5.0
– An assessment of the potential impacts of the project, including potential cumulative impacts (particularly on flora and fauna, surface water, groundwater, noise and air quality) that may arise from the combined operation of the project, together with the other approved and existing mines in the region	Section 5.0
– A description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the impacts of the project	Section 5.0
• A draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures	Section 6.0
• A conclusion justifying the project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and whether or not the project is in the public interest	Section 7.0
• A signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading.	Appendix 1
Key Issues	
• **Flora and Fauna** – including impacts on critical habitats, threatened species, populations, ecological communities and native vegetation. A comprehensive offset strategy must be included as part of the mitigation measures for the project to ensure that there is no net loss of flora and fauna values in the area in the medium to long term.	Section 5.4 & Appendix 9
• **Noise** – including construction, operation, and on-site and off-site road and rail noise impacts.	Section 5.6 & Appendix 12
• **Blasting and Vibration**	Section 5.7 & Appendix 12
• **Air Quality** – including a detailed greenhouse gas assessment	Section 5.5 & Appendix 10

Requirement	Section of EA
• **Surface and Groundwater** – including detailed modelling of potential surface and groundwater impacts, a site water balance, and a detailed description of any proposed creek diversions. A surface and groundwater contingency strategy must be included as part of the mitigation measures for the project which details the measures proposed to protect the supply of water to landowners and the environment in the region.	Sections 5.2 & 5.3, Appendices 7 & 8
• **Rehabilitation, Final Landform and Final Void Management** – including a justification of the proposed final land use for the site in relation to the strategic land use objectives for the Wybong area; a detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape; and the measures which would be put in place for the long term management of the site (including biodiversity offset areas) following cessation of mining operations.	Section 5.1
• **Heritage** – both Aboriginal and non-Aboriginal	Section 5.8 & Appendices 13 & 14
• **Visual**	Section 5.9 & Appendix 15
• **Traffic and Transport**	Section 5.10 & Appendix 16
• **Social and Economic**	Section 5.11 & Appendix 3
References	
The Environmental Assessment must take into account relevant State government technical and policy guidelines. While not exhaustive, guidelines which may be relevant to the project are included in the attached list.	Section 9.0
Consultation	
During the preparation of the Environmental Assessment, you must consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and the issues raised must be described in the Environmental Assessment.	Section 4.0 & Appendices 2 & 3

References

Section 9.0

9.0 References

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Abbreviations and Glossary

Section 10.0

10.0 Abbreviations and Glossary

10.1 Abbreviations

ACARP	Australian Coal Association Research Program
AEMR	Annual Environmental Management Report
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
Centennial	Centennial Hunter Pty Limited
CPP	Coal Preparation Plant
dB	Decibel
dBA	A-weighted decibel
DEC	Department of Environment and Conservation
DNR	Department of Natural Resources
DoP	Department of Planning
DPI	Department of Primary Industries
EA	Environmental Assessment
EMS	Environmental Management System
EPA	Environment Protection Authority of NSW (former, now DEC)
EP&A Act	*Environmental Planning and Assessment Act* 1979 (NSW)
EP&A Regulation	*Environmental Planning and Assessment Regulation* 2000 (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth)
EPL	Environment Protection Licence
ha	hectares
HVAS	high volume air sampler
kV	Kilovolt (1000 volts)
LEP	Local Environmental Plan
LGA	Local Government Area

m	metres
ML	Megalitres
MLA	Mining Lease Application
MSB	Mine Subsidence Board
Mt	million tonnes
Mtpa	million tonnes per annum
POEO Act	*Protection of the Environment Operations Act* 1997 (NSW)
RBL	Rating Background Level
ROM	Run of mine
RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TDS	Total Dissolved Solids
TSC Act	*Threatened Species Conservation Act* 1995 (NSW)
TSS	Total Suspended Solids
TSP	total suspended particulate matter, usually in the size range of zero to 50 micrometres
Umwelt	Umwelt (Australia) Pty Limited
yr	Year

10.2 Glossary

AHD:	Australian Height Datum.
Alluvium:	Sediment deposited by a flowing stream, e.g., clay, silt, sand, etc.
Amenities:	Lunch room, showers, toilets.
Amenity:	An agreeable feature, facility or service which makes for a comfortable and pleasant life.
Aquifer:	A water-bearing rock formation.
Arboreal:	Adapted for living and moving around in trees.
Archaeological:	Pertaining to the study of culture and description of its remains.

