Appendix G

Biodiversity offset package

EMGA Mitchell McLennan

Biodiversity Offset Package

Cobbora Coal Project

Prepared for Cobbora Holding Company Pty Limited | 12 August 2013

Planning + Environment + Acoustics

Biodiversity offset package

Cobbora Coal Project

Prepared for Cobbora Holding Company Pty Limited | 12 August 2013

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065

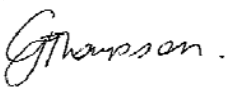
T +61 2 9493 9500
F +61 2 9493 9599
E info@emgamm.com

emgamm.com

Biodiversity offset package

Final

Report J11030RP5 | Prepared for Cobbora Holding Company Pty Limited Pty Limited | 12 August 2013

Prepared by	C. Thompson	Approved by	P. Towler
Position	Associate (Senior Ecologist)	Position	Associate Director
Signature		Signature	
Date	12 August 2013	Date	12 August 2013

Document Control

Version	Date	Prepared by	Reviewed by
1	17 June 2013	C. Thompson	K. Whiting & P. Towler
2	15 July 2013	C. Thompson	P. Towler
3	12 August 2013	C. Thompson	P. Towler

EMM
EMGA Mitchell McLennan

T +61 (0)2 9493 9500 | F +61 (0)2 9493 9599

Ground Floor | Suite 01 | 20 Chandos Street | St Leonards | New South Wales | 2065 | Australia

emgamm.com

Executive summary

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by the Cobbora Holding Company Pty Limited (CHC). The Project aims to avoid and minimise impacts on threatened biodiversity and other ecological values and has recently been revised to meet this objective. However, the Project will have unavoidable impacts on vegetation and fauna habitat including some which is listed under the *Threatened Species Conservation Act* 1995 (TSC Act) or *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC).

A biodiversity offset strategy was part of the Environmental Assessment (EA) report prepared to support a project approval application under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The objective of the strategy is to ensure that the Project maintains or improves the biodiversity values of the region in the medium to long term to compensate for unavoidable impacts.

This report describes the final offset package for the Project, based on the offset strategy (EMM 2012).

The biodiversity offset package meets both Commonwealth and NSW policy requirements. Under the EPBC Act Environmental Offset Policy, the 90% threshold has been reached for all matters of National Environmental Significance. The offset package will also result in an overall Tier 3 outcome under the OEH Interim Offset Policy.

Key outcomes of the biodiversity offset package are:

- protection and enhancement of the ecological values (vegetation types and habitat values) that are impacted, within the same catchment management authority (CMA) region as the Project;
- conservation of areas which complement and add to the existing reserve system;
- conservation management to improve the habitat values of the offsets including invasive animal and weed control, assisted regeneration of woodland and habitat creation;
- provision of equivalent habitat with most threatened species recorded in the Project area also recorded in the offsets including significant populations of threatened flora; and
- protection and enhancement of substantial areas of threatened ecological communities (TECs).

Table of Contents

Table of Contents *(Cont'd)*

Appendices

Tables

Tables

Figures

1 Introduction

1.1 Background

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by the Cobbora Holding Company Pty Limited (CHC). An Environmental Assessment (EA) report has been prepared to support a project approval application for the Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Director General's Environmental Assessment Requirements (DGRs) required a comprehensive offset strategy to ensure that the Project maintains or improves the biodiversity values of the region in the medium to long term (in accordance with NSW and Commonwealth policies).

A draft biodiversity offset strategy was provided as part of the EA for the Project in accordance with the *OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) Projects* (the OEH policy), Commonwealth *Draft Policy Statement: Use of Environmental Offsets Under the EPBC Act* (DEWR 2007), the Commonwealth *Draft Environmental Offsets Policy* (SEWPaC 2011) and the *Principles for the use of biodiversity offsets in NSW* (OEH 2011).

In line with the guiding offset principles, the Project offsets:

- provide a net improvement in the quantity, quality and conservation of biodiversity values within the region in the medium to long term through:
    - the regeneration and protection of woodland, particularly the Box Gum Woodland, Inland Grey Box Woodland and Fuzzy Box Woodland threatened ecological communities (TECs); and
    - the protection of threatened flora and fauna habitat and habitat features (eg hollow-bearing trees).
- provide long-term protection for threatened flora and fauna and TECs;
- improve vegetation and habitat connectivity between existing conservation areas within the locality; and
- protect areas identified as key corridors within the Central West Catchment Action Plan (CW CMA 2011) and as NPWS conservation priorities.

The offset strategy provided a framework for determining the appropriate level and scale of offsets required to compensate for Project impacts. Subsequent to submitting the EA, an updated Biodiversity Offset Strategy (EMM 2013) was provided with the Preferred Project Report and Response to Submissions report (PPR and RTS). This updated strategy was based on ongoing offset investigations and modifications to the Project.

In April 2013, an offset update was also prepared that provided an assessment of the proposed package against the offset strategy requirements, the OEH Interim Offset Policy and the Commonwealth EPBC Act Environmental Offset Policy (EMM 2013a). This offset update provided information for an offset package meeting, which was held on the 24 April 2013 with the Department of Planning and Infrastructure (DP&I), the Office of Environment and Heritage (OEH), the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), CHC and EMGA Mitchell McLennan (EMM).

During this meeting, SEWPaC requested additional information for habitat values for matters of National Environmental Significance (NES) at the offset sites and offset calculations. OEH also requested additional information on the habitat values of the offset areas for threatened species, further justification for the number and location of fauna crossings over the rail spur, and consideration of indirect impacts of the Project and compensation for these impacts via offsets where appropriate.

The mine plan has been amended since the meeting and following the Planning and Assessment Commission's (PAC) recommendations to minimise the potential impacts of the Project. In addition, further surveys have been undertaken in the northern offset areas (Figure 2.1) to target threatened flora species. The offset package has now been finalised and is presented in this report.

1.2 Objectives

This Biodiversity Offset Package provides:

- details of the final offset package for the Project;
- details of the final Project including refinements, recent mine plan amendments and subsequent changes to offset requirements;
- results of offset surveys undertaken to date; and
- the additional information requested by SEWPaC and OEH to inform decision making on the adequacy of the package proposed.

2 The Project and offset sites

2.1 The Project

The Project is located approximately 5 km south of Cobbora, 22 km south-west of Dunedoo, 64 km north-west of Mudgee and 60 km east of Dubbo in the central west of NSW. The Project will include an open cut mine; a coal handling and preparation plant (CHPP); a train loading facility and rail spur; and a mine infrastructure area. Supporting infrastructure will include access roads; water supply and storage; and electricity supply. Construction is planned to commence in mid-2013. Mine operations will start in the first half of 2015 and a mine life of 21 years is proposed.

The Project occurs in a region that is dominated by agricultural grazing land with large tracts of remnant vegetation on the less fertile slopes and ridges. The Project will require removal of woodland and grassland areas, some of which have been identified as TECs or threatened species habitat. The overall removal of vegetation and fauna habitat is minor in the regional context, based on vegetation mapping. Woodland to be cleared represents less than 7% of the non-conserved woodland of the Talbragar CMA sub-region and less than 1% in the Central West CMA.

CHC has incorporated a range of controls into the design and implementation of the Project, which will minimise potential impacts on threatened species, populations and ecological communities through avoidance, minimisation and mitigation. A detailed biodiversity management plan will be prepared within an Integrated Land Management Plan to implement best practice management measures during progressive clearing, operation and rehabilitation for the Project.

Progressive rehabilitation will establish woodland representative of the existing vegetation types and grassland, compensating for the loss of vegetation as a result of the Project. An offset strategy has been proposed to compensate for any remaining significant impacts to threatened species and their habitat after mitigation. The strategy compensates for the loss of vegetation, the direct loss of TECs, threatened flora and threatened fauna habitat. Coupled with the progressive rehabilitation of the mine and assisted natural regeneration of native pasture areas in the offsets, it also compensates for any potential indirect impacts on biodiversity. The offset strategy has guided this Biodiversity Offset Package.

2.1.1 Project revisions

The Project was revised in May and June 2013 based on recommendations made in the PAC Review Report (April 2013). The revised mine plan reduces the amount of woodland vegetation to be impacted by the Project. It also includes protection and enhancement of a 185 ha biodiversity corridor linking the remnant vegetation to the north of the Project with remnant vegetation to the east.

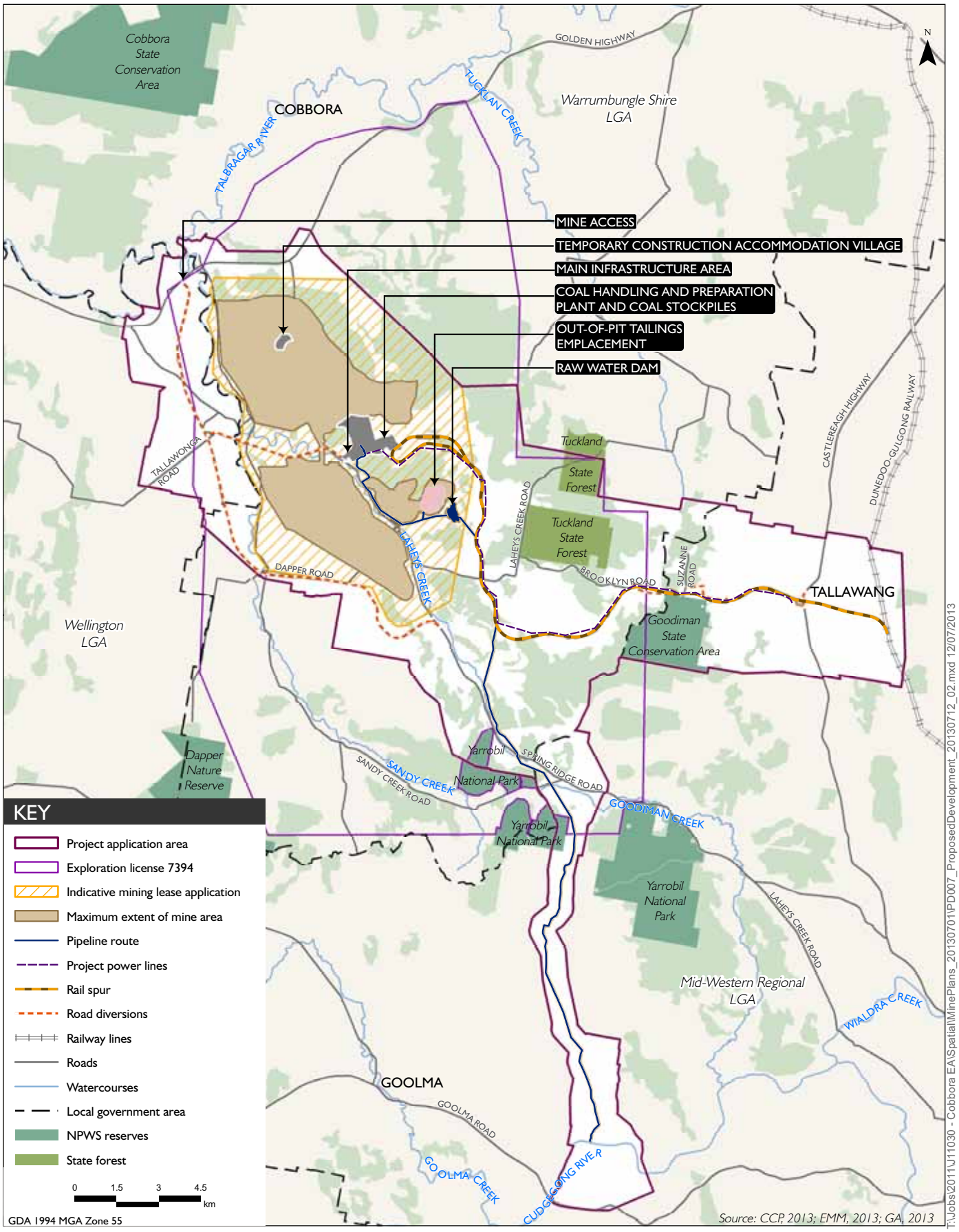
Where possible, impacts to TECs were minimised through the mine plan revisions. Reductions in the area of TECs impacted have resulted from:

- reducing the footprint of the out of pit waste rock emplacement (B-OOP E);
- moving the northern limit of mining 250 m south to minimise impacts on a biodiversity corridor in this area; and
- refinements to vegetation mapping to reclassify man-made features such as roads which were previously classified as native vegetation.

Reductions to impacts on other vegetation types have resulted from these changes as well as minimisation of buffers and mapping refinements. The design changes have also resulted in an increase in impacts to some vegetation types (Table 4.1).

The mine plan revisions and vegetation mapping updates result in an additional 196 hectares (ha) of woodland and derived native grassland (DNG) being protected from direct impacts (Figure 1.1). Reductions have occurred in nine of the 15 vegetation types in the Project area, predominantly Blue-leaved Ironbark, regrowth, Cypress Pine Woodland and Box Gum Woodland DNG (Table 4.1).

The revisions have decreased the area of TECs to be impacted by the Project, from a total of 232 ha to 217 ha. The area of Fuzzy Box Woodland endangered ecological community (EEC) (9 ha) and Box Gum Woodland EEC (7 ha) to be impacted has been reduced by the latest mine plan. However, an additional 2 ha of Inland Grey Box Woodland DNG EEC will be impacted by the mine changes.



Proposed development
Cobbora Coal Project
Biodiversity Offset Package
Figure 2.1

Table 2.1 Vegetation types impacted by revised mine plan

Vegetation types	Previous Project area (ha) (EMM 2013a, EMM 2013b)	Revised mine plan Project area (ha)	Difference (ha)
CW107 Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion	188	171	-17
CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland[1]	9	12	3
CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion[1]	13	16	3
CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion DNG[1]	105	91	-14
CW115 Blue-leaved Ironbark woodland on sandy uplands and slopes of the Darling Riverine Plains Bioregion	1,043	919	-124
CW115 Blue-leaved Ironbark woodland on sandy uplands and slopes of the Darling Riverine Plains Bioregion - regrowth	450	405	-45
CW133 Dwyer's Red Gum - Currawang grassy mid-high woodland of central NSW	67	65	-2
CW138 Fuzzy Box Woodland on Alluvial Plains[2]	14	9	-5
CW138 Fuzzy Box Woodland on Alluvial Plains DNG[2]	14	9	-5
CW145 Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions[3]	43	41	-2
CW145 Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions DNG[3]	34	38	4
CW155 Mugga Ironbark - Inland Grey Box - pine tall woodland of the NSW South Western Slopes Bioregion	1	0	-1
CW176 Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	5	5	0
CW177 Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	20	23	3
CW191 Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion	101	107	6
Total woodland (and DNG)	**2,107**	**1,911**	**-196**

Notes: *1. Vegetation types are part of the Box Gum Woodland EEC (note only the woodland form is listed under the EPBC Act).*

2. Vegetation types are part of the Fuzzy Box Woodland EEC.

3. Vegetation types are part of the Inland Grey Box Woodland EEC (note only the woodland form is listed under the EPBC Act).

The revised mine plan also reduces impacts to Ingram's Zieria (*Zieria ingramii*) and *Homoranthus darwinioides* (Table 4.2). This has been accomplished by modifying the footprint of one of the out-of-pit tailings emplacements (B-OOP E), principally to avoid an area which contains both species, and the provision of a biodiversity corridor to the north of the Project area. This is a reduction of 248 (34%) Ingram's Zieria and approximately 100 (40%) *H. darwinioides* (Table 1.2).

Table 2.2 Threatened species impacted by revised mine plan

Species	Previous project area number of individuals impacted (EMM 2013)	Revised mine plan number of individuals impacted	Difference
Zieria ingramii	727	480	-247
Homoranthus darwinioides	227	127	-100
Tylophora linearis	9	9	0
Acacia ausfeldii	200	200	0

2.1.2 Project status

On 1 July 2013, the NSW Government announced that it will not be constructing or operating the Cobbora Coal Project but that it will be leased or sold. The Government also announced that it will continue to seek approvals and continue to construct and operate the Project. This will be in accordance with the *Cobbora Coal Project Environmental Assessment* (EA) (EMM 2012), the *Preferred Project Report and Response to Submissions* (PPR&RTS) (EMM 2013) and the revised Project as described in the *Response to Recommendations of the Planning Assessment Commission Review Incorporating a Revised Preferred Project Report* (shortened here to 'Responses to PAC Review report') that is currently being in prepared.

Project Approval conditions will require that the proponent carries out the Project generally in accordance with the EA, PPR&RTS and the Responses to PAC Review report; the statement of commitments; and the Project Approval conditions. The Biodiversity Offset Package will be part of the statement of commitments.

Development of this Biodiversity Offset Package has required the following steps:

1. survey and quantification of biodiversity potentially impacted by the Project;
2. updates of Project design to avoid or minimise impacts;
3. calculation of required offsets to compensate for unavoidable impacts;
4. identification of potential offset sites to meet calculated requirements;
5. survey and quantification of biodiversity values in potential offset sites;
6. purchase of offset properties;
7. calculation of offset achieved; and
8. preparation of this Biodiversity Offset Package.

Each step has been iterative, considering ongoing changes to Project design (including changes to avoid impacts); ongoing surveys of impacted and offset sites; and consultation, particularly with DP&I, OEH and SEWPaC.

The purchased offset properties are currently being managed by CHC. Management includes activities such as repairing and/or installing fencing, excluding grazing in identified sensitive ecological areas, and weed and pest control that will continue while CHC owns these properties.

The following steps are required before the Biodiversity Offset Package is implemented:

1. agree the acceptability of the package with DP&I, OEH and SEWPaC;

2. receive NSW Project Approval;

3. receive Commonwealth Project Approval;

4. prepare a detailed Biodiversity Offset Management Plan describing how each of the offset properties will be managed; and

5. providing long-term security for biodiversity values in the properties through conservation agreements, covenants or additions to National Parks Estate.

It is proposed to proceed with steps 1 to 4. The Biodiversity Offset Management Plan will describe the management of offset properties to ensure that their biodiversity value is maintained prior to the Project physically commencing. This plan will be implemented after receiving Project Approvals.

Actions to improve the biodiversity value of offset properties, eg assisted regeneration, will be described in the Biodiversity Offset Management Plan but will only be started once Project construction is confirmed. The potential delay to these actions does not change the biodiversity offset calculations, which do not include credits for regeneration activities.

Step 5 will proceed prior to physical commencement of the Project if it is sold or leased.

Where they are not already occurring, activities outside of the offset properties, such as regeneration of the biodiversity corridor north of mining areas A and C, are expected to start following Project Approval but do not form part of the offset package.

2.2 Residual impacts to be offset

Design changes, particularly the mine revisions, have resulted in the avoidance of a number of ecological features within the Project area. Mitigation measures will minimise the potential impacts of the Project on sensitive biodiversity. Management plans will detail methods for the implementation of mitigation measures during construction, progressive clearing works and mine operation. However, residual impacts on TECs, threatened flora and fauna and their habitat, will still occur after avoidance and mitigation measures are applied.

A total of 216 ha of TSC Act-listed threatened ecological communities will be directly impacted comprising:

- 41 ha of Inland Grey Box Woodland (Grey Box Woodland) EEC and 38 ha of Inland Grey Box Woodland EEC DNG;

- 28 ha of White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland) EEC and 91 ha of Box Gum Woodland EEC DNG (28 ha of EPBC Act listed Box Gum Woodland); and

- 9 ha of Fuzzy Box Woodland on alluvial soils EEC and 9 ha of Fuzzy Box Woodland EEC DNG.

Impacts after mitigation are also likely for threatened flora and fauna species that were recorded in the Project area, or were considered likely to have a moderate to high likelihood of occurrence (Table 1.3). The offset package focuses on the provision of habitat for such species.

Table 2.3 Impact assessment results for recorded threatened species

Species or community	Status		Recorded within the study area?	Impact description
	TSC Act	EPBC Act		
Acacia ausfeldii	V	-	Yes	Removal of 200 individuals in one sub-population
Barking Owl (*Ninox connivens*)	V	-	Yes	Removal of foraging and potential breeding habitat
Brown Treecreeper (*Climacteris picumnus*)	V	-	Yes	Removal of foraging and breeding habitat
Diamond Firetail (*Stagonopleura guttata*)	V	-	Yes	Removal of foraging and potential breeding habitat
Eastern Cave Bat (*Vespadelus troughtoni*)	V	-	No	Removal of foraging and potential breeding (cliff line) habitat
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V	-	Yes	Removal of foraging and potential breeding habitat
Grey-crowned Babbler (*Pomatostomus temporalis*)	V	-	Yes	Removal of foraging and breeding habitat
Homoranthus darwinioides	V	V	Yes	Removal of 127 individuals from 1 sub-population
Hooded Robin (*Melanodryas cucullata*)	V	-	Yes	Removal of foraging and potential breeding habitat
Ingram's Zieria (*Zieria ingramii*)	E	E	Yes	Removal of 480 individuals within 8 sub-populations
Koala (*Phascolarctos cinereus*)	V	V	No	Removal of potential foraging and breeding habitat
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V	Yes	Removal of foraging and potential breeding (cliff line) habitat
Little Pied Bat (*Chalinolobus picatus*)	V	-	Yes	Removal of foraging and potential breeding (cliff line) habitat
Masked Owl (*Tyto novaehollandiae*)	V	-	Yes	Removal of foraging and potential breeding habitat
Pale-headed Snake (*Hoplocephalus bitorquatus*)	V	-	No	Removal of potential foraging and breeding habitat
Powerful Owl (*Ninox strenua*)	V	-	Yes	Removal of foraging and potential breeding habitat
Regent Honeyeater (*Anthochaera phrygia*)	E	CE	No	Removal of potential foraging and breeding habitat
Sloane's Froglet (*Crinia sloanei*)	V	-	No	Removal of potential foraging and breeding habitat
South-eastern Long-eared Bat (*Nyctophilus corbeni)*	V	V	Yes	Removal of foraging and potential breeding habitat
Speckled Warbler (*Pyrrholaemus sagittatus*)	V	-	Yes	Removal of foraging and potential breeding habitat
Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)	V	E	No	Removal of potential foraging and breeding habitat
Squirrel Glider (*Petaurus norfolcensis*)	V	-	No	Removal of potential foraging and breeding habitat
Swift Parrot (*Lathamus discolour*)	E	E	No	Removal of potential foraging habitat
Superb Parrot (*Polytelis*	V	V	Yes	Removal of potential foraging habitat

Table 2.3 Impact assessment results for recorded threatened species

Species or community	Status		Recorded within the study area?	Impact description
	TSC Act	EPBC Act		
swainsonii)				
Tylophora linearis	V	E	Yes	Removal of 9 individuals from one sub-population
Varied Sittella (*Daphoenositta chrysoptera*)	V	-	Yes	Removal of foraging and potential breeding habitat
Yellow-Bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V	-	Yes	Removal of foraging and potential breeding habitat

Notes: Species recorded in the Project area are shaded.

