7. Assessment of key issues

7.1. Indigenous heritage

The DGRs identify Indigenous heritage as a key issue for the Environmental Assessment. A detailed assessment of Indigenous heritage is provided in Volume 2, Technical Paper 1 and summarised in this section.

Table 7.1a outlines the DGRs relevant to Indigenous heritage and where they have been addressed in this section.

Table 7.1a Director-General's Environmental Assessment Requirements – Indigenous heritage

Director-General's Environmental Assessment Requirements	Location addressed
Key Issues	
Heritage – including but not limited to: • Indigenous heritage, objects, places of significance, natural and landscape values of the site and surrounding area, taking into account the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005).	This section and Volume 2 Technical Paper 1

7.1.1. Assessment approach

The Indigenous heritage assessment was undertaken in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005), ICOMOS *Burra Charter* (Australia ICOMOS, 1999) and the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW, 2010). The level of research undertaken during this assessment is considered commensurate with the level of potential impacts that would result from the Proposal.

The assessment included background desktop research, heritage register searches and a field survey from Monday 6 September to Friday 10 September.

The field survey inspected the entire Proposal area however focused on areas and features where Aboriginal cultural heritage was considered more likely to be identified, such as areas exposed by erosion, slightly elevated land forms and mature appearing trees.

Consultation with the Aboriginal community was carried out in accordance with the document, *Aboriginal cultural heritage consultation requirements for proponents* (DECCW, 2010). The following government bodies were contacted on 29 June 2010 requesting contact details for Aboriginal people and / or groups that may have an interest in the Proposal. These included:

- Planning and Aboriginal Heritage Section, DECCW NSW (North East);
- Wanaruah Local Aboriginal Land Council (LALC);
- Office of the Registrar, *Aboriginal Land Rights Act 1983* (NSW);
- National Native Title Tribunal;
- Native Title Services Corporation Limited (NTSCORP Limited);
- Singleton Council; and
- Hunter-Central Rivers Catchment Management Authority (CMA).

Responses were received from the Office of the Registrar, National Native Title Tribunal, Wanaruah LALC and DECCW, providing contact details for a number of Aboriginal groups.

Letters were sent on 7 and 13 July 2010 to a number of Aboriginal organisations inviting them to register an interest in corresponding about the cultural heritage management of the Proposal. Registrations were received until close of business (COB) 22 July 2010 and 28 July 2010, for groups contacted on 7 and 13 of July respectively.

A public notice was also placed in the Hunter Valley News published on 7 July 2010, with registrations received until COB 21 July 2010.

The following Aboriginal organisations (the Aboriginal Parties) registered their interest:

- Kayaway Eco Cultural & Heritage Services;
- Cacatua Culture Consultants;
- Carrawonga Consultants;
- Gidawaa Walang Cultural Heritage Consultancy;
- Lower Hunter Wonnarua Council Incorporated;
- Ungoorooo Aboriginal Corporation;
- Ungooroo Cultural and Community Services Incorporated;
- Tracey Skene, Wonnarua Person and Traditional Owner;
- Wanaruah LALC;
- Wattaka Wonnaraua CCS;
- Wonnarua Nation Aboriginal Corporation; and
- Yarrawalk Enterprises.

Registration of these parties was formally acknowledged on 21 and 27 July 2010 and on 28 July the Aboriginal parties were provided with an information pack containing details of the Proposal and the proposed Aboriginal cultural heritage assessment process and methodology. Comments were received in support of the assessment process and methodology and no objections or requests for amendments were made. The field survey was therefore based on the assessment process and methodology detailed in the information packs.

The following Aboriginal Parties participated in the field survey:

- Wayne French, Yarrawalk Enterprises;
- Sarah Jane Hall, Wanaruah Local Aboriginal Land Council; and
- Allen Paget, Ungoorooo Aboriginal Corporation.

Indigenous heritage report was prepared in accordance with the assessment process. Registered Aboriginal Parties were forwarded a copy of a draft report for the Proposal on 23 November 2010 for comment. In accordance with DECCW's consultation requirements, the parties were given 28 days to provide comments prior to the report being finalised.

7.1.2. Heritage register search results

A search of Commonwealth, State and local government heritage lists, registers and schedules was undertaken to determine the location of any heritage items within or in close proximity to the Proposal. A summary of the statutory and non-statutory registers, planning instruments and management documents searched for Aboriginal cultural heritage information is provided in Table 7.1b.

Table 7.1b Summary of heritage registers search results

Sources	Listed Aboriginal sites
Register of the National Estate	None
Commonwealth Heritage List	None
National Heritage List	None
AHIMS Database	Nine sites within and/ or in the immediate vicinity of the Proposal area
State Heritage Register	None
State Heritage Inventory	None
National Native Title Register (NNTR)	None

A4 Original

0 50 100 200

Metres

GDA 1994 MGA Zone 56

Artefact

Site Extent

Third Track Alignment

Existing Alignment

Proposed Impact Area

ARTC
Nundah Bank

Job Number	2110501b
Revision	A1
Date	09.02.11
Scale	1:7,000

Indigenous Heritage **Figure 7.1A**

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A4 Original

0 50 100 200

Metres

GDA 1994 MGA Zone 56

Artefact

Site Extent

Third Track Alignment

Existing Alignment

Proposed Impact Area

ARTC
Nundah Bank

Job Number	2110501B
Revision	A1
Date	09.02.11
Scale	1:7,000

Indigenous Heritage **Figure 7.1B**

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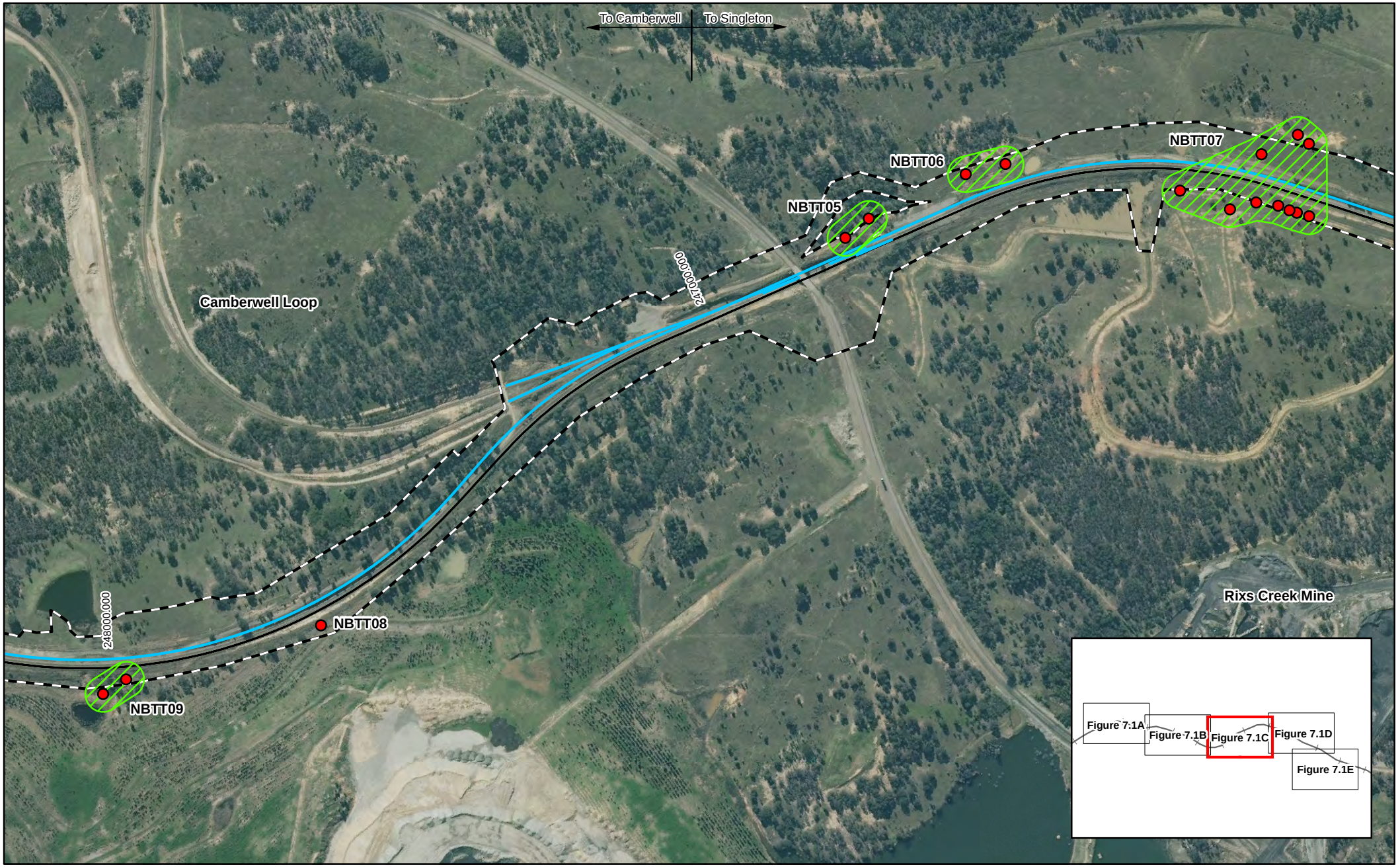

A4 Original

0 50 100 200

Metres

GDA 1994 MGA Zone 56

Artefact

Site Extent

Third Track Alignment

Existing Alignment

Proposed Impact Area

ARTC
Nundah Bank

Job Number	2110501B
Revision	A1
Date	09.02.11
Scale	1:7,000

Indigenous Heritage **Figure 7.1C**

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A4 Original

0 50 100 200

Metres

GDA 1994 MGA Zone 56

Artefact

Site Extent

Third Track Alignment

Existing Alignment

Proposed Impact Area

ARTC
Nundah Bank

Job Number	2110501B
Revision	A1
Date	09.02.11
Scale	1:7,000

Indigenous Heritage **Figure 7.1D**

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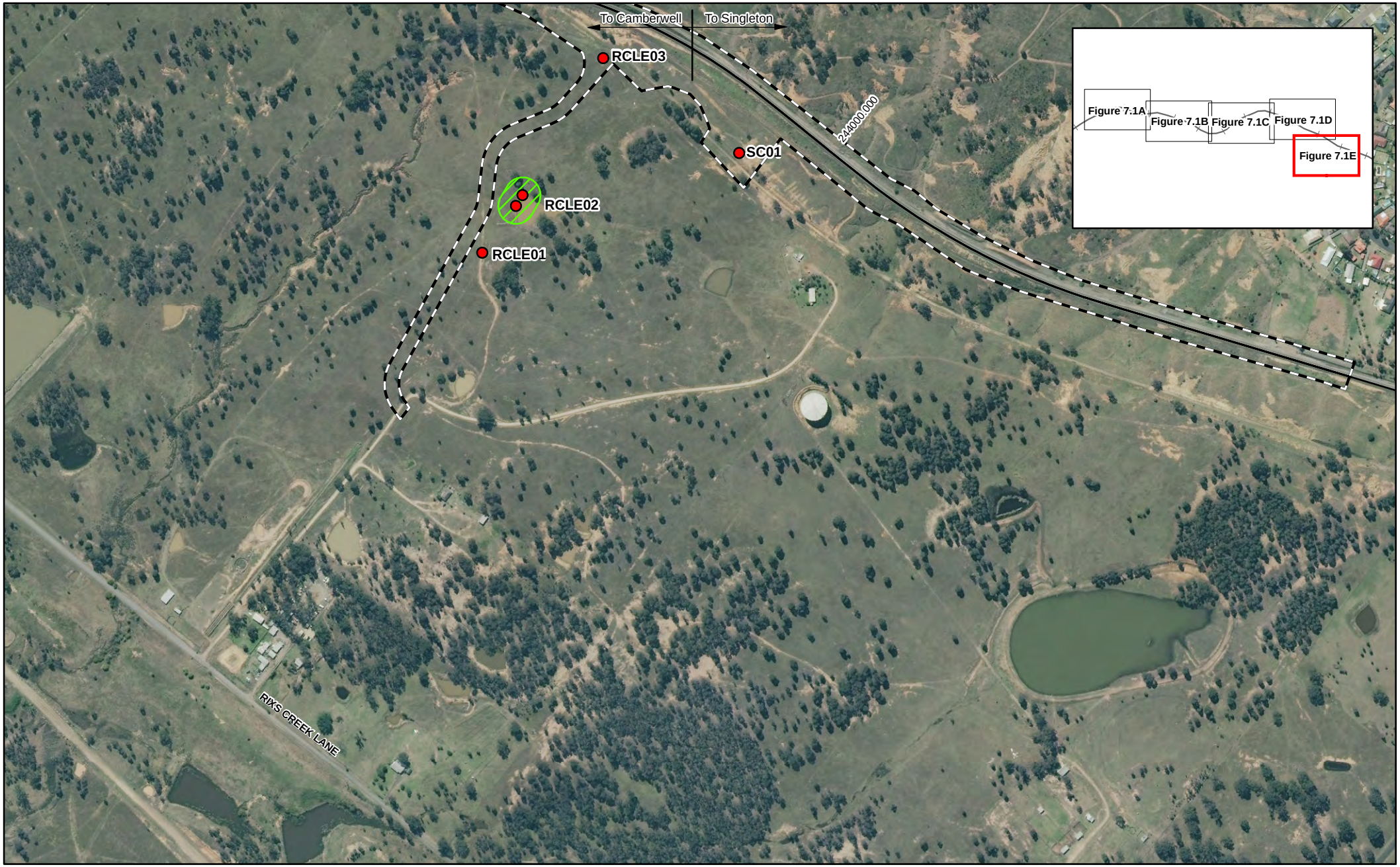

A4 Original

0 50 100 200

Metres

GDA 1994 MGA Zone 56

Artefact

Site Extent

Third Track Alignment

Existing Alignment

Proposed Impact Area

ARTC
Nundah Bank

Job Number	2110501B
Revision	A1
Date	09.02.11
Scale	1:7,000

Indigenous Heritage **Figure 7.1E**

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Sources	Listed Aboriginal sites
Register of Native Title Claims	None
Register of Indigenous Land Use Agreements	None
Singleton LEP 1996 Schedule 3	None

AHIMS and NNTR were searched in January 2010 and again in August 2010 during the Environmental Assessment process.

There are nine previously documented Aboriginal sites recorded within the immediate vicinity of the Proposal area (within 100 m). The details of these nine items are as follows:

- Site SC/75 (37-6-1208) – four mudstone flakes (one retouched) and a core, one of the artefacts was found within 10 m of the railway line on north east facing slope, near an unnamed creek;
- Site SC/74 (37-6-1207) – four mudstone flakes (two retouched) and one mudstone core, artefacts found on a 30 m by 35 m exposure subject to sheet wash and rill erosion, on top of south facing slope near an unnamed creek;
- Site SC/73 (37-6-1206) – three mudstone artefacts, found on two large exposures subject to sheet wash and rill erosion, on a gently inclined slope near an unnamed creek;
- Rixs Creek (Singleton) (37-6-0239) – less than 20 chert and siltstone flakes in an eroded area 25 m by 25 m, between the junction of two gullies;
- 36; (37-3-0157) – five indurated mudstone, located near minor creek, creek flat and gentle slope;
- GCC26; Camberwell; (37-3-0088) – three mudstone and one quartz, four artefacts found scattered along 40 m of creek to a small confluence, on the western bank of the western tributary;
- GCC25; Camberwell; (37-3-0087) – mudstone and silcrete artefacts, 19 artefacts found over 50 m of creek bank, on the western bank of the western tributary, 200 to 250 m above the confluence; and
- GCC24; Caswell; (37-3-0886) – five artefacts situated adjacent to and on two dam walls, four tuff and one silcrete artifact, on lower slopes.

It should be noted that one site, Rixs Creek Stone Quarry Gully (37-6-0241), places the site within the Proposal area, however, further investigation shows this site to be located outside of the Proposal area and the immediate vicinity.

7.1.3. Field survey results

The aim of the field survey of the Proposal area was to:

- Identify, record and assess the condition of previously unrecorded Aboriginal cultural heritage sites;
- Locate and update the information for documented sites where possible;
- Assist in assessing the archaeological (scientific) and cultural potential of the Proposal area; and
- Identify and document cultural heritage values noted by the Aboriginal people involved in the field survey and / or previously noted by the Aboriginal parties.

The field survey identified seventeen previously undocumented Aboriginal cultural heritage sites within and in the immediate vicinity of the Proposal area. The location of these sites is shown on Figures 7.1A-E.

The seventeen previously unrecorded Aboriginal cultural heritage sites include nine stone artefact scatters and eight isolated stone artefacts which are consistent with predictions that these types of finds were most likely to be identified within the Proposal area.

The overall effectiveness of the survey for assessing the location, nature and extent of Aboriginal archaeological sites was considered low due to poor surface visibility resulting from vegetation cover and the limited amount of exposures. The main exposures present consisted of grassed vehicle tracks, dam walls, tree plantings and exposure from erosion.

The Proposal area is surrounded by existing and former mining pits and mining rehabilitation areas. There is, however, remnant natural landscape that appears to exist as evidenced by remnant vegetation and occasionally by the presence of discrete stone artefact scatters.

Sites were considered to be more likely to occur within the Proposal area in the immediate vicinity of Station Creek (within approximately 100 m) on relatively undisturbed parts of the valley floor. The archaeological value of the potential sites within this area is not clear.

7.1.4. Assessment of significance

Archeological (scientific) significance

The assessment of significance for archaeological sites and places is carried out to enable a decision regarding the most appropriate way of protecting and managing a particular item or place. The nature and level of significance also determines the appropriate approval process for managing impact to those sites and objects.