Attenuation:	The reduction in magnitude of some variable in a transmission system, for example, the reduction of noise with distance as it travels through air.
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.
Catchment Area:	The area from which a river or stream receives its water.
Coal Reserves:	Those parts of the Coal Resources for which sufficient information is available to enable detailed or conceptual mine planning and for which such planning has been undertaken.
Coal Resources:	All of the potentially useable coal in a defined area, based on geological data at certain points and extrapolations from these points.
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.
dB (Decibel)	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).
dBA	A modified decibel scale which is weighted to take account of the frequency response of the normal human ear.
Dip:	The direction in which rock strata is inclined.
Ecology:	The science dealing with the relationships between organisms and their environment.
Ecosystem:	Organisms of a community together with its non-living components through which energy and matter flow.
Effluent:	The liquid waste of sewage and industrial processes.
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.
Environmental Planning and Assessment Act 1979:	NSW Government Act to provide for the orderly development of land in NSW.

Environment Protection and Biodiversity Conservation Act 1999:	Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance.
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.
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.
Geology:	Science relating to the earth, the rocks of which it is composed and the changes it undergoes.
Geomorphic Processes:	Processes involved in the formation of the earth's surface features.
Geotechnical:	Relates to the form, arrangement and structure of geology.
Groundwater:	Sub-surface water which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table.
Habitat:	The environment in which a plant or animal lives; often described in terms of geography and climate.
Indigenous:	Native to, or originating in, a particular region or country.
***In situ*:**	In its original place.
Intrusion:	The forcing of extraneous matter, like molten rock, into some other formation.
kV (Kilo Volt):	One thousand volts.
L_{A1} Noise Level:	The noise level exceeded for one per cent of the time. It is used in assessment of sleep disturbance.
L_{A10} 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.
L_{A90} 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 L_{90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes.
L_{Aeq} Noise Level:	The average noise energy, measured in dB(A), during a measurement period.

L_{AMax} Noise Level: The maximum noise energy, measured in dB(A), during a measurement period.

Land Capability: The ability of a parcel of land to be used in a sustainable manner (that is without permanent damage) for a given land use.

Landform: Sections of the earth's surface which have a definable appearance (e.g. cliff, valley, mountain range, plain, etc).

Mean: The average value of a particular set of numbers.

Megalitre (ML): One million litres.

Meteorology: Science dealing with atmospheric phenomena and weather.

Mitigate: To lessen in force, intensity or harshness. To moderate in severity.

Native: Belonging to the natural flora or fauna in a region.

Outcrop: Bedrock exposed at the ground surface.

Overburden Emplacement: An area for placing overburden or waste rock, removed from above and between the coal seams.

Particulates: Fine solid particles which remain individually dispersed in gases.

Peak Discharge: Maximum discharge down a stream following a storm event.

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 groundwaters.

Protection of the Environment Operations Act 1997: NSW legislation administered by DEC that regulates discharges to land, air and water.

Rating Background Level (RBL): A period (day, evening or night) background noise level determined in accordance with chapter 3 of the EPA Industrial Noise Policy (EPA, 2000).

Rehabilitation: The process of restoring to a condition of usefulness. In regard to quarrying, relates to restoration of land from a degraded or quarried condition to a stable and vegetated landform.

Revegetation: The process of re-establishing vegetation cover.

Run of mine (ROM): Bulk material extracted from a mine, before it is processed in any way.

Salinity: A measure of the concentration of dissolved solids in water.

Seam: An identifiable discrete coal unit.

Sedimentation:	Deposition or settling of materials by means of water, ice or wind action.
Sediment Dam:	A dam built to retard dirty runoff to allow sediment to settle out before allowing clean water discharge.
Site Specific Context:	Relating to conditions existing at a particular location.
Socio-economic:	Combination of social and economic factors.
Sound Power Level:	The total sound energy radiated per unit time measured as 10 times a logarithmic scale, the reference power being 12 picowatts.
Spontaneous Combustion:	Spontaneous ignition of some or all of a combustible material.
Subcrop:	A unit of material that occurs just below the soil profile.
Surface Infrastructure:	Any man made object, facility or structure on the surface of the land.
Tailings:	Fine residual waste material separated in the coal preparation process.
Thermal Coal:	Includes medium to high ash, low sulphur coals used for domestic power generation and medium to low ash energy coals which are exported.
Topography:	Description of all the physical features of an area of land and their relative positions, either in words or by way of a map.
Total Dissolved Solids (TDS):	A measure of salinity expressed in milligrams per litre (mg/L).
Total Suspended Particulates (TSP):	A measure of the total amount of un-dissolved matter in a volume of water or air usually expressed in milligrams per litre (mg/L) (for water) or micrograms per cubic metre ($\mu g/m^3$) for air.
Woodland:	Land covered by trees that do not form a closed canopy.

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