2.3 Offset sites

Six broad offset areas have been identified (Figure 2.1):

- Southern NPWS additions;
- Eastern link areas;
- Zieria patch;
- Cobbora SCA additions;
- Adelyne SCA additions; and
- Goonoo SCA additions.

Three of these areas, namely the southern NPWS additions, eastern link areas and Zieria patch, occur on land surrounding the proposed mine and infrastructure areas (Figure 2.1). The remaining areas occur to the north of the Project area and contain large tracts of remnant woodland adjacent to NPWS estate. The offset sites have been chosen to provide like for like offsets and therefore contain similar values to the Project area.

Since the last offset update, the CHC has made significant progress with the purchase of offset properties. More than 76% of the proposed 9,254 ha of offset area is now owned by CHC. CHC is awaiting settlement on the remaining properties (Table 2.1).

An Integrated Landscape Management Plan is being prepared that will include measures to manage the offset areas for conservation prior to dedication to conservation reserves, or until other conservation measures are implemented on the title. Separate offset management plans will be drafted for those sites not dedicated to NPWS estate.

Table 2.4 Offset area ownership

Property/offset area	Size (ha)	Status
Southern NPWS additions		
Lot 2 and 3-839623, and Lot 3-1112933	57.1	Owned by CHC
Lot 2-1112933	112.1	Owned by CHC
Lot 3-802679 and Lot 88-750780	161.7	Owned by CHC
Lot 1-802679	41.4	Owned by CHC
Lot 1-1072945 and Lots 78 and 79-750751	168.0	Owned by CHC
Lot 46, 48 and 49-754329	194.1	Owned by CHC
Lot 2-1072945	356.4	Owned by CHC
Lot 45-754329	214.4	Owned by CHC
Part Lot 115-721236, part Lots 16,17, 25,26-754329	928.0	Owned by CHC
Sub-total for Southern NPWS additions	**2,233.2**	
Eastern link areas		
Lot 20, 21 and 23-754329, and Lot 9-130575	188.9	Owned by CHC
Part Lot 31-754329	185.5	Owned by CHC
Lot 102-754334	198.7	Owned by CHC
Part Lot 30-754329, and part Lot 2 and part 3-586911	195.2	Owned by CHC
Part Lot 141-721256	162.7	Owned by CHC
Sub-total for Eastern link areas	**931**	
Zieria patch		
Part Lot 36-754289 and part Lot 44-754289	43.2	Owned by CHC
Cobbora SCA additions		
Lot 45-720311	1,571.1	Owned by CHC
Lot 42-257240 and Lot 18-754312	1,057.8	Owned by CHC
Sub-total for Cobbora additions	**2,628.9**	
Adelyne SCA additions		
Lot 35-754326	412.9	Awaiting property settlement
Goonoo SCA additions		
Lot 3-754325	393.2	Awaiting property settlement
Lot 39-754330	383.4	Awaiting property settlement
Lot 36-754330	992.1	Awaiting property settlement
Lot 17-754293	1,236.0	Owned by CHC
Sub-total for Goonoo SCA additions	**3,004.7**	
Total offset areas	**9,254**	

2.3.1 Southern NPWS additions and eastern link areas

The southern NPWS additions and eastern link areas aim to link three local reserves (Tucklan State Forest, Goodiman SCA and Yarrobil National Park) and protect significant populations of threatened flora and fauna that will be impacted by the Project in other areas. A total of 2,194 ha of native vegetation (including DNG) occurs in this area, with more than 372 ha of TECs. This includes 231 ha of Box Gum Woodland and 141 ha of Grey Box Woodland. In addition to this, 970 ha of native pasture and disturbed areas are present, some of which contain native pasture that would potentially regenerate to TECs where they occur adjacent to TEC areas.

The southern NPWS additions and eastern link areas are all owned by CHC and are currently leased for agriculture, mainly grazing. The agricultural areas contain native pastures with some weed invasion present. However, in areas where stock has been removed, natural regeneration is abundant with pioneer species such as Sifton Bush (*Cassinia arcuata*) dominant in many areas and eucalypt seedlings present throughout the sites.

The southern NPWS additions and eastern link areas contain large patches of native vegetation with extensive cliff line habitats. A number of threatened species have been recorded in the eastern link areas including the Eastern Cave Bat (*Vespadelus troughtoni*) and Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis)*. The eastern link areas also provide known habitat for a range of threatened woodland bird species, including an important area for the Glossy Black-cockatoo (*Calyptorhynchus lathami*), which was repeatedly recorded in this area and for which abundant foraging resources and some breeding habitat is available.

2.3.2 Zieria patch

This area of Dwyer's Red Gum/Blue-leaved Ironbark Woodland was intentionally avoided by the Project as it contains a significant population of Ingram's Zieria (totalling 340 individuals). The patch is approximately 43 ha in size and has been subject to previous cattle grazing.

2.3.3 Cobbora SCA additions

Ultimately the Cobbora SCA additions will link to and increase the value and extent of Cobbora SCA significantly by providing habitat for a range of threatened species. This area also protects parts of the Talbragar River and large patches of TECs. The Cobbora SCA additions are approximately 2,600 ha with some areas of significant cliff lines. The Eastern Cave Bat and Eastern Bentwing Bat have both been recorded in this area. Such habitat may also provide habitat for the Large-eared Pied Bat (*Chalinobus dwyeri*).

The combined Cobbora SCA additions contain 402 ha of TECs, with both Box Gum Woodland and Inland Grey Box Woodland. These also contain native grassland areas which would respond to assisted regeneration to form part of these TECs.

2.3.4 Adelyne SCA additions

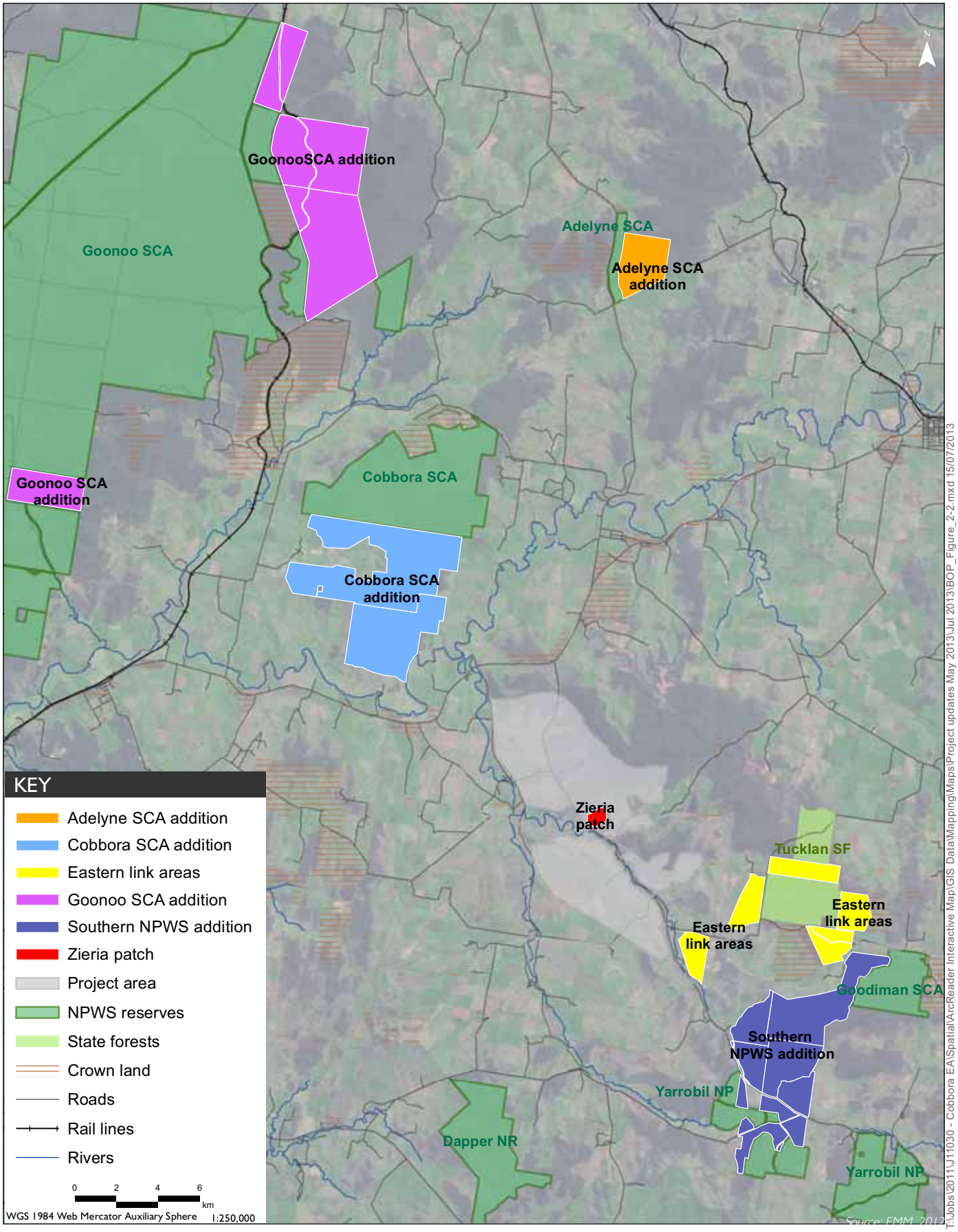
This 400 ha property contains significant patches of remnant native vegetation, including a number of areas which contains TECs. Significant ridgelines with cave-like structures and overhangs occur throughout the north of the area. The offset site adjoins a small reserve and will significantly enhance the viability of this reserve into the future.

2.3.5 Goonoo SCA additions

Several properties to the north of the Project area and to the east of the Goonoo SCA comprise the Goonoo SCA additions. The vegetation in this area is a mixture of that found in the Project area with influences from the semi-arid communities further west associated with the Pilliga landscape.

Vegetation in the Goonoo additions is in good condition, with past disturbances including grazing and timber collection. Some areas have been previously cleared for agriculture, however these vary in stages of regeneration and mainly contain native pastures. The Goonoo SCA additions will protect significant habitat features with an abundance of hollow-bearing trees, fallen timber and key foraging resources such as *Allocasuarina diminuta* and *A. gymnanthera* for the Glossy Black-cockatoo, which was recorded throughout the sites. Some cliff lines occur and drainage lines and associated riparian vegetation occurs throughout the offset areas.

Some large populations of Ingram's Zieria and *T. linearis* were identified in the Goonoo SCA additions. It is possible that additional populations occur which have not been targeted for survey. Dedicated fauna surveys have not been completed in these areas, however the areas contain an abundance of birdlife. This includes threatened species recorded in the Project area, as well as common species recorded in the Project area, and others which are associated with the Pilliga landscape such as the Australian Ringneck (*Barnardius zonarius*).



Offset areas

Cobbora Coal Project: Biodiversity Offset Package

Figure 2.2

2.4 Offset vegetation types

A total of 7,674 ha of woodland vegetation and DNG has been recorded in the offset areas (Table 2.2). This includes 1,227 ha of TECs, compromising approximately 994 ha of Box Gum Woodland and DNG, 37 ha of Fuzzy Box Woodland, 196 ha of Inland Grey Box Woodland.

Most areas of grassland in the offsets have been grazed by cattle and sheep and were typically dominated by three awn grass *(Aristida* spp.) and speargrass *(Austrostipa* spp.), both of which are grazing tolerant species. Where Box Gum Woodland and Inland Grey Box Woodland was present, the adjacent grassland had higher species diversity in both forb and grass species. However forb species were still low and these areas are unlikely to meet the description of the EPBC Act listed communities given the lack of important species recognised under the identification guidelines for the listed community. These areas have been classified as native pasture and not included in the offset calculations, as this is consistent with the approach taken in the Environmental Assessment (EA).

An additional 1,580 ha of native pasture (not considered to meet the definition of any listed TEC as DNG) occurs in the offset areas which has not been included in the calculations (Table 2.2). These are in addition to the 7,674 ha of woodland and DNG identified in the offset areas. Native pasture areas are likely to respond quickly to conservation management, rehabilitating into vegetation types representative of the former communities and those that occur in surrounding areas.

Table 2.5 Vegetation types by offset area

Vegetation types	Adelyne NPWS addition	Cobbora NPWS addition	Eastern link areas	Goonoo NPWS addition	Southern NPWS addition	Zieria patch	Total
CW107 Black Cypress Pine - Narrow-leaved Stringybark Heathy Woodland	0	247	76	27	125	0	475
CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland[1]	43	327	54	153	82	0	659
CW112 Blakely's Red Gum - Yellow Box Grassy Woodland[1]	0	6	1	122	77	0	207
CW112 Blakely's Red Gum - Yellow Box Grassy Woodland DNG[1]	0	28	0	0	82	0	111
CW115 Blue-leaved Ironbark Woodland	209	938	254	1,435	501	39	3,377
CW115 Blue-leaved Ironbark Woodland Regrowth	0	51	68	81	78	0	277
CW133 Dwyer's Red Gum - Currawang Grassy Mid-high Woodland	34	224	12	315	6	4	594
CW138 Fuzzy Box Woodland on Alluvial Plains[2]	0	0	0	37	0	0	37
CW138 Fuzzy Box Woodland on Alluvial Plains DNG[2]							0
CW145 Inland Grey Box Tall Grassy Woodland[3]	66	41	35	30	24	0	196
CW145 Inland Grey Box Tall Grassy Woodland DNG[3]							0
CW155 Mugga Ironbark - Inland Grey Box - Pine Tall Woodland	0	0	38	5	43	0	87
CW156 Mugga Ironbark - Inland Grey Box Shrubby Woodland	0	0	1	198	30	0	229
CW160 Narrow-leaved Ironbark Shrubby Woodland	0	0	0	109	0	0	109

Table 2.5 Vegetation types by offset area

Vegetation types	Adelyne NPWS addition	Cobbora NPWS addition	Eastern link areas	Goonoo NPWS addition	Southern NPWS addition	Zieria patch	Total
CW176 Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box Shrub - Tussock Grass Open Forest	9	32	0	0	16	0	57
CW177 Red Stringybark Woodland	26	236	145	170	247	0	824
CW191 Slaty Gum Woodland	0	0	115	0	51	0	166
CW202 Tumbledown Red Gum - Black Cypress Pine - Red Box Low Woodland	0	0	0	0	14	0	14
CW213 White Box - White Cypress Pine - Inland Grey Box Woodland[1]	0	0	0	0	17	0	17
CW268 Mugga Ironbark - Blakely's Red Gum Woodland	0	0	0	238	0	0	238
Total	**387**	**2,130**	**800**	**2,920**	**1,394**	**43**	**7,674**

Notes: *1. Vegetation types are part of the Box Gum Woodland EEC (note only the woodland form is listed under the EPBC Act).*

2. Vegetation types are part of the Fuzzy Box Woodland EEC.

3. Vegetation types are part of the Inland Grey Box Woodland EEC (note only the woodland form is listed under the EPBC Act).

2.5 Offset tenure

Offsets will be protected either by establishing formal conservation agreements or dedication to the reserve network. Offsets are in strategic locations to maximise corridor values. Offsets will be protected in perpetuity in line with current OEH advice which includes two levels of priority. As a priority, offsets will be established under the following mechanisms where possible:

- dedication of land as a public reserve under the *National Parks and Wildlife Act 1974* (NPW Act); or
- the establishment of biobank sites with a Biobanking Agreements under the TSC Act; or
- retirement of biobanking credits, where appropriate credits are available.

Where this is not achievable, the following mechanisms will be investigated (in order of priority):

- establishment of a conservation agreement with the Minister for the Environment under the NPW Act; or
- establishment of a trust agreement with the Nature Conservation Trust under the *Nature Conservation Trust Act 2001*; or
- establishment of a planning agreement by a planning authority under the EPA Act; or
- establishment of a conservation property vegetation plan under the *Native Vegetation Act 2003*.

The proposed dedication of offset sites as a public reserve is currently being assessed by the NPWS. Recommendations will soon be made for Ministerial approval of the addition of these areas to the NPWS estate. For the areas to be transferred to NPWS estate, it is likely that a set of actions will need to be completed prior to transfer, possibly with management funding requirements. These terms are currently being discussed with NPWS.

CHC is committed to providing long-term security for the offset sites not dedicated to NPWS, and the appropriate mechanisms for this will be determined in consultation with OEH and SEWPaC.

2.6 Management of the offsets

2.6.1 Offset management plan

The offset areas will be managed in accordance with a biodiversity offset management plan. The plan will be completed and implemented within 12 months of Project approval. It will detail the measures to be implemented in the short, medium and long term to achieve the offset objectives. It will include procedures to be applied for the management of the offset properties, the arrangements for conservation in perpetuity and regeneration works to be undertaken. This will include the procedures for:

- assisting the revegetation and regeneration in the offset areas, including establishment of canopy, understorey and groundcover in areas of native pasture where required;
- investigating the feasibility of seed and cutting collection, propagation, establishment and translocation of threatened flora species from the Project area to offset areas (this work is already underway);
- the introduction of artificial tree hollows and bat roosting structures;
- controlling weeds and feral pests;
- areas for additional flora and fauna surveys in the offset areas to targeted threatened flora and fauna;
- fencing and access arrangements and erosion control;
- managing grazing and agriculture, excluding livestock grazing from existing treed areas and TECs; and
- bushfire management.

The biodiversity offset management plan will provide programs for further research and survey for threatened flora and fauna within the offset areas. It will also provide management actions to reduce known threats for the threatened species, populations and communities recorded.

Plans of management are not available for the Goonoo SCA, Cobbora SCA, Yarrobil NP or Goodiman SCA. These will be incorporated into the biodiversity offset management plan when they are prepared to ensure consistency with local conservation targets and practices.

2.6.2 Assisted natural regeneration

The aim of assisted natural regeneration will be to establish habitat representative of surrounding remnant vegetation in the offset areas. This will include the establishment of canopy, understorey and ground layers in the offset areas which are currently dominated by native pasture or regrowth. The restoration of vegetation in these areas would increase the habitat linkages in the offset areas and provide additional habitat resources for fauna.

Native pasture and disturbed areas occur throughout the offset areas, particularly in the southern offsets. These areas will naturally regenerate over time through the management of threatening processes that inhibit natural regeneration. Throughout the Project and offset areas, natural regeneration is evident with shrubs and trees regrowing in native pasture where stock has been removed. As such, the landscape is considered to be reasonably resilient and likely to respond well to management actions. Natural regeneration will be assisted by planting representative tree species in strategic areas where required.

Sifton Bush has formed dense thickets in some areas which have been left ungrazed. This may become a problem in some areas and will be monitored and, if required, managed through ecological thinning or supplementary planting to maximise regeneration success. Erosion control works and supplementary planting in such areas may also be required where this is an issue in the offset areas.

2.6.3 Offset monitoring

An offset monitoring program will be included within the biodiversity offset management plan. The purpose of the program will be to survey the offset sites for the presence of threatened species and monitor any changes to the condition of these areas to:

- assess any indirect impacts from the Project; and
- determine the success of the management actions implemented.

Specifically, the monitoring program will target the condition and extent of threatened species, populations and communities identified in the offset area. In particular, the success of any relocation of threatened flora species will be monitored.

An adaptive monitoring approach will involve the development of action triggers for the various monitoring parameters. Measures of health will employ the benchmark data as outlined in the Biobanking Methodology for comparison. Maintenance of ecosystem function will also be monitored (eg maintenance of flowering). Specific triggers will be provided to ensure that an adaptive approach to management is used for the Project, whereby indirect impacts and failure of management actions can be measured and corrective actions developed. It is likely that the following will be monitored in the offset areas:

- health and condition of remnant vegetation and how this changes over time as a result of management actions;
- ecosystem function analysis and success of assisted natural regeneration;
- weed presence, distribution and abundance;
- the impacts of land use; and
- diversity and abundance of significant ecological features such as threatened species and TECs.

Management and monitoring activities will be undertaken on CHC-managed offsets for a period of up to five years. The condition will be assessed at this time and then appropriate ongoing requirements will be determined for the long-term management of the sites.

3 EPBC offset calculations

3.1 Overview

The EPBC offset calculations have been updated in this chapter in line with the Project revisions and offset package finalisation. It also provides additional habitat information as requested by SEWPaC for each matter of NES, with additional details on the calculations included in Appendix A.

The EPBC Act Environmental Offset Policy requires that a minimum 90% direct offset is met using the calculator for all matters of NES which may be impacted by the Project. This requirement has been met for all matters of NES identified in the Project area or with a high likelihood of occurrence (Table 3.1). The reasoning behind the calculation values for each matters of NES and the calculator results have been included in Appendix A. A broad discussion of the habitat values of the Project and offset sites are provided in the following sections.