The predicted level of archaeological (scientific) sensitivity for the study area was assessed and zoned as low (refer to Volume 2 Technical Paper 1 Indigenous heritage). Sensitivity, (archaeological potential) was determined by desktop assessment of the study area to inform the methodology for field survey. The assessment of the predictive zoning was based on a consideration of the following archaeological (scientific) sensitivity criteria:

- AHIMS site list and location of sites (previously identified and registered sites);
- Environmental background identifying topography and resources
- Previous report review at a local and regional scale;
- More specific areas of sensitivity identified by other assessments.
- Predictive modeling detailing the type and Aboriginal archaeological sites likely to exist(ed) throughout the study area and where they are more likely to be located;
- Information obtained from the field survey; and
- Site analysis (including land use history/previous disturbance);

During the survey, 18 sites were found to be within the study area and were assessed in relation to their archaeological (scientific) significance, that is, the value of the technical information those sites and objects possess. The criteria used for the archaeological assessment process include rarity, representativeness, integrity, connectedness, complexity and potential for archaeological deposit. These values are distinct from *cultural* significance, which is determined by Aboriginal people. All sites in the study area were assessed as having *low scientific significance* for the following reasons:

- Rarity: artefact scatters and isolated finds are common in the local area and region; the location within the landscape is typical of the local and regional trends; the type of raw material of these items reflects local and regional trends; all items are located within landscape areas of low integrity with all being recorded in exposures resulting from erosion or human action.
- Representativeness: these are common site types with distribution reflecting local and regional trends and are within areas previously disturbed by human activity and / or natural erosion.
- Integrity: all sites have been subject to ongoing erosion and soil movement; a number of sites are within the existing rail corridor and have been directly impacted by previous earthworks.
- Connectedness: no recorded archaeological evidence provides associations between sites on the basis of landform distribution or the nature of assemblages recorded.
- Complexity: there are low artefact numbers, are a limited range of raw materials and types, and there is an absence of associated features such as hearths, knapping floors or heat treatment pits.
- Potential for archaeological deposit: the sites occur in a generally disturbed area, all being in open contexts directly affected by erosion and / or human activity, and there is limited potential for high density subsurface deposits to occur in these landforms based on archaeological site patterning in the Hunter Valley.

The predicted level of *low* archaeological (scientific) sensitivity for the study area was confirmed through the desktop assessment process and field survey. Assessment of the sites against the criteria concluded that their significance was also *low.*

Aboriginal cultural significance

Aboriginal people are the primary determiners of their cultural heritage. No comments in relation to the cultural significance of the area or identified sites were provided by the Aboriginal Parties in the preparation of the Indigenous heritage report. As a result, the cultural significance of the identified sites and study area was not able to be determined (refer to Volume 2 Technical Paper 1 Indigenous heritage).

7.1.5. Potential impacts

An assessment of the potential impacts of the Proposal to Aboriginal cultural heritage has been undertaken including potential impacts from the construction compounds, stockpile sites and construction access roads (refer Table 7.1c.).

The assessment of potential impacts addresses each Aboriginal site within and in the immediate vicinity of the Proposal area, alongside their significance, and the zone of low (archaeological) sensitivity identified.

Table 7.1c Impact assessment of identified Aboriginal site

Sites	Identification	Raw material	Significance	Cultural significance	Potential impacts
Within the Proposal area					
Third track impact area					
NBTT01 (site card pending)	Open site – artefact scatter	6 artifacts including mudstone and silcrete	Low	Not identified	There would be potential impacts due to the construction of the third track and associated infrastructure.
NBTT02 (site card pending)	Open site – isolated artefact	Mudstone	Low	Not identified	
NBTT03 (site card pending)	Open site – isolated artefact	Mudstone	Low	Not identified	
NBTT04 (site card pending)	Open site – artefact scatter	4 mudstone	Low	Not identified	
NBTT05 (site card pending)	Open site – artefact scatter	1 mudstone and 1 silcrete	Low	Not identified	
NBTT06 (site card pending)	Open site – artefact scatter	3 mudstone	Low	Not identified	
NBTT07 (site card pending)	Open site – artefact scatter	14 mudstone	Low	Not identified	
NBTT08 (site card pending)	Open site – isolated artefact	Silcrete	Very low	Not identified	
NBTT09 (site card pending)	Open site – artefact scatter	2 mudstone and 1 silcrete	Low	Not identified	
NBTT10 (site card pending)	Open site – isolated artifact	2 silcrete	Low	Not identified	

Sites	Identification	Raw material	Significance	Cultural significance	Potential impacts
Rixs Creek Lane extension impact area					
RCLE01 (site card pending)	Open site – artefact scatter	Silcrete	Low	Not identified	There would be potential impacts due to the extension of Rixs Creek Lane.
RCLE03 (site card pending)	Open site – isolated artefact	Mudstone	Low	Not identified	
Secondary site compound impact area					
SC01 (site card pending)	Open site – isolated artefact	Silcrete	Low	Not identified	Impacts would occur due to the secondary site compound.
In the immediate vicinity of the Proposal area (within 100 m)					
RCLE02 (site card pending)	Open site – artefact scatter	4 mudstone	Low	Not identified	None
Integra 31 (I31) (37-3-0886)	Open site – artifact scatter	4 tuff and 1 silcrete	Low	Not identified	
36; (37-3-0157)	Open site – artefact scatter	4 indurate mudstone	Low	Not identified	
GCC26; Camberwell; (37-3-0088)	Open site – artefact scatter	4 stone including 2 mudstone and 1 silcrete	Low	Not identified	
GCC25; Camberwell; (37-3-0087)	Open site – artefact scatter	19 stone including 3 mudstone and 3 silcrete	Low	Not identified	
Rixs Creek (Singleton) (37-6-0239)	Open site – artefact scatter	20 artefact including chert and siltstone	Low	Not identified	
SC/73 (37-6-1206)	Open site – artefact scatter	3 mudstone	Low	Not identified	
Site SC/74 (37-6-1207)	Open site – artefact scatter	5 mudstone	Low	Not identified	
Site SC-75 (37-6-1208)	Open site – artefact scatter	5 mudstone	Low	Not identified	

7.1.6. Mitigation and management measures

Mitigation measures to reduce the potential for impact on the identified sites and to cater for any unexpected finds would be included in the PCEMP and would include those listed below.

- Consultation would continue with registered Aboriginal Parties about the management of Aboriginal cultural heritage sites within the Proposal area throughout the life of the project in accordance with the DECCW Consultation Requirements for Proponents 2010.
- A Cultural Heritage Management Sub Plan would be developed. The plan would provide an overarching framework guiding the management of Aboriginal cultural heritage. The plan would be developed in consultation with the Aboriginal community and the management strategies listed in this section.

- Exclusion zones would be established around all identified sites within the Proposal area. Where practical, exclusion zones would entail the erection of fencing to provide an approximate 10 metre buffer around the sites.
- All construction personnel would be inducted in the importance of avoiding exclusion zones. Work would stop in the event of unexpected Aboriginal cultural heritage items being uncovered during any time in the life of the Proposal. A qualified archaeologist would be contacted to make an assessment of the find. Aboriginal Parties would be notified of any find.
- If any human remains are discovered during any of the proposed works, all activity in the vicinity of the remains would cease immediately. The remains area would be left in place and protected from harm or damage. The following steps would to be undertaken:
    - The find would be reported to the NSW Police and State Coroner
    - KMH Environmental and the ARTC would be notified
    - Aboriginal stakeholders would be notified
    - DECCW would be notified
    - If the skeletal remains are of Aboriginal ancestral origin, an appropriate management strategy would be developed in consultation with the Aboriginal Parties
    - The find would be recorded in accordance with the *National Parks and Wildlife Act 1974* (NSW) and the NSW NPWS Aboriginal Cultural Heritage Standards and Guidelines Kit (1997)
    - The PCEMP would be amended to include the newly discovered Aboriginal ancestral remains.

Further archaeological work may be required where impacts to Aboriginal cultural heritage sites within the Proposal area are unavoidable. The cultural heritage material would be collected, with the relocation of collected artefacts determined in consultation with Aboriginal Parties.

7.2. Ecology

7.2.1. Introduction

A detailed assessment of flora and fauna has been carried out by specialist consultants. The detailed specialist study is summarised in this section and provided in Volume 3, Technical Paper 2. Table 7.2a outlines the DGRs relevant to ecology and where they have been addressed in this section.

Table 7.2a Director-General's Environmental Assessment Requirements - ecology

Director-General's Environmental Assessment Requirements	Location addressed
Key Issues	
Ecology – including but not limited to: • Flora, fauna and habitat, with specific consideration of Endangered Ecological Communities, threatened flora, fauna and populations; • Vegetation clearing (and resultant foraging, roosting, habitat loss, fragmentation, connectivity and edge effects) and operational impacts (such as increase in rail movements); and • Consideration of: the Draft Guidelines for Threatened Species Assessment (DEC and DPI, 2005), Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC, 2004) and Principles for the Use of Biodiversity Offsets in NSW (DECCW, 2008).	Section 7.2.3 and Volume 3, Technical Paper 2. Section 7.2.4 and Volume 3, Technical Paper 2. Section 7.2.2, 7.2.5 and Volume 3, Technical Paper 2.

7.2.2. Assessment Methodology

The ecological assessment included both desk-based assessment of the literature and relevant databases, as well as field surveys of the study area and surrounding landscape. A worst case corridor assessment was undertaken addressing an area much larger than expected to be required to construct the Proposal to facilitate future flexibility in the detailed design process. Records of threatened species known or predicted to occur within the Proposal locality were obtained from the following:

- Threatened species, populations and communities database (DECCW);
- Atlas of NSW Wildlife (DECCW);
- Threatened & protected species - records viewer (Industry and Investment NSW); and
- The EPBC protected matters search tool.

Available literature was reviewed including regional assessments as well as ecological studies undertaken within the study area, such as:

- *Nundah Bank Concept Assessment Report* (SKM 2009);
- *Integra Underground Coal Project: Flora and Fauna Assessment* (ERM 2009); and
- *Integra Open Cut Project: Biodiversity Assessment* (URS 2009).

Field surveys were undertaken between the 16 and 20 August, 2010. The survey methods, effort and assessments were undertaken in accordance with the following guidelines:

- The *Draft Guidelines for Threatened Species Assessment* (Department of Environment and Conservation & Department of Primary Industries 2005);
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Department of Environment and Conservation 2004); and
- *Threatened Species Survey and Assessment Guidelines: Field Survey and Methods for Fauna-Amphibians* (NSW Department of Environment 2009).

Flora surveys

The floristic diversity and possible presence of threatened species was assessed using a combination of random meander and plot-based (quadrate) surveys. Due to the linear nature of the Proposal, random meander surveys were completed along the entire length of the Proposal corridor. Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by *Cropper* (1993), whereby the recorder walks in a random manner throughout the site recording all species observed, boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Five quantitative (quadrat) site surveys were undertaken as outlined in the methodology contained within *BioBanking Operation Manual* (Seidel & Briggs 2008). The following site attributes were recorded at each site:

- Location;
- Vegetation structure and dominant species and vegetation condition;
- Native and exotic species richness;
- Number of trees with hollows;
- Total length of fallen logs;
- Native overstorey cover;
- Native mid-storey cover;
- Ground cover (grasses, shrubs, other, exotics); and
- Evaluation of regeneration.

The condition of vegetation was assessed through general observation and comparison against this benchmark data as well as using parameters such as intactness, diversity, history of disturbance, weed invasion and health. Three categories were used to describe the condition of vegetation communities: good, moderate and low.

Fauna surveys

The fauna surveys included habitat assessment and targeted fauna surveys. In addition, opportunistic recordings of species were made through incidental sightings, aural recognition of calls and observations of indirect evidence of species' presence (i.e. Yellow-bellied Glider chews, Glossy-black Cockatoo chew cones, nests/dreys, whitewash, burrows and scats).

The following survey techniques were employed:

- Habitat assessment;
- Tree hollow survey;
- Small mammal trapping (Elliot type A and B);
- Microchiropteran bat surveys;
- Spotlighting;
- Call playback;
- Diurnal bird surveys; and
- Herpetofauna active searches.

A full description of the flora and fauna survey methods and locations is provided in Volume 3, Technical Paper 2.

7.2.3. Existing Environment

Vegetation communities
The majority of the vegetation within the site has been previously cleared and extensively modified as a result of:

- Historic and current grazing;
- Rail construction in the current and former locations; and
- Open cut coal mining and associated works including rehabilitation post mining.

Where the landscape and soil profile has not been significantly modified, the original vegetation is regenerating from a soil stored seed bank. There is some regeneration in areas where the soil profile has been disturbed/removed through dispersal of seeds from isolated mature trees and colonising species (such as Acacia spp.) as well as planting undertaken by the surrounding mines.

Figures 7.2A-E illustrates the vegetation communities and hollow bearing trees within the study area. The distinct vegetation types are:

- Central Hunter Spotted Gum – Ironbark – Grey Box Forest;
- Derived grassland (native grassland formed as a result of clearing and/or ongoing grazing);
- Aquatic vegetation along drainage lines and dams;
- Weed dominated areas; and
- Plantation (rehabilitation areas).

Central Hunter Spotted Gum – Ironbark – Grey Box Forest and derived grassland

Previous vegetation mapping of the local area had identified the presence of Central Hunter Spotted Gum – Ironbark – Grey Box Forest within the study area. This was confirmed during the site surveys. A comparison of the quadrat data against biometric benchmark data (NSW Department of Environment and Conservation 2007) suggests that within the study area, this community was degraded with many of the vegetation characteristics below benchmark condition. The vegetation characteristics of this community are summarised in Table 7.2b. Photo 7.2.a shows an indicative picture of this type of community.

To Camberwell

To Singleton

MIDDLE FALBROOK ROAD

Figure 7.2A
Figure 7.2B
Figure 7.2C
Figure 7.2D
Figure 7.2E

Vegetation Communities

- Aquatic Vegetation
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest
- Derived Grassland
- Plantation
- Swamp Oak
- Weed Dominated

A3 Original

0 50 100 200

Meters

GDA 1994 MGA Zone 56

- Hollow Bearing Tree
- Study Area
- Subject Site
- Cadastre

ARTC
Nundah Bank
Proposed Third Track

Job Number	2110501B
Revision	A1
Date	08.02.2011
Scale	1:5,000

Vegetation Communities and Hollow Bearing Trees Figure 7.2A

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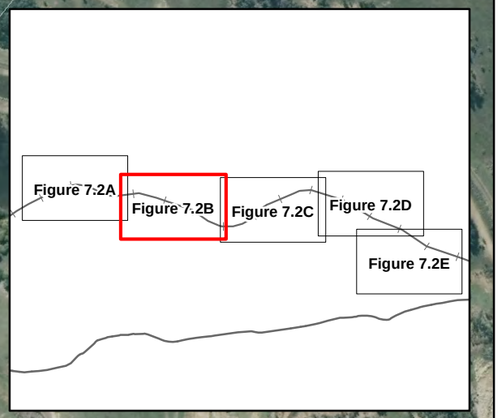
To Camberwell

To Singleton



Vegetation Communities

- Aquatic Vegetation
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest
- Plantation
- Weed Dominated

A3 Original

0 50 100 200

Meters

GDA 1994 MGA Zone 56

N

- Hollow Bearing Tree
- Proposed Third Track Alignment
- Subject Site
- Study Area
- Cadastre

UHVA

ARTC

ARTC
Nundah Bank
Proposed Third Track

Job Number	2110501B
Revision	A1
Date	08.02.2011
Scale	1:5,000

Vegetation Communities and Hollow Bearing Trees Figure 7.2B

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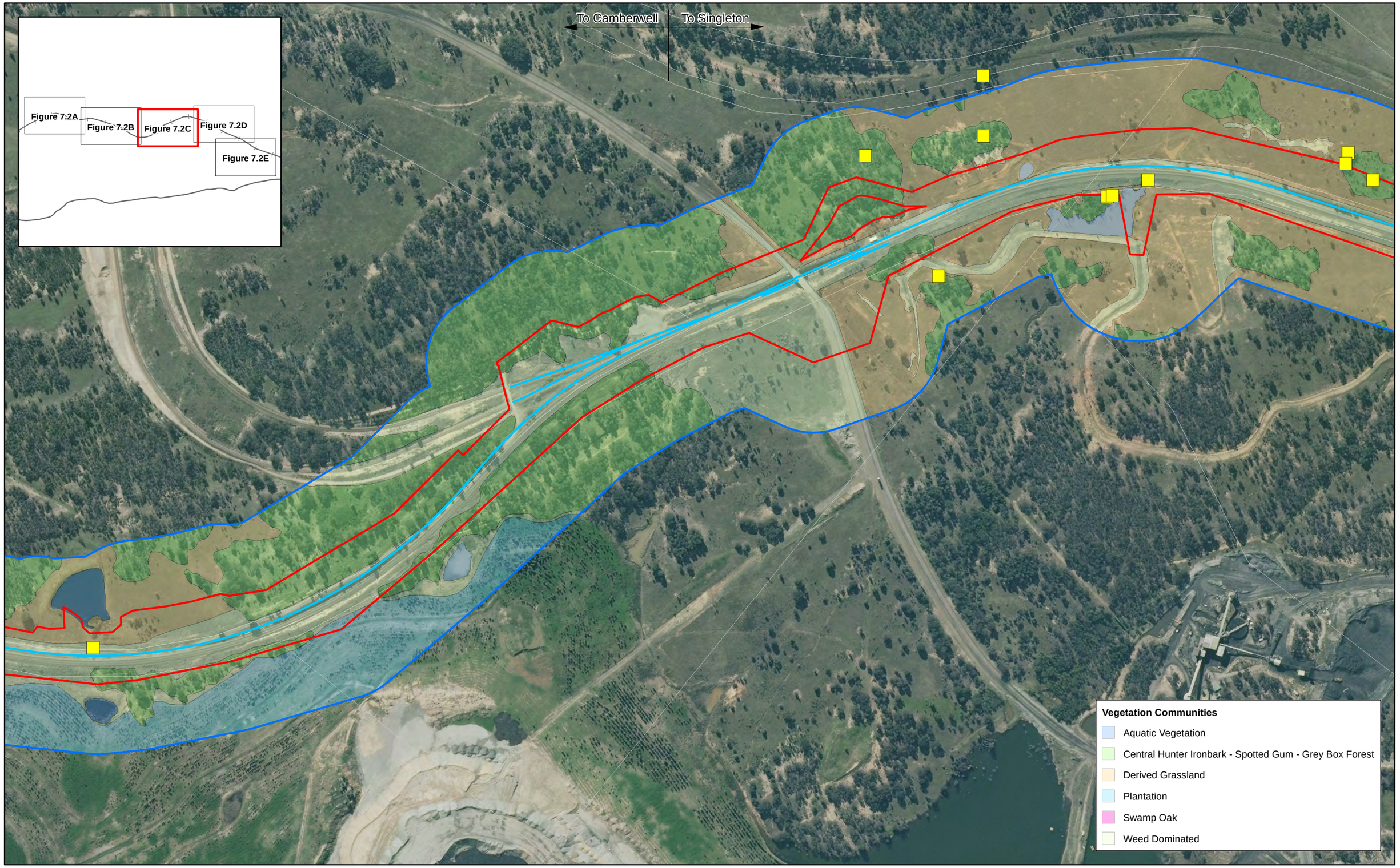