Table 3.1 Summary of offset calculations for matters of National Environmental Significance

Matter	Area/ individuals impacted	Area/ individuals offset	Percentage of impact on matter offset
Box Gum Woodland	28 ha	883 ha	400.18%
Inland Grey Box Woodland	41 ha	196 ha	154.44%
Homoranthus darwinioides	127 individuals	200 individuals (future value of 400)	92.62%
Ingram's Zieria	480 individuals	1,435 individuals (future value of 2,135)	104.81%
Tylophora linearis	9 individuals (stems)	45 individuals (stems) (future value of 50)	98.62%
Australasian Bittern	9 ha	44 ha	139.94%
Large-eared Pied Bat	1,192 ha	5,792 ha	122.88%
Regent Honeyeater*	1,127 ha	5,226 ha	132.73%
Southern Long-eared Bat	1,340 ha	6,167 ha	124.51%
Spotted-tail Quoll*	167 ha	2,240 ha	383.93%
Superb Parrot	304 ha	2,961 ha	238.60%
Swift Parrot*	1,196 ha	5,972 ha	142.93%

*Note: *Not recorded in the Project area but identified as having a high likelihood of occurrence and included based on OEH and SEWPaC recommendations.*

3.2 Threatened ecological communities

3.2.1 Box Gum Woodland

i Project area

Two sub-formations of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland) critically endangered ecological community were identified in the Project area (Figure 3.1). These represent the following broad vegetation types (BVTs) from the Biometric database:

- CW112 Blakely's Red Gum - Yellow Box Grassy Woodland; and
- CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland.

CW112 was characterised by Yellow Box (*E. melliodora*) with Blakely's Red Gum (*E. blakelyi*) and a grassy understorey. It occurred along roadsides, in low-lying parts of the study area and along drainage lines and depressions. Other associated canopy species included Grey Box (*E. microcarpa*), Fuzzy Box (*E. conica*) and Rough-barked Apple (*Angophora floribunda)* with the canopy reaching 30 m in height. In areas, the canopy has been removed but the understorey remains, forming derived native grassland.

Dominant grass species recorded included wallaby grasses (*Austrodanthonia* sp.), speargrasses and three-awn grasses. Forbs present included *Calotis* sp., *Wahlenbergia* sp., *Dichondra* sp. and the creepers *Glycine* sp. and *Desmodium* sp. CW112 graded into other box-type woodlands on the floodplains and lower elevation areas of the offsets. Disturbances present included domestic animal grazing, weed invasion and feral animal grazing.

CW111 was dominated by Rough-barked Apple in very small patches, either along drainage depressions or at the foot slopes of ironbark/stringybark communities (Figure 3.1). This vegetation type typically occurred as monotypic stands of Rough-barked Apple trees, often in grazed areas, being impacted by cattle, sheep, sheep camps and weed invasion. Rough-barked Apple trees observed in the offsets were usually mature, with little to no regeneration occurring, and commonly were paddock trees surrounded by cultivated and improved pasture.

In other areas, this community was dominated by Blakely's Red Gum with a grassy/shrubby understorey. Species recorded included *Melaleuca erubescens*, Seven Dwarfs Grevillea (*Grevillea floribunda*), Sifton Bush and Cough Bush (*Cassinia laevis*). This vegetation type was recorded in, or adjacent to, ironbark and stringybark communities, commonly in drainage depressions.

ii Offset area

Three sub-formations of the Box Gum Woodland complex were identified in the offset areas (Figure 3.1). These represent the following broad vegetation types (BVTs) from the Biometric database:

- CW112 Blakely's Red Gum - Yellow Box Grassy Woodland;
- CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland; and
- CW213 White Box - White Cypress Pine - Inland Grey Box woodland.

The former two communities were similar in composition to those mapped in the Project area. Some areas dominated by Blakely's Red Gum were identified, particularly in the northern offset areas. CW213

was recorded along Spring Ridge Road where it graded into ironbark woodland and other box communities. It was dominated by White Box (*E. albens*) with a small tree layer of Black Cypress Pine (*Callitris endlicheri*).

Generally, the condition of the remnants in the offset areas was better than those in the Project area. This may be due to the large tracts of remnant vegetation in the majority of the proposed offset areas and lack of intensive agricultural activities in these areas. While most remnants have been subject to logging and grazing, important habitat components including over-mature trees and natural regeneration were observed in most of the offset areas containing Box Gum Woodland.

Areas mapped as Box Gum Woodland DNG in the offset areas are not considered likely to currently meet the description of the EPBC Act listed community, as with the Project area and have not been included in the impact calculations. Areas of native pasture adjacent to areas of Box Gum Woodland that have not been recognised as DNG (244 ha), may meet the description of the EPBC Act listed community at some point in the future with appropriate management. However, these have not been included in the calculations.

3.2.2 Inland Grey Box Woodland

i Project area

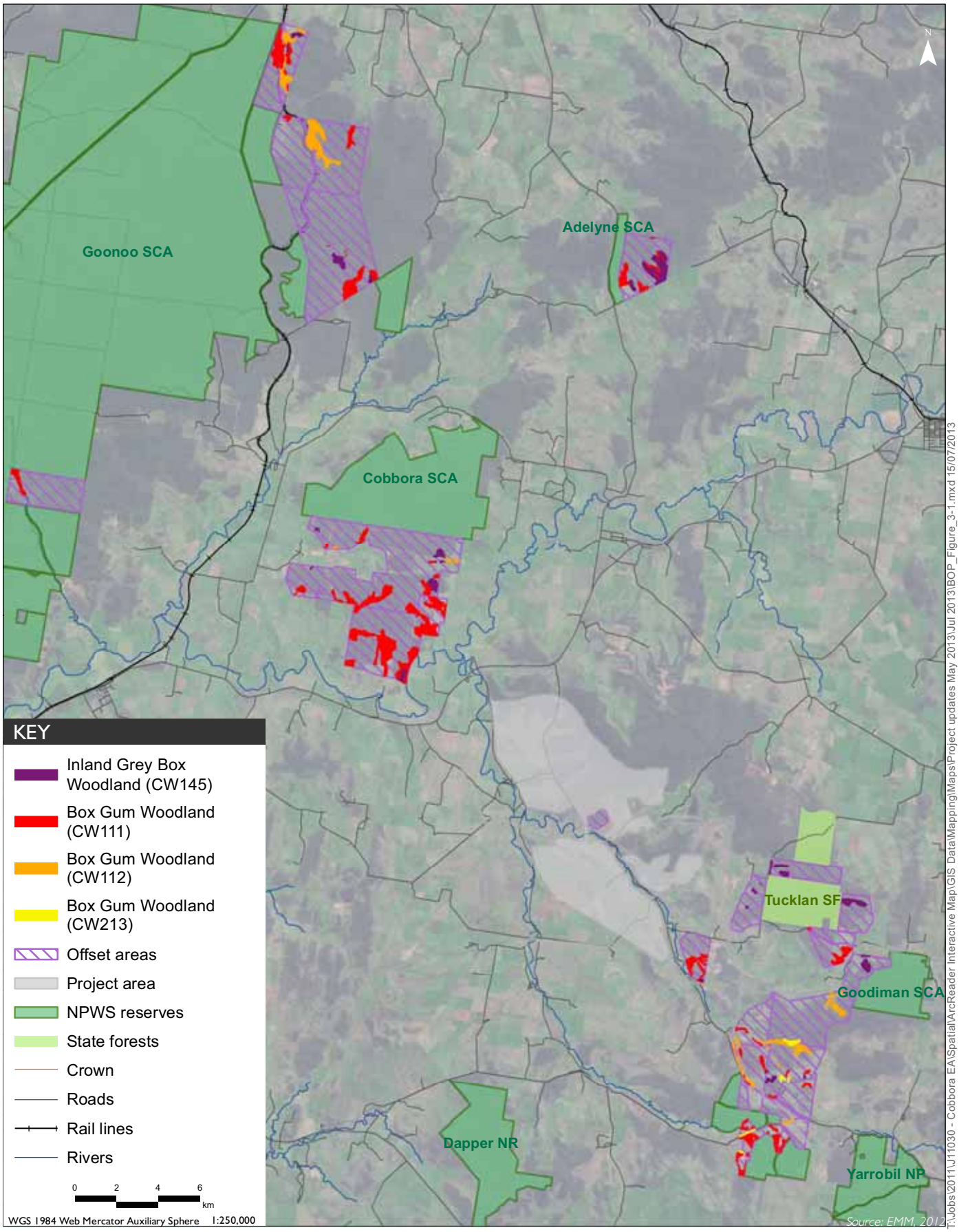
CW145 Inland Grey Box Tall Grassy Woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Inland Grey Box Woodland) typically occurred as monotypic stands of Grey Box trees up to 25 m high in the offset areas with a grassy understorey. Other occasional canopy species included Fuzzy Box and Blakely's Red Gum. Where it occurs in low-lying areas, the community grades into other box woodlands and occurs at the foot slopes of the Blue-leaved Ironbark Woodlands (Figure 3.1).

Most Inland Grey Box remnants in the Project area had been subject to high levels of disturbance such as logging, grazing (cattle and sheep), sheep camps and exotic species invasion.

ii Offset areas

Inland Grey Box Woodland in the offset areas was characterised by a grassy understorey with a sparse to absent shrub cover, with occasional Cough Bush and Sifton Bush. There was usually a dense leaf litter present, with low cover of rock, mosses and lichen. Regeneration was recorded in remnants not impacted by grazing.

Small areas of grassland derived from this community were also present in the offset areas (36 ha), but were not mapped as DNG as they conformed more to the description of native pasture and do not meet the EPBC Act description. In time and with appropriate management, these remnants are likely to form viable components of the community but have not been included in the offset calculations.



Woodland threatened ecological communities in the offsets (EPBC Act listed)

Cobbora Coal Project: Biodiversity Offset Package

Figure 3.1

3.3 Threatened flora species

Three EPBC Act listed flora species will be impacted by the Project. The number of individuals or stems has been included for these species in the EPBC offset calculations. It was assumed that the future value of the threatened flora without the offset would be reduced from the current value by 50% as a result of agricultural activities and the potential for future clearing and wood collection in these areas over a ten year period. Continued grazing and agricultural disturbances are likely given the existing management and land use of these areas.

3.3.1 Homoranthus darwinioides

i Project area

One of the identified populations of *Homoranthus darwinioides* will be impacted by the Project. Approximately 55% of the sub-population (127 individuals) and 30% of the overall local populations will be impacted. The impacted sub-population occurs in an area of Dwyer's Red Gum Woodland, Blue-leaved Ironbark Woodland and surrounding regrowth. *H. darwinioides* is most abundant where the canopy is sparse. In the regrowth areas, it occurs as large solitary plants on open ground amongst dense patches of Sifton Bush. The sub-population occurs on a light brown sandy loam with loose sandstone rocks at the surface.

Two distinct meta-populations of *H. darwinioides* occur in the region, with one to the north-west of the Project area in and surrounding Goonoo SCA and another to the east associated with the Goulburn River National Park. The Project area is between these and forms a new meta-population area.

ii Offset area

A population of approximately 200 individuals occurs in the proposed offset areas. This sub-population is located in Blue-leaved Ironbark Woodland. The dominant shrub species was Common Fringe-myrtle. Other species recorded included Silver-leaved Ironbark (*E. melanophloia*), Black Cypress Pine, *Allocasuarina gymanthera,* Spurwing Wattle *(Acacia triptera), Philotheca ciliata,* Wattle Mat-rush *(Lomandra filiformis* subsp. *filiformis)* and *Platysace linearifolia*.

In addition to this, but excluded from the offset calculations, an additional population of 100 individuals (adjacent to the impacted sub-population) will be managed on CHC property outside the Project area. Further, the offset areas adjacent to Goonoo SCA contain potential habitat for this species, however it has not yet been identified in these areas.

Limited recruitment was observed in the impact or offset areas. Little is known about this species reproduction, however seed was collected from the impact population in 2013 and germination and propagation trials are underway.

The main identified threats to *H. darwinioides* are localised extinction due to stochastic events, feral animals in particular European Rabbit (*Oryctolagus cuniculus*) and Feral Goats (*Capra hircus*), stock impacts from grazing and trampling; erosion of sandstone habitat and inappropriate fire regimes (TSSC 2008a). If the offsets are not protected, *H. darwinioides* will be at threat particularly from feral animal and stock grazing which currently occurs at the proposed offset sites. It is considered that the proposed management measures in the offset areas will reduce the risk of these threats to the existing population. The populations outside the offset areas on CHC-owned land, will also be managed under the Integrated Land Management Plan, to reduce such threats and will assist in the long-term survival of the local population. In addition, the proposed propagation trials will add to the available data for this species and aid in its long-term recovery in the region.

Additional plants may establish as a result of the proposed management of the offset areas, propagation trials and proposed translocation program (calculations assume an additional 200 individuals made up of approximately 100 individuals from translocation and 100 from the propagation of cuttings). Propagation trials from seeds are currently underway for this species and trails with cuttings are also planned. *Homoranthus darwinioides* is able to be propagated from seeds, but is grown fairly easily from cuttings of new growth (Australian Native Plant Society 2009). Therefore it is assumed that this outcome can be achieved at the offset sites in 10 years with active and adaptive management to minimise threats and promote recruitment. Therefore the calculations assume 40% for confidence in these outcomes.

3.3.2 Ingram's Zieria

i Project area

Sub-populations of Ingram's Zieria to be impacted by the Project range from poor to good condition. Some areas appear to be subject to intense grazing pressure, potentially from stock and invasive species, but also from native species. In Blue-leaved Ironbark Woodland, this species sometimes occurred at disturbed track edges in close proximity to fallen timber, which appeared to be affording individual plants some of protection from herbivores.

In other Project areas, the sub-populations are being 'shaded out' by other shrub species which have regenerated as a result of good seasons and recent ground disturbance for fence installation by grazing. Such areas are considered to be in lower condition. Other areas which contain large numbers of plants and regeneration evident, are considered to be in good condition.

This species has a restricted distribution. The Project area represents the known eastern extent of the species in the region (DEWHA 2007). However only 6 of the 15 sub-populations in the locality will be impacted by the Project and this impact will not influence this distribution.

A number of the populations are isolated and contain few individuals. Generally, the Project avoids impacting on the identified large populations of the species, which will be more viable in the long-term. The species is relatively common where it occurs in the Project area in suitable habitat. The current sub-populations appear to be stable, with only a couple of the sub-populations (eg sub-population 4) containing new individuals.

ii Offset areas

Eight sub-populations of Ingram's Zieria were identified in the offset areas. A total of 1,435 plants have been recorded in these areas (Table 3.2). Other populations may occur in the offset areas which have not been surveyed in detail.

Table 3.2 Ingram's Zieria populations in the offset areas

Population number	Number of Individuals	Offset area	Description of sub-population	Vegetation community
3	340	Zieria patch	Located on a small grassy hill surrounded by paddocks. Small rock outcrops occur throughout with the plants generally below these areas on flatter ground. The sub-population ranges from north-facing slopes to south-east facing slopes and flat ground. Open woodland with a high percentage of bare ground. Individuals had set seed in November 2011 in this area.	Blue-leaved Ironbark Woodland and Dwyer's Red Gum Woodland
11	28	Eastern link area	On an eastern-facing slope in open woodland.	Blue-leaved Ironbark Woodland, Dwyer's Red Gum Woodland and Cypress Pine Woodland
12	70	Eastern link area	On a flat to north-facing gentle slope. Adjacent to a population of Homoranthus darwinioides. It occurs in a rocky area where there is a low percent canopy cover and a high proportion of open ground. The sub-population contained seedlings and some older plants.	Blue-leaved Ironbark Woodland and Cypress Pine Woodland
13	25	Eastern link area	Plants were predominantly located on the midslope with some plants recorded at the base of gentle slopes.	Blue-leaved Ironbark Woodland
14	23	Eastern link area	Plants recorded on the upper parts of south to south-east facing slopes. The sub-population contained seedlings and some older plants in open woodland with a low sparse shrub layer and scattered grass tussocks.	Blue-leaved Ironbark Woodland
15	216	Cobbora additions	Plants were recorded on a number of rocky knolls.	Dwyer's Red Gum amongst Blue-leaf Ironbark and near patches of Red Stringybark Woodland
16	5	Goonoo addition	Plants were recorded in two areas on a slight slope.	Dwyer's Red Gum amongst Blue-leaf Ironbark and near patches of Red Stringybark Woodland
17	728	Goonoo addition	Plants were recorded on a cleared track and in adjacent bushland on a hillslope.	Dwyer's Red Gum amongst Blue-leaf Ironbark
Total	**1,435**			

As with the Project area, some of the offset sub-populations are in good condition and others in poorer condition. A number of the larger populations in the offsets contain significant regeneration, with a number of new individuals less than 10 cm tall. Other sub-populations appeared to be affected by grazing, with a number of individuals having few remaining leaves. Therefore the condition is similar to the Project area.

The offset sites, particularly in the north, contain large areas of suitable habitat for this species. This includes large areas of Blue-leaved Ironbark Woodland adjacent to Dwyer's Red Gum Woodland which is where this species was most commonly observed in the Project area. The populations in the northern sites did not appear to have been affected as much as those in the Project area and southern offset areas from grazing.

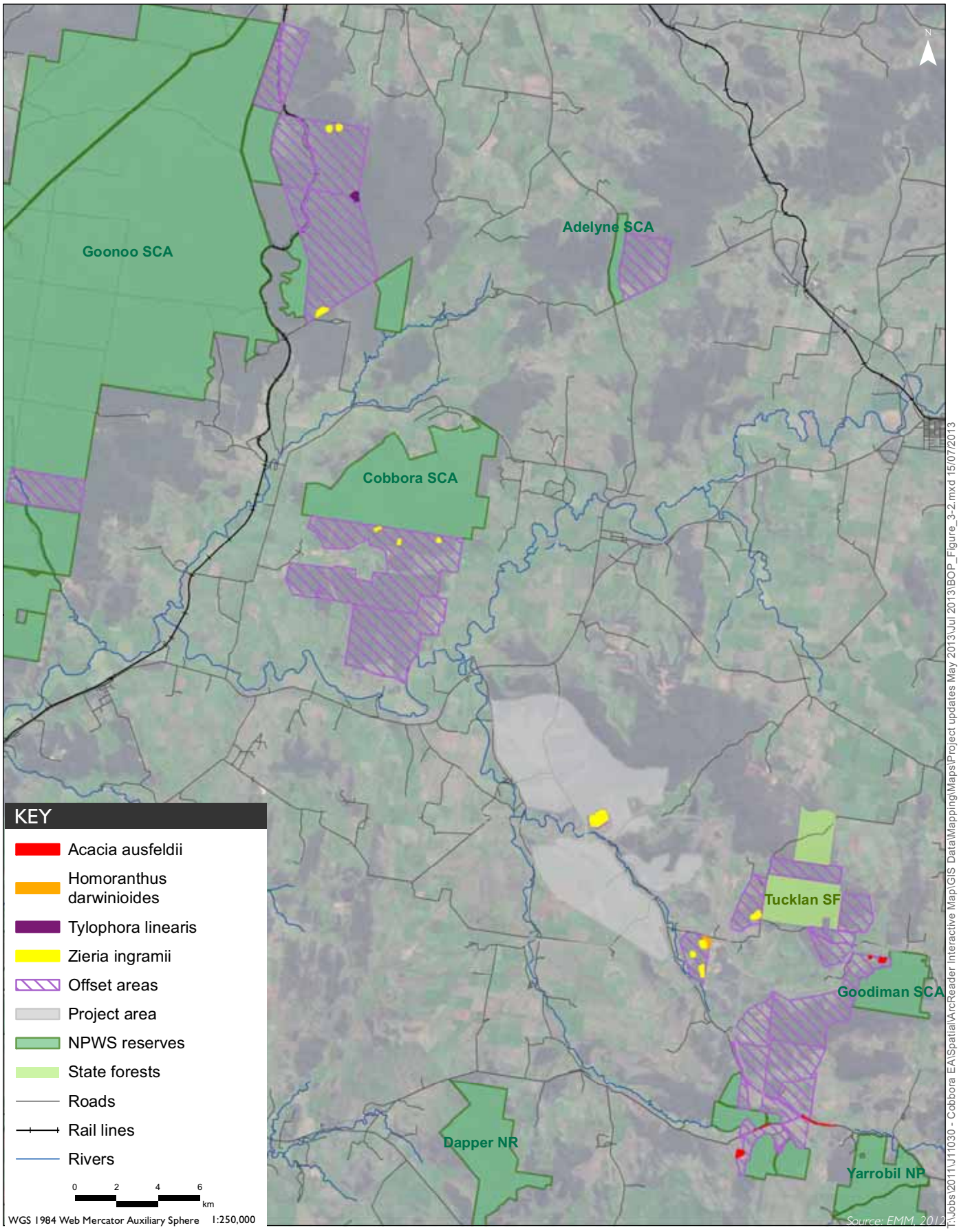
As with the Project area, sub-populations of Ingram's Zieria are isolated and fragmented in the offset areas as a result of habitat preferences and past agricultural influences. Three sub-populations occur in the offset areas, one south-east of and extending into the Project area, one to the north associated with the Cobbora SCA additions and another further to the north associated with the Goonoo SCA additions. The south-eastern sub-population is at the eastern extent of the known distribution of the species. The other sub-populations are in the known range of the species, but extends the known population boundaries into unsurveyed habitat.

In addition to the offset sites, some additional populations occur in the Project area, outside the mining footprint. These will be monitored and managed in accordance with the Integrated Landscape Management Plan. These individuals are additional to the offsets and therefore have not been included in the offset calculations.

A total of 480 individuals will be impacted by the Project and 1,435 individuals have been identified in the offset areas. As with the Project areas, the species is relatively common where it occurs in the offset areas in suitable habitat. Significant new growth and individuals were observed in recently disturbed areas in the offsets, however individuals in other offset areas are under threat from grazing.

Additional populations may occur in the offset areas and additional plants are likely to establish as a result of the proposed management and propagation trials (seeds, cuttings and natural recruitment assume an additional 700 individuals). Propagation of *Z. ingramii* cuttings was attempted by the Australian National Botanic Gardens in Canberra on numerous occasions with up to 81% strike rate, however difficulties were encountered in growing plants on after propagation (DEWHA 2007). *Z. ingramii* individuals have been successfully propagated from seed as part of the propagation trials for the Project by Bilby Blooms near Coonabarabran NSW. The propagation trials are planned to include the use of cuttings for this species.

It is assumed that the proposed increase in plants at the offset sites can be achieved in 10 years with active and adaptive management including feral animal control (preventing grazing), replanting of propagated individuals and introduction of translocated individuals (approximately 400 individuals). It is evident that where threatening processes are active in the locality, including grazing by feral herbivores, this species is being impacted. Conversely, in those areas where such impacts were not observed, significant natural regeneration was observed. Therefore the calculations assume 40% for confidence in the outcomes associated with management.



Threatened flora in the offsets (EPBC Act listed)

Cobbora Coal Project: Biodiversity Offset Package

Figure 3.2

3.3.3 Tylophora linearis

i Project area

Nine individuals of *Tylophora linearis* were recorded in the central portion of the study area in Dwyer's Red Gum Woodland and Blue-leaved Ironbark Woodland. All plants recorded were growing amongst *Lepidosperma* sp. or *Gahnia* sp., where they appeared to be afforded protection from grazing. A total of nine individuals were identified in two areas.

Subsequent surveys of the population identified that plants were being adversely affected by grazing and the area was fenced off from stock. Only one individual was identified during the last survey in the area in early 2013.

A second population has been identified south of the Project area along the road verge of Spring Ridge Road near Yarrobil National Park. The population was identified during surveys by Council for a proposed road upgrade. Approximately 25 individuals occur in this new population. This new population contained seed capsules in April 2013.

ii Offset area

A sub-population of *T. linearis* was identified in the offsets, adjacent to Goonoo SCA. The species was identified in early May and no flowers or seeds were present.

The sub-population (45 individuals) occurs adjacent to a fence line which had been recently disturbed for the installation of a new fence. The area has been subject to previous logging with a disused milling area nearby. The vegetation was dominated by Blue-leaved Ironbark in open woodland with a high percentage of bare ground (25%). The species was often identified adjacent to *Gahnia spp*. which appeared to be affording individuals protection from grazing but also providing a platform for growth. Others were in open areas and did not may have been grazed though new growth was evident. A sparse shrub and small tree layer was present with Wedge-leaved Hop-bush (*Dodonaea viscosa* subsp. *cuneata*), Cough Bush, she-oaks (*Allocasuarina sp*.), Varnish Wattle (*Acacia verniciflua*), Bulloak (*Allocasuarina luehmannii*) and Cherry Ballart (*Exocarpos cupressiformis*). Other understorey species included *Lepidosperma laterale*, Urn Heath (*Melichrus urceolatus*) and *Persoonia spp*. The soils in the area were sandy loam and the site occurred on a crest.

The main identified threats to *T. linearis* include forestry activities, disturbances such as grazing and fire, and invasion of habitat by introduced weeds (TSSC 2008b). Both the identified sub-populations did not contain any exotic species and there was no evidence of herbivory on these plants, with new growth recorded in both areas. Recent disturbance near the first sub-population included the installation of a fence and associated clearing immediately adjacent to the population. No new individuals were identified in the disturbed areas.

A total of 45 individuals have been identified in the proposed offsets, however it is anticipated that additional populations occur, but are yet to be surveyed in the locality (NSWSC 2008). As the reproductive capacity of this species is largely unknown, only five additional individuals have been included in the offset calculations and therefore it is considered conservative. A 20% confidence has been placed on the assumption that these individuals will remain with management, although it is likely to be higher.

3.4 Threatened fauna species and habitat

Threatened fauna species habitat was used for the calculations in the absence of detailed information on the number of habitat features, birth rate or mortality rate for such species.

The characteristics of each threatened fauna species were considered to determine the appropriate condition of the impact and offset areas. Information on the condition, including important habitat features, and the context of the sites were assessed to provide an overall habitat condition value (Table A.3 and Table A.4). Site context included proximity of the area to other habitat areas and movement corridors when considering mobility of species or breeding opportunities.

3.4.1 Australasian Bittern

i Project area

The dams, soaks and ephemeral creeks of the Project area contain suitable habitat for the Australasian Bittern (*Botaurus poiciloptilus*). It was recorded in the north of the study area, along Dannabar Road in a cleared habitat near a small dam where numerous frogs were calling (spotlighted at night). The Project area also includes dams with tall, dense vegetation such as Bullrushes (*Typha spp*.) providing potential habitat for this species (Morcombe 2000). Occasional scattered records in the wider region over the last 30 years, however strongholds in the region appear to be associated with forests in the west and the Newcastle estuary.

It is considered unlikely that this species would be breeding in the area. Available data indicates that the Australasian Bittern breeds in relatively deep, densely vegetated freshwater swamps and pools, building its nests in deep cover over shallow water (SEWPaC 2012). No such areas occur in the Project area.

A total of 9 ha of habitat including dams, soaks and wet riparian areas, which provide potential non-breeding habitat for this species, will be impacted by the Project.

ii Offset areas

The proposed offset sites include a number of dams, soaks and wet riparian areas which contain potential habitat for this species. A total of 44 ha of such habitat have been recorded in the offset areas. The Australasian Bittern has not been recorded in the offsets, however dedicated fauna surveys have not been conducted throughout most of the offset sites. No suitable breeding habitat is considered to occur in the offset areas.

3.4.2 Large-eared Pied Bat

i Project area

Rocky outcrops were recorded in the hills and low escarpments in the northern section of the Project area. Rocky outcrops, small caves and overhangs in this area provide breeding habitat for some bat species, however no evidence of this was observed during the surveys. The Large-eared Pied Bat was recorded by ERM using an Anabat detector to the south-east of this area, outside the current Project footprint.

Large populations of Feral Goats (up to 20 individuals) were recorded in these areas and appeared to be causing significant degradation to understorey vegetation and tree trunks. Evidence of the use of some of the caves and overhangs was also present with goat scats in many of these structures, particularly in the south-east of mining area C. Many suitable roost caves in the Pilliga that have been used by Feral Goats or other animals are subsequently not used by the Large-eared Pied Bat (SEWPaC 2013a).

With the Project revisions, approximately 14 km of cliff line habitat will be removed. Changes around waste rock emplacement area B OOP-E have reduced in the length of cliff line that will be impacted. Not all identified cliff habitat provides suitable roosting or breeding habitat for the Large-eared Pied Bat. Recent studies in the greater Sydney region have identified that totally cleared land does not provide suitable habitat for this species (DECC 2007). There was also a relationship with disturbance, probably reflecting a preference for vegetation on fertile soils, which is mostly disturbed to some degree. It is estimated that 1,192 ha of woodland and regrowth that provides potential foraging habitat for this species will be impacted by the Project. As most of this vegetation does not occur on fertile soils, only some of this area contains foraging habitat for this species. However the total area of woodland habitat has been used for the calculations using a conservative approach.

Clearing or timber harvesting in or around roosts has the potential to affect foraging resources and fragment surrounding vegetation for this species (SEWPaC 2013; DERM 2011). The woodland areas of the Project area have been heavily logged and therefore the condition of the habitat provided is considered to be of lower quality than that of nearby conservation areas.

ii Offset areas

More than 32 km of cliff line habitat has been identified in the offset areas. This includes some cave structures and overhangs where bat droppings were identified. Caves occur predominantly in the southern offset areas as well as the eastern link area, Cobbora SCA additions and Adelyne SCA additions. Few rocky outcrops occur in the northern offset sites adjacent to Goonoo SCA. Feral Goats did not appear as common in the offset areas as in the Project area along the ridgelines. However, it may be this species may be impacting potential habitat for the Large-eared Pied Bat in the offsets given their proximity in the south to the Project area.

Initial Anabat detection surveys have not identified this species in the offsets. However, a total of 5,792 ha of woodland and regrowth occur in the proposed offset areas and are considered to provide potential foraging habitat for the Large-eared Pied Bat. Given the location of the record adjacent to the Project area, it is considered that if present, the species would be occupying the southern offset areas.

3.4.3 Regent Honeyeater

i Project area

This species was not recorded in the Project area, however suitable foraging and breeding habitat is considered to be present. It has been previously recorded east of Cobbora SCA and east of Cope State Forest in proximity to the Project area. It is recorded as a rare visitor to the Dubbo area, with breeding recorded near the local forestry office (Hosking *et al.* 2009). A number of very old records (from 1910 – 1920) occur in proximity to the Project area. However no recent records occur in the locality. Known breeding areas (not key breeding areas) have been identified nearby in the Warrumbungle NP, Pilliga forests and Mudgee-Wollar region. The Project area provides suitable breeding habitat, however given its lack of occurrence during the breeding season over a number of years of survey, it is unlikely that it is an important area for the species, should it occur.

Potential foraging habitat is present for this species in Box Gum Woodland and ironbark/stringybark woodlands that contain large numbers of mature trees, high canopy cover and abundance of mistletoes. Key eucalypt feed species are present (Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box, Inland Grey Box, Narrow-leaved Ironbark (*Eucalyptus crebra*), Red Stringybark (*Eucalyptus macrorhyncha*), Rough-barked Apple and mistletoes) as a foraging resource for this species (DEC 2005). According to the likely vegetation types associated with this species in the Central West region, 1,127 ha of suitable habitat will be impacted by the Project area.

ii Offset areas

As with the Project area, the offset areas provide potential habitat for this species. The Regent Honeyeater (*Anthochaera phrygia*) has not been recorded in the offset areas, however dedicated fauna surveys have not been undertaken in the northern offset sites. According to the likely vegetation types associated with this species in the Central West region, 5,226 ha of potential habitat occurs in the offset areas.

3.4.4 Southern Long-eared Bat

i Project area

The Southern Long-eared Bat (*Nyctophilus corbeni*) was recorded in Scribbly Gum woodland close to Spring Ridge Road, with one individual trapped. The Project will not directly impact this area. This species is unable to be identified using ultrasonic detection and therefore trapping is required to confirm its presence. Given the open nature of the Project area, bat trap success was low. It may be more common in the locality than this record indicates, as it is known to be common in nearby conservation areas (NPWS 2000).

This species roosts in hollows of live trees which are also used as maternity sites. Individuals forage up to 3 km away from the roost and are most abundant where the vegetation has a canopy and a dense cluttered understorey layer. It is most commonly recorded in box, ironbark and cypress open forests of inland northern NSW (Churchill 2008; Schulz and Lumsden 2010).

The Project area provides 1,340 ha of potential foraging habitat for this species, with hollow-bearing trees providing suitable breeding and roosting habitat. Hollow-bearing trees are considered a limiting resource in the area. The woodland of the Project area has been heavily logged and therefore the condition of the habitat provided is considered to be of lower quality to that of nearby conservation areas. The Project area is also isolated from nearby conservation reserves through agricultural land uses, limiting genetic exchange between populations of this species.

ii Offset areas

Bat trapping surveys were conducted in the southern offset areas in spring 2012 (one week). This species was not detected in any of the proposed offset areas. However, the recorded location occurs in proximity to the proposed eastern link offset areas.

The Southern Long-eared Bat has been recorded in the Goonoo SCA, being one of the most common and widespread bats detected by harp-trapping in this reserve (NPWS 2000). A number of the proposed offset areas occur immediately adjacent to this reserve and are likely to provide suitable habitat for this species.

The proposed offset sites, particularly those in the southern offset areas have been subject to logging. Generally there are more hollow-bearing trees in the offset areas and therefore potential roosting and breeding habitat in the offsets, when compared with the Project area.

A total of 6,167 ha of woodland and regrowth occur in the proposed offset areas and are considered to provide potential foraging, roosting and breeding habitat for this species. Given the location of the record adjacent to the Project area and eastern link offset area, it is considered that if present, the species would be occupying this habitat particularly in the southern offset areas. Given the known presence in the Goonoo SCA, it is also likely that this species occurs in the northern offset areas.

3.4.5 Spotted-tailed Quoll

i Project area

This species was not recorded in the Project area, however suitable foraging, den and breeding habitat is considered to be present. A number of large rocky outcrops and areas of fallen timber, which is abundant due to the logging history, provide suitable potential den habitat for this species in the Project area.

The areas of remnant vegetation along the riparian zones and hills are likely to provide foraging habitat and movement corridors for this species. With the Project revisions, approximately 14 km of cliff line habitat and 167 ha of suitable habitat (a reduction of 2.7 km of cliff line), according to the likely vegetation types associated with this species in the Central West region (OEH 2012), will be removed by the Project. These areas provide potential habitat for this species.

ii Offset areas

The Spotted-tail Quoll (*Dasyurus maculatus*) has not been recorded in the offset areas, however detailed fauna surveys have not been conducted in the northern offsets. Records exist at the south of Goonoo SCA (from 2007) in the area of the northern offset sites. However no other records exist in the area for this species.

More than 32 ha of cliff line habitat has been identified in the offset areas. According to the likely vegetation types associated with this species in the Central West region, more than 2,240 ha of potential habitat occurs in the offset areas for this species (OEH 2012). It is possible that additional vegetation types outside these also support this species in the region. As with the Project area, the offsets also contain vegetated riparian zones and large tracts of native vegetation which may be used as habitat and movement corridors for this species.

3.4.6 Superb Parrot

i Project area

The Superb Parrot (*Polytelis swainsonii*) was recorded throughout the Project area and surrounds following a mass flowering event in the locality. Foraging habitat for this species in the Project area was recorded in box woodlands and ironbark/stringybark woodland. According to the likely vegetation types associated with this species in the Central West region, the Project will impact on 304 ha of suitable habitat for this species (OEH 2012). This includes the grassy box woodlands, stringybark woodlands and Mugga Ironbark woodlands.

Nesting habitat is available in hollows of large trees (dead and alive) in open Box Gum Woodland and in isolated paddock trees. Potential nest tree species are present in the Project area and include Blakely's Red Gum and Yellow Box, although core breeding habitat is at least 200 km to the south of the Project area (Baker-Gabb 2005; Webster 1988; Webster and Ahern 1992). No individuals were recorded as breeding in the Project area, despite the species being recorded in the Project area during the breeding season. This species nests in small colonies, often with more than one nest in a single tree (DEC 2005).

ii Offset areas

According to the likely vegetation types associated with this species in the Central West region, the offset areas contain 2,961 ha of suitable foraging habitat for this species. This species was recorded on a number of occasions in the eastern link offset areas and southern NPWS addition offset areas during a mass flowering event. It may be following such events, it would also occur in the northern offset areas.

As with the Project area, it is unlikely that the species breeds in the area, however suitable hollow resources occur throughout the offset sites for breeding habitat for this species. In particular, large areas of Blakely's Red Gum with hollows occur in the northern offset areas.

3.4.7 Swift Parrot

i Project area

The Swift Parrot (*Lathamus discolor*) was not recorded in the Project area. It has not been recorded previously in the Talbragar CMA subregion, but is predicted to occur, and is known from the Upper Slopes subregion both of which occur in the Project area (DEC 2005). Potential foraging habitat is available throughout the Project area with favoured feed trees including winter flowering species (Mugga Ironbark, White Box and Inland Grey Box) occurring in a number of areas. A total of 1,196 ha of foraging habitat with known feed trees has been identified in the Project area. According to the likely vegetation types associated with this species in the Central West region, most of the vegetation types recorded in the Project area contain suitable foraging habitat for this species (OEH 2012).

ii Offset areas

As with the Project area, most of the proposed offsets contain suitable foraging habitat for this species with large areas containing known feed trees for this species. A total of 5,972 ha of foraging habitat with known feed trees as a dominant species occur in the offset areas. However, most of the woodland in the offset areas is considered to provide potential foraging habitat for this species.

3.5 Commonwealth offset principles

The Commonwealth offset principles have been considered in the formulation of the offset package. Table 3.3 details the consideration of these principles for the final offset package.

Table 3.3 Compliance with Commonwealth offset principles

	Principle	Compliance
1	Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	The offset package aims to increase the existing conservation network in the locality. Key areas have been included that contain known and potential habitat for matters of NES that will be impacted by the Project. These additions will create links and extensions to the conservation network which would otherwise be at risk from key threatening processes.
2	Be built around direct offsets but may include other compensatory measures	The offset package is based on direct, land-based offsets which meet the minimum 90% requirement under the EPBC Act Environmental Offset Policy. It will also include some indirect offset measures such as translocation or propagation and supplementary planting of threatened flora populations.
3	Be in proportion to the level of statutory protection that applies to the protected matter	The EPBC Act Environmental Offset Policy and offset calculator have been used to determine if adequate offsets have been provided for matters of NES. The calculator accounts for the various levels of statutory protection for each matter of NES and therefore the offset package.
4	Be of a size and scale proportionate to the residual impacts on the protected matter	The EPBC Act Environmental Offset Policy and offset calculator determine if the offset proposed is proportionate to the residual impacts to each matter of NES. The offset package meets the requirements of the policy for all matters of NES and is considered to be suitable to compensate for the residual impacts of the Project. In most cases, the minimum requirements have been exceeded for threatened species from the proposed offsets.
5	Effectively account for and manage the risks of the offset not succeeding	The EPBC Act Environmental Offset Policy accounts for uncertainty with the offsets within the calculations. This includes assessing the risk of the offset not succeeding. CHC is committed to implementing the proposed offset package, to ensure that the policy is met for all matters of NES. The biodiversity values discussed in this offset package will be managed for conservation in the long-term to compensate for the Project impacts. The offset management plans will include monitoring and an adaptive management framework to ensure that additional measures are implemented, should this be required.
6	Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The proposed offset package provides for the protection of biodiversity values for each of the matters of NES identified within the Project area or with a high likelihood of occurring. The offset properties are privately owned and are currently unprotected from threatening processes which have the potential to impact on matters of NES. The offset package is additional to any other requirements, but includes values which will be used to offset impacts on those matters of NES which are also listed in NSW under the TSC Act.
7	Be efficient, effective, timely, transparent, scientifically robust and reasonable	The offset package will be delivered over the next 12 months. This will include the procurement of the final offset properties and management actions required in the offsets prior to transfer to NPWS. The methods behind the offset package have been provided in the offset strategy and the biodiversity values of these areas have

Table 3.3 Compliance with Commonwealth offset principles

	Principle	Compliance
		been presented here and in earlier offset update documents. The adequacy of the offset package proposed has been assessed against state and Commonwealth requirements and is considered to adequately compensate for the impacts of the Project on matters of NES.
8	Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	The majority of the offset areas will be transferred to NPWS estate with management funds to ensure ongoing management for conservation outcomes. The remaining offset areas will be protected in perpetuity and managed for conservation. The biodiversity values in these areas will be monitored over the life of the mine, with reporting to relevant government agencies.

4 OEH offset calculations

4.1 Overview

The offset calculations including offset ratios and Biobanking calculations have been updated based on the mine plan revisions and the final offset package. These have been presented in this chapter.

OEH have also requested additional information on the habitat values of the offset areas for threatened species, further justification for the number and location of crossing structures and consideration of indirect impacts of the Project and compensate for these via offsets where appropriate. This additional information has also been included in this chapter.

4.2 Offset ratios

The offset package will result in an overall offset to impact ratio for woodland, regrowth and derived native grasslands of 4:1. When combined, the TECs will have an offset to impact ratio of 5.7:1. The offset package would result in a substantial increase in protected vegetation in the locality and region, complementing the existing conservation areas and providing management funding for biodiversity conservation.

In addition to the areas of woodland, regrowth and derived native grasslands, 1,580 ha of native pasture have been identified in the offset areas. The biodiversity offset management plan will provide measures to enhance the diversity and structure of these areas through natural and assisted regeneration and weed control. These additional areas have not been included in the offset calculations and are considered to be additional to the vegetated offsets proposed to compensate for the Project impacts on biodiversity.

Table 4.1 Offset to impact ratios

Vegetation type	Project area (ha)	Offset area (ha)	Offset to impact ratio
Box Gum Woodland EEC (includes DNG)	119	994	8.4:1
Inland Grey Box Woodland EEC (includes DNG)	79	196	2.5:1
Fuzzy Box Woodland EEC (includes DNG)	18	37	2.1:1
Sub-total TECs	**216**	**1,227**	**5.7:1**
Other woodland vegetation	1,695	6,447	3.8:1
Total woodland and DNG	**1,911**	**7,674**	**4:1**

4.3 Credit calculations for vegetation types

To determine the suitability of the final offset package against the OEH Interim Offset Policy, credits per hectare have been used as a surrogate for the Project and offset calculations, based on the original Biobanking calculations. The full vegetation type credit assessment is included as Appendix 2.

Tier 2 outcomes under the OEH Offset Policy are achieved for 5 of the 13 vegetation types impacted by the Project:

- CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland;
- CW112 Blakely's Red Gum - Yellow Box Grassy Woodland;
- CW145 Inland Grey Box Tall Grassy Woodland
- CW176 Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box Shrub - Tussock Grass Open Forest; and
- CW177 Red Stringybark Woodland.

The variation criteria have been applied under the OEH Interim Offset Policy, resulting in a Tier 3 outcome for the remaining vegetation types. The criteria can be applied in the absence of credits or offset sites on the market and in considering the overall cost of the offsets and whether these costs are reasonable given the circumstances and in comparison with recent approvals in the region (see the April Offset Update (EMM 2013)).

The Project achieves an overall Tier 3 outcome for vegetation types under the OEH Interim Offset Policy. Under the Tier 3 outcome, the minimum area standard for offsets is an offset to clearing ratio of 2:1. The offset to clearing ratio for the remaining vegetation types is closer to 3:1. This does not include the excess areas which are generated by the Tier 2 vegetation types, where these exceed the requirements. The offset package provides an overall outcome which exceeds the minimum standard Tier 3 outcome under the OEH Interim Policy.

4.4 Credit calculations for species

4.4.1 Threatened flora

The proposed offset areas contain populations of all four TSC Act listed threatened flora species to be impacted by the Project. When applying the Biobanking species credit calculations for the Project, the Project achieves an overall Tier 3 outcome for threatened flora, with Tier 2 outcomes achieved for Ingram's Zieria and Ausfeld's Wattle. Shortfalls for both *Tylophora linearis* and *Homoranthus darwinioides* can be compensated by the additional credits generated for Ingram's Zieria and Ausfeld's Wattle using the variation criteria under the OEH Interim Offset Policy (EMM 2012).