A3 Original

0 50 100 200

Meters

GDA 1994 MGA Zone 56

N

Hollow Bearing Tree

Proposed Third Track Alignment

Subject Site

Study Area

Cadastre

UHVA

ARTC

ARTC
Nundah Bank
Proposed Third Track

Job Number	2110501B
Revision	A1
Date	08.02.2011
Scale	1:5,000

Vegetation Communities and Hollow Bearing Trees Figure 7.2C

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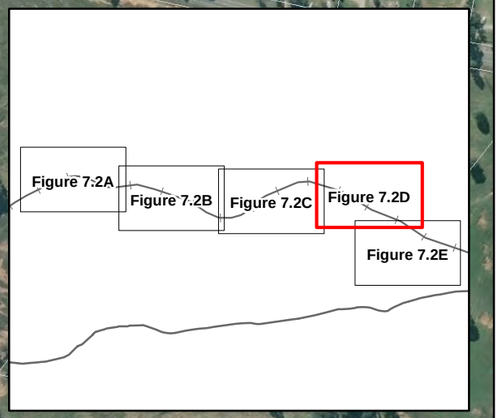
To Camberwell

To Singleton



Vegetation Communities

- Aquatic Vegetation
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest
- Derived Grassland
- Weed Dominated

A3 Original

0 50 100 200

Meters

GDA 1994 MGA Zone 56

- Hollow Bearing Tree
- Proposed Third Track Alignment
- Subject Site
- Study Area
- Cadastre

ARTC
Nundah Bank
Proposed Third Track

Job Number	2110501B
Revision	A1
Date	08.02.2011
Scale	1:5,000

Vegetation Communities and Hollow Bearing Trees Figure 7.2D

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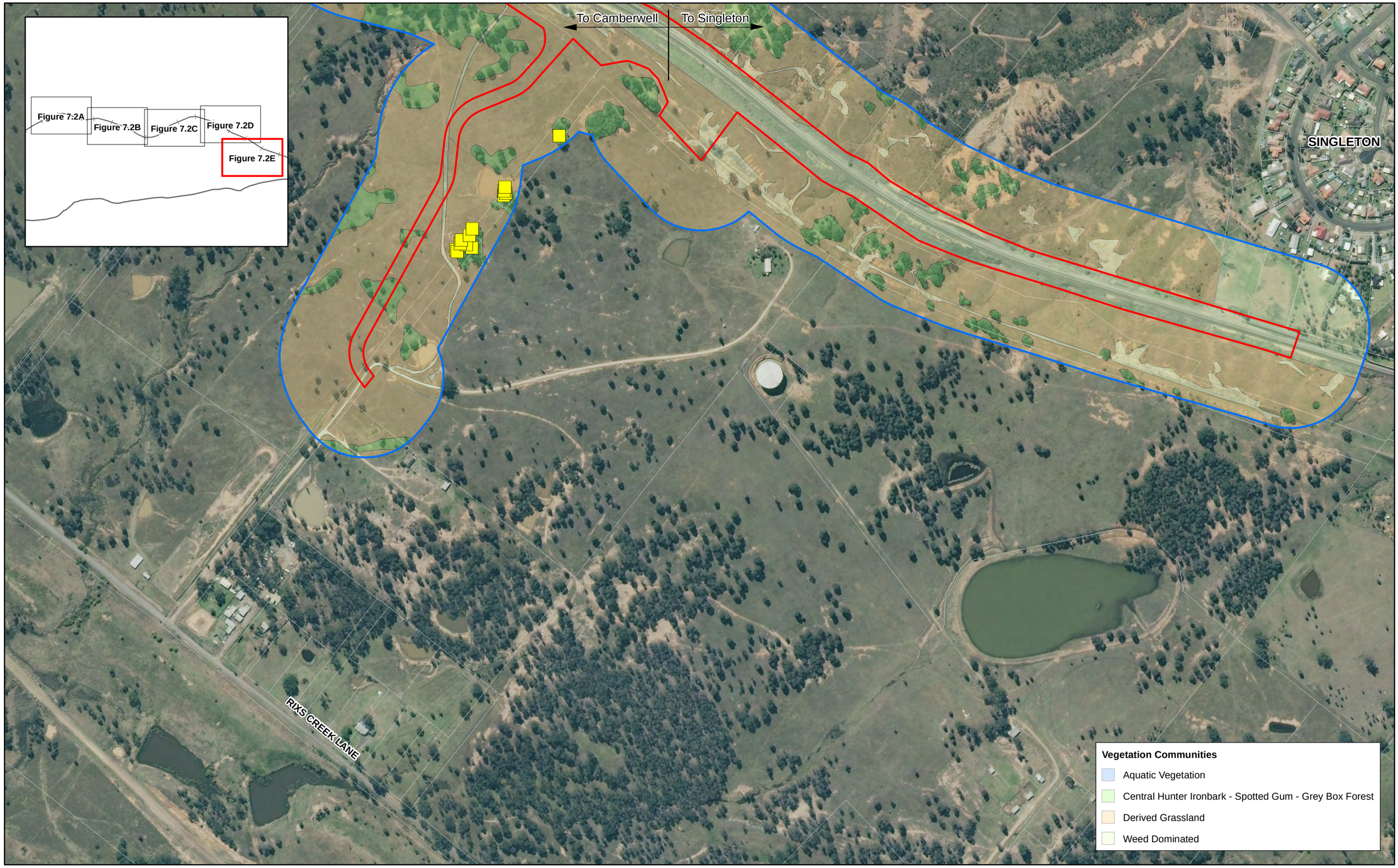

A3 Original

0 50 100 200

Meters

GDA 1994 MGA Zone 56

Hollow Bearing Tree
Subject Site
Study Area
Cadastre

ARTC
Nundah Bank
Proposed Third Track

Job Number	2110501B
Revision	A1
Date	08.02.2011
Scale	1:5,000

Vegetation Communities and Hollow Bearing Trees Figure 7.2E

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Photo 7.2a Central Hunter Spotted Gum – Ironbark – Grey Box Forest

Source: Volume 3, Technical Paper 2

Table 7.2b Summary of characteristics of Central Hunter Spotted Gum – Ironbark – Grey Box Forest

Central Hunter Spotted Gum – Ironbark – Grey Box Forest			
Conservation significance	Listed as an Endangered ecological community under the TSC Act		
Condition	The majority of this community has been previously cleared, occurs as small patches and is subject to ongoing disturbance from grazing or edge effects from mining and the railway. Two condition classes were observed: · Moderate-generally low weed cover and including regenerating eucalypts (covering 8.75 ha); and · Poor-derived grassland areas in poor condition with low species diversity and lacking canopy species. In some areas, limited regeneration of canopy and colonising species was evident (particularly of *Eucalyptus crebra*). Covering 13.37 hectares.		
Strata	Height range (m)	Foliage cover (%)	Dominant species
Canopy	10-18	8	*Corymbia maculata, Eucalyptus crebra, Eucalyptus moluccana* (generally absent in derived grassland areas)
Shrub stratum	0.5-2	4	*Acacia amblygona, Acacia falcata* (generally absent in derived grassland areas)
Ground cover	0-0.5	70	*Cymbopogon refractus, Aristida vagans, Dichondra repens, Cheilanthes sieberi, Senecio madagascariensis**

Source: Volume 3, Technical Paper 2, Table 3-2 *Introduced species

Aquatic vegetation

Several artificial dams along the route have been created as a result of mining or agricultural activities. Many dams have dead stags indicating that these areas were once forest vegetation (Photo 7.2b).The vegetation characteristics of this community are summarised in Table 7.2c.

Table 7.2c Summary of characteristics of aquatic vegetation

Aquatic vegetation			
Conservation significance	Low. Not consistent with a native vegetation community.		
Condition	Poor		
Strata	Height range (median height) (in m)	Foliage cover (%)	Dominant species

Aquatic vegetation			
Ground cover	0-1.5 (0.8)	90%	*Juncus acutus*, Chloris gayana*, Typha* sp., *Senecio madagascariensis*, Juncus* spp.

Source: Volume 3, Technical Paper 2, Table 3-4 *Introduced species

Photo 7.2b Aquatic vegetation

Source: Volume 3, Technical Paper 2

Weed dominated areas

Weed dominated vegetation is the most common vegetation within the rail corridor. This vegetation is not consistent with a native vegetation community and is unlikely to regenerate due to modification of soil profile (Photograph 7.2c). The vegetation characteristics of this community are summarised in Table 7.2d.

Table 7.2d Summary of characteristics of weed dominated areas

Weed dominated			
Conservation significance	Low. Not consistent with a native vegetation community.		
Condition	Low- had less than 25% of benchmark canopy cover and has less than 50% native ground cover. Unlikely to regenerate due to disturbance of soil profile and native seedbank. Native species recorded were colonising species likely to have germinated as a result of wind-dispersed seed.		
Strata	Height range (median height) (in m)	Foliage cover (%)	Dominant species
Canopy	1-10 (4)	<1%	*Eucalyptus crebra*

Weed dominated			
Shrub stratum	0.3-2 (0.5)	<1%	*Acacia amblygona, Acacia falcata*
Ground cover	0-1.5 (1)	90%	*Chloris gayana*, Melinis repens*, Hyparrhenia hirta*, Cirsium vulgare*, Foeniculum vulgare*, Ricinus communis*, Hardenbergia violaceae*

Source: Volume 3, Technical Paper 2, Table 3-5 *Introduced species

Photo 7.2c Weed dominated areas

Source: Volume 3, Technical Paper 2

Plantation

Plantations cover approximately 0.64 ha of the subject site. These areas consist of planting undertaken by the mines following completion of mining activities. Although the plantings generally consist of *Eucalyptus* spp., this vegetation is not consistent with a native vegetation community. Planted species included *Eucalyptus maculata*, *Eucalyptus tereticornis, Allocasuarina littoralis* and *Acacia saligna**. The ground cover was dominated by introduced species. The vegetation characteristics of this community are summarised in Table 7.2e.

Table 7.2e Summary of characteristics of plantations

Plantations			
Conservation significance	Low. Not consistent with a native vegetation community.		
Condition	Low - Unlikely to regenerate due to disturbance of soil profile and native seedbank. Native species recorded were planted		
Strata	Height range (median height) (in m)	Foliage cover (%)	Dominant species
Canopy	3-10 (6)	<10%	*Eucalyptus maculata*, *Eucalyptus tereticornis, Allocasuarina littoralis*
Shrub stratum	2-5 (3)	<1%	*Acacia saligna**

Plantations			
Ground cover	0-1.5 (1)	90%	*Chloris gayana*, Melinis repens*, Hyparrhenia hirta**

*Introduced species

Plant species recorded

A total of 226 plant species were recorded in the study area of which 167 species (74%) were native. Of the 59 exotic species of plant recorded, four are listed under the *Noxious Weeds Act,* 1993 for the Upper Hunter County Council Noxious Weed Control Area (includes Singleton Local Government Area). These were: *Romulea rosea* (Onion Grass), *Lantana camara* (Lantana), *Opuntia stricta* (Prickly Pear) and *Opuntia aurantiaca* (Prickly Pear – Tiger Pear).

Fauna habitats

The suitability, size and configuration of the fauna habitats present, correlate broadly with the vegetation communities. These areas provided habitat for a range of birds, mammals and herpetofauna, and were in moderate to poor condition. Specific habitat attributes of each community type are described in further detail in Table 7.2f.

Table 7.2f Fauna habitat features

Microhabitat attributes	Fauna habitat stratification		
	Dry open forest	Aquatic habitat	Cleared land
Upper canopy	Upper canopy to 14 metres consisting of *Eucalyptus moluccana*, *Corymbia maculata*, *Eucalyptus crebra* and *Eucalyptus tereticornis.* An average crown cover across this habitat was estimated at up to 70%. Mistletoe was observed to occur at a low density within this habitat, generally not being recorded over much of the alignment. However, survey site S3 contained 16 mistletoe plants, which were observed to parasitise *Eucalyptus moluccana.*	Absent	Generally absent, however emergent individuals of *Eucalyptus moluccana* and *Eucalyptus crebra.*
Shrub layer	Open understorey was recorded throughout this habitat with a sparse shrub layer of *Acacia* spp.	Absent	Generally absent due to clearing and current management practices.
Grasses, herbs, forbs, sedges and rushes	A moderate ground cover of grasses, herbs and sedges was recorded over much of this habitat. Species included *Cymbopogon refractus, Aristida vagans, Dichondra repens, Cheilanthes sieberi, Senecio madagascariensis*.*	Dominant emergent species included *Juncus acutus*, Chloris gayana*, Typha sp., Senecio madagascariensis*, Juncus spp*	Ground cover composition was generally dominated by exotic species.
Leaf litter	A leaf litter of <1 centimetre thick was recorded over much of this habitat, although it was observed at a depth of up to 3 centimetre below some trees. Survey site S4 recorded a leaf litter at 1-2 centimetres, with a percent cover up to 80%.	Generally absent. However, some leaf litter present at the ecotone with Dry open forest.	Generally absent
Fallen timber	Although fallen timber was generally sparse throughout the study area, a moderate amount of fallen timber was recorded in this habitat at four of the five habitat assessment site, including survey site S1, S2, S3. These sites contained up to 33 metres of fallen timber ranging from 10 to 40 centimetres DBH. Decorticating bark was recorded from *Eucalyptus moluccana* and *Eucalyptus tereticornis*, where they occurred along the alignment.	Generally absent	Generally absent

Microhabitat attributes	Fauna habitat stratification		
	Dry open forest	Aquatic habitat	Cleared land
Tree hollows and stags	A total of 42 hollow trees were recorded in the study area, with 139 hollows observed.	Absent	Although tree hollows were scarce in the cleared area, a total of 42 hollow trees were recorded across the study area, with 139 hollows observed.
Rocks and rock shelves	Generally absent. However, survey site S4 contained partially to deeply imbedded rocks in one small area on the upper slopes. Survey sites S3 and S4 contained boulders in the dry drainage lines that dissected them, while survey site S1 contained two dumped rock piles.	Generally absent	Generally absent
Drainage lines and water bodies	Generally absent	Several artificially constructed dams occurring along the alignment were likely created as a result of mining and agricultural activities. Water bodies ranged from periodically inundated dams to permanent dams.	Majority of artificially constructed dams (aquatic habitat) occurred in this habitat.
Overall condition	Moderate - poor	Moderate - poor	Poor

Source: Volume 3, Technical Paper 2, Table 3-9 *Introduced species

Species of animal recorded

Seventy-nine vertebrate fauna species were recorded during the field surveys including four threatened species of animal: Squirrel Glider, Grey-headed Flying-fox, Grey-crowned Babbler and Little Lorikeet. Four introduced species were also recorded during surveys, including Brown Hare, Rabbit, Common Myna and Mosquito Fish. Table 7.2g details the number of each of these species surveyed.

Table 7.2g Fauna species recorded

Group	Introduced	Native	Total
Birds	1	55	56
Mammals	2	11	13
Frogs	-	6	6
Reptiles	-	3	3
Fish	1	-	1
Total	**4**	**75**	**79**

Source: Volume 3, Technical Paper 2, Table 3-4

Threatened biodiversity and migratory species

Threatened Ecological Communities

Seventeen threatened ecological communities listed under the TSC Act and/or EPBC Act have been identified as having potential to occur within the locality. One threatened ecological community listed under the TSC Act was recorded within the study area: Central Hunter Ironbark – Spotted Gum – Grey Box Forest (Photo 7.2d). No threatened ecological communities listed under the EPBC Act or FM Act are present within the study area.

Endangered Populations

No Endangered populations listed under the TSC Act or FM Act occur within the study area.

Threatened Flora Species
A total of 39 threatened flora species listed under the TSC Act and/or EPBC Act are known or predicted to occur in the locality. While no threatened plant species were recorded in the study area, two threatened species of plant are considered low to moderately likely to occur based on the presence of potential habitat. These are:

- *Diuris tricolor* (Pine Donkey Orchid or Tricolour Donkey Orchid) is listed as Vulnerable under the TSC Act.
- *Bothriochloa biloba* (Lobed Blue-grass) is listed as Vulnerable under the EPBC Act.

The field surveys completed for the *Ecological Assessment (EA)* (PB 2010), were completed in accordance with Draft Guidelines for Threatened Species Assessment (DEC and DPI, 2005), Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC, 2004) and Principles for the Use of Biodiversity Offsets in NSW (DECCW, 2008). The timing of these surveys were specifically targeted to optimally cover the majority of threatened species seasonal requirements within a spring period between 16 and 20 August 2010, coinciding with access arrangements and environmental conditions following a wet winter. While this survey period was outside the specific seasonal flowering period for *Diuris tricolor* (September – November) (Bishop 2000) *(NSW Scientific Committee 2007)* it was considered to have only marginal potential habitat present.

However, given the habitat characteristics of the study area and the species current known distribution, the actual likelihood of this species occurring is considered to be very low given the following points;

- The targeted field surveys completed within the subject site were conducted in late August at a time when *Diuris tricolor* may not have been in flower but would likely have been in bud. However, no terrestrial orchid stems in bud or otherwise were identified during these surveys;

- *Diuris tricolor* was not recorded by recent targeted surveys conducted during its flowering period (*19-21 November 2009)* throughout two/thirds of the study area and within adjoining Integra Coal Mine lease areas for *Integra open cut project: biodiversity assessment* (URS 2009);

- Despite numerous detailed ecological surveys associated with assessments for the expansion of coal mines in the central hunter region surrounding the study area, this species has not been previously recorded within the locality (10km) on any threatened species database, Department of Environment and Climate Change (2010);

- The habitat condition of both the vegetation types; Central Hunter Spotted Gum – Ironbark – Grey Box Forest and Derived grassland (native grassland formed as a result of clearing and/or ongoing grazing), identified as having marginal potential habitat for this species had been significantly affected by exotic pasture weeds and/or a history of grazing.

Despite the limited potential for *Diuris tricolor* occurring within the study area the *EA* used a precautionary approach in the assessment of *Diuris tricolor* which was identified as having “moderate likelihood of occurrence” based on marginal potential habitat within the subject site and the fact surveys were completed outside of the species specific seasonal flowering period. This assessment determined the project would not constitute a significant impact on the habitat of this species.

Other threatened species known or predicted to occur in the locality are considered unlikely to occur in the study area for one or more of the following reasons:

- Preferred habitat not present;
- Outside known range of the species and habitat marginal; and
- Species is not cryptic and based on survey effort, would have been recorded if present.

Threatened Fauna Species
A total of 67 threatened species of animal listed under the TSC Act, FM Act and/or the EPBC Act have been recorded, or are predicted to have habitat in the locality. Four threatened species of animal,

Squirrel Glider, Grey-headed Flying Fox, Grey-crowned Babbler and Little Lorikeet, were recorded in the study area during field surveys.

It is not likely, however, that all 67 species would be affected by the Proposal. Thirty-three threatened species are considered to have a low likelihood of occurrence based on the availability of habitat.

Migratory Species
One species of migratory bird; Eastern Great Egret, was recorded in the study area during field surveys. A further 14 migratory species have the potential to occur in the locality based on previous reports in the study area, database searches and experience and knowledge of the area.

7.2.4. Construction and operational impact assessment

The Proposal would have both direct and indirect impacts on biodiversity during both the construction and operation phases. Table 7.2h summarises these impacts.

Table 7.2h Potential impacts on biodiversity

Impacts	Construction	Operation
Vegetation/habitat clearing	•	
Migratory species	•	•
Fragmentation and connectivity	•	
Noise impacts on fauna	•	•
Weed invasion	•	•
Increase in edge effects	•	
Hydrological changes	•	
Aquatic disturbance	•	
Increase in fauna mortality	•	•
Increase in key threatening processes	•	•

Source: Volume 3, Technical Paper 2, Table 5-1

Vegetation and habitat clearing
Construction of the Proposal would require the clearing of vegetation and habitats as summarised in Table 7.2i. This includes loss of habitat features including tree hollows.

Table 7.2i Potential loss of vegetation within the Proposal area

Vegetation community/fauna habitat	Extent within study area (ha)	Vegetation clearing (ha)
Vegetation		
Central Hunter Spotted Gum – Ironbark – Grey Box Forest[1]	45.24	8.75
Central Hunter Spotted Gum – Ironbark – Grey Box Derived grassland[1]	84.9	13.37
Weed dominated areas	102.53	40.99
Aquatic vegetation along drainage lines and dams	6.29	0.26
Plantation	17.57	0.64
Total area of EEC clearing	**130.14**	**22.12**
Fauna habitats		
Dry open forest[2]	63.39	9.5
Aquatic habitat	6.29	0.26
Cleared land[3]	187.44	54.36

Notes: 1 - Endangered Ecological Community as listed under the *Threatened Species Conservation Act 1995*; 2 – includes plantation and forest; 3 – includes derived grassland and weed dominated vegetation

Source: Volume 3, Technical Paper 2, Table 5-2

Fragmentation and habitat clearing
The Proposal would result in the removal of approximately 9.5 hectares of forest occurring in the Proposal area. Due to the linear nature of the Proposal, the proposed impact area would essentially encroach on vegetation at the interface of existing clearings and easements.

Vegetation in the study area is already isolated/fragmented by existing rail infrastructure, coal mine operations and agriculture developments. The Proposal is not likely to further fragment or isolate vegetation anymore than that currently occurring in the study area given its location adjacent to already disturbed areas.

However, in habitat where the threatened Squirrel Glider was recorded, the Proposal would increase remnant isolation (near Camberwell Rail Loop), which may effectively inhibit this species from accessing vegetation occurring to the south. While the Squirrel Glider may still access such vegetation, the increased separation distance of up to 75 metres is likely to hinder this dispersal.

Noise impacts on fauna
While the construction phase may cause temporary disturbance to animals, the impacts from noise emissions are likely to be localised close to the Proposal (up to 100 metres) and are not likely to have a significant, long-term, impact on wildlife populations. Noise would occur during day time hours, and most species that have potential to be disturbed are nocturnal in their habits. During possessions, there would be additional noise during night time hours for the length of the possession which usually last for a few days.

Furthermore, it is considered likely that most animal species would habituate to periodic noise disturbance from regular maintenance activities and it is likely that surrounding mining operations and existing rail operations would already have an impact on background levels of noise due to 24 hour operations.

Weeds
The Proposal has the potential to further disperse weeds into areas of native vegetation within the study area, particularly adjacent to cleared areas. The existing rail corridor has a high level of weed invasion, particularly exotic grasses.

The most likely causes of weed dispersal associated with the Proposal would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery.

Existing disturbed vegetation within the study area, however, has considerable weed growth already; therefore, the overall extent of weed invasion is not likely to increase significantly.

Edge effects
The study area has been extensively cleared and is within an existing railway corridor. The surrounding area consists of open cut coal mining as well as areas of stock grazing. Forest vegetation occurs as small patches of regenerating woodland fragmented by the existing railway line, derived grassland, open cut coal mining, access tracks and haul roads. Due to the small size of native vegetation patches, the majority are likely to be completely subject to edge effects. As such the Proposal is unlikely to result in a significant increase in edge effects.

Hydrological changes
While a number of dams are located in the study area, most drainage lines have been modified as a result of coal mine operations, agricultural practices and existing rail infrastructure. However, Station Creek, which in the study area runs perpendicular to Middle Falbrook Road, has the potential to be affected by the Proposal. Works are proposed to upgrade the existing bridge over Station Creek to ensure the bridge is load bearing for construction vehicles. Erosion and sediment control is recommended for this upgrade.

Aquatic disturbance and impacts on fish passage
Construction works required for the existing or proposed new bridge structure over Station Creek has the capacity to alter creek bed characteristics and sediment loading. However, little aquatic disturbance in the study area is expected once construction of any waterway crossing is complete, provided that crossings are designed according to Industry and Investment NSW (Fisheries) guidelines on fish passage (Fairfull & Witheridge 2003), and damage to any aquatic habitat and riparian vegetation during construction is minimised.

During construction, run-off from disturbed surfaces could potentially affect water quality in local creeks and dams due to sedimentation. In addition, there is the potential for accidental spillage/leakage of rail construction materials including fuels, lubricants and hydraulic oils from construction equipment.

Direct fauna mortality
Fauna injury or death could occur as a result of the construction phase, when vegetation and habitats are being cleared. They also have the potential to occur during operation of the rail corridor as a result of collision with survey/maintenance vehicles and through increased rail movements.

While some mobile species, such as birds, have the potential to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows, may have difficulty moving over relatively large distances.

The Proposal would increase the width of an existing linear rail corridor that effectively traverses a modified landscape. This would increase the distance and area for animals to cross and negotiate. It is likely that the Proposal would have the greatest impacts near the Camberwell Rail Loop, where regrowth/remnant vegetation borders the subject site.

Key threatening processes
Key threatening processes are listed under Schedule 3 of the NSW TSC Act, NSW FM Act and also under the Commonwealth EPBC Act. Key threatening processes relevant to the Proposal are listed in Table 7.2j.

Table 7.2j Key threatening processes relevant to the Proposal

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Pest species			
Competition and grazing by the feral European rabbit	Competition and land degradation by rabbits.		No. Proposal unlikely to increase this threat anymore than that currently occurring in the study area.
Competition and habitat degradation by feral goats	Competition and land degradation by unmanaged goats.		No. Feral goats were not recorded in the study area.
Invasion and establishment of the cane toad	The biological effects, including lethal toxic ingestion, caused by cane toads (*Bufo marinus*).		No. Proposal unlikely to result in invasion or establishment of the cane toad.
Predation by the European Red Fox	Predation by the European Red Fox.		No. Proposal unlikely to increase this threat anymore than that currently occurring in the study area.
Importation of red imported fire ants into NSW	The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant).		No. Proposal unlikely to result in the importation of red fire ants.
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)	Predation, habitat degradation, competition and disease transmission by feral pigs.		No. This species was not recorded in the study area and the Proposal is unlikely to increase this threat.
Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*)	Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean.		No. Proposal unlikely to result in the invasion of the yellow crazy ant.

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Introduction of the large earth bumblebee (*Bombus terrestris*)			Unlikely. Species not recorded in study area.
Predation and hybridisation by feral Dogs (*Canis lupus familiaris*)			Unlikely. Species not recorded in study area.
Predation by the Plague Minnow (*Gambusia holbrooki*)			Possible. Plague Minnow was recorded in one dam in the study area.
Predation by the ship rat (*Rattus rattus*) on Lord Howe Island			No
Predation by feral cats			No. Proposal unlikely to increase predation by feral cats.
Competition from feral honeybees			No. Proposal is unlikely to increase competition.
Herbivory and environmental degradation caused by feral deer			No. Species not recorded in study area.
	Predation by exotic rats on Australian offshore islands of less than 1,000 km^2 (100,000 ha).		No
Weeds			
Invasion and establishment of exotic vines and scramblers	-		Unlikely. Exotic vines and scramblers not recorded within study area.
Invasion, establishment and spread of *Lantana camara*	-		Possible. Lantana recorded within the study area, however, only rarely and in low abundance.
Invasion of native plant communities by bitou bush & boneseed (*Chrysanthemoides monilifera*)	-		Unlikely. Species not recorded within the area.
Invasion of native plant communities by exotic perennial grasses	-		Yes, rail corridor is dominated by exotic perennial grasses and the Proposal has potential to spread these to other areas.
	Invasion of northern Australia by Gamba Grass and other introduced grasses.		No. Site is not within northern Australia.
	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.		Unlikely. The Proposal does not include garden plants.

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Habitat loss or change			
Clearing of native vegetation	**Land clearance**		**Yes. See Section 7.2.4**
Human-caused climate change	Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases.	Human-caused climate change	Unlikely. The alternative is transport using trucks which is not feasible.
Loss of hollow-bearing trees			Possible. While hollow trees were recorded in the study area, the majority were not located in the subject site.
Removal of dead wood and dead trees			No. The majority of the subject site occurred as an existing maintained easement.
Bush rock removal			No. Bush rock was recorded outside the subject site and occurred as deeply imbedded material.
Ecological consequences of high frequency fires			No. Proposal unlikely to increase frequency of fires.
Loss and/or degradation of sites used for hill-topping by butterflies			No.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners			Unlikely. Proposal is unlikely to affect the abundance of psyllids or Bell Miners.
Alteration of habitat following subsidence due to longwall mining			No. Proposal does not include long wall mining.
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			No. Proposal would not impact natural flow regimes of rivers and streams.
Disease			
Infection by *Psittacine circoviral* (beak & feather) disease affecting endangered psittacine species	Disease affecting endangered *psittacine* species.		No. Proposal unlikely to increase frequency.
Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis	Infection of amphibians with chytrid fungus resulting in chytridiomycosis.		Unlikely. Proposal is unlikely to spread chytrid fungus.
Infection of native plants by *Phytophthora cinnamomi*	Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*).		Unlikely. No evidence of Phytophthora within the study area.
Threats to marine species and habitats			
	Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees south.		No. Proposal would not impact marine species or areas.

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
	Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations.		No. Proposal would not impact marine species or areas.
Death or injury to marine species following capture in shark control programs on ocean beaches		Current shark meshing program in NSW waters.	No. Proposal would not impact marine species or areas.
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments	Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris.		No. Proposal would not impact marine species or areas.
		Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales.	No. Proposal would not impact marine species or areas.
Impacts to riparian habitats and species			
		The degradation of native riparian vegetation along New South Wales water courses.	No. Proposal would not impact riparian vegetation.
		Hook and line fishing in areas important for the survival of threatened fish species.	No. Proposal would not include fishing.
		The introduction of fish to fresh waters within a river catchment outside their natural range.	No. Proposal would not include introduction of fish.
		The removal of large woody debris from NSW rivers and streams.	No. Proposal would not result in the removal of large woody debris from any river or stream.
		In stream structures and other mechanisms that alter natural flow.	No. Proposal does not include any in stream structures (subject to confirmation of requirements at Station Creek bridge)

Source: Volume 3, Technical Paper 2, Table 5-3

Impact Assessment Guidelines

This section summarises the assessment of significance of the potential impacts following the requirements of the EP&A Act 1979 and the EPBC Act. Projects assessed under Part 3A of the EP&A Act 1979 do not require assessments of significance under Section 5A of the Act (the Seven Part Test). Instead the assessment is based against heads of consideration detailed in the *draft Guidelines for Threatened Species Assessment*, indicating the significance of the impacts relative to the conservation importance of the habitat, individuals and populations likely to be affected.

Significance assessments for threatened ecological communities and threatened species concluded that the Proposal is not likely to result in any significant impact due to the small area (22.12 hectares) of native vegetation communities likely to be affected and the existing disturbed nature of the subject site (refer Volume 3, Technical Paper 2). A summary of the likely impacts on threatened biodiversity is presented in Table 7.2k.

Table 7.2k Summary of likely impacts to threatened biodiversity

Threatened biodiversity		TSC Act	EPBC Act	Recorded?	Impacts	Fragmentation	Affect the lifecycle	Weeds/pests/ disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
Threatened ecological communities											
Central Hunter Ironbark - Spotted Gum – Grey Box Forest		E	-	Yes, dominant community within study area	Yes. 22.12 hectares would be cleared (including 8.75 hectares of forest and 13.37 hectares of derived grassland). No critical habitat would be cleared.	Unlikely. Study area already highly fragmented. Proposal unlikely to increase fragmentation.	N/A	Potential impact, however, mitigation measures would reduce likelihood of weed spread.	N/A	No	No
Flora											
Bothriochloa biloba			V	No	Yes, 22.12 hectares potential habitat would be cleared. No critical habitat would be cleared.	Unlikely. Study area already highly fragmented. Proposal unlikely to increase fragmentation.	No	Potential impact, however, mitigation measures would reduce likelihood of weed spread.	N/A	No	No
Diuris tricolor	Pine Donkey Orchid	V		No	Yes, 22.12hectares potential habitat would be cleared. No critical habitat would be cleared.	Unlikely. Study area already highly fragmented. Proposal unlikely to increase fragmentation.	No	Potential impact, however, mitigation measures would reduce likelihood of weed spread.	N/A	No	No

Threatened biodiversity		TSC Act	EPBC Act	Recorded?	Impacts	Fragmentation	Affect the lifecycle	Weeds/pests/ disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
Fauna											
Squirrel Glider		V	-	Yes	Yes, 8.75 hectares of known habitat would be cleared.	Yes. Although study area is highly fragmented, Proposal would increase fragmentation where species was recorded.		No	No	No	No
Brush-tailed Phascogale		V	-	No	Yes, 8.75hectares of potential habitat would be cleared.	Unlikely. Study area already highly fragmented. Proposal unlikely to increase fragmentation	No	No	No	No	No
Threatened woodland birds (Brown Treecreeper, Hooded Robin, Scarlet Robin, Flame Robin, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Painted Honeyeater and Black-chinned Honeyeater)		V	-	Yes. Grey-crowned Babbler only	Yes8.87 ha (including 8.75 ha of Spotted Gum – Grey Box Forest and 0.12061 ha of swamp oak) of potential habitat would be cleared.	Unlikely. Study area already highly fragmented. Proposal unlikely to increase fragmentation	No	No	No	No	No
Threatened aquatic birds (Black-necked Stork, Blue-billed Duck and Freckled Duck)		V	-	No	Yes, .26 hectares of potential habitat would be cleared.	No	No	No	No	No	No
Threatened raptors (Little Eagle, Spotted Harrier and Square-tailed Kite)		V	-	No	Yes, 64.14 hectares of potential habitat would be	No	No	No	No	No	No

Threatened biodiversity		TSC Act	EPBC Act	Recorded?	Impacts	Fragmentation	Affect the lifecycle	Weeds/pests/ disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
					cleared.						
Threatened owls (Barking Owl, Powerful Owl and Masked Owl)		V	-	No	Yes, 8.75 hectares of potential habitat would be cleared.	No	No	No	No	No	No
Threatened opportunistic blossom nomads (Regent Honeyeater, Swift Parrot, Little Lorikeet and Grey-headed Flying-fox)		V	E/V	Yes. Little Lorikeet and Grey-headed Flying-fox	Yes, 9.5 ha (Ironbark, plantation and swamp oak) of known/potential habitat would be cleared.	No	No	No	No	No	No
Microchiropteran bats (Eastern False Pipistrelle, Eastern Free-tail bat, South-eastern Long-eared Bat, Yellow-bellied Sheathtail Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Little Bent-wing Bat, Eastern Bent-wing Bat, Large-footed Myotis, Eastern Cave Bat)		V	V	No	Yes, 64.14 hectares of potential habitat would be cleared.	No	No	No	No	No	No

Source: Volume 3, Technical Paper 2, Table 5-3

Assessment against Part 3A criteria

Improve or maintain biodiversity values

The term „improve or maintain' is defined in the *draft Guidelines for Threatened Species Assessment* under Part 3A of the EP&A Act 1979 as „no net impact on threatened species or native vegetation'. Given that the Proposal would result in clearing of native vegetation, including an Endangered Ecological Community and habitat for threatened species, it would be necessary to develop offset strategies to fulfil this outcome. (refer Section 7.2.5).

Conserve biological diversity and promote ecologically sustainable development

The Proposal maintains vegetation in the study area (where practicable) by locating access roads, stockpiles and construction compounds in disturbed and cleared areas and locating the additional track adjacent to existing tracks.

Protect areas of high conservation value (including areas of critical habitat)

There is no critical habitat as defined under the TSC Act within the Proposal locality. Although much of the vegetation within the study area is consistent with an Endangered ecological community (Central Hunter Ironbark – Spotted Gum – Grey Box Forest, listed under the TSC Act), this vegetation has been previously cleared, occurs as small fragmented patches and is in poor to moderate condition. As such it is not considered to be of high conservation value. Mitigation measures have been included to further minimise impacts on threatened biodiversity.