Table 4.2 Threatened flora species credit calculations

		Project area		Offset areas		Shortfalls (negative numbers)	Offset to impact ratio
Species	Tg value	Individuals impacted	Credits generated	Individuals offset	Credits generated		
Zieria ingramii	0.65	480	7,385	1,435	8,610	1,225	3:1
Tylophora linearis	0.125	9	720	45	270	-450	5:1
Homoranthus darwinioides	0.675	127	1,881	200	1,200	-681	1.6:1
Acacia ausfeldii	0.125	200	16,000	56,200	337,200	321,200	281:1

Note: The Tg value is the ability of a species to respond to management actions on a biobank site and is used in the offset calculations under the Biobanking calculations.

4.4.2 Threatened fauna and fauna habitat

Habitat values of the Project and offset areas have been provided in Chapter 3 for EPBC Act listed threatened species and ecological communities. Most of these are also listed under the TSC Act. Therefore, this section focuses on those species listed under state legislation for which additional information has not been provided.

The species credit outcomes have been determined for all threatened fauna recorded in the Project area or considered to have a moderate to high likelihood for occurrence (Table 4.3). A Tier 2 outcome is achieved for almost all threatened fauna species for which species credits exist, under the OEH Interim Offset Policy. The only species credit which is not achieved by the proposed offset package is Large-eared Pied Bat and Eastern Cave Bat potential roosting and breeding habitat. Neither species was recorded roosting in the Project area (recorded using an Anabat detector), however bat scats were identified in a number of overhang and cave structures in the offset areas. Excess credits are generated for other threatened fauna specie of the same conservation status, which can be used for a Tier 3 outcome for this factor using the variation criteria (EMM 2013).

The length of cliff line features was used to calculate potential breeding habitat credits for the Large-eared Pied Bat and Eastern Cave Bat (Table 4.3). All areas of woodland (excluding regeneration) were used to calculate the area of potential foraging habitat for this species as they are known to occur in well-timbered areas, particularly with gullies.

Table 4.3 Threatened fauna species credit calculations

		Project area		Offset areas		
Species	**Tg value[3]**	**Individuals/ habitat (ha) impacted[2]**	**Credits generated**	**Individuals / habitat (ha) offset[2]**	**Credits generated**	**Shortfalls (negative numbers)**
Large-eared Pied Bat (breeding habitat)	0.125	14 km cliff line	1,120	32 km cliff line	192	-928
Large-eared Pied Bat (foraging habitat)	0.75	1192 ha	15,893	5,792 ha	34,750	18,857
Australasian Bittern	0.75	9 ha	120	44 ha	264	144
Eastern Bent-wing Bat	0.75	37 ha	493	920 ha	5,522	5,029
Eastern Cave Bat (breeding habitat)	0.125	14 km cliff line	1,120	32 km cliff line	192	-928
Eastern Cave Bat (foraging habitat)	0.75	37 ha	493	1,345 ha	8,072	7,579
Koala[1]	0.825	342 ha	4,145	3,505 ha	21,028	16,882
Pale-headed Snake[1]	0.3	16	533	403 ha	2,416	1,883
Regent Honeyeater[1]	0.75	1,127 ha	15,027	5,226 ha	31,358	16,331
Sloane's Froglet[1]	0.75	9 ha	120	44 ha	264	144
Spotted-tailed Quoll[1]	0.35	167 ha	4,771	2,240 ha	13,441	8,670
Squirrel Glider[1]	0.45	106 ha	2,356	2,660 ha	15,959	13,604
Superb Parrot	0.525	304 ha	5,790	2,961 ha	17,763	11,973
Swift Parrot[1]	0.75	1,196 ha	15,947	5,972 ha	35,831	19,885

Note: *1. Species was not recorded in the Project area.*

2. Area of habitat was determined using the vegetation associations for each species identified on the NSW threatened species website (DEC 2005.)

3. The Tg value is the ability of a species to respond to management actions on a biobank site and is used in the offset calculations under the Biobanking calculations.

The following information was used to inform the species credit calculations. This section also provides an overview of habitat provided by the Project area and offsets for each of the species from Table 4.3 which are not listed under the EPBC Act and have therefore not been discussed in detail in Chapter 3.

i Bats

The offset areas contain a number of timbered gullies which provide suitable habitat for these species. Surveys in the offset areas as part of the monitoring and management program for the sites will target this species, however the Eastern Cave Bat has been recorded in the offset areas.

Key areas for the Eastern Cave Bat, from previous records, are associated with the Goulburn River NP in the east and the Warrumbungle NP in the north of the Project area. There are few records in proximity to the Project and offset areas. Therefore the Project area is not considered an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat components for foraging and roosting for this species.

Substantial cave and outcrops occur in the proposed offsets, which contained bat droppings during the offset surveys. It is considered that these areas provide suitable roosting and potential breeding habitat for these species.

ii Wetlands and soaks

Records indicate that Sloane's Froglet (*Crinia sloanei*) occurs in only a handful of locations in NSW, with a record from the late 1990's to the south-west of the Project area at Goobang NP. The low number of sites, low number of recorded individuals per site, and the low proportion of records of this species in regional surveys all indicate that a small number of mature individuals exist (OEH 2012). The absence of this species from the Project area is a likely indication that it does not occur in the locality, despite the presence of suitable habitat.

Dams, soaks and intermittently wet drainage lines were mapped in the Project area and offsets to determine the amount of habitat present for the Australasian Bittern and Sloane's Froglet. The offset areas contain a number of dams and drainage depressions, which provide suitable habitat for these species.

iii Pale-headed Snake

Type specimens were collected of the Pale-headed Snake (*Hoplocephalus bitorquatus*) from the Dubbo region in the 19th century. However no recent records occur in the region, with the closest records 150 km to the north of the Project area. Habitat in the form of dry sclerophyll forest near waterways provide suitable habitat for the Pale-headed Snake in the area.

Targeted reptile surveys failed to identify this species in the Project area. In both the Project and offset sites, hollow-bearing trees provide potential breeding habitat, while the dams and waterways provide foraging opportunities, with abundant frogs and small lizards, however none of the vegetation types associated with this species occur in the Project areas (OEH 2012).

iv Mammals

The Project area and proposed offsets contain a number of recognised secondary feed tree species for the Koala (*Phascolarctos cinereus*) including White Box, Yellow Box, Inland Grey Box, Tumbledown Gum (*E. dealbata*), Blakely's Red Gum, Fuzzy Box, Dwyer's Red Gum (*E. dyweri*) and the supplementary species Narrow-leaved Stringybark and Red Stringybark (DECC 2008). Records occur for this species to the south

around Mudgee and to the north associated with the Goonoo SCA and Dunedoo. A single record from 2004 occurs to the south of the Project area adjacent to Yarrobil NP in the southern offsets.

If this species occurs in the Project area or offsets, it must be in very low numbers as it was not identified during the numerous surveys conducted in the area. The area may be used as a movement corridor between more suitable primary habitat to the south around Mudgee and to the north. As the northern offset areas occur adjacent to the Goonoo SCA, the conservation of these areas will provide protection of additional food resources for the Koala in a known population area.

The Squirrel Glider (*Petaurus norfolcensis*) was not recorded in the Project area or offsets using hair tubes, infrared camera traps baited with honey spray or spotlighting. It has been recorded in the Goulburn River NP to the east of the Project area, around Dunedoo in 2004 and a single record occurs in Goonoo SCA. Several records also occur to the north associated with the Warrumbungle NP. Suitable habitat occurs in the Project area and the offset sites, particularly where hollow-bearing trees are present in the more productive areas. If it does occur in the locality, it would be in very low numbers due to the absence of records from numerous surveys in the Project area and scarcity of hollow-bearing trees.

4.5 Consideration of NSW offset principles

The OEH principles for offsetting in NSW have been considered in the formulation of the offset strategy. Table 4.4 details the consideration of these principles.

Table 4.4 Compliance with NSW offset principles

	Principle	Compliance
1	Impacts must be avoided first by using prevention and mitigation measures	The Project has aimed to avoid potential impacts where possible. Impacts on local wildlife corridors and threatened species habitat have been reduced by recent amendments to the mine plan (see Section 1.3.1). Offsets have only been recommended for those residual impacts that remain after avoidance and mitigation.
2	All regulatory requirements must be met	The Project will meet all regulatory requirements.
3	Offsets must never reward ongoing poor performance	The Project will implement best practice environmental management, rehabilitation and mitigation. The offset package has been developed according to relevant offsetting policies and will be approved by relevant government agencies.
4	Offsets will complement other government programs	Corridor mapping, OEH priorities and the Central West Catchment Action Plan (CW CMA, 2011) have been considered when identifying offsets sites. The offset package includes sites which build on the existing reserve network and creating corridors between conservation areas and areas of remnant vegetation. The proposed sites also correspond with local NPWS estate addition priorities.
5	Offsets must be underpinned by sound ecological principles	The strategy detailed in this document is in line with the OEH Offset Policy and the EPBC Act Environmental Offsets Policy which are based on sound ecological principles.
6	Offsets should aim to result in a net improvement in biodiversity over time	The offsets will ensure a net improvement in biodiversity in the locality in the long term through conservation management including minimising threatening processes. It will also protect areas from clearing associated with agricultural activities and timber collection as well as grazing impacts from stock. Along with the progressive rehabilitation of the mining area, the Project will result in an increase in the amount of remnant native vegetation and therefore fauna habitat in the locality and region.

Table 4.4 Compliance with NSW offset principles

	Principle	Compliance
	Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs	Offset sites will be protected into the future through secure land tenure for ongoing conservation management through an appropriate legal instrument including transfer to NPWS estate. Offset areas will be conserved in perpetuity, well beyond the mine life.
	Offsets should be agreed prior to the impact occurring	The offset package, including land acquisitions and covenants, will be finalised prior to removal of areas of TECs.
	Offsets must be quantifiable and the impacts and benefits must be reliably estimated	The Biobanking calculator was used to quantify the potential biodiversity impacts of the Project. The results were used in line with the OEH Interim Offset Policy to determine the adequacy of the offset package. The offset package is considered to meet an overall Tier 3 outcome under this policy.
	Offsets must be targeted	Offset areas have targeted the vegetation communities, TECs and threatened species habitats to be impacted by the Project. The offsets contain similar vegetation to the Project area and provide similar habitat values as those in the Project area. The offsets also contain known populations of most of the threatened flora and fauna species identified in the Project area.
	Offsets must be located appropriately	Offsets have been chosen to improve connectivity of remnant vegetation and protected areas in the locality. Offsets have been located in appropriate areas where potential socio-economic impacts are minimised, outside important agricultural areas and areas that have been identified as containing potential future coal resources.
7	Offsets must be supplementary	Offset areas are not already part of the reserve system and are therefore supplementary areas for the protection and enhancement of biodiversity values.
	Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract	All offset areas will be secured under appropriate mechanisms under the NPW Act, TSC Act, NCT Act or NV Act. The majority of the offset areas will be transferred to NPWS estate.

4.6 Other issues

4.6.1 Crossing structures

Three crossing structures for fauna have been proposed for movement corridors, along intermittent drainage lines and between areas of connecting vegetation to maintain fauna connectivity along the rail spur (Figure 4.1).

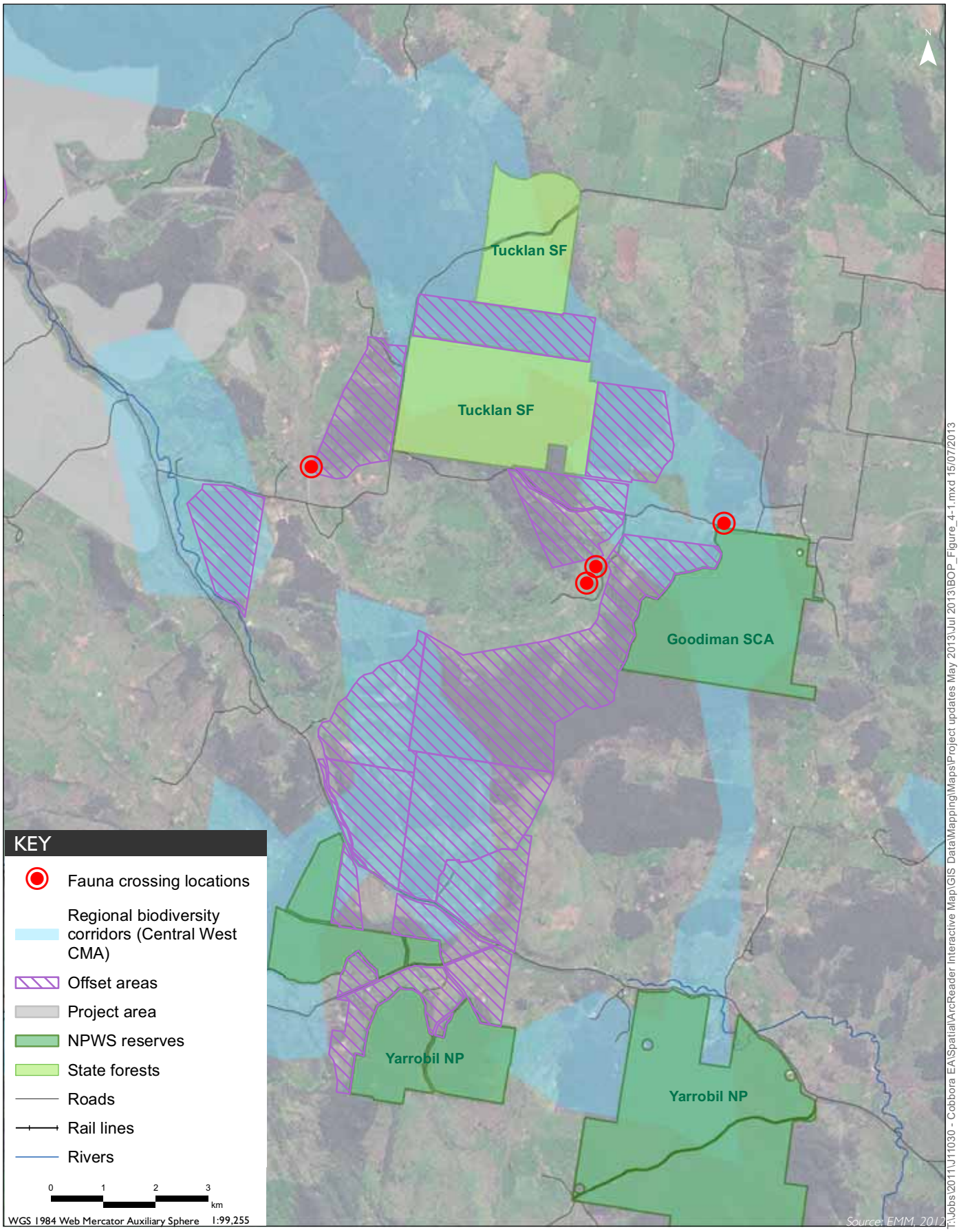
Wildlife will preferentially use certain landscape and topographical features (eg waterways and vegetated corridors) for movement and these features are therefore good locations for crossing structures (RTA 2012). Accordingly, crossing structures have been positioned in areas of likely high animal movement in consideration of the current and future vegetated corridors of the locality.

A landscape approach has been taken, considering the existing fauna corridors, and the potential barriers to fauna movement arising from the Project. The main linkage from Cobbora SCA to the Goodiman SCA will be severed by the rail spur. A number of riparian corridors occur through this area as well as a fragmented vegetation corridor associated with the Goodiman SCA and the remnant vegetation to the north. Future corridors associated with the proposed offset areas and vegetation corridor enhancement will provide important fauna movement corridors during the mine life and have also been considered for the location of fauna movement structures.

Species of concern include woodland birds which could be deterred from moving through open areas associated with the rail corridor and medium sized mammals which could strike with trains or may not be able to negotiate the built up rail corridor. As such, the movement structures have been designed with these species in mind. The feasibility and reasonability of the proposed crossing structures were determined in consultation with the design engineers and in consideration of the key species of concern and their status under relevant legislation.

The eastern movement structure will be designed as a bridge over a cutting. This crossing structure has been designed for woodland birds as many species are adapted to dense habitat and often avoid open spaces, such as roads, resulting in a loss of connectivity. The bridge structure will be vegetated and fauna habitat provided (fallen timber) to minimise the impacts from open areas on woodland birds in this area and promote use of the structure between habitat patches.

Kangaroos typically graze in open grassland. Areas of high kangaroo mortality often occur where transport infrastructure separate grassland or water sources from forest used for shelter (Ramp et al. 2005). Crossing structures for macropods and other mammals are proposed in anticipated movement pathways, close to areas of remnant vegetation which is likely to provide daytime shelter, or at watercourses according to best practice (RTA 2012). Fencing is likely to be installed in association with box culvert structures (3 x 3 m for kangaroos) to funnel fauna to the crossing locations.



Fauna crossing locations

Cobbora Coal Project: Biodiversity Offset Package

Figure 4.1

4.6.2 Indirect impacts

Using a conservative buffer distance of 50 m from the active mining and emplacement areas where potential indirect impacts could occur to species and habitat, an additional 167 ha of woodland and regrowth habitat would be affected by the Project. The majority of this vegetation is Blue-leaved Ironbark Woodland, with smaller areas of Regrowth, Red Stringybark Woodland and Fuzzy Box Woodland. The vegetation in this area may be impacted by changes in the microclimate, noise, dust and light from the mining and emplacement areas. This may impact on the ability of fauna to use these areas as habitat, reducing the area of occupancy available in the locality.

In areas along the rail spur near remnant vegetation and conservation reserves (Goodiman SCA), train movements may cause temporary impacts to species and habitat through edge effects. Temporary noise is not likely to interfere with vocal communication for woodland birds, however edge effects from disturbance associated with the train movements, may temporarily or perhaps more permanently result in the loss of the habitat available for such species. As this area is already subject to disturbances associated with a local road and powerline easement, it is likely that fauna using these areas are already habituated to edge effects.

As the mine will be progressively worked and rehabilitated, only small parts of the areas subject to indirect impacts will be disturbed at any one time. The northern boundary and associated adjacent vegetation of the mine areas will begin to be indirectly impacted from Year 4 with this area rehabilitated by Year 16, with a large proportion rehabilitated from Year 12. Likewise, the eastern boundary will begin to be exposed to potential indirect impacts from Year 4, with about half of this area rehabilitated by Year 12 and completely rehabilitated by Year 16. Therefore only small areas of vegetation to be retained will be exposed to indirect impacts at any one time throughout the life of the mine and any such impacts will be temporary.

As vegetation in these areas will not be removed, but only be temporarily disturbed or made unsuitable for certain species, any compensatory measures required for this impact would be less than if the habitat was to be removed altogether. Reducing the compensatory measures by 50% is considered appropriate for this. Using this discount measure and an average offset to impact ratio of 4:1 for woodland vegetation for the Project, an additional 334 ha of woodland would be required to offset any temporary indirect impacts of the Project.

The Project includes the progressive rehabilitation and revegetation of over 1,900 ha of woodland vegetation surrounding the mining areas. Rehabilitated areas will be available for fauna progressively throughout the mine life and to provide buffers from active mining areas to be retained habitat. This will minimise the potential indirect impacts during active mining.

A 185 ha biodiversity corridor will be established to the north of the Project area. This is additional to the offset package and mine rehabilitation proposed. This area will be regenerated using assisted natural regeneration techniques and provide a corridor for fauna movement through the area into the future.

It is considered that the proposed mine rehabilitation and 185 ha wildlife corridor (not part of the offset areas), along with the additional 1,580 ha of native pasture which will regenerate to woodland in the offset areas from conservation management (note these have not been included in the offset calculations), will be more than sufficient to compensate for the likely temporary indirect impacts on 167 ha of woodland and regrowth habitat.

5 Conclusion

Despite avoidance, minimisation and mitigation measures, some biodiversity impacts from the Cobbora Coal Project are unavoidable and offsets are required to compensate for these. Offsets are required for residual impacts to Box Gum Woodland, Inland Grey Box Woodland and Fuzzy Box Woodland TECs; Ingram's Zieria, *Homoranthus darwinioides, Tylophora linearis* and Ausfeld's Wattle; and threatened fauna habitat for microbats, woodland birds, owls and mammals.

This report outlines the final offset package for the Project, based on the offset strategy prepared as part of the EA for the Project (EMM 2012). It assesses the package against NSW and Commonwealth policies to ensure that the Project maintains or improves the biodiversity values of the region in the medium to long term.

The proposed offset package:

- provides a net improvement in the quantity, quality and conservation of biodiversity values within the region in the medium to long term through:
    - the regeneration and protection of woodland, particularly the Box Gum Woodland, Inland Grey Box Woodland and Fuzzy Box Woodland TECs; and
    - the protection of threatened flora and fauna habitat and habitat features (eg hollow-bearing trees).
- provides long-term protection for threatened flora and fauna and TECs;
- improves vegetation and habitat connectivity between existing conservation areas within the locality; and
- protects areas identified as key corridors within the Central West Catchment Action Plan (CW CMA 2011) and as NPWS conservation priorities.

The proposed offset areas are located adjacent to existing NPWS estate or in areas with important biodiversity values surrounding the Project area. OEH has been consulted to ensure that offsets accord with regional conservation priorities. High priority areas have been identified close to the Project area to the south of Goodiman SCA, and to the north of the Project area adjacent to Goonoo SCA, Cobbora SCA and Adelyne SCA. Significant wildlife corridors will be created in such areas by the permanent dedication to conservation, of land currently used for agricultural practices such as grazing and firewood collection. These areas contain known habitat for a number of threatened species and ecological communities and create links between and expand existing conservation areas.