Protect the long-term viability of local populations of a species, population or ecological community

The vegetation and habitats within the study area are disturbed and fragmented by existing mining, rail, haul roads and cleared grazing land. Clearing for the Proposal has been minimised by avoiding native vegetation and habitats where practical. Mitigation measures would be implemented to further minimise impacts to local biodiversity. As a result, the long-term viability of biodiversity would be protected. The Proposal is unlikely to significantly impact any threatened species, populations or communities of affect their long-term viability.

Protect aspects of the environment that are matters of National Environmental Significance

Under the EPBC Act, the approval of the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (DSEWPC) is required for the following controlled actions:

- An action which has, would have or is likely to have a significant impact on "Matters of National Environmental Significance" (NES matters). The NES matters include:
    - The World Heritage values of a declared World Heritage property;
    - The National Heritage values of a listed National Heritage place;
    - The ecological character of a declared Ramsar wetland;
    - Listed threatened species and ecological communities;
    - Listed migratory species;
    - The Commonwealth marine environment; and
    - Nuclear actions.
- An action by the Commonwealth or a Commonwealth agency which has, would have or is likely to have a significant impact on the environment.
- An action on Commonwealth land which has, would have or is likely to have a significant impact on the environment.
- An action which has, would have or is likely to have a significant impact on the environment on Commonwealth land, no matter where it is to be carried out.

On 14 November 2009, the *Environment Protection and Biodiversity Conservation Regulation* 2000 was amended to exclude the ARTC as a Commonwealth agency under the EPBC Act. The ARTC is therefore not a Commonwealth agency as defined by the EPBC Act, the rail corridor is not classified as Commonwealth land under the EPBC Act and only actions that are likely to have a significant impact on Matters of National Significance require approval by the DSEWPC.

The study area includes habitat (or potential habitat) for two threatened species of plant and four threatened species of animal listed under the EPBC Act. Significance assessments for these threatened species (Volume 3, Technical Paper 2) concluded that the Proposal is not likely to result in any significant impact due to the small area (36.6 hectares) of native vegetation communities likely to

be affected and the existing disturbed nature of the subject site. As such no referral under the EPBC Act is required.

No other Matters of National Environmental Significance occur within the study area.

7.2.5. Mitigation and management measures

Table 7.2l summarises the mitigation and management measures which would be implemented to reduce the identified impacts on ecology.

Table 7.2l Summary of ecological mitigation and management measures

Impact	Mitigation
General	Ensure all workers are provided an environmental induction prior to starting work on site. This would include information on the ecological values of the site, protection measures to be implemented to protect biodiversity and penalties for breeches. Prepare a Flora and Fauna Management Sub Plan as part of the PCEMP.
Vegetation and habitat loss	Limit disturbance of vegetation to the minimum necessary to construct works. Where appropriate mark the limits of clearing and install fencing around the construction footprint area prior to the commencement of construction activities to avoid unnecessary vegetation and habitat removal. Install nest boxes to offset affected hollow trees where the Threatened Squirrel Glider was located. Implement clearing protocols, including: • Marking trees to be removed and preparing an inventory of trees and hollows to be removed, checking hollow-bearing trees for the presence of bird nests and arboreal mammals, such as possum, gliders and bats, prior to felling; • Animals found to be occupying trees should be safely removed before the clearing of trees and relocated into nearby woodlands; and • Nest boxes or salvaged tree hollows should be provided in nearby woodland for each relocated animal. Restrict equipment storage and stockpiling to designated areas in cleared land.
Weeds	Weed management actions would be developed during the construction of the proposal. This would include the management of exotic perennial grasses, such as *Chloris gayana, Melinis repens, Hyparrhenia hirta* that were recorded abundantly within the existing rail corridor and the four noxious weeds of *Romulea rosea, Opuntia stricta, Opuntia aurantiaca* and *Lantana camara* as per the *Noxious Weeds Act 1993*. Vehicles and other equipment to be used in clearing within the construction zone and general construction equipment (such as excavators, graders etc) are to be cleaned so that they are completely free of soil, seeds and plant material before entering the site to prevent the introduction of further exotic plant species and pathogens.
Direct fauna mortality	Design drainage structures to incorporate fauna movement where required. Reduce the median width of infrastructure to the minimum necessary for safe operation of the Proposal in potential fauna crossing zones.
Fragmentation and connectivity	During design include a crossing zone (with multiple gliding poles) in the area of the Camberwell Rail Loop, to aid Squirrel Glider movement.
Aquatic disturbance	Best practice erosion and sediment controls would be implemented in accordance with Volume 2D of *Managing Urban Stormwater: soils and construction* DECC. Design temporary scour protection and energy dissipation measures to protect receiving environments from erosion. Design and construct waterway crossings in accordance with the DPI's *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull & Witheridge 2003). All water discharge into streams would be guided by the ANZECC Water Quality Guidelines (2000).
Residual impacts	Develop an offset strategy to mitigate the residual impacts. This would fulfil the need to improve or maintain as required under *Part 3A of the EP&A Act* 1979.

7.2.6. Approach to achieving the biodiversity offset

The ecological assessment carried out for the Proposal (refer Technical Paper 2) provides a worst case scenario for impacts on biodiversity as it provides a broad, „corridor' assessment rather than the actual project-specific footprint. The assessment concluded that the Proposal would require the clearing of 22.12 hectares of native vegetation, including 8.75 hectares of Central Hunter Ironbark – Spotted Gum – Grey Box Forest, which is listed as an endangered ecological community under the TSC Act. In accordance with the „Part 3A' *draft Guidelines for Threatened Species Assessment* to „maintain or improve', a biodiversity offset is therefore proposed to offset the residual biodiversity impacts of the Proposal.

A strategy to achieve the proposed biodiversity offset has been prepared in accordance with relevant legislation and guidelines; including the Principles for the Use of Biodiversity Offsets in NSW. An assessment of the strategy against the principles is demonstrated in Table 7.2m.

Table 7.2m Assessment of biodiversity offset strategy against the Principles for the use of biodiversity offsets in NSW

DECCW principles for offsets (Department of Environment and Climate Change 2008)	Response
Impacts must be avoided first by using prevention and mitigation measures.	A general principle of environmental management is to, in order of preference: ▪ avoid environmental impacts ▪ minimise impacts ▪ mitigate the impacts. Where impacts cannot be avoided or minimised, compensate for the residual impacts using other mitigation measures such as offsets. These principles have been followed, where possible, for the Project.
All regulatory requirements must be met.	These have been followed, where possible, for the Project. DECCW have identified the projects offsets should meet the quantum of offsets determined by the BioBanking credit calculator.
Offsets must never reward ongoing poor performance.	ARTC is not known to have a history of poor performance. The existing operation of the rail infrastructure has been satisfactory to all regulatory authorities.
Offsets will complement other government programs.	The offsets proposed consider the landscape and assessment requirements for determining offsets requirements under the NSW BioBanking Assessment Scheme.
Offsets must be underpinned by sound ecological principles.	The offsets strategy has been developed in accordance with the following broad ecological principles: ▪ Distance from proposal. ▪ Presence of Threatened biodiversity. ▪ Current condition and potential for improvement. ▪ Connectivity. ▪ Management issues. ▪ „Like for Like'. ▪ Improve or Maintain.
Offsets should aim to result in a net improvement in biodiversity over time.	The biodiversity offsets strategy will aim to result in a net improvement in biodiversity over time.
Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs.	It is proposed the Offset strategy will be designated for conservation with binding title agreements attached to the properties in-perpetuity.
Offsets should be agreed prior to the impact occurring.	The Offset Strategy is currently being developed and commitment to an appropriate offset suitable for agencies approval is likely to be finalised prior to the approval of the Project.

DECCW principles for offsets (Department of Environment and Climate Change 2008)	Response
Offsets must be quantifiable (the impacts and benefits must be reliably estimated).	The ecological characteristics, including areas of remnant vegetation and rehabilitation will be calculated using the best available information and incorporate the BioBanking assessment methodology. It is likely that further ground truthing and surveys of the final offsets site will be completed prior to finalisation of the strategy.
Offsets must be targeted.	The offsets will meet the „like for like' or better criteria of similar condition, size and conservation significance, including the Threatened Central Hunter Spotted Gum Ironbark-GreyBox Forest ;and/or other suitable vegetation types as identified in the BioBanking assessment, namely, Broad-leaved Stringybark- Blakely's Red Gum grassy woodlands of the gorges and upper Hunter Valley, north coast (HU517); or, Spotted Gum- Broad –leaved ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin (HU629).
Offsets must be located appropriately.	All of the proposed offsets will be located within Hunter CMA boundary in accordance with the NSW BioBanking Assessment Scheme.
Offsets must be supplementary.	The Projects offsets will be supplementary to a range of strategies including ongoing mitigation and management activities, changes in land management, restoration rehabilitation.
Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	It is proposed the Offset strategy will be designated for conservation with binding title agreements attached to the properties in-perpetuity.

The ARTC is currently investigating a biodiversity offset as part of another project, Maitland to Minimbah Third Track (ARTC 2010a). This project was approved on the 20 December 2010 by the Minister for Planning. The area being investigated for this project may be sufficient to account for both projects, subject to further investigations. Should the size be sufficient and the species and vegetation type match the Proposal requirements, the ARTC would prefer to use this area to achieve the offset requirements for both projects. This approach would provide a larger, consolidated offset with greater ecological viability than two separate areas.

Alternatively, a separate, land parcel would be sought. One of the options currently being investigated is land parcels which are part of the NSW DECCW "Land Alive" program which gives Aboriginal landowners a chance to create jobs and business opportunities through managing land for conservation purposes. Other privately held or Government-owned lands may also be considered suitable, subject to further investigations. The project capital cost estimate includes an allowance for achieving the biodiversity offset for the Proposal. This will be regularly reviewed in line with the developing concept design and offset requirements.

The key tasks to achieve the biodiversity offset for the Proposal and indicative target dates for completion is provided in Table 7.2n. Not all tasks are sequential and a number of tasks may be carried out in parallel.

Table 7.2n Approach to implementing the biodiversity offset

Key task	Target date
1. Identify reduced project-specific construction footprint	Completed
2. Estimate initial size of offset area required	February 2011
3. Identify target species (if impacted species is not available)	February 2011
4. Identify potentially suitable offset sites	February/March 2011
5. Refine biodiversity impact assessment based on final concept design and subsequent size of offset	February/March 2011
6. Achieve in-principle agreement(s) with landowner(s) of target sites	March/April 2011
7. Survey and quantify potential offset site values	April 2011

Key task	Target date
8. Finalise biodiversity offset strategy and seek approval from DECCW	May/June 2011
9. Implement biodiversity offset	Post approval

7.3. Noise and vibration

The DGRs identify construction and operational noise and vibration impacts as a key issue for the Environmental Assessment. A detailed assessment of noise and vibration issues was undertaken for the Proposal. The detailed specialist study report can be found in Volume 3, Technical Paper 3. This section provides a summary of that report.

Table 7.3a outlines the DGRs relevant to noise and vibration and where each requirement has been addressed in this section.

Table 7.3a Director-General's Environmental Assessment Requirements - noise and vibration

Director-General's Environmental Assessment requirements	Where addressed
Key issues	
General Construction Impacts – the Environmental Assessment must assess the impacts of and present a management framework for:	Section 9.2
• Noise and vibration, with consideration given to:	
○ The intensity and duration of noise and vibration impacts from all activities and sources on and off site;	Section 7.3.2 and Volume 2, Technical Paper 3
○ The nature, sensitivity and impact to potentially affected receives and structures;	Section 7.3.4 and Volume 2, Technical Paper 3
○ Scheduling of construction works having regard to the nature of construction activities (including transport, blasting and tonal or impulsive noise -generating works).	Section 7.3.7 and Volume 2, Technical Paper 3
○ A strategy for managing construction noise and vibration, with a particular focus placed on those activities identified as having the greatest potential for adverse noise or vibration impacts, and a broader, more generic approach developed for lower-risk activities; and	Section 7.3.7 and Volume 2, Technical Paper 3
○ The Interim Construction Noise Guidelines (DECC, 2009) and Assessing Vibration: A Technical Guideline (DEC, 2006).	Section 7.3.2, Section 7.3.6 and Volume 2, Technical Paper 3
Air, Noise and Water – including but not limited to:	
• Air, noise and vibration impacts along the corridor associated with rail operations and ongoing maintenance. Including, where relevant specific consideration of impacts to sensitive receivers;	Section 7.3.5 and Volume 2, Technical Paper 3
• Consideration of: Interim Guidelines for the Assessment of Noise from Rail Infrastructure Projects (DECC/DoP, 2007) and Assessing Vibration: A Technical Guideline (DEC, 2006).	Section 7.3.5, 7.3.2 and Volume 2, Technical Paper 3

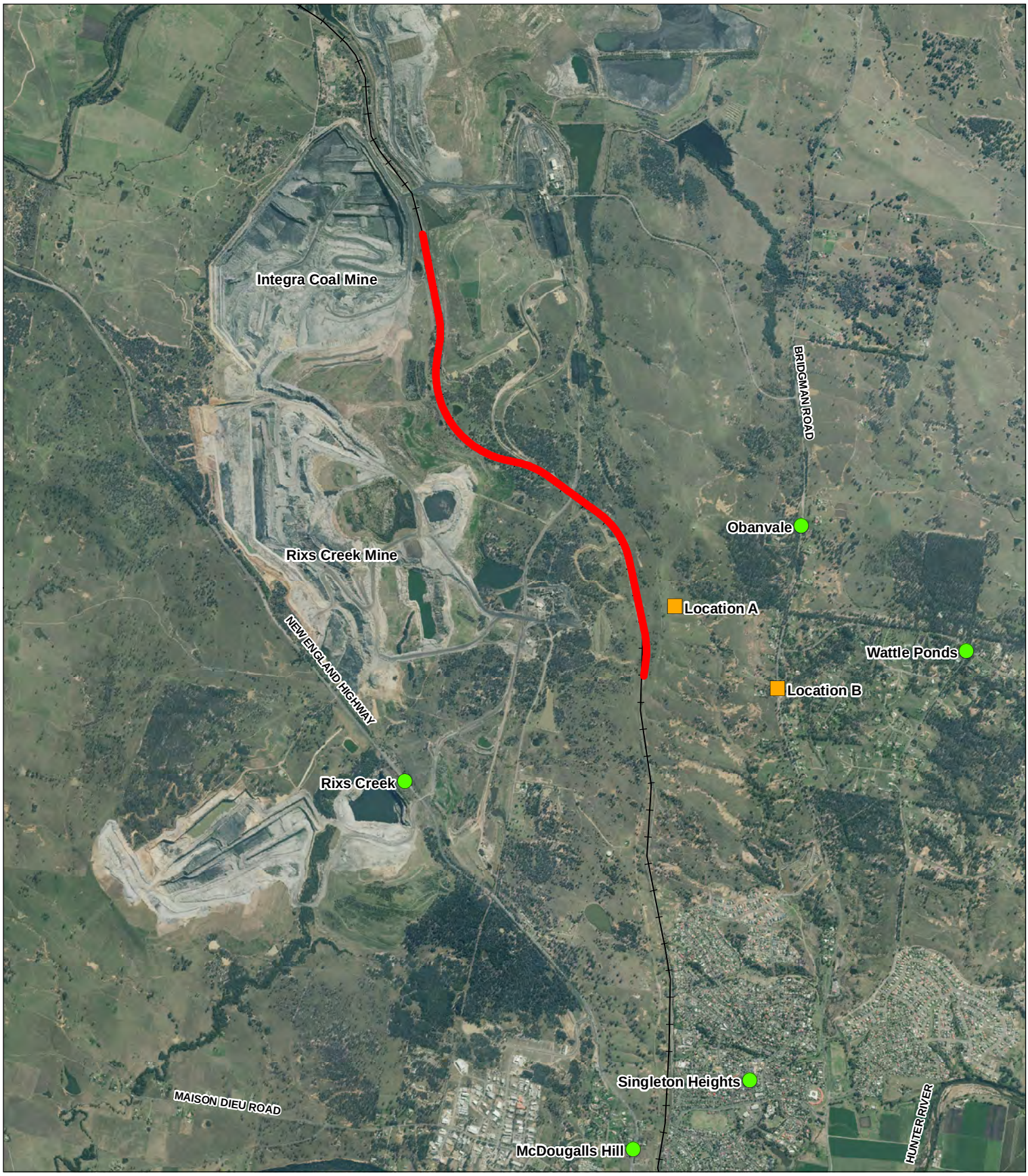
Assessment has been undertaken in accordance with the following NSW Government guidelines:

- Interim Guidelines for the Assessment of Noise from Rail Infrastructure Projects (IGANRIP);
- Interim Construction Noise Guidelines (ICNG);
- Assessing Vibration: A Technical Guideline; and
- Environmental Criteria for Road Traffic Noise (ECRTN).

7.3.1. Ambient noise monitoring

Attended and unattended noise monitoring was undertaken between Monday 26 and Friday 30 July 2010 to determine the level of background noise in the vicinity of the Proposal. Monitoring locations are shown in Figure 7.3. Location A is approximately 140 metres from the railway and was selected to calibrate noise modelling in the event that train noise at the closest sensitive receiver could not be clearly identified above ambient noise. Location B approximately 770 metres from the rail corridor is the nearest sensitive receiver to the Proposal.

A noise logger was used to determine the L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional



Third Track

Rail Lines

Noise Monitor

Town / Locality

A4 Original

0 0.25 0.5 1 1.5

Kilometres

GDA 1994 MGA Zone 56

N

UHVA

ARTC

ARTC
Nundah Bank

Noise Monitoring Locations

Job Number	2110501B
Revision	A1
Date	09.02.2011
Scale	1:40,000

Figure 7.3

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passby of a train. The L_{A90} level is used to derive the Rating Background Level (RBL) which is used to determine the noise level criteria for the construction noise impact assessment. The L_{Aeq} level is the average noise level of a fluctuating noise environment over a given sample period. The L_{Aeq} is used for the assessment of operational rail noise as well as vehicular traffic noise.

7.3.2. Ambient vibration monitoring

As the nearest residential receiver is approximately 770 metres from the Proposal, vibration impacts have been assumed to be negligible. Previous assessments (ARTC, 2009b) have shown that vibration impacts as close as 40 metres to freight/ coal train passbys are generally compliant with relevant guidelines for both human comfort and building damage. Recent measurements at a distance of 200 metres (Koolbury and Quipolly rail loops) showed that vibration levels were below perceptible levels. Therefore the assumption that vibration impacts at greater than 700 metres would be negligible is considered reasonable and thus vibration impacts have not been considered further in this assessment.

The most stringent goal level specified in DECCW's *Assessing Vibration: A Technical Guideline* is 0.2mm/s peak particle velocity (PPV) for the assessment of continuous vibration occurring at night with regard to human comfort. A 30 tonne rock hammer would produce much less than 0.1mm/s PPV at the distance of 770m to the nearest receiver for this project. This magnitude of vibration is unperceivable and thus vibration levels produced during construction do not warrant further investigation or assessment.

7.3.3. Noise criteria

Construction noise

Construction noise is assessed with consideration to DECCW's Interim Construction Noise Guidelines (ICNG) (DECCW 2009). The ICNG recommends the following standard hours for construction:

- Monday to Friday 7am to 6pm;
- Saturday 8am to 1pm; and
- No work on Sundays or Public Holiday.

Table 7.3b provides the ICNG criteria for construction noise at residential receivers. The criteria are determined based on the existing at nearby residential locations. As discussed in Section 7.3.1, the L_{A90} is used to derive the RBL for this assessment.

Table 7.3b ICNG construction noise criteria at residential receivers

Time period	Management level $L_{Aeq(15\ min)}$
Recommended standard hours	Noise affected level: RBL + 10 Highly noise affected level: 75 dB(A)
Outside recommended standard hours	Noise affected level: RBL + 5

Operational noise

The DECCW's Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects, 2007 (IGANRIP) provides guidance for the assessment of noise from rail infrastructure. IGANRIP specifies „trigger levels', which are "non mandatory targets that can be used to initiate an assessment of noise impacts and consideration of feasible and reasonable mitigation measures".

For residential receivers, the noise trigger levels for rail noise has two components, L_{Aeq} and L_{Amax}. The L_{Aeq} component of rail noise is the average noise level over a given period. The L_{Amax} component is the maximum rail noise from train passby events.

Under IGANRIP, the Proposal is considered a „new rail line development' as the existing background levels at sensitive receivers are below the IGANRIP noise trigger levels for a new rail line development. Table 7.3c provides the IGANRIP noise trigger levels for new rail line developments. Exceedance of these trigger levels must occur to initiate an assessment of rail noise impacts and the investigation of mitigation measures.

Table 7.3c IGANRIP noise trigger levels for residential land uses

Type of development	Noise trigger levels dB(A)		Comment
	Day (0700-2200)	Night (2200-0700)	
New rail line development	Development increases existing rail noise levels **and** resulting rail noise levels exceed:		These numbers represent external levels of noise that trigger the need for an assessment of the potential noise impacts from a rail infrastructure project. An „increase' in existing rail noise levels is taken to be an increase of 2 dB(A) or more in L_{Aeq} in any hour or an increase of 3 dB(A) or more in L_{Amax}.
	60 $L_{Aeq(15h)}$ 80 L_{Amax}	55 $L_{Aeq(9h)}$ 80 L_{Amax}	

Source: Extract of Table 1, DECCW, 2007

7.3.4. Existing environment

Sensitive receivers

The area surrounding the Proposal is generally rural in nature, with scattered residential receivers. The nearest four sensitive receivers to the Proposal are:

- Receiver 1 - 427 Bridgman Road, approximately 770 metres from the rail line;
- Receiver 2 - 411 Bridgman Road, approximately 920 metres from the rail line;
- Receiver 3 - 447 Bridgman Road, approximately 950 metres from the rail line; and
- Receiver 4 - Dulwich Homestead, Middle Falbrook Road, approximately 550 metres from the primary compound.

Rail traffic

Table 4.8b in Section 4 shows the existing number of train passbys on the Nundah Bank section of the Main North Line in 2010. The table also shows the estimated future train passbys that are expected in 2018. The figures for 2018 represent the limit of the ARTC's train forecast modelling and therefore have been adopted as the future scenario for the assessment of operational noise impacts.

Acoustic environment

Unattended noise monitoring was undertaken at two locations (refer Figure 7.3) to determine the existing acoustic environment. Unexpectedly during unattended noise monitoring, the noise logger at Location B stopped after approximately 24 hours. Therefore only noise level data for the night of the 26th and the day of the 27th July 2010 for Location B was recorded.

The measured noise levels at Location A for the 26th and 27th July 2010, when the Location B logger was operational, are shown in Table 7.3d for comparison of the two locations. The table also presents a summary of the measured noise levels at Location A over the entire 5 day monitoring period (all noise sources).

Table 7.3d Summary of existing noise levels at representative sensitive receivers

Location	Day	L_{Aeq} (dBA)		RBL (dBA)		
		Day	Night	Day	Evening	Night
Location A	Entire 5 day period	56	57	38	37	38
	26th Night, 27th Day	56	58	38	38	40
Location B	26th Night, 27th Day	44	45	37	40	39

Source: Table 4.1 in Volume 2, Technical Paper 3
Note: RBL is derived from the L_{A90}

A review of the measurements taken at Location A indicates that the measured noise levels on the 26th and 27th July 2010 were typical of other days during the 5 day monitoring period. Therefore, it is assumed the RBL values at Location B recorded over the 26th and 27th are also likely to have been typical of the 5 day monitoring period at this location had the noise logger not stopped working. The RBL values at Location B on these days have therefore been adopted for the noise impact assessment at this location.

Notes to the NSW Industrial Noise Policy (DECCW, 2000) state that where evening or night time noise levels exceed the daytime noise levels without justification for the increased noise, the daytime noise level should be adopted for these periods. Hence, at Location B an RBL of 37dBA was adopted for all time periods.

7.3.5. Operational noise assessment

Operational noise from the Proposal has been assessed in accordance with IGANRIP (DECCW, 2007). The first stage of this assessment is to determine if the IGANRIP trigger levels outlined in Table 7.3c have been exceeded. If these levels are exceeded, it is then necessary to conduct a full assessment of reasonable and feasible mitigation measures.

In order to determine if the trigger levels have been exceeded, it is necessary to determine the current and future $L_{Aeq,period}$ and L_{Amax} noise levels from rail events.

Rail noise levels were calculated using the CadnaA computer noise modelling software. The modelled $L_{Aeq, 1hr}$ noise levels are presented in Table 7.3e.

Table 7.3e Existing and future $L_{Aeq\ 1hr}$ rail noise levels

Receiver	IGANRIP $L_{Aeq\ 1hr}$ trigger level	Predicted $L_{Aeq\ 1hr}$ level (dBA)		Difference (dBA)	IGANRIP –Increase" trigger exceeded
		Existing (2010)	Future (2018)		
1	Increase of greater than 2dBA	44.7	48.9	4.2	YES
2		44.2	48.3	4.1	YES
3		43.6	47.8	4.2	YES

The results show that the change in $L_{Aeq,1hr}$ noise levels is sufficient to constitute an „increase' as defined by IGANRIP. This increase is due to the additional number of trains predicted in the future.

Table 7.3f and Table 7.3g summarise the modelling results for existing and future operational noise levels, i.e. L_{Aeq} period for the day and night time periods respectively. This includes the projected future increases in train movements.

Table 7.3f Existing and future $L_{Aeq,\ 15hr}$ day rail noise levels

Receiver	IGANRIP $L_{Aeq,\ 15hr}$ trigger level	Predicted $L_{Aeq,\ 15hr}$ level (dBA)		IGANRIP –Base level" trigger exceeded
		Existing (2010)	Future (2018)	
1	Rail noise level exceeds 60dBA	44.7	48.9	NO
2		44.2	48.3	NO
3		43.6	47.8	NO

Table 7.3g Existing and future $L_{Aeq,\ 9hr}$ night rail noise levels

Receiver	IGANRIP $L_{Aeq,\ 9hr}$ trigger level	Predicted $L_{Aeq,\ 9hr}$ level (dBA)		IGANRIP –Base level" trigger exceeded
		Existing (2010)	Future (2018)	
1	Rail noise level exceeds 55dBA	44.7	48.9	NO
2		44.2	48.3	NO
3		43.6	47.8	NO

The results show that noise levels at each of the identified sensitive receivers are predicted to be within relevant IGANRIP trigger levels for both the day and night time periods.

Table 7.3h presents the existing and future L_{Amax} noise levels. Again, in order for IGANRIP trigger levels to be exceeded both the "Future" column and the "Increase" column need to exceed the appropriate trigger level.

Table 7.3h Existing and future 95th percentile L_{Amax} rail noise levels (day and night)

Receiver	IGANRIP L_{Amax} trigger level	Predicted L_{Amax} level (dBA)		_Bæse level' trigger exceeded	_hcrease' trigger level exceeded
		Existing (2010)	Future (2018)		
1	80dBA and greater than 3dB „increase'	67.0	67.0	NO	NO
2		66.5	66.5	NO	NO
3		65.9	65.9	NO	NO

Note: As both day and night time L_{Amax} trigger levels are the same, they have been considered together.

L_{Amax} noise levels are predicted to be well within appropriate criteria for both day and night time periods. There is not expected to be any increase in L_{Amax} noise levels as a result of the Proposal.

The modelling results show that none of the receivers are predicted to experience noise levels exceeding relevant IGANRIP trigger levels outlined in Table 7.3c and thus the Proposal does not trigger the need for a full assessment of reasonable and feasible mitigation for operational rail noise.

7.3.6. Construction noise impact assessment

Methodology

Construction phases

Construction noise from the Proposal has the potential to impact nearby sensitive receivers such as residential dwellings. Potential construction noise impacts have been assessed by breaking down construction activities into phases and estimating the likely noise that could be generated at any one time. The phases for construction activities are as follows:

- Site establishment;
- Bulk earthworks;
- Rail construction; and
- Demobilisation and regeneration.

No blasting is required during any phase of construction.

The typical L_{Aeq} Sound Power Level (SWL) of plant likely to be used during the various phases of work is identified in Table 7.3i. These SWL have been recently measured at other similar construction sites (Wilkinson Murray database). Note that the correction for impulsiveness or tonality is shown for reference only. The application of such a penalty for these characteristics needs to be assessed at the residence i.e. the character of the sound that the resident is exposed to. Wherever such a penalty is considered applicable, it has been applied.

Table 7.3i Typical L_{Aeq} construction plant sound power levels

Plant	L_{Aeq} SWL (dBA)	L_{Aeq} SWL with corrections for impulsiveness and tonality (dBA)	$L_{A1,1min}$ SWL (dBA)
Concrete saw	112	117	118
Rail saw	112	117	118
Concrete truck	107	107	114
Concrete pump	103	103	110
Concrete vibrator	105	105	112
Excavators	100-110	100-110	116
Hydraulic hammer – excavator mounted	115-118	120-123	123
Backhoe	105	105	112
Generators	90	90	92
Pumps	90-100	90-100	100
Front end loader	111	111	116
Grader	107	107	114

Plant	L_{Aeq} SWL (dBA)	L_{Aeq} SWL with corrections for impulsiveness and tonality (dBA)	$L_{A1,1min}$ SWL (dBA)
Vibratory roller	101	106	110
Cranes	105-111	105-111	118
Truck	105	105	114
Dump truck	105	105	114
Tamping machine	113	118	120
Ballast regulator	111	116	118
Welding torch	90	90	95
Rail grinder	109	114	120
Dozer	115	115	120

Using the information above and the CadnaA computer noise modelling software, the SWL from all plant operating simultaneously was calculated for each construction phase. A correction was then applied because in reality, all pieces of equipment would not operate at their loudest levels simultaneously. The result is the maximum likely SWL emitted at any one time.

Primary compound and adjoining access road
Typically, the following equipment would be used in the primary compound:

- Front end loaders
- Trucks for delivery; and
- Light vehicles.

The adjoining access road would typically be used for material delivery and light vehicle movements. Noise modelling has assumed that the cumulative L_{Aeq} sound power level from the primary compound would be 11dBA, primarily from the use of the front end loader. Noise modelling has assumed eight truck movements per hour on the access road (refer to Section 7.6). The $L_{A1,1min}$ sound power level for the primary compound and access road is assumed to be 116dBA and would be expected from infrequent high noise events in the compound during loading or unloading.

Predicted noise levels at receivers
The predicted receiver L_{Aeq} noise levels calculated for each stage of construction are presented in Table 7.3j. The ICNG noise criteria are also provided for comparison.

Table 7.3j Predicted $L_{Aeq,15min}$ construction noise levels

Receiver	ICNG noise level criteria (dBA)			Predicted receiver noise levels during different stages of construction (dBA)			
	Standard hours (RBL + 10dBA)	Outside standard hours (RBL+5dBA)					
		Evening	Night	Site establishment	Bulk earthworks	Rail construction	Demobilisation/ regeneration
1	47	42	42	41	48	44	33
2				40	47	43	32
3				38	45	41	30

Note: ICNG noise level criteria is based on an RBL of 37 dBA as per Table 7.3d

Table 7.3k Predicted $L_{Aeq,15min}$ Compound and access road noise levels

Receiver	ICNG noise level criteria (dBA)			Predicted receiver noise level (dBA)	
	Standard hours (RBL + 10dBA)	Outside standard hours (RBL+5dBA)			
		Evening	Night	Compound	Access road
4	47	42	42	42	33

The noise levels generated by typical worst case scenarios for each stage of construction, except earthworks are predicted to be within ICNG noise level criteria at the nearest sensitive receivers during standard construction hours.

The predicted exceedance of the ICNG during bulk earthworks is only 1 dB. It is generally considered that an average person cannot distinguish a 1 dB difference in sound pressure levels. Furthermore, the predicted receiver noise levels represent a worst-case noise level, with the noisiest equipment operating in the most exposed location; a scenario that may not eventuate. The Proposal has its nearest receivers some 770m away from these works and as such noise levels are well less than other infrastructure projects. Given the conservatism of this modelling approach and for the most part of construction therefore, mitigation would not be warranted. However, management measures for the predicted noise level exceedance have been proposed and include undertaking community consultation during construction, monitoring and where possible, modifying work practices if complaints are generated.

The ICNG provides criteria for works „outside of standard hours', however only if strong justification for the works is demonstrated i.e. compliance with these criteria does not demonstrate that works outside standard construction hours is acceptable. Justification is typically limited to works in the public interest, engineering reasons, access to public infrastructure etc.

The Proposal would include occasional works outside of standard hours to reduce operational impacts on the Main North Line i.e. during track possessions. This is considered to be a strong justification and therefore the ICNG construction noise criteria have been applied.

The predicted noise levels indicate that bulk earthworks and rail construction are likely to exceed ICNG criteria for works outside standard hours. Therefore, these works should be limited to standard construction hours wherever possible. Further investigation into the potential for construction noise impacts during works outside standard hours included an assessment of the predicted $L_{A1, 1min}$ noise levels. $L_{A1, 1min}$ noise levels assess impulsive noises that cause awakening reactions. The investigation indicated that awakening reactions from impulsive noises are unlikely to occur (refer Table 7.4 in Volume 2, Technical Paper 3). It should be noted that these predictions have been made assuming still, isothermal conditions. At these distances meteorological conditions can have a significant impact on noise levels, particularly at night when temperature inversions can occur.

The noise levels associated with the primary compound and access road are predicted to comply with the relevant criteria.

Based on the above findings, construction noise impacts outside standard hours are predicted to be limited. It is noted that most of the scheduled track possession works are located near Camberwell Junction and Rix's Creek mine overbridge. These locations are shielded from the nearest receivers by topography and as such noise levels are expected to be lower than those estimated in Table 7.3j.

Construction traffic noise impacts

Noise generated from construction vehicles using local roads also has the potential to cause impacts on sensitive receivers. Existing traffic numbers have been derived from the Proposal's traffic assessment (refer Volume 2, Technical Paper 4).

A number of residential dwellings are located on proposed construction traffic routes however in general, the traffic routes are sparsely populated. Traffic noise levels have been calculated based on a typical setback of 50 metres. The results of this calculation are presented in Table 7.3k.

Table 7.3l Construction traffic noise levels – $L_{Aeq,1hr}$ (dBA)

Construction traffic route	ECRTN criteria		Predicted levels					
			Existing			With construction		
	Day	Night	Staff		Trucks	Staff		Trucks
			6-7am	6-7pm	7am-6pm	6-7am	6-7pm	7am-6pm
Middle Falbrook Road and Bridgman Road	60	55	62.5	63.2	62.5	62.9	63.6	62.7
Rixs Creek Lane	55	50	54.9	45.7	48.3	55.6	49.7	50.8

Note: Peak traffic numbers are expected to occur during track possessions and other high intensity works.

Applicable noise criteria for proposals that have the potential to increase traffic on roads are presented in the Environmental Criteria for Road Traffic Noise (ECRTN) (DECCW, 1999). All roads leading to the New England Highway from the Proposal are considered local roads and therefore the applicable noise criteria are:

- $L_{Aeq,1hour}$ 55dBA during daytime (7.00am – 10.00pm)
- $L_{Aeq,1hour}$ 50dBA during night time (10.00pm – 7.00am).

Where these criteria are already exceeded by existing traffic noise levels, the ECRTN recommends traffic arising from the development should not lead to an increase in existing noise levels of more than 2dB.

Construction traffic on Bridgman Road is predicted to increase existing noise levels by less than 1 dB in all scenarios. Traffic noise levels on Rixs Creek Lane are predicted either to be within the relevant criteria, or the increase is predicted to be less than 1dB. Therefore traffic noise levels at the assumed setback are predicted to comply with the relevant criteria during typical days.

Some exceedances of criteria during track possessions might be expected if a significant number of vehicles access the site during the night time period (10pm – 7am). As the night time works would only occur for up to four nights at a time, some minor exceedances such as these are considered acceptable.