The offset sites provide similar vegetation types and habitat to the Project areas. More than four times the woodland area to be impacted by the Project will be protected and managed for conservation in the offsets. This includes significant areas of Box Gum Woodland EEC (994 ha), Fuzzy Box Woodland EEC (37 ha) and Inland Grey Box Woodland EEC (196 ha).

Sub-populations of Ingram's Zieria, *Homoranthus darwinioides, Tylophora linearis* and Ausfeld's Wattle have also been identified in the offset areas. Other populations occurring outside the offset areas on CHC-owned land that will not be impacted by the Project, will be monitored for indirect impacts and managed over the life of the mine. With the recommended management strategies in these areas and the offsets, the long-term viability of these populations will be improved in the area as a result of the Project.

Numerous threatened fauna that were identified in the Project area have also been identified in the offset sites. Habitat for fauna in the offset sites include significant areas of cliff line habitat for microbat species including potential roost and breeding sites where scats were recorded, hollow-bearing trees and fallen timber, creeks and dams, and large tracts of remnant vegetation providing fauna corridors.

The biodiversity offset package meets both Commonwealth and NSW policy requirements. Under the EPBC Act Environmental Offset Policy, the 90% threshold has been reached for all matters of National Environmental Significance. The offset package will also result in an overall Tier 3 outcome under the OEH Interim Offset Policy, however higher Tier 2 outcomes are achieved for five of the vegetation types, two of the threatened flora species and 12 of the threatened fauna species values.

Key outcomes of the biodiversity offset package are:

- protection and enhancement of the ecological values (vegetation types and habitat values) that are impacted, within the same catchment management authority (CMA) region as the Project;
- conservation of areas which complement and add to the existing reserve system;
- conservation management to improve the habitat values of the offsets including invasive animal and weed control, assisted regeneration of woodland and habitat creation;
- provision of equivalent habitat with most threatened species recorded in the Project area also recorded in the offsets including significant populations of threatened flora; and
- protection and enhancement of substantial areas of threatened ecological communities (TECs).

References

Australian Native Plant Society (Australia) 2009, *Homoranthus darwinioides*, *viewed August 2013*, http://asgap.org.au/h-dar.html

Baker – Gabb, D 2011, National recovery plan for the Superb Parrot *Polytelis swainsonii*. Prepared by the Department of Sustainability and Environment

Central West Catchment Management Authority (CW CMA) 2011, *Central West Catchment Action Plan 2011-2012,* Central West Catchment Management Authority, Wellington

Churchill S 2008, *Australian Bats Second Edition,* Jacana Books, Crows Nest

Department of Environment and Conservation (DEC) 2005, Threatened species profiles for the Central Western CMA*, viewed May 30 2013,* www.threatenedspecies.environment.nsw.gov.au.

Department of Environment and Climate Change NSW (DECC) 2007, Bats: Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region -Fauna of Conservation Concern & Priority Pest Species, viewed 30 May 2013, http://www.environment.nsw.gov.au/resources/threatenedspecies/07471tpagssvol2pt12bats.pdf.

Department of Environment and Climate Change NSW (DECC) 2008, *Recovery plan for the koala (Phascolarctos cinereus).* Prepared by the State of NSW and the Department of Environment and Climate Change NSW.

Department of Environment and Resource Management (DERM) 2011, *National recovery plan for the large-eared pied bat Chalinolobus dwyeri.* Prepared by DERM for the Department of Sustainability, Environment, Water, Population and Communities.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2011, *EPBC Act Environmental Offsets Policy Consultation Draft,* Department of Sustainability, Environment, Water, Population and Communities, Canberra

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2012, Species Profile and Threats (SPRAT) Database, viewed 27 May 2013, http://www.environment.gov.au/sprat

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2013, *Chalinolobus dwyeri – Large-eared Pied Bat SPRAT Profile,* viewed 30 May 2013, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=183

Department of Environment, Water, Heritage and the Arts (DEWHA) 2007, *Zieria ingramii* Recovery Plan, viewed 30 May 2013, http://www.environment.gov.au/biodiversity/threatened/publications/recovery/zieria-ingramii/pubs/zieria-ingramii.pdf.

Department of Environment and Water Resources (DEWR) 2007, *Use of Environmental Offsets under the Environment Protection and Biodiversity Conservation Act 1999 Discussion Paper,* Department of Environment and Water Resources, Canberra

EMGA Mitchell McLennan (EMM) 2012, *Cobbora Coal Project: Biodiversity offset strategy.* Prepared for Cobbora Holding Company Pty Limited.

EMGA Mitchell McLennan (EMM) 2013a, *Cobbora Coal Project: Offset update – April 2013*. Prepared for Cobbora Holding Company Pty Limited.

EMGA Mitchell McLennan (EMM) 2013b, *Cobbora Coal Project: Preferred project Report and Response to Submissions*. Prepared for Cobbora Holding Company Pty Limited.

Hosking T, Hosking J and Geering D 2009, Dubbo Naturalists Bird list of the Dubbo area. Dubbo Field Naturalist and Conservation Society Inc.

Maguire, O & Mulvaney, M 2011, *Box Gum Woodland in the Act*. Technical Report 25 prepared by the Environment and Sustainable Development Directorate, Canberra.

Morcombe M 2000, Field guide to Australian Birds, complete compact edition. Steve Parish Publishing Pty Ltd.

NSW Scientific Committee (NSWSC) 2008,*Tylophora linearis* P.I.Forst (Apocynaceae) Review of Current Information in NSW, viewed 30 May 2013, http://www.environment.nsw.gov.au/resources/nature/schedules/Tylolinear.pdf.

NSW National Parks and Wildlife Service (NPWS) 2000, *Brigalow Belt South Preliminary Fauna Survey (Stage 1), NSW Western Regional Assessments*. Prepared by *the* NSW National Parks and Wildlife Service Western Directorate for the Resource and Conservation Assessment Council (RACAC).

Office of Environment and Heritage (OEH) 2011, Principles for the use of biodiversity offsets in NSW, viewed 30 May 2013, http://environment.nsw.gov.au/biocertification/offsets.htm

Office of Environment and Heritage (OEH) 2012, Threatened species profiles for the Central West CMA, viewed 30 May 2013, http://www.environment.nsw.gov.au/threatenedspecies/index.htm

Ramp, D, Caldwell, J, Edwards, KA, Warton, D, and Croft, DB 2005, 'Modelling of wildlife fatality hotspots along the Snowy Mountain Highway in New South Wales, Australia', *Biological Conservation* 126(4), pp. 474-490.

Roads and Traffic Authority (RTA) 2012, *Draft Wildlife Connectivity Guidelines: Improving wildlife connectivity on RTA projects*. NSW Roads and Traffic Authority, Sydney.

Schulz M and Lumsden L 2010, Draft National Recovery Plan for the South-eastern Long-eared Bat *Nyctophilus corbeni,* Victorian Department of Sustainability and Environment.

Threatened Species Scientific Committee (TSSC) 2008a, Approved Conservation Advice for *Homoranthus darwinioides*,viewed 30 May 2013, http://www.environment.gov.au/biodiversity/threatened/species/pubs/12974-conservation-advice.pdf.

Threatened Species Scientific Committee (TSSC) 2008b, Approved Conservation Advice for *Tylophora linearis*, viewed 30 May 2013, http://www.environment.gov.au/biodiversity/threatened/species/pubs/55231-conservation-advice.pdf.

Webster R 1988, *The Superb Parrot: a survey of the breeding distribution and habitat requirements*. Technical Report Series 12 prepared by the Australian National Parks and Wildlife Service.

Webster R and Ahern L 1992, *Management for the conservation of the Superb Parrot (Polytelis swainsonii) in New South Wales and Victoria.* Report prepared by the Victorian Department of Conservation and

Natural Resources for the New South Wales National Parks and Wildlife Service and Victorian Department of Conservation and Natural Resources.

Appendix A

EPBC Offset calculations

A.1 Box Gum Woodland

Table A.1 Impact site calculations Box Gum Woodland

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	Most patches to be impacted contain minimal regeneration, hollow-bearing trees and few if any forbs. Most of the habitat for this community has been cleared for agricultural purposes, with most remnants occurring in linear strips along drainage lines and depressions and road corridors. A number of the patches in the Project area are dominated by Rough-barked Apple often occurring with some individuals of Blakely's Red Gum. In most locations these were shrubby communities, but were included as part of the listed community using a precautionary approach. The Project generally avoids the areas of highest diversity and condition which were along the Spring Ridge Road south and Laheys Creek corridors. Remnants outside these areas are subject to grazing, weed invasion and have low species diversity. In most cases, these met the Commonwealth listing as a result of patch size being greater than 2 ha, however these patches are long linear remnants.	3
Context	3	Patches are isolated, often in linear strips along drainage depressions and road corridors. The EEC areas are not connected outside of these linear strips to any large conservation areas and most of the habitat for this community in the locality has been heavily disturbed and is now degraded from agricultural use.	2
Species stocking rate	2	The condition of the landscape and soils where Box Gum Woodland occurs has been degraded from historical and current agricultural practices. The areas between patches of the community now provide limited habitat for the ecological community which is fragmented and isolated. Box Gum Woodland occurs in similar habitats throughout the PAA and surrounding areas, with large remnants in roadside reserves, areas of crown land and conservation areas in the locality. Therefore, the Box Gum Woodland to be removed is not important to the extent of the ecological community in the locality and region.	1
Total	**10**		**6**

Table A.2 Offset site calculations Box Gum Woodland

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	Most of the Box Gum Woodland remnants surround the Project area and are in a similar condition. Areas of Box Gum Woodland in the northern offset areas are generally in better condition, but have been subject to grazing and other agricultural influences. Overall, the combined existing condition of the Box Gum Woodland patches is comparable to those in the Project area.	3
Context	3	As with the Project area, patches of Box Gum Woodland are isolated and fragmented in the offset areas, mainly being confined to drainage lines and roadside landscapes.	2
Species stocking rate	2	As with the Project areas, the extent of Box Gum Woodland in the offsets is not significantly important to the extent of the community in the locality and the region.	1
Total	**10**		**6**
Future quality			
Without	n/a	The majority of the patches of Box Gum Woodland in the offset areas are	5

Table A.2 Offset site calculations Box Gum Woodland

Attribute	Weighting	Reasoning	Score
offset		subject to agricultural disturbance, mainly grazing and wood collection. These disturbances are likely to continue in the absence of conservation management at these sites. The quality of Box Gum Woodland is decreased with such activities, with lower species diversity observed in areas which have been heavily grazed in the locality.	
With offset	n/a	The management of the offsets for conservation will reduce the current impacts on this community from agricultural disturbances. This is likely to improve the condition and habitat value of the areas identified as Box Gum Woodland and also potentially the areas adjacent which have been identified as derived native grasslands, but which do not currently meet the Commonwealth's description of the listed community. As a result, the species diversity and habitat complexity of the patches is likely to increase significantly.	7
Risk of loss in 20 yrs			
Without offset	n/a	The risk of loss in 20 years has been determined if no management actions were undertaken and considering the existing land use, zoning and management of the offset sites. The area is covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also the potential for clearing for agricultural practices, particularly the areas in which Box Gum Woodlands have been identified as these contain the more fertile soils of the woodland areas. In addition, limited regeneration and recruitment is evident in most of the areas, particularly in the south, as a result of current management regimes. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. Therefore, the areas of Box Gum Woodland may be lost from the proposed offset sites without protection from offsetting.	30%
With offset	n/a	The offsets will be protected from future clearing through conversion into the National Parks Estate or with conservation agreements on the land title. These communities may still be subject to impacts which could lead to their loss in the long-term despite these protection measures. With protection from offsetting, this remains relatively low but not zero.	20%
Confidence in result			
Risk of loss	n/a	Agricultural practices in the area have led to the degradation and loss of areas of Box Gum Woodland in the locality historically. If the offsets are not conserved through protection mechanisms, they may be lost in the long-term given their position in the landscape adjacent to cleared areas and on better agricultural soils. Several mechanisms are in place to prevent further degradation of these communities and therefore the risk of loss without the offsets is uncertain. The risk of loss for offsets that are part of the National Park Estate is low, however other conservation mechanisms for offsets outside these areas are not as stringent and may be higher. Overall, the risk of loss is considered moderate.	70%
Habitat quality change	n/a	Scientific data shows that Box Gum Woodland has the ability to regenerate over a relatively short timeframe, particularly when grazing is removed (Maguire & Mulvaney 2011). It is likely that Box Gum Woodland will respond quickly to the removal of grazing and assisted and natural regeneration. It has been demonstrated on other sites that such management activities provide a positive outcome and improvement in condition for the community.	70%

A.2 Inland Grey Box Woodland

Table A.3 Impact site calculations for Inland Grey Box Woodland

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	Most patches to be impacted had been subject to high levels of disturbance such as logging, grazing (cattle and sheep), sheep camps and exotic species invasion. These areas contain minimal regeneration, hollow-bearing trees and few if any forbs. Most of the habitat for this community has been cleared for agricultural purposes, with most remnants occurring in linear strips along roads and above drainage lines and depressions. The community intergrades with a shrubby woodland that contains Mugga Ironbark and Grey Box. The latter community is not part of the listed EEC. Approximately 50% of the community in the Project area exists as derived native grassland in low to moderate condition.	2
Context	3	Patches are isolated, often in linear strips along roads and above drainage lines and depressions. The EEC areas are not connected outside of these linear strips to any large conservation areas and most of the habitat for this community in the locality has been heavily disturbed and is now degraded from agricultural use.	2
Species stocking rate	2	The condition of the landscape and soils where Inland Grey Box Woodland occurs has been degraded from historical and current agricultural practices. The areas between patches of the community now provide limited habitat as the ecological community is fragmented and patches are isolated. Inland Grey Box Woodland occurs in similar habitats throughout the PAA and surrounding areas, with large remnants in roadside reserves, areas of Crown Land and conservation areas in the locality. Therefore, the Inland Grey Box Woodland to be removed is not important to the extent of the ecological community in the locality and region.	1
Total	**10**		**5**

Table A.4 Offset site calculations Inland Grey Box Woodland

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	Most of the Inland Grey Box Woodland remnants surround the Project area and are in a similar condition, but all areas identified were woodland. Areas of Inland Grey Box Woodland in the northern offset areas are generally in better condition, but have been subject to grazing and other agricultural influences. Overall, the combined existing condition of the Inland Grey Box Woodland patches is comparable to those in the Project area.	3
Context	3	As with the Project area, patches of Inland Grey Box Woodland are isolated and fragmented in the offset areas, mainly being confined to lower lying areas adjacent to agriculture.	2
Species stocking rate	2	As with the Project areas, the extent of Inland Grey Box Woodland in the offsets is not important to the extent of the community in the locality and the region.	1
Total	**10**		**6**
Future quality			
Without offset	n/a	The majority of the patches of Inland Grey Box Woodland in the offset areas are subject to agricultural disturbance, mainly grazing and wood collection. These disturbances are likely to continue in the absence of conservation	5

Table A.4 Offset site calculations Inland Grey Box Woodland

Attribute	Weighting	Reasoning	Score
		management at these sites. The quality of Inland Grey Box Woodland is decreased with such activities, with lower species diversity observed in areas which have been heavily grazed in the locality and these areas dominated by pioneer tree species where Grey Box has been heavily logged.	
With offset	n/a	The management of the offsets for conservation will reduce the current impacts on this community from agricultural disturbances. This is likely to improve the condition and habitat value of the areas identified as Inland Grey Box Woodland and also potentially the areas adjacent which have been identified as native grasslands, but which do not currently meet the Commonwealth's description of the listed community. As a result, the species diversity and habitat complexity of the patches is likely to increase significantly.	7
Risk of loss in 20 yrs			
Without offset	n/a	The risk of loss in 20 years has been determined if no management actions were undertaken and considering the existing land use, zoning and management of the offset sites. The area is covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also the potential for clearing for agricultural practices, particularly the areas in which Inland Grey Box Woodlands have been identified as these contain the more fertile soils of the woodland areas. In addition, limited regeneration and recruitment is evident in most of the areas, particularly in the south, as a result of current management regimes. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. Many of the remnant patches have been heavily logged and this community appears to be susceptible for this due to its accessibility on lower slopes. Therefore, the areas of Inland Grey Box Woodland may be lost from the proposed offset sites without protection from offsetting.	40%
With offset	n/a	The offsets will be protected from future clearing through conversion into the National Parks estate or with conservation agreements on the land title. These communities may still be subject to impacts which could lead to their loss in the long-term despite these protection measures. With protection from offsetting, this remains low but not zero.	20%
Confidence in result			
Risk of loss	n/a	Agricultural practices in the area have led to the degradation and loss of areas of Inland Grey Box Woodland in the locality historically. If the offsets are not conserved through protection mechanisms, the potential for their loss in the long-term is likely given their position in the landscape adjacent to cleared areas and on better agricultural soils. Several mechanisms are in place to prevent further degradation of these communities and therefore the risk of loss without the offsets is uncertain. The risk of loss for offsets part of the National Park Estate is low, however other conservation mechanisms for offsets outside these areas are not as stringent and may be higher. Overall, the risk of loss is considered moderate.	75%
Habitat quality change	n/a	While little scientific data is available for the success of rehabilitation and regeneration of Inland Grey Box Woodland, ceasing agricultural activities, the implementation of appropriate management techniques such as weed control and supplementary planting have the potential to substantially increase biodiversity. It is likely that proposed management activities will provide a positive outcome and improvement in condition for the Inland Grey Box Woodland in the offsets.	80%

A.3 Australasian Bittern

Table A.5 Impact site calculations for Australasian Bittern

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The Project area contains foraging habitat for the Australasian Bittern. The Project area provides limited habitat for this species as it contains few wetland areas, with only a few of the dams containing wetland vegetation. The single record at the site is likely to have been a vagrant to the area given the lack of other records in the locality. Given the above, the Project area provides low to moderate condition habitat for this species.	2
Context	3	Scattered records occur for this species in the locality and wider region. The locality does not represent a stronghold for the species, with most records significant distances to the west and east. The Project area may provide stepping stone habitat and non-breeding foraging resources for dispersal between suitable areas.	1
Species stocking rate	2	Despite surveys over a number of years in the locality, this species was only recorded once in the Project area. The Project is unlikely to reduce the local population as it is considered transient.	1
Total	**10**		**4**

Table A.6 Offset site calculations for Australasian Bittern

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The proposed offsets contain suitable habitat for this species with areas of foraging resources. However, the condition of the offsets for this species is similar to the Project area.	2
Context	3	As with the Project area, the southern and northern offset areas do not represent an important area for this species, but may represent stepping stone habitat between suitable areas, or foraging habitat following rainfall events.	1
Species stocking rate	2	As with the Project areas, the population viability for this species in the locality is considered to already be at risk given its likely occasional dispersal into the area when suitable conditions occur.	1
Total	**10**		**4**
Future quality			
Without offset	n/a	This has been determined if no management actions were undertaken and considering the existing land use, zoning and management of the offset sites. The area is covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also the potential for clearing for agricultural practices and disturbance associated with timber collection. Therefore, habitat quality may degrade for the Australasian Bittern in the proposed offset sites.	3
With offset	n/a	Predation by foxes and cats, use of herbicides, pesticides and other chemicals near wetland areas and grazing and associated frequent burning of wetland areas are key threats to this species. The offsets will be protected from future disturbance by threatening agricultural activities through conversion into the National Parks estate or with conservation agreements on the land title. Feral animal control in the offset areas will also benefit this species.	5
Risk of loss in 20 yrs			

Table A.6 Offset site calculations for Australasian Bittern

Attribute	Weighting	Reasoning	Score
Without offset	n/a	The local population is small and is therefore vulnerable to impacts. Predation by the Red Fox and Feral Cat (*Felis catus*), use of herbicides, pesticides and other chemicals near wetland areas and grazing and associated frequent burning of wetland areas are key threats to this species. Such threats would continue through agricultural activities and the lack of feral animal control in the proposed offset areas if these were not managed for conservation.	30%
With offset	n/a	The proposed management measures will improve the quality of the offset areas to provide habitat by conserving and protecting potential habitat. With offset, the Australasian Bittern may still be subject to impacts which could lead to their loss in the long-term and therefore the risk of loss is low but not zero.	15%
Confidence in result			
Risk of loss	n/a	The local population is likely to be small or transient given the lack of records of this species, and may be lost from the locality in the future. By conserving and enhancing potential habitat for this species, its risk of loss will be decreased. A moderate confidence has been placed on this factor.	60%
Habitat quality change	n/a	The implementation of the proposed conservation management actions in the offset areas will improve the protection and habitat quality for this species. A moderate confidence has been placed on this factor.	60%

A.4 Large-eared Pied Bat

Table A.7 Impact site calculations for Large-eared Pied Bat

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The Project area contains sub-optimal roosting and breeding habitat when compared with surrounding areas containing well developed overhangs and caves and fewer disturbances from feral animals. However, the Project area provides some suitable, though disturbed (by feral animals and logging), potential foraging habitat for this species, with a number of areas on fertile soils and with intact vegetation.	2.5
Context	3	Records suggest that the largest concentrations of populations appear to be in the sandstone escarpments of the Sydney basin and the north-west slopes. The record adjacent to the Project area is the only sighting in the locality, with no records from nearby protected areas. The closest known populations are to the east in the Goulburn River NP and to the north-west at Warrumbungle NP. Therefore, the Project area is not an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat components for foraging and roosting for this species.	1.5
Species stocking rate	2	This species has only been recorded using an Anabat once over the many surveys in the Project area and its surrounds. It is likely to have either been passing through the area, or is likely to occur in very low numbers in the Project area. The population viability for this species in the locality is already likely to be at risk given its low numbers in the Project area. It will not be reduced significantly by the Project.	1
Total	**10**		**5**