The noise predictions indicate that the works are expected to be generally within relevant construction noise goals at the nearest receivers. However, the noise from construction is likely to be audible at residences and therefore mitigation would be implemented to minimise potential noise impacts.

7.3.7. Mitigation and management measures

The following mitigation and management measures would be included in the PCEMP to reduce the potential for construction noise impacts from the Proposal:

- All mechanical plant would be silenced by best practical means using current technology. Noise suppression devices would be maintained to the manufacturer's specifications. Internal combustion engines would be fitted with a suitable muffler in good working order.
- All vehicular movements to and from the site would comply with the appropriate regulatory authority requirements for such activities including appropriate speed limits.
- The constructor (as appropriate) would communicate with the local residents potentially affected by the works, particularly when work outside standard construction hours is planned. This communication would be made well in advance of potential impact occurring e.g. 7 days prior to works commencing.
- All plant on site would be operated in accordance with the manufacturer's instructions and, where necessary, have current Roads & Traffic Authority (RTA) registration licences.
- All engine covers would be kept closed while equipment is operating.
- As far as possible, materials dropped from heights into or out of trucks would be minimised, particularly during outside of standard working hours (night time track possession works).
- Where possible, managing material stockpiles within the primary compound such that they provide a barrier between the plant and nearest receivers.

- Broadband reversing alarms would be considered for use on the site. The sensitivity of receivers to tonal alarms at night is particularly heightened and this would be considered in preparing for works outside standard working hours (night time track possession works).
- All drivers accessing the site would be briefed on the locations of sensitive receivers and required to drive considerately when they are in the vicinity of sensitive receivers, particularly during the night time period.
- Metal contact on equipment would be avoided as far as possible.
- Truck movements would be scheduled to avoid residential streets where possible during works outside of standard working hours (night time track possession works).
- Mobile plan clustering near sensitive receivers would be avoided, particularly during works outside of standard working hours (night time track possession works).

7.4. Air quality

7.4.1. Introduction

The DGRs identify construction and operational air quality impacts as a key issue for the Environmental Assessment. Table 7.4a below outlines the DGRs relevant to air quality and where they have been addressed in this section.

Table 7.4a Director-General's Environmental Assessment Requirements - air quality

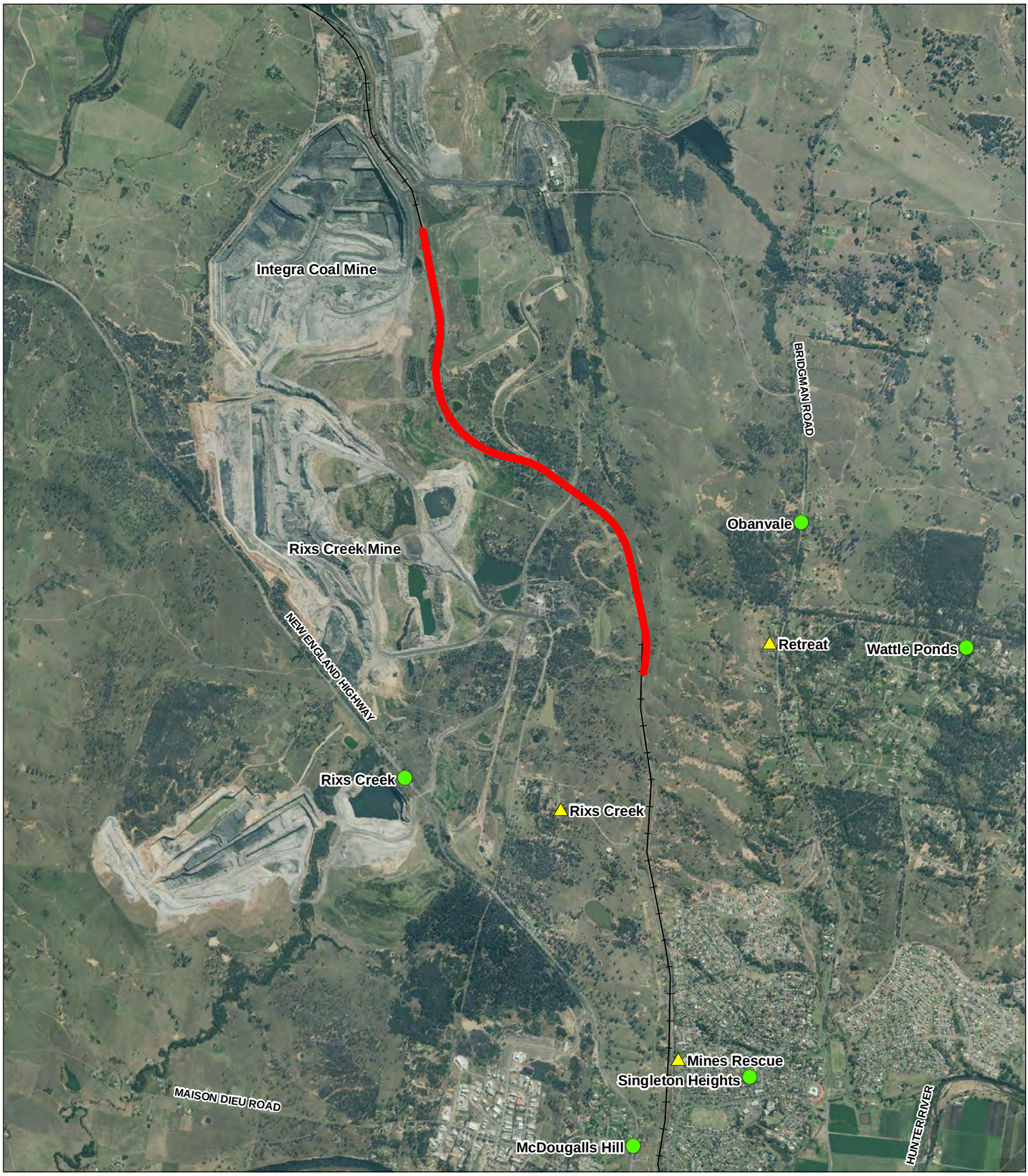
Director-Generals Requirements	Where addressed
Key issues	
General Construction Impacts	
The Environmental Assessment must assess the impacts of and present a management framework for:	Section 9.2
• Earthworks, including a considered approach to minimising impacts associated with the excavation, movement, stockpiling, rehabilitation and disposal of spoil and fill, with consideration given to:	Section 7.8
○ Air quality impacts on sensitive receivers, in particular cumulative impacts form adjacent mining operations; and...	Section 7.4.4
Air, Noise and Water	
Operational Impacts – Air Quality	
• Air ... impacts along the corridor associated with rail operations and ongoing maintenance. Including, where relevant specific consideration of impacts to sensitive receivers;	Section 7.4.5
• Consideration of: ... *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA).	Section 7.4.4

Air quality impacts associated with the Proposal have been assessed in accordance with the following legislative requirements and government guidelines where relevant:

- Protection of the Environment Operations (Clear Air) Regulation 2002;
- Approved methods for sampling and analysis of air pollutants in NSW (2006);
- Approved methods for the modelling and assessment of air pollutants in NSW (2006); and
- Assessment and management of odour from stationary sources in NSW (2006).

7.4.2. Existing environment

The primary air pollution sources that influence local air quality in the vicinity of the Proposal are likely to be dust from coal mining activities, agricultural activities, and to a lesser extent smoke from wood heaters, vehicle exhaust emissions from the road network (particularly the New England Highway) and existing operations on the Main North Line.



Third Track

Rail Lines

Sensitive Receptor / Ambient Monitor

Town / Locality

A4 Original

0 0.25 0.5 1 1.5

Kilometres

GDA 1994 MGA Zone 56

N

UHVA

ARTC

ARTC
Nundah Bank

Location of Sensitive Receptors and Ambient Monitoring Sites

Job Number	2110501B
Revision	A1
Date	09.02.2011
Scale	1:40,000

Figure 7.4

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The Proposal is located approximately five kilometres to the north of the town of Singleton and is situated between the Rixs Creek coal mine to the west and the Integra coal mine to the northeast, as shown on Figure 7.3.

The nearest sensitive receivers to the Proposal, with respect to potential air quality impacts, include:

- A rural residential property on Bridgman Road about 770 metres to the east of the southern end of the site (just west of Wattle Ponds residential area);
- Wattle Ponds residential area just over 1 kilometre to the east and southeast;
- The town of Obanvale about 1.3 kilometres to the east of the southern half of the site; and
- The Singleton Heights residential area about 1.7 kilometres to the south.

The last 500 metres of southern section of the Nundah Bank Third Track runs through a cutting, which provides some visual screening of the locomotives. This cutting would also provide some geographical shielding with respect to any fugitive dust emissions from the coal trains or the maintenance vehicles on the access tracks.

The coal mining industries in the Hunter Valley are required to monitor ambient air quality as a condition of mine development consents issued by the DoP and/or an EPL issued by DECCW.

In May 2010, DECCW released a document titled *Compendium of Upper Hunter Ambient Air Quality Monitoring Data* (the Compendium) to assist NSW Health in its review of community concerns regarding potential impacts on health from air pollutants from coal mining and power generation in the Upper Hunter.

The Compendium presents air quality monitoring data from industry monitoring sites for particles less than 10 microns (PM_{10}), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2), using the National Environment Protection Measure (Ambient Air Quality NEPM) standards of concentration as a benchmark for the period 2005-2009.

The Rixs Creek coal mine EPL conditions require the monitoring of PM_{10} concentrations at three locations close to the coal mining site and at nearby residences. The locations of the three PM_{10} ambient monitoring sites are shown in Figure 7.3. These monitoring sites provide the most relevant and recent data on background ambient air quality for PM_{10} particulate matter.

The Compendium also presents ambient monitoring data for SO_2 and NO_2 from the Macquarie Generation Singleton monitoring site.

It is noted by DECCW that *'the monitoring sites reported in the Compendium are not NEPM sites and they were not established to comply with the location requirements specified in the Ambient Air Quality NEPM'* and therefore *'their location may not necessarily reflect the air quality likely to be experienced by the general population in the region'.* However, given the location of the Rixs Creek PM_{10} sites and the Singleton SO_2 and NO_2 sites with respect to the nearest sensitive receptors, the data from these sites may be considered representative of the populations potentially affected by the Proposal.

It is worth noting that *'a new monitoring network is being established in the Upper Hunter that will consist of up to 14 high-quality ambient air quality monitoring stations located in strategic locations around mining areas and population centres to give accurate, quality assured and up-to-date data to the community on regional air quality. When fully operational the air quality data, as well as data on wind speed and direction, will be updated on the DECCW website hourly to provide a continuous information stream to the community, industry and government (DECCW website).'*

A summary of the ambient background data for each of the PM_{10} monitoring sites are provided in Tables 7.4b to 7.4d. A summary of the ambient background monitoring data for SO_2 and NO_2 for Singleton is presented in Tables 7.4e and 7.4f respectively.

A review of the PM_{10} data indicates that there has been several occasions where the PM_{10} ambient air criteria have been exceeded. The reason for the exceedences is not explained in the Compendium, but it is expected that, given the prevailing northwest winds, they are most likely attributed to a combination of the major coal mining activities to the northwest and west of the monitoring sites and agricultural activities in the area, particularly during extended dry periods.

A review of the SO_2 data indicates that there was only one exceedence of the 1 hour ambient air quality criteria data in 2005. The rest of the time, ambient air quality for SO_2 in Singleton was typically less than half the 1 hour ambient criteria and typically less than a quarter of the 1 day ambient criteria.

A review of the NO_2 data indicates that there were no exceedences of the 1 hour ambient air quality criteria data between 2005 and 2009. The ambient air quality for NO_2 in Singleton was typically less than half the 1 hour ambient criteria and typically less than a third of the annual average ambient criteria.

Table 7.4b Summary of 2005 – 2009 Ambient PM_{10} Data at Mines Rescue

Pollutant	Averaging period	Concentration	Criteria (µg/m³)	Number of exceedences	
Maximum PM_{10}	1 day	**87 (2008)**	50 (Not to be exceeded more than 5 times a year)	**Year**	**No.**
Range 1st highest		42 to 87		2005	0
Range 2nd highest		36 to 85		2006	0
Range 3rd highest		30 to 79		2007	1
Range 4th highest		28 to 74		2008	12
Range 5th highest		27 to 70		2009	3

Table 7.4c Summary of 2005 – 2009 Ambient PM_{10} Data at Retreat

Pollutant	Averaging period	Concentration	Criteria (µg/m³)	Number of exceedences	
Maximum PM_{10}	1 day	**89 (2007)**	50 (Not to be exceeded more than 5 times a year)	**Year**	**No.**
Range 1st highest		57 to 83		2005	7
Range 2nd highest		57 to 73		2006	6
Range 3rd highest		54 to 70		2007	7
Range 4th highest		52 to 69		2008	9
Range 5th highest		50 to 63		2009	4

Table 7.4d Summary of 2005 – 2009 Ambient PM_{10} Data at Rixs Creek

Pollutant	Averaging period	Concentration	Criteria (µg/m³)	Number of exceedences	
Maximum PM_{10}	1 day	**108 (2009)**	50 (Not to be exceeded more than 5 times a year)	**Year**	**No.**
Range 1st highest		58 to 108		2005	2
Range 2nd highest		53 to 94		2006	4
Range 3rd highest		46 to 82		2007	5
Range 4th highest		35 to 76		2008	8
Range 5th highest		25 to 60		2009	3

Table 7.4e Summary of 2005 – 2009 Ambient SO_2 Data at Singleton

Pollutant	Averaging period	Concentration (ppm)	Criteria (ppm)	Number of exceedences
Maximum SO_2	1 hour	**0.228 (2005)**	**0.20** (not to be exceed more than 1 day a year)	1 (2005)
Range 1st highest		0.093 to 0.228		
Range 2nd highest		0.086 to 0.108		
Maximum SO_2	1 day	**none**	**0.08** (not to be exceed more than 1 day a year)	none
Range 1st highest		0.025 to 0.228		
Range 2nd highest		0.015 to 0.021		
Annual Average range	1 day	0.0011 to 0.0024	0.02	-

Table 7.4f Summary of 2005 – 2009 Ambient NO_2 data at Singleton

Pollutant	Averaging period	Concentration (ppm)	Criteria (ppm)	Number of exceedences
Maximum SO_2	1 hour	**0.047 (2005)**	**0.12** (not to be exceed more than 1 day a year)	none
Range 1st highest		0.037 to 0.047		
Range 2nd highest		0.035 to 0.042		
Annual Average range	1 day	0.0081 to 0.0101	0.03	-

7.4.3. Meteorology

A site-representative meteorological data file was synthesised for Singleton using *The Air Pollution Model* (TAPM) meteorological model (Version 4). TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to

realign the predicted solution towards the observation values. Table 7.4g details the parameters used in the TAPM meteorological modelling for this assessment.

Table 7.4g Meteorological parameters used for the Proposal

Category	Parameter
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grid points	25 x 25 x 25
Year of analysis	2009
Centre of analysis	327893 m E, 6,395,268 m S
Data assimilation	None Available

Annual and seasonal windroses for the 2009 Singleton data are presented in Figure 7.4. The data show a prevalence of winds from the northwest, which are the most common winds in winter, and southeast, which are the most common winds in summer.

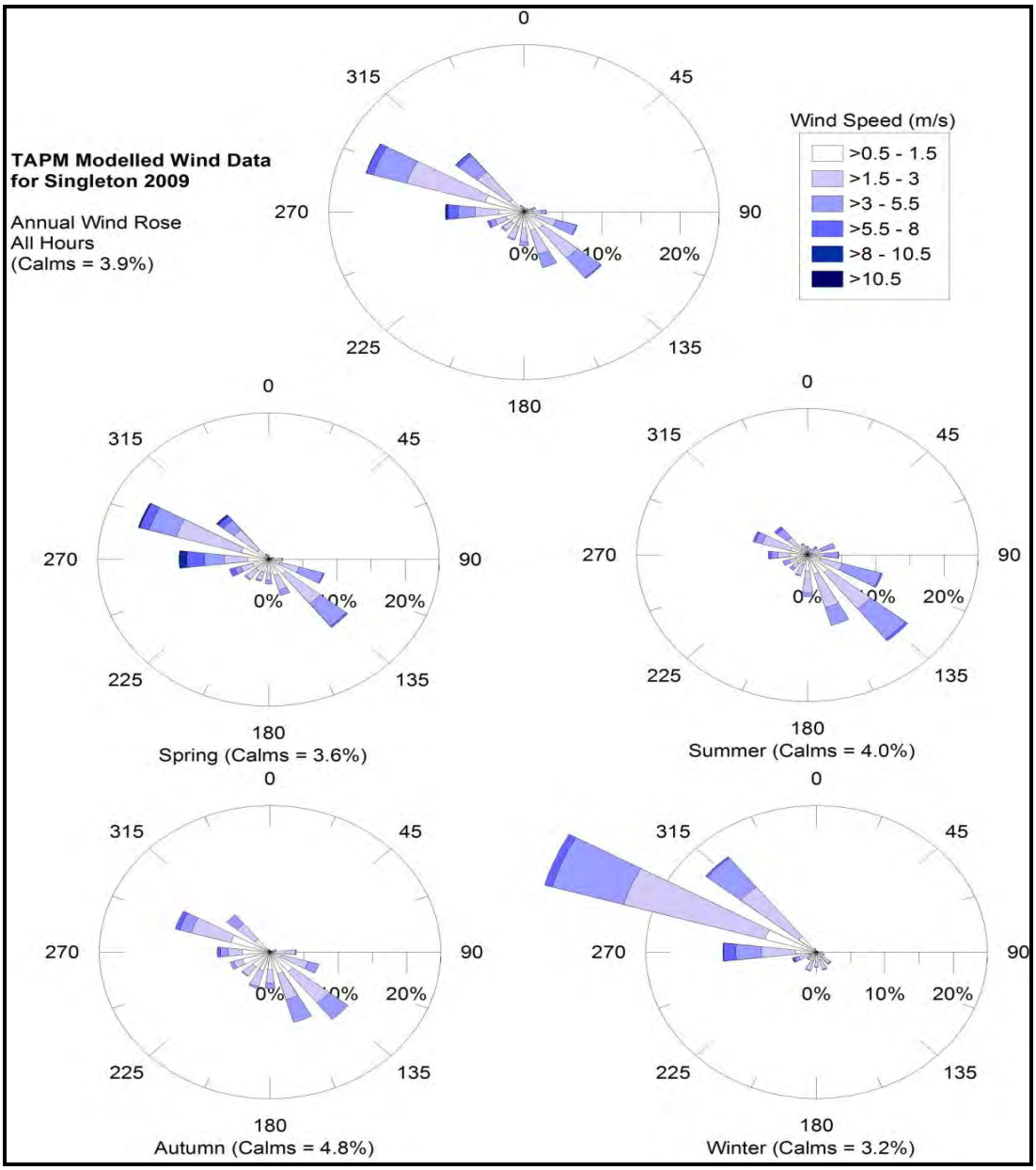

Figure 7.4A TAPM modelled wind data

7.4.4. Construction impact assessment

Construction sources

The most significant types of emissions to air during the construction phase that have the potential to impact the neighbouring communities would primarily consist of:

- Dust emissions from both the mechanical disturbance and wind erosion of surface material; and
- Exhaust emissions from the range of motor vehicle and mobile plant required for the Proposal.