Table A.8 Offset site calculations for Large-eared Pied Bat

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The offset areas do not appear to have been impacted as severely as some of the Project areas by feral animals. While feral animals are still present in the offsets, rocky outcrops did not contain significant evidence of use of these areas. However there is the potential that without control, disturbance to these areas could increase. In addition, the Project may cause the movement of feral animals from the Project area into the proposed southern offset sites. Substantial cave and outcrops occur in some of the proposed offsets, which contained bat droppings during the offset surveys. These areas provide suitable roosting and potential breeding habitat for this species. The offset areas have also been subject to timber collection, as with the Project areas. However, potential suitable foraging habitat, including some areas on fertile soils, occurs throughout the proposed offsets.	2.5
Context	3	As with the Project area, the offset areas do not represent important habitat for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat components for foraging and roosting.	1.5

Table A.8 Offset site calculations for Large-eared Pied Bat

Attribute	Weighting	Reasoning	Score
Species stocking rate	2	As with the Project areas, the population viability for this species in the locality is already likely to be at risk given its low numbers. This species has only been recorded using an Anabat once over the many surveys in the Project area and its surrounds. This record is outside the offset areas, but close to some of the proposed southern offset sites.	1
Total	**10**		**5**
Future quality			
Without offset	n/a	This has been determined if no management actions were undertaken and considering the existing land use, zoning and management of the offset sites. The area is covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also the potential for clearing for agricultural practices and disturbance associated with timber collection. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. In addition to this, the threat from feral animals will remain or potentially increase in the offset areas if the Project displaces them. It is considered that Large-eared Pied Bat habitat in the proposed offset sites may degrade or be lost.	4
With offset	n/a	The offsets will be protected from future clearing through conversion into the National Parks estate or with conservation agreements on the land title. In addition, feral animals will be managed in the offsets and Project area. The proposed management measures will improve the quality of the offset areas as habitat for this species by managing the current threats recognised to be effecting the regional population.	6
Risk of loss in 20 yrs			
Without offset	n/a	Small, fragmented sub-populations of the species may be at a greater risk of extinction from random events (DERM 2011). As only one individual was recorded in the years of surveys in the Project area and surrounds. If present, the local any sub-population would be small in the locality. Known threats including disturbance of roost and breeding structures by feral animals, and logging around roost areas and in foraging habitat, would continue in the proposed offset areas if these were not managed for conservation.	30%
With offset	n/a	The proposed management measures will improve the quality of the offset areas as habitat for this species by managing the current threats recognised to be effecting the regional population. With offset, the Large-eared Pied Bat may still be subject to impacts which could lead to their loss in the long-term despite and therefore the risk of loss remains low but not zero.	15%
Confidence in result			
Risk of loss	n/a	There is a scarcity of data regarding the Large-eared Pied Bat in the region and the importance of the locality to the regional population. Movement between areas has not been recorded and its dispersal ability and habits are not known (DERM 2011). However as the population in the Project area and surrounding locality would be small, it is reasonable that it may be lost in the future. By removing the known threats to this species in the offset areas, this risk of loss will decrease. A moderate confidence has been placed on this factor.	50%

Table A.8 Offset site calculations for Large-eared Pied Bat

Attribute	Weighting	Reasoning	Score
Habitat quality change	n/a	Feral animal control, removal of logging and clearing and associated disturbance of potential roosting and breeding caves and overhangs, are all measures that have been identified in the recovery plan for this species to protection known populations. The implementation of the proposed conservation management actions in the offset areas will improve the level of protection and habitat quality for this species in the offset areas. A moderate confidence has been placed on this factor.	60%

A.5 Regent Honeyeater

Table A.9 Impact site calculations for Regent Honeyeater

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The Project area contains potential foraging habitat for the Regent Honeyeater. It contains known feed trees species and mistletoes. However this species has not been recorded in the Project area despite numerous surveys targeting this species, particularly in mass flowering events. If it does occur, it would only use the habitat while migrating through the area to known feeding and breeding locations. The Project area provides low to moderate condition habitat for this species, given its apparent absence.	2
Context	3	Records suggest that this species does not frequent the wider region. Some records occur to the west of the Project area associated with Dubbo, to the north near Warrumbungle NP and to the south-east associated with Munghorn Gap Nature Reserve and the Goulburn River NP. No recent records occur in proximity to the Project area. The Project area does not represent an important area for this species, but may represent stepping stone habitat for migration between suitable areas in the non-breeding season, particularly as it contains feed trees for foraging.	1
Species stocking rate	2	This species has not been recorded despite numerous targeted surveys over the last few years in the Project area. If it occurs, it is likely to use the habitat in the Project area while passing through the area, or is likely to occur in very low numbers during mass flowering events. The population viability for this species in the locality is considered to already be at risk given its low numbers in the Project area. Viability will not be reduced significantly by the Project.	1
Total	**10**		**4**

Table A.10 Offset site calculations for Regent Honeyeater

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The proposed offsets contain suitable habitat for this species with areas of known feed trees and mistletoes. Targeted surveys have not been conducted for this species in the majority of the offset areas (particularly the northern offsets) and this species has not been recorded in the offset areas. The condition of the offsets for this species is similar to the Project area and the northern offsets are only marginally closer to known records and habitat areas.	2
Context	3	As with the Project area, the southern and northern offset areas do not represent an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat with known feed trees.	1
Species stocking rate	2	No records occur in the locality. As with the Project areas, the population viability for this species in the locality is already likely be at risk given its likely low numbers.	1
Total	**10**		**4**
Future quality			
Without offset	n/a	This has been determined if no management actions were undertaken and considering the existing land use, zoning and management of the offset sites. The area is covered by an exploration license and it is possible that future	3

Table A.10 Offset site calculations for Regent Honeyeater

Attribute	Weighting	Reasoning	Score
		mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also the risk of clearing for agricultural practices and disturbance associated with timber collection. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. Therefore, areas of habitat for the Regent Honeyeater may be degraded or lost in the proposed offset sites.	
With offset	n/a	Loss of habitat is the main threat to this species. The offsets will be protected from future clearing through conversion into the National Parks estate or with conservation agreements on the land title. The proposed management measures will improve the quality of the offset areas as habitat for this species by removing existing agricultural disturbances.	5
Risk of loss in 20 yrs			
Without offset	n/a	If present, the local population would be small and therefore vulnerable to impacts. Loss of habitat is the main threat to this species, particularly the loss of grassy box woodlands. Continuing loss of key habitat tree species and remnant woodlands from strategic agricultural developments and timber gathering, and suppression of natural regeneration of overstorey tree species and shrub species from overgrazing are also identified threats to the Regent Honeyeater (OEH 2012). These threats would continue through agricultural activities and firewood collection in the proposed offset areas if these were not managed for conservation.	30%
With offset	n/a	The proposed management measures will improve the quality of the offset areas by conserving and protecting potential habitat. With protection from offsetting, the Regent Honeyeater may still be subject to impacts which could lead to their loss in the long-term, and therefore the risk of loss remains low but not zero.	15%
Confidence in result			
Risk of loss	n/a	There are no recent records of this species in the locality of the Project area or offsets. If present, the local population would be small or transient given this species dispersal habit in the non-breeding season and following flowering events in drier times. Therefore, it is reasonable that the species may be lost from the locality in the future. By conserving and enhancing potential habitat for this species, its risk of loss will be decreased. A moderate confidence has been placed on this factor.	60%
Habitat quality change	n/a	The implementation of the proposed conservation management actions in the offset areas will improve the protection and habitat quality for this species. It will also reduce identified threats and protect and enhance key species and habitat for this species. A moderate confidence has been placed on this factor.	60%

A.6 Southern Long-eared Bat

Table A.11 Impact site calculations for Southern Long-eared Bat

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The Project area contains potential roosting and breeding habitat for the Southern Long-eared Bat. However, hollow-bearing trees are a limiting feature in the landscape with the Project area heavily logged in the past. The Project area also provides some suitable foraging habitat for this species, with a number of areas on fertile soils and with intact vegetation adjacent to watercourses.	3
Context	3	Records suggest that the largest concentrations of populations in the region appear to be associated with Goonoo SCA, Warrumbungle NP and the Goulburn River NP in the east. No records occur between these areas in the vicinity of the Project area. Therefore, the Project area does not represent an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat components for foraging, roosting and breeding.	1
Species stocking rate	2	This species has only been recorded once over the surveys in the Project area and its surrounds. It is likely to have either been passing through the area, or is likely to occur in very low numbers in the Project area. However, as it is not detectable using ultrasonic call detection, this could be misrepresenting the population in the Project area. The population viability for this species in the offsets is already likely be at risk given its low numbers in the Project area. This threat will not be significantly increased by the Project.	1
Total	**10**		**5**

Table A.12 Offset site calculations for Southern Long-eared Bat

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The offset areas do not appear to have been impacted as severely as some of the Project areas by logging. While signs of historical logging are still present in the offsets, a number of hollow-bearing trees occur throughout the offset areas, particularly in the northern offsets. The proposed offsets also contain suitable habitat for this species with significant areas of vegetation adjacent to watercourses, particularly in the northern offset areas.	3
Context	3	As with the Project area, the offset areas do not represent an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat components for foraging roosting and breeding for this species.	1
Species stocking rate	2	As with the Project areas, the population viability for this species in the locality is already likely to be at risk given its low numbers. This species has only been recorded once over the many surveys in the Project area and its surrounds. This record is outside the offset areas, but close to some of the proposed southern offset sites.	1
Total	**10**		**5**
Future quality			
Without offset	n/a	The future quality without offset was determined in consideration of the current land use, zoning and management of the offset sites. The area is	4

Table A.12 Offset site calculations for Southern Long-eared Bat

Attribute	Weighting	Reasoning	Score
		covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However, most of the offset sites in the south have been investigated and contain limited coal resources. There is also the potential for clearing for agricultural practices and disturbance associated with timber collection. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. In addition to this, the threat from feral animals will remain or potentially increase in the offset areas if the Project displaces them. Without offset, the areas of habitat for the Southern Long-eared Bat may be degraded or lost in the proposed offset sites.	
With offset	n/a	The offsets will be protected from future clearing through conversion into the National Parks estate or with conservation agreements on the land title. In addition, feral animals will be managed in the offsets and Project area. The proposed management measures will improve the quality of the offset areas as habitat for this species by managing the current threats recognised to be effecting the regional population. The offsets will also add to the protected habitat in a known population area associated with Goonoo SCA.	6
Risk of loss in 20 yrs			
Without offset	n/a	Tree clearing is likely to be a major factor in the South-eastern Long-eared Bat's decline. The South-eastern Long-eared Bat is also believed to forage on low ground and shrubs and therefore high density grazing impacts foraging habitat. Overgrazing by feral species such as the rabbit may also pose the threat to this species (SEWPaC 2012). Such threats would continue in the proposed offset areas if these were not managed for conservation.	30%
With offset	n/a	The proposed management measures will improve the quality of the offset areas as habitat for this species by managing the current threats recognised to be effecting the regional population. There is still the potential for some impacts on habitat for the Southern Long-eared Bat which could lead to their loss in the long-term despite these protection measures and therefore this remains relatively low but not zero.	15%
Confidence in result			
Risk of loss	n/a	There are no records of this species in the Project area and southern offsets. If present, the population is likely to be small or transient in this area. Therefore, the species may be lost from the locality in the future. By removing the known threats to this species in the offset areas, this risk of loss will decrease, particularly with the increase in protection for habitat associated with a known population in the Goonoo SCA. A moderate confidence has been placed on this factor.	60%
Habitat quality change	n/a	Removal of logging and clearing and associated disturbance of potential roosting and breeding habitat, feral animal control and grazing management are all measures that have been identified in the recovery plan for this species to protection known populations. The implementation of the proposed conservation management actions in the offset areas will therefore improve the protection and therefore improve the habitat quality for this species in the offset areas. A moderate confidence has been placed on this factor.	60%

A.7 Spotted-tailed Quoll

Table A.13 Impact site calculations for Spotted-tail Quoll

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The Project area contains potential foraging and den habitat for the Spotted-tail Quoll. The area also provides suitable prey items in the form of small mammals and birds. However this species has not been recorded in the Project area despite numerous surveys targeting this species. If it does occur, it would be in very low numbers or migrating through the area. Predation and competition with the Red Fox (*Vulpes vulpes*)are known to be a threat to this species. Red Foxes are common in the Project area. Logging and wood harvesting are also known threats, which are both present in the Project area. Given the above, the Project area provides low to moderate condition habitat for this species.	2
Context	3	Records suggest that this species does not occur in large numbers in the wider region. In the locality, the nearest recent sightings occur some 40 km to the west in Goonoo SCA and 40 km to the south-east associated with the Goulburn River NP. No records occur between these areas in the vicinity of the Project area. The Project area does not represent an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat for this species.	1
Species stocking rate	2	This species has not been recorded despite numerous targeted surveys over the last few years in the Project area. If it occurs, it is likely to use the habitat in the Project area while passing through, or is likely to occur in very low numbers. The population viability for this species in the locality is already likely to be at risk given its low numbers in the Project area. The risk of loss is not increased significantly by the Project.	1
Total	**10**		**4**

Table A.14 Offset site calculations for Spotted-tail Quoll

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The offset areas have not been impacted as severely as some of the Project areas by logging. While signs of historical logging are still present in the offsets, a number of hollow-bearing trees occur throughout the offset areas, particularly in the northern offsets, and therefore may provide more abundant prey for this species. However, the offsets also contain populations of the Red Fox. The proposed offsets contain suitable habitat for this species with significant areas of vegetation required by the Spotted-tail Quoll. They also provide suitable foraging habitat with a range of small mammals and birds and den opportunities in fallen timber and along the ridges and cliff lines.	2
Context	3	As with the Project area, the southern offset areas do not represent an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat for this species. The northern offset areas may form part of the habitat associated with the local population identified in the Goonoo SCA.	1

Table A.14 Offset site calculations for Spotted-tail Quoll

Attribute	Weighting	Reasoning	Score
Species stocking rate	2	As with the Project areas, the population viability of this species in the locality is already likely to be at risk given its likely low numbers. There are no records in the locality with the most recent records near the northern offsets associated with Goonoo SCA.	1
Total	**10**		**4**
Future quality			
Without offset	n/a	The future quality without offset was determined in consideration of the current land use, zoning and management of the offset sites. The area is covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also risk of for clearing for agricultural practices and disturbance associated with timber collection. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. In addition to this, the threat from feral animals will remain or potentially increase in the offset areas if the Project displaces them. Therefore the areas of habitat for the Spotted-tail Quoll may be degraded or lost in the proposed offset sites.	3
With offset	n/a	The offsets will be protected from future clearing through conversion into the National Parks estate or with conservation agreements on the land title. In addition, feral animals will be managed in the offsets and Project area. The proposed management measures will improve the quality of the offset areas as habitat for this species by managing the current threats recognised to be effecting the regional population. The offsets will also add to the protected habitat in a known population area associated with Goonoo SCA.	5
Risk of loss in 20 yrs			
Without offset	n/a	If present, the local population would be small and therefore vulnerable to impacts. Known threats including disturbance by, competition and predation by feral animals, and logging and agricultural disturbance of potential foraging habitat would continue in the proposed offset areas if these were not managed for conservation.	30%
With offset	n/a	The proposed management measures will improve the quality of the offset areas to provide habitat for this species by managing the current threats recognised to be effecting the regional population. With offset, the Spotted-tail Quoll may still be subject to impacts which could lead to their loss in the long-term, and therefore this remains low but not zero.	15%
Confidence in result			
Risk of loss	n/a	There are no records of this species in the Project area and southern offsets. If present, the local population is likely to be small or transient. Therefore it is reasonable that its loss in the future may occur. By removing the known threats to this species in the offset areas, this risk of loss will decrease, particularly with the increase in protection for habitat associated with a known population in the Goonoo SCA. A moderate confidence has been placed on this factor.	60%
Habitat quality change	n/a	Removal of logging and clearing of potential habitat and feral animal control are measures identified in the recovery plan for this species to protect known populations. The implementation of the proposed conservation management actions in the offset areas will improve the protection and habitat quality for this species in the offset areas. A moderate confidence has been placed on this factor.	60%

A.8 Superb Parrot

Table A.15 Impact site calculations for Superb Parrot

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The Project area contains potential foraging habitat for the Superb Parrot. This species was recorded frequently during a mass flowering event in the Project area. However it was not recorded in the area outside this event. Therefore the Project area provides suitable foraging habitat for this species in favourable times, but it is unlikely to represent core habitat.	2.5
Context	3	Scattered records occur for this species in the locality and wider region. The locality does not represent a stronghold for the species, with most records occurring further to the south and south-west. This species may follow flowering events into the Project area, particularly after the breeding season when it is known to disperse to the eucalypt-pine woodlands of west-central and north-central NSW (Baker-Gabb 2011). The Project area does not represent an important area for this species, but may represent stepping stone habitat and non-breeding foraging resources for dispersal between suitable areas.	1.5
Species stocking rate	2	A number of individuals were identified in the Project area coinciding with a mass flowering event after a long period of drought. Surveys undertaken outside this event did not record this species in the locality and it is therefore likely only to disburse to the area after such events. The Project is unlikely to reduce the local population as it is transient.	1
Total	**10**		**5**

Table A.16 Offset site calculations for Superb Parrot

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The proposed offsets contain suitable habitat for this species with significant areas of foraging resources. However, the condition of the offsets for this species is similar to the Project area.	2.5
Context	3	As with the Project area, the southern and northern offset areas do not represent an important area for this species, but may represent stepping stone habitat between suitable areas, or foraging habitat following mass flowering and seeding events.	1.5
Species stocking rate	2	As with the Project areas, the population viability for this species in the locality is may already be at risk given its likely occasional dispersal into the area when suitable conditions occur.	1
Total	**10**		**5**
Future quality			
Without offset	n/a	The future quality without offset was determined in consideration of the current land use, zoning and management of the offset sites. The area covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also the risk of clearing for agricultural practices and disturbance associated with timber collection. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. Without offset, areas of habitat for the Superb Parrot may be	4

Table A.16 Offset site calculations for Superb Parrot

Attribute	Weighting	Reasoning	Score
		degraded or lost in the proposed offset sites.	
With offset	n/a	Loss of habitat is the main threat to this species. The offsets will be protected from future clearing through conversion into the National Parks estate or with conservation agreements on the land title. The proposed management measures will improve the quality of the offset areas as habitat for this species by removing existing agricultural disturbances.	6
Risk of loss in 20 yrs			
Without offset	n/a	If present, the local population would be small and therefore vulnerable to impacts. Loss of habitat is the main threat to this species, which would continue through agricultural activities and logging in the proposed offset areas if these were not managed for conservation.	30%
With offset	n/a	The proposed management measures will improve the quality of the offset areas to provide habitat by conserving and protecting potential habitat. There is still the potential for some impacts on habitat for the Superb Parrot which could lead to their loss in the long-term despite these protection measures and therefore this remains low but not zero.	15%
Confidence in result			
Risk of loss	n/a	There are no previous records of this species in the locality of the Project area or offsets. If present, the local population is likely to be small or transient given this species disbursal habit. Therefore it is reasonable that its loss in the future may occur. By conserving and enhancing potential habitat for this species, the risk of loss will be decreased. A moderate confidence has been placed on this factor.	60%
Habitat quality change	n/a	The implementation of the proposed conservation management actions in the offset areas will improve the protection and habitat quality for this species. A moderate confidence has been placed on this factor.	60%

A.9 Swift Parrot

Table A.17 Impact site calculations for Swift Parrot

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The Project area contains potential foraging habitat for the Swift Parrot. However this species has not been recorded in the Project area despite numerous surveys targeting this species, particularly in mass flowering events. If it does occur, it would only use the habitat while migrating through the area to known feeding locations. Given the above, the Project area provides low to moderate condition habitat for this species.	2
Context	3	Records suggest that this species does not frequent the region. Some records occur to the south of the Project area associated with Lake Burrendong and to the east near Munghorn Gap NR and the Goulburn River NP. It was recorded a decade ago to the north near the Warrambungle NP. There are o records near the Project area. Therefore the Project area does not represent an important area for this species, but may represent stepping stone habitat for migration between suitable areas, particularly as it contains known feed trees for foraging.	1
Species stocking rate	2	This species has not been recorded despite numerous targeted surveys over the last few years in the Project area. If it occurs, it is likely to use the habitat in the Project area while passing through the area, or is likely to occur in very low numbers following mass flowering events. The population viability for this species in the locality may already be at risk given its low numbers in the Project area. Therefore the risk of loss will not be significantly increased by the Project.	1
Total	**10**		**4**

Table A.18 Offset site calculations for Swift Parrot

Attribute	Weighting	Reasoning	Score
Quality			
Condition	5	The proposed offsets contain suitable habitat for this species with known feed trees. However, the condition of the offsets for this species is similar to the Project area.	2
Context	3	As with the Project area, the southern and northern offset areas do not represent an important area for this species, but may represent stepping stone habitat between suitable areas, particularly as it contains suitable habitat with large areas of known feed trees.	1
Species stocking rate	2	As with the Project areas, the population viability for this species in the locality may already be at risk given its likely low numbers. No records occur in the locality.	1
Total	**10**		**4**

Table A.18 Offset site calculations for Swift Parrot

Attribute	Weighting	Reasoning	Score
Future quality			
Without offset	n/a	The future quality without offset was determined in consideration of the current land use, zoning and management of the offset sites. The area is covered by an exploration license and it is possible that future mining could be considered in some of the offset sites. However most of the offset sites in the south have been investigated and contain limited coal resources. There is also a risk of clearing for agricultural practices and disturbance associated with timber collection. Some of the proposed offset sites have been cleared in the past, and some of the holdings have been brought purely for firewood collection. Therefore, areas of habitat for the Swift Parrot may be degraded or lost in the proposed offset sites.	3
With offset	n/a	Loss of habitat is the main threat to this species. The offsets will be protected from future clearing through conversion into the National Parks estate or with conservation agreements on the land title. The proposed management measures will improve the quality of the offset areas as habitat for this species by removing existing agricultural disturbances.	5
Risk of loss in 20 yrs			
Without offset	n/a	If present, the local population would be small and therefore vulnerable to impacts. Loss of habitat is the main threat to this species, which would continue through agricultural activities and logging in the proposed offset areas if these were not managed for conservation.	30%
With offset	n/a	The proposed management measures will improve the quality of the offset areas to provide habitat by conserving and protecting potential habitat. There is still the potential for some impacts on habitat for the Swift Parrot which could lead to their loss in the long-term despite these protection measures and therefore this remains relatively low but not zero.	15%
Confidence in result			
Risk of loss	n/a	There are no records of this species in the Project area or offsets. If present, the local population is likely to be small or transient given this species migratory habit and may be lost in the future. By conserving and enhancing potential habitat for this species, the risk of loss will be decreased. A moderate confidence has been placed on this factor.	60%
Habitat quality change	n/a	The implementation of the proposed conservation management actions in the offset areas will improve the protection and habitat quality for this species. A moderate confidence has been placed on this factor.	60%