The major potential dust sources during the construction phase are expected to include:

- Clearance of vegetation, rock and soil material;
- General surface earthworks and excavation works;
- Pneumatic rock-breaking;
- Top soil and soil handling (stockpiling, loading, dumping);
- Levelling and grading of disturbed soil surfaces;
- Passage of construction and administrative vehicles over unsealed sections of road or localised unconsolidated soil surfaces; and
- Wind erosion of unstable/uncovered surfaces and stockpiles and other unconsolidated surfaces.

It is considered that the dominant sources of dust emissions during the construction works would be during activities that cause large mechanical disturbances during their operations, such as operations of a bulldozer, grader or scraper. This has generally been accepted to be the case for similar ARTC rail construction projects, including the Maitland to Minimbah Bank Third Track (ARTC 2010a).

Potential for dust impact construction

Airborne particles (dust) are typically less than 100 micrometres in aerodynamic diameter and are referred to as Total Suspended Particulates (TSP). The fraction of these particles that are less than 10 micrometres in equivalent aerodynamic diameter is referred to as PM_{10}. The impact of dust emissions principally relates to the potential effect on human health on inhalation of particles in the air column, and it is the finer fraction that has the greater potential to cause respiratory health effects.

A secondary effect relates to the deposition of the course fraction of dust onto surfaces (soiling of material surfaces), which is an impact on amenity and considered a nuisance. Typically, deposition effects are confined to short ranges, as the high settling velocity of the course particles means that the larger particulates drop out from the dust plume in the near vicinity of the operations.

Construction activities would create particulate (dust) emissions which, if uncontrolled, would be additive to those levels resulting from other activities in the area, particularly the mining activities. The construction dust emissions are considered to be relatively minor by comparison to dust emissions from the mining activities, but these emissions would be controlled and managed in accordance with good dust management practices.

The potential for dust impact decreases with distance from the construction areas. Based on previous experience with similar ARTC construction projects, sensitive land uses located less than approximately 500 metres away are typically only considered to be impacted by the construction dust impacts. There are no receivers within this distance of the Proposal.

Analysis of the local wind climate indicates that the prevailing winds are from the northwest, which means sensitive receivers to the southeast of the Proposal would expect a higher exposure to dust potentially emitted from construction. However, it is expected that the resultant offsite impacts on the nearest sensitive receivers, which are located more than 500 metres from the Proposal corridor, would be negligible with good dust management practices.

A management framework for controlling earthworks and additional mitigation measures are outlined in Sections 7.8 and 9.2.

7.4.5. Operational impact assessment

The major sources of air emissions during the operational phase of the Proposal would be:

- Exhaust emissions from the locomotives; and
- Fugitive coal dust emissions from the loaded coal wagons.

The proposed upgrade to the Main North Line would allow greater capacity on the line. Hence, there would be an increase in the number of trains that currently pass through area on the rail line. This would contribute to an incremental impact on local air quality in the vicinity of the Proposal.

Air assessment methodology

In order to assess the potential air quality impacts, DECCW's Air Policy Branch was consulted (9 August 2010), to determine the appropriate methodology to be adopted. The agreed approach was to use the same methodology as in the Maitland to Minimbah Third Track (MMTT) air quality assessment and assess the potential cumulative impacts against the existing ambient background air quality determined from the Compendium (refer Section 7.1.2).

The MMTT air quality modelling was undertaken using the DECCW approved dispersion model AUSPLUME (Version 6) in accordance with DECCW's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, where potential impacts were modelled as a generic one kilometre link in a series of orientations (such as north-south, east-west) to determine the worst case alignment under averaging periods of one-hour, 24-hour and one-year. Year-long simulations using the synthesised meteorology for the project footprint were used for identifying worst-case impacts over hourly, daily and annual time periods.

Predictions of the potential cumulative impacts of pollutants were determined by adopting and extrapolating the worst case ground level concentrations from the MMTT Ausplume modelling simulation. Exhaust emissions from passenger trains and maintenance vehicles have not been considered in the assessment as their relative contribution is considered negligible.

Assessment criteria

The dispersion modelling results have been compared to ground level concentration criteria defined in the NSW Department of Environment and Conservation's 2006 publication *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*. The substances identified as possible pollutants from locomotives and their impact assessment criteria are given in Table 7.4h.

Table 7.4h Ambient air quality impact assessment criteria and air quality goals

Impact assessment criteria				
Pollutant	**Averaging period**	**Concentration**		**Maximum allowable exceedences**
Oxides of Nitrogen (NO_2)	1 hour	0.12 ppm	246 µg/m³	1 day a year
	1 year	0.03 ppm	62 µg/m³	none
Sulphur Dioxide (SO_2)	1 hour	0.20 ppm	570 µg/m³	1 day a year
	1 day	0.08 ppm	228 µg/m³	1 day a year
	1 year	0.02 ppm	60 µg/m³	none
Carbon Monoxide	1 hour	30 mg/m^3		none
Particulate Matter ≤10.0 µm (PM_{10})	1 day	50 µg/m³		5 days a year
	I year	30 µg/m³		none
Particulate Matter ≤2.5 µm ($PM_{2.5}$)	1 day	25 µg/m³		Goal is to gather data to facilitate a review of Advisory reporting Standards
	1 year	8 µg/m³		

µm = microgram
Ppm = parts per million

Fugitive coal dust

Appendix R of the MMTT emissions from coal trains in the Central Queensland region presents the results of a study on fugitive coal dust. The report identifies the following coal dust emission sources:

- Coal surface of loaded wagons;
- Coal leakage from doors of loaded wagons;
- Wind erosion of spilled coal in the rail corridor;
- Residual coal in unloaded wagons and leakage from doors; and
- Spilled coal on sills, shear plates and bogies of wagons.

Emission of coal dust from coal trains is primarily caused by the movement of air over the exposed coal surface. The amount of dust lifted is determined by the train speed and ambient wind speed was found to be the key factor contributing to coal dust emission rates, as well as the moisture content of the coal dust.

The incremental impact on air quality from fugitive coal dust would be comparable to that indentified in the Maitland to Minimbah Third Track EA. The actual number would be slightly less as the Nundah Bank section of track is further north of the Port of Newcastle and there are coal trains that would terminate at coal mines between the Nundah Bank section and the Maitland to Minimbah section.

The number of movements of coal and freight train movements per day is assumed as follows:

- 2009:33 on the Up track and 37 on the Down track;
- 2022: 38 on the Up track, 74 on the Down track and 39 on the Third track;
- Six freight train movements per day for each of the above scenarios;
- Average coal train capacities is 7,200 net tonnes;
- Loaded coal trains assumed half that of total coal train movements; and
- Coal tonnage capacity of 191 megatonnes per annum (mtpa).

The TSP emission factor from loaded coal wagons of 0.17 grams per kilometre per tonne of coal hauled has been adopted from the MMTT report and used to calculate the current and future emissions of coal dust per loaded coal train per kilometre of track per day on the Nundah Bank section. The assumptions used were applied to the same locomotive emission inventory resulting in the emission estimates presented in Table 7.4i.

The projected increase in train movements translates into a proportional increase in the dust emissions over time. It is important to note that other factors affect the emission rate including mine-specific coal properties (such as moisture content and particle size distribution), wagon vibration, coal load profile and exposure to wind and rainfall, which would all affect actual emissions levels. However, the resulting emission inventory and subsequent impact assessment is useful for the purpose of comparing the existing and future operating scenarios. In addition, it is important to note that the assessment assumes no mitigation measures to control fugitive coal dust emissions, which may be implemented in the future.

Table 7.4i Existing and future fugitive coal dust emission rates

Pollutant	Emission rate (kg/km/day)	
	2009	2018
TSP	45	88
PM_{10}*	15.8	30.8

Note: Assumes PM_{10} emissions are 35% of TSP emission from coal wagons.

Locomotive emission rates

Exhaust emissions from diesel engines have been sourced from the National Pollutant Inventory (NPI) *Emissions Estimation Technique Manual for Railway Yard Operations* version 2.0, (NPI, 2008) and include oxides of nitrogen (NO_x), sulphur dioxide (SO_2) and PM_{10}.

NO_x, SO_2, CO and PM_{10} emission rates from coal and freight locomotives were calculated based on daily movement profiles, diesel fuel consumption rates, published NPI emission factors and the following assumptions:

- Coal train average diesel fuel consumption of 0.0064 litres per net tonne per kilometre; and
- Freight train average diesel fuel consumption of 0.005 litres per net tonne per kilometre.

Emissions data for locomotives used in the assessment are presented in Table 7.4j.

It is worth noting that the NPI emission factors are for uncontrolled diesel engines from 2007. Therefore it is considered that these factors are conservative for use in predicting current and future emissions because:

- New locomotive engines are likely to have better control technologies; and
- Since 2009, Australia has been using extra low sulphur diesel fuel (< 10 parts per million), which would reduce both sulphur and particulate emissions.

In order to gauge relative effects from each of the potential pollutants, the ratios of emissions to ambient air criteria were calculated. The ratio of emissions to ambient air criteria was highest for PM_{10} and then NO_2. If the modelling shows the ground level concentrations of PM_{10} and NO_2 are acceptable, it follows that any other parameters with a lower ratio of its emissions to its ambient air criterion would also be acceptable.

Table 7.4j Estimated emission rates for idling diesel locomotives

Pollutant	Emission Rate (kg/km/day)		Ratio of emissions (in 2009) to ambient air criteria (in ug/m^3)
	2009	2022	
Nitrogen dioxides (NO_2)	25.6	50	4.4 (1-hour criteria)
Sulphur dioxide (SO_2)	0.48	0.93	0.03 (1-hour criteria)
Carbon Monoxide (CO)	74.5	145.4	0.1 (1-hour criteria)
Particulate matter 10 microns or less (PM_{10})	10.2	19.9	204 (1 day criteria)

Note: Based on 20% rate of conversion of NO_x to NO_2, a conservative approach for modelling purposes in the near field.

Operational Impacts

Predictions of the potential cumulative impacts of pollutants during operations were determined by adopting and extrapolating the worse case ground level concentrations from the MMTT Ausplume modelling simulation. The predicted peak increases in ground level concentrations (GLCs) for NO_2 and PM_{10} are presented in Tables 7.4k-m, along with DECCW's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ambient air quality criteria (refer Table 7.4h).

The background levels used are an average of the maximum pollutant levels recorded at the ambient monitoring sites over the years 2005 to 2009. The PM_{10} average maximum background was based on the Retreat PM_{10} monitoring site, which is closest to the nearest sensitive receptors. The NO_2 is from Singleton. Therefore, the adopted background levels are considered representative of the sites potentially impacted.

Table 7.4k Predicted peak in NO_2 GLCs (µg/m^3)

Pollutant	Scenario	Averaging period	Maximum background	Incremental increase (2022 only)		Ambient air criteria
				800 m	1000 m	
NO_2	2009	1 hour	89	3	2	246
	2022			6	4	
	2009	1 year	18	0.4	0.2	62
	2022			0.7	0.4	

Table 7.4l Predicted peak PM_{10} GLCs (µg/m^3) for locomotive exhaust only

Pollutant	Scenario	Averaging period	Maximum Background	Incremental increase (2022 only)		Ambient Air Criteria
				800 m	1000 m	
PM10	2009	1 day	74	0.5	0.4	50
	2022			0.9	0.7	
	2009	1 year	No data	0.2	0.2	30
	2022			0.4	0.3	

Table 7.4m Predicted peak PM_{10} GLCs (µg/m^3) for fugitive coal dust only

Pollutant	Scenario	Averaging period	Maximum Background	Incremental increase (2022 only)		Ambient Air Criteria
				800 m	1000 m	
PM10	2009	1 day	74	0.8	0.6	50
	2022			1.6	1.2	
	2009	1 year	No data	0.4	0.3	30
	2022			0.8	0.6	

The maximum 1 hour average NO_2 GLCs were predicted to be below DECCW's criterion as shown in Table 7.4k for the both the current and future operating scenarios.

Based on the ratio of emissions to ambient air criteria presented in Table 7.4j and the NO_2 results in Table 7.4k, the predicted peak increases in GLCs for CO & SO_2 would be at least one to two orders of magnitude below the ambient air criteria respectively and so are considered to be insignificant.

The impacts from PM_{10} emissions attributed to diesel locomotive exhaust or fugitive coal dust decrease rapidly with increasing distance from the train track. In the vicinity of the nearest sensitive receivers they are predicted to be 2.5 µg/m^3 for the worst case scenario at 2022 (locomotive plus coal wagon dust) as shown in Table 7.4l.

PM_{10} emissions from locomotive exhaust and fugitive coal dust on their own are not predicted to exceed the criterion. PM_{10} cumulative emissions however, may not comply if they occur on days when the PM_{10} ambient background levels already exceed DECCW's PM_{10} ambient air quality criteria and goals.

It should be noted that exceedences of the PM_{10} 24-hour criteria are most likely to occur when winds are from the northwest when ambient emissions are likely to be elevated as a result of coal mining and agricultural activities. Therefore, the PM_{10} emissions from the rail operations, due to their relatively small contribution, are unlikely to increase the number of days in a year when the PM_{10} 24-hour goal is exceeded, unless the peak PM_{10} GLC occurs on a day when the ambient GLC is near 49 µg/m^3.

It is therefore considered that the incremental increase in NO_2 and PM_{10} associated with operation of the third track is not considered a significant impact.

7.4.6. Mitigation and management measures

Construction

A range of standard dust management practices would be adopted and implemented during the construction phase and included in the PCEMP. Examples of dust control practices to be adopted include:

- Use of water sprays on roads;
- Use of binding materials or water containing salt on stockpiles and other unsealed surfaces;
- Existing vegetation would be retained where possible. Where clearing is required, cleared areas no longer subject to construction activities and stockpiles would be seeded with fast growing species for rapid coverage to temporarily or permanently stabilise soil;
- Vehicle speeds would be limited to suit site conditions and as sign posted;
- All trucks hauling dirt, sand, soil or other loose materials (materials that could generate dust emissions or result in spillages) to and from the construction site would be covered;
- Cattle grids, ballast beds or other methods would be installed to minimise mud and dirt being tracked onto public roadways by trucks and any equipment leaving the site. Material spillage on roads and pathways would be cleaned; and
- All construction vehicles, mobile plant and machinery would be maintained and operated in accordance with the manufacturers' specifications to minimise exhaust emissions.

Operation
Emissions to air from operations on the ARTC rail network are currently addressed through the ARTC's EPL 3142.

The ARTC Environment Protection Licence EPL 3142 states in Condition O4 that: *'Significant dust generating activities on the premises must be managed in a proper and efficient manner to minimise dust emissions from the premises.'*

The EPL also includes a condition for a Pollution Reduction Program *PRP 4: Reduction of Coal Dust Emissions from Locomotive Loads*, which states:

> *'The licensee is required to comply with PRP 4 outlined in Table 4.1 [in the EPL] below by completing each described action in the program within the set timeframe. Coal dust emissions generated during the transportation of coal by rail is becoming a significant environmental issue and community concern. PRP 4 aims to significantly reduce coal dust emissions from locomotive coal loads by requiring ARTC to implement appropriate technology to significantly reduce coal dust emissions.'*

Thus, the mitigation of fugitive coal dust emission from locomotives would be controlled in accordance with PRP 4 for ARTC operations as whole.

7.5. Surface and groundwater

This section examines the potential effects on surface and groundwater resources during operation of the Proposal and includes a summary of the hydrological assessment undertaken by the UHVA (UHVA, 2010f). Table 7.5a outlines the DGRs relevant to surface and groundwaters and where each requirement is addressed in this section.

Table 7.5a Director-General's Environmental Assessment Requirements - surface and groundwater

Director-General's Environmental Assessment Requirements	Where addressed
Key issues	
Air, noise and water • Surface and groundwater resources and infrastructure, including existing water quality management facilities.	Section 7.5.2 and 7.5.3.

Section 7.8 addresses the potential impacts on the identified resources during the bulk earthworks (construction) phase of the Proposal and measures to control potential impacts on water quality during construction are outlined in Section 7.8 in addition to a management strategy in Section 9.2. This section should therefore be read in conjunction with these other sections of the document.

Potential surface and groundwater impacts associated with the Proposal have been assessed in accordance with the following NSW Government guidelines where relevant:

- Australian and New Zealand Guidelines for fresh and marine water quality (ANZECC, 2000);
- Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC, 2000);
- Managing Urban Stormwater: Soils and Construction (Landcom, 2004);
- State Groundwater Policy Framework Document (DLWC, 1997);
- NSW State Government Quality Protection Policy (DLWC, 1998).
- NSW State Government Groundwater quantity management policy
- NSW State Goundwater dependent Ecosystem Policy (DLWC, 2002);
- Guidelines for Groundwater Protection in Australia (ARMCANZ and ANZECC, 1995)

7.5.1. Methodology
The surface and groundwater assessment comprised the following steps:

- Identification of existing surface and groundwater resources and features;
- Review of the condition and capacity of existing hydraulic structures via site inspection;