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Box Gum Woodland
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	**6.8%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes	Box Gum Woodland	**Area**	28	Hectares	
			Quality	**6**	Scale 0-10	
			Total quantum of impact	16.80	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	Yes	16.80	Adjusted hectares	Unsecured and secured offsets	**Risk-related time horizon (max. 20 years)**	10	**Start area (hectares)**	883	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	20%	88.30	70%	61.81	32.01	67.23	400.18%	Yes		
									Future area without offset (adjusted hectares)	618.1	**Future area with offset (adjusted hectares)**	706.4								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	6	**Future quality without offset (scale of 0-10)**	5	**Future quality with offset (scale of 0-10)**	7	2.00	70%	1.40	0.73				
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	16.8	67.23	400.18%	**Yes**	$0.00	N/A	$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Grey Box
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes	Grey Box Woodland	**Area**	41	Hectares	
			Quality	**5**	Scale 0-10	
			Total quantum of impact	20.50	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	Yes	20.50	Adjusted hectares	Unsecured and secured offsets	**Risk-related time horizon (max. 20 years)**	10	**Start area (hectares)**	196	**Risk of loss (%) without offset**	40%	**Risk of loss (%) with offset**	20%	39.20	70%	27.44	24.35	154.44%	Yes		
									Future area without offset (adjusted hectares)	117.6	**Future area with offset (adjusted hectares)**	156.8				31.66				
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**5**	**Future quality with offset (scale of 0-10)**	**7**	2.00	70%	1.40	1.24				
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	20.5	31.66	154.44%	**Yes**	$0.00	N/A	$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Matter of National Environmental Significance	
Name	Asutralasian Bittern
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Asutralasian Bittern	**Area**	9	Hectares	
			Quality	**4**	Scale 0-10	
			Total quantum of impact	3.60	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	3.60	Adjusted hectares	secured and unsecured offsets	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	44	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	6.60	60%	3.96	3.51	5.04	139.94%	Yes	
									Future area without offset (adjusted hectares)	30.8	**Future area with offset (adjusted hectares)**	37.4								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**4**	**Future quality without offset (scale of 0-10)**	**3**	**Future quality with offset (scale of 0-10)**	**5**	2.00	60%	1.20	1.07				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	3.6	5.04	139.94%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Large-eared Pied Bat
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Large-eared Pied Bat	**Area**	1192	Hectares	
			Quality	**5**	Scale 0-10	
			Total quantum of impact	596.00	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	596.00	Adjusted hectares	secured and unsecured offsets	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	5792	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	868.80	50%	434.40	425.81	732.39	122.88%	Yes	
									Future area without offset (adjusted hectares)	4054.4	**Future area with offset (adjusted hectares)**	4923.2								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**5**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**6**	2.00	60%	1.20	1.18				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	596	732.39	122.88%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Regent Honeyeater
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Regent Honeyeater	**Area**	1127	Hectares	
			Quality	**4**	Scale 0-10	
			Total quantum of impact	450.80	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	450.80	Adjusted hectares	secured and unsecured offsets	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	5226	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	783.90	60%	470.34	417.45	598.35	132.73%	Yes	
									Future area without offset (adjusted hectares)	3658.2	**Future area with offset (adjusted hectares)**	4442.1								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**4**	**Future quality without offset (scale of 0-10)**	**3**	**Future quality with offset (scale of 0-10)**	**5**	2.00	60%	1.20	1.07				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	450.8	598.35	132.73%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Southern Long-eared Bat
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Southern Long-eared Bat	**Area**	1340	Hectares	
			Quality	**5**	Scale 0-10	
			Total quantum of impact	670.00	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	670.00	Adjusted hectares	secured and unsecured offsets	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	6167	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	925.05	60%	555.03	544.05	834.21	124.51%	Yes	
									Future area without offset (adjusted hectares)	4316.9	**Future area with offset (adjusted hectares)**	5242.0								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**5**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**6**	2.00	60%	1.20	1.18				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	670	834.21	124.51%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Spotted-tailed Quoll
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Spotted-tailed Quoll	**Area**	167	Hectares	
			Quality	**4**	Scale 0-10	
			Total quantum of impact	66.80	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	66.80	Adjusted hectares	secured and unsecured offsets	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	2240	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	336.00	60%	201.60	178.93	256.47	383.93%	Yes	
									Future area without offset (adjusted hectares)	1568.0	**Future area with offset (adjusted hectares)**	1904.0								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**4**	**Future quality without offset (scale of 0-10)**	**3**	**Future quality with offset (scale of 0-10)**	**5**	2.00	60%	1.20	1.07				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	66.8	256.47	383.93%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Superb Parrot
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Swift Parrot	**Area**	304	Hectares	
			Quality	**5**	Scale 0-10	
			Total quantum of impact	152.00	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	152.00	Adjusted hectares	secured and unsecured offsets	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	2961	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	444.15	60%	266.49	236.52	362.67	238.60%	Yes	
									Future area without offset (adjusted hectares)	2072.7	**Future area with offset (adjusted hectares)**	2516.9								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	5	**Future quality without offset (scale of 0-10)**	4	**Future quality with offset (scale of 0-10)**	6	2.00	60%	1.20	1.07				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	152	362.67	238.60%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Matter of National Environmental Significance	
Name	Swift Parrot
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Swift Parrot	**Area**	1196	Hectares	
			Quality	**4**	Scale 0-10	
			Total quantum of impact	478.40	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	478.40	Adjusted hectares	secured and unsecured offsets	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	5972	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	15%	895.80	60%	537.48	477.04	142.93%	Yes		
									Future area without offset (adjusted hectares)	4180.4	**Future area with offset (adjusted hectares)**	5076.2				683.76				
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**4**	**Future quality without offset (scale of 0-10)**	**3**	**Future quality with offset (scale of 0-10)**	**5**	2.00	60%	1.20	1.07				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	478.4	683.76	142.93%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Homoranthus darwinioides
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	Yes	Homoranthus darwinioides	127		Count	

Offset calculator

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	Yes	127	Count	Secures and unsecured offsets	10		200		100		400		300	40%	120.00	117.63	92.62%	Yes		

Summary

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	127	117.63	92.62%	**Yes**	$0.00	#DIV/0!	#DIV/0!
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Tylophora linearis
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	Yes	Tylophora linearis	9		Count	

Offset calculator

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	Yes	9	Count	Secures and unsecured offsets	10		45		0		50		50	20%	10.00	8.88	98.62%	Yes		

Summary

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	9	8.88	98.62%	**Yes**	$0.00	#DIV/0!	#DIV/0!
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Zieria ingramii
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	Yes	Zieria ingramii	480		Count	

Offset calculator

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	Yes	480	Count	Secures and unsecured offsets	10		1435		718		2135		1417	40%	566.80	503.07	104.81%	Yes		

Summary

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	480	503.07	104.81%	**Yes**	$0.00	N/A	$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Appendix B

Detailed Biobanking results for vegetation types

Table B.1 Biobanking calculations

	Project area			Offset areas				
Vegetation types	**Revised mine plan impact area (ha)**	**Credits generated per hectare cleared[1]**	**Credits required**	**Credits generated per hectare offset[1]**	**Offset area (ha)**	**Credits achieved**	**Credit outcome**	**Offset to impact ratio**
CW107 Black Cypress Pine - Narrow-leaved Stringybark Heathy Woodland	171	65	11,115	10.3	507	5,222	-6223	2.8:1
CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland	12	78	936	9.2	722	6,641	5,127	54.9:1
CW112 Blakely's Red Gum - Yellow Box Grassy Woodland	16	70	1,120	14.4	207	2,979	1,861	12.9:1
CW112 Blakely's Red Gum - Yellow Box Grassy Woodland DNG	91	41	3,731	7.8	111	862	-2,865	1.2:1
CW115 Blue-leaved Ironbark Woodland	919	66	60,654	10.7	3,410	36,483	-24,520	3.7:1
CW115 Blue-leaved Ironbark Woodland Regrowth	405	66	26,730	6.4	277	1,773	-24,957	0.7:1
CW133 Dwyer's Red Gum - Currawang Grassy Mid-high Woodland	65	65	4,225	6.2	592	3,672	-542	9.1:1
CW138 Fuzzy Box Woodland on Alluvial Plains	9	76	684	7.1	45	319	-421	4.1:1
CW138 Fuzzy Box Woodland on Alluvial Plains DNG	9	41	369	7.4	0	0	-369	0
CW145 Inland Grey Box Tall Grassy Woodland	41	74	3,034	17.3	196	3,384	357	4.8:1
CW145 Inland Grey Box Tall Grassy Woodland DNG	38	41	1,558	7.4	0	0	-1,558	0
CW155 Mugga Ironbark - Inland Grey Box - Pine Tall Woodland	0	77	0	22.2	87	1,927	1,931	0
CW156 Mugga Ironbark - Inland Grey Box Shrubby Woodland	0	-	-	13.8	287	3,977	3,169	0
CW160 Narrow-leaved Ironbark Shrubby Woodland	0	-	-	9.0	112	1,011	981	0
CW176 Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box Shrub - Tussock Grass Open Forest	5	76	380	15.4	57	877	498	11.4:1

Table B.1 Biobanking calculations

	Project area			Offset areas				
Vegetation types	**Revised mine plan impact area (ha)**	**Credits generated per hectare cleared[1]**	**Credits required**	**Credits generated per hectare offset[1]**	**Offset area (ha)**	**Credits achieved**	**Credit outcome**	**Offset to impact ratio**
CW177 Red Stringybark Woodland	23	73	1,679	10.2	862	8,790	6,726	35.8:1
CW191 Slaty Gum Woodland	107	69	7,383	8.3	166	1,380	-6,005	1.6:1
CW202 Tumbledown Red Gum - Black Cypress Pine - Red Box Low Woodland	0	-	-	8.8	14	120	123	0
CW213 White Box - White Cypress Pine - Inland Grey Box Woodland	0	-	-	12.7	17	220	216	0
CW268 Mugga Ironbark - Blakely's Red Gum Woodland	0	-		9.0	267	2,404	2,142	0
Total	**1,911**	**-**	**123-,598**	**-**	**7,935**	**82,042**	**-44,331**	**4.0:1**

Notes: 1. Calculate from the original Biobanking calculations for each condition class and applied to the project changes on a pro-rata basis.

Appendix C

Offset vegetation descriptions and maps

C.1 Offset vegetation type descriptions

C.1.1 CW107 Black Cypress Pine - Narrow-leaved Stringybark heathy woodland

Black Cypress Pine - Narrow-leaved Stringybark heathy woodland was dominated by Black Cypress Pine (*Callitris endlicheri*), with a cover abundance of greater than 70%. This vegetation type occurred on low rises with rocky substrate, typically on the mid to upper slope. Associated overstorey species included Dwyer's Red Gum (*E. dyweri*), *Allocasuarina* sp., ironbarks (*E. nubila, E. crebra* and *E. sideroxylon*) and Red Stringybark (*E. macroryhncha*), which were all recorded as scattered individuals within the community. CW107 was characterised by a low cover abundance of forbs (typically less than 5%) consisting of species such as Slender Rice Flower (*Pimelea linifolia*). It was also characterised by low percent shrub cover, usually dominated by Common Fringe-myrtle (*Calytrix tetragona*) (height of 1.2 m and cover of 15% or less).

The Cypress Pine canopy reached to 20 m in height with emergent Ironbarks reaching to 30 m. There was usually a dense leaf litter present, formed from the Cypress Pine, with an abundance of small rock, lichen and woody debris. Regeneration was either absent or sparse. This community graded into the Ironbark/Stringybark communities on hill slopes, or into box communities on the lower elevation parts of the offset areas. Disturbances recorded within the Cypress Pine Woodland included grazing by domestic and feral animals. Exotic flora species were not common.

Some areas of this community were dominated by Narrow-leaved Stringybark, often at the top of rocky outcrops, grading into other stringybark and ironbark communities.

C.1.2 CW111 Blakely's Red Gum - Rough-Barked Apple flats woodland

Blakely's Red Gum - Rough-Barked Apple flats woodland was dominated by Rough-barked Apple in very small patches, either along drainage depressions or at the foot slopes of ironbark/stringybark communities. This vegetation type typically occurred as monotypic stands of Rough-barked Apple trees, often in grazed areas, being impacted by cattle, sheep, sheep camps and weed invasion. Rough-barked Apple trees observed within the offsets were usually mature, with little to no regeneration occurring, and commonly were paddock trees surrounded by cultivated and improved pasture.

In other areas, this community was dominated by Blakely's Red Gum with a grassy/shrubby understorey. Species recorded included *Melaleuca erubescens*, Seven Dwarfs Grevillea (*Grevillea floribunda*), Sifton Bush and Cough Bush. This vegetation type was recorded within, or adjacent to, ironbark and stringybark communities, commonly in drainage depressions.

This vegetation type qualifies as White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the TSC Act and White Box Yellow Box Blakeley's Red Gum Grassy Woodland and Derived Native Grasslands critically endangered ecological community under the EPBC Act.

C.1.3 CW112 Blakely's Red Gum - Yellow Box grassy woodland

Blakely's Red Gum - Yellow Box grassy woodland was characterised by Yellow Box (*E. melliodora*) with Blakely's Red Gum (*E. blakelyi*) and a grassy understorey. It occurred along roadsides, in low-lying parts of the offsets and along drainage lines and depressions. Other associated canopy species included Grey Box (*E. microcarpa*), Fuzzy Box (*E. conica*) and Rough-barked Apple (*Angophora floribunda)* with the canopy reaching 30 m in height. In areas, the canopy has been removed but the understorey remains, forming derived native grassland.

Dominant grass species recorded included Wallaby Grasses (*Austrodanthonia* sp.), Speargrasses *(Austrostipa* sp.) and Three-awn Grasses (*Aristida* sp.). Forbs present included *Calotis* sp., *Wahlenbergia* sp., *Dichondra* sp. and the creepers *Glyicne* sp. and *Desmodium* sp. Blakely's Red Gum - Yellow Box grassy woodland graded into other box-type woodlands on the floodplains and lower elevation areas of the offsets. Disturbances present included domestic animal grazing, weed invasion and feral animal grazing.

This vegetation type qualifies as White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the TSC Act and White Box Yellow Box Blakeley's Red Gum Grassy Woodland and Derived Native Grasslands critically endangered ecological community under the EPBC Act.

C.1.4 CW115 Blue-leaved Ironbark Woodland

Blue-leaved Ironbark Woodland in the offsets was dominated by Blue-leaved Ironbark (*Eucalyptus nubila*), typically with a small tree layer of Black Cypress Pine. Red Stringybark, Dwyer's Red Gum or Slaty Gum (*E. dawsonii*) were also common. It typically occurred on rocky substrates on gentle slopes. She-oaks (*Allocasuarina* sp.) were locally common in some areas. Where ironbarks occurred with a small tree layer of Cypress Pine, there was low ground cover and low diversity; where they occurred on lower foot slopes, the ground cover became grassy and there was an increase in species diversity.

The community graded into Stringybark communities on steeper hillslopes, or into areas dominated by Slaty Gum or box communities on the lower elevations. The understorey was characterised by the dominant shrub Common Fringe Myrtle, with Sifton Bush, Hoary Guinea Flower (*Hibberita obtusifolia)*, Forest Goodenia (*Goodenia hederacea)* and Purple Burr-daisy (*Calotis cuneifolia),* all commonly occurring small shrubs. There was usually greater than five grass species present, with Red Anther Wallaby Grass (*Joycea pallida*) being commonly recorded. Disturbances recorded within this community include logging and grazing by domestic and feral animals. Exotic flora species were not common within this vegetation type.

'Regrowth' Blue-leaved Ironbark Woodland was recorded in areas that had been cleared and grazed in the recent past. Coloniser species (predominantly Sifton Bush) were dominant in regrowth areas, indicating that the areas were at an early successional stage. This also explained the low species diversity observed.

C.1.5 CW133 Dwyer's Red Gum - Currawang grassy mid-high woodland

Dwyer's Red Gum - Currawang grassy mid-high woodland was recorded as small remnants predominantly in flat, sandy areas. It commonly occurred as a mallee type community, with a high cover of small shrubs including Sifton Bush and Violet Kunzea (*Kunzea parvifolia*). Grasses and grass-like plants were also relatively diverse when compared to other vegetation types within the offsets.

C.1.6 CW138 Fuzzy Box Woodland on alluvial plains

Fuzzy Box Woodland occurred as a grassy woodland up to 20 m high dominated by Fuzzy Box canopy, with Yellow Box or Grey Box trees also present. Understorey shrubs were sparse or absent, with the dominant ground cover species being grasses (one plot recorded 11 species of grass). Slender Bamboo Grass (*Austrostipa verticillata)* was noted as a commonly associated species. Other grasses recorded included Three-awn Grass, Weeping Meadow Grass *(Microlaena stipoides)* and Wallaby Grasses. In the offset areas, Fuzzy Box Woodland was identified along drainage depressions and ephemeral streams, particularly in the northern offset areas associated with Goonoo SCA.

C.1.7 CW145 Inland Grey Box tall grassy woodland

Inland Grey Box tall grassy woodland typically occurred as monotypic stands of Grey Box trees up to 25 m high. Other occasional canopy species included Fuzzy Box and Blakely's Red Gum. When it occurred in low-lying areas, the community graded into other box woodlands and occurred at the foot slopes of the Blue-leaved Ironbark Woodlands. Most remnants had been subject to high levels of disturbance such as logging, grazing (cattle and sheep), sheep camps and exotic species invasion. Small areas of grassland derived from this community were also present in the offset areas.

Inland Grey Box tall grassy woodland was characterised by a grassy understorey with a sparse to absent shrub cover. Species recorded included Cough Bush (*Cassinia laevis*) and Sifton Bush. There was usually a dense leaf litter present, with low cover of rock, mosses and lichen. Regeneration was recorded in remnants not impacted by grazing.

This vegetation type qualifies as Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions endangered ecological community under the TSC Act and Grey Box Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia endangered ecological community under the EPBC Act.

C.1.8 CW155 Mugga Ironbark - Inland Grey Box - pine tall woodland

Mugga Ironbark - Inland Grey Box - pine tall woodland occurred as small remnants grading into other ironbark or box communities. It was characterised by Mugga Ironbark and Grey Box as co-dominants, with a shrubby understorey. Species recorded included White Cypress Pine (*Callitris glaucophylla*), *Melaleuca erubsecens*, Sifton Bush and Cough Bush.

C.1.9 CW160 Narrow-leaved Ironbark shrubby woodland

Narrow-leaved Ironbark formed a shrubby woodland in the offset areas dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*) and Black Cypress Pine, with Bulloak (*Allocasuarina luehmannii*), Sticky Daisybush (*Olearia elliptica*), *Cassinia quinquefaria, Melichrus urceolatus* and *Aristida ramosa*. It often occurred in areas adjacent to Blue-leaved Ironbark Woodland in the northern offset sites associated with Goonoo SCA.

C.1.10 CW176 Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest

Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest was recorded in two small areas in the offsets near Spring Ridge Road to the south of the Project. This vegetation type was uncommon within the offsets, with Inland Scribbly Gum (*E. rossii*) being the dominant species. It commonly occurred with Red Stringybark as a scattered subdominant.

C.1.11 CW177 Red Stringybark Woodland

Red Stringybark Woodland occurred as a grassy/shrubby woodland up to 20 m high dominated by Red Stringybark, with Ironbarks, Black Cypress Pine and red gums (Dwyer's and Slaty) also occurring at varying densities. In some areas, shrub cover was absent. Where shrubs occurred, Sifton Bush dominated. The common ground cover species recorded were Mat Rushes (*Lomandra longifolia, L. filiformis*) Hoary Guinea Flower and Thyme Spurge (*Phyllanthus hirtellus)*.

Red Stringybark Woodland was recorded on mid to upper slopes, usually with rocky outcropping. It was also recorded in saddles in the landscape, between Cypress Pine and ironbark communities. Disturbances present included agricultural and feral animal (goats, rabbits) grazing.

C.1.12 CW191 Slaty Gum Woodland

Slaty Gum Woodland typically occurred as monotypic stands of tall Slaty Gum trees (up to 25 m in height). Other canopy species rarely occurred within this community. In some instances where this vegetation type occurred within a matrix of other communities or graded into Ironbark communities, it was mapped as Slaty Gum Woodland but exhibited characteristics of Ironbark communities. For example, some Slaty Gum Woodland remnants mapped within the offsets contained a shrub layer that included She-oak, a species not characteristic of the Slaty Gum community.

Where Slaty Gum Woodland occurred as a monotypic stand of Slaty Gum trees, this vegetation type was characterised by a very sparse ground cover of forbs and grasses consisting of species such as Purple Burr-daisy, Three-Awn Grass, Wallaby Grass and Speargrass. Shrub cover was generally sparse to absent, but where it occurred it consisted of *Acacia* and C*assinia* species. There was usually a dense leaf litter present, with sparse layer of small rocks, lichen and woody debris. Regeneration was generally absent.

C.1.13 CW202 Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland

Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland was recorded on low rises where it graded into Mugga Ironbark Woodland and Red Stringybark Woodland. It was uncommon in the offset areas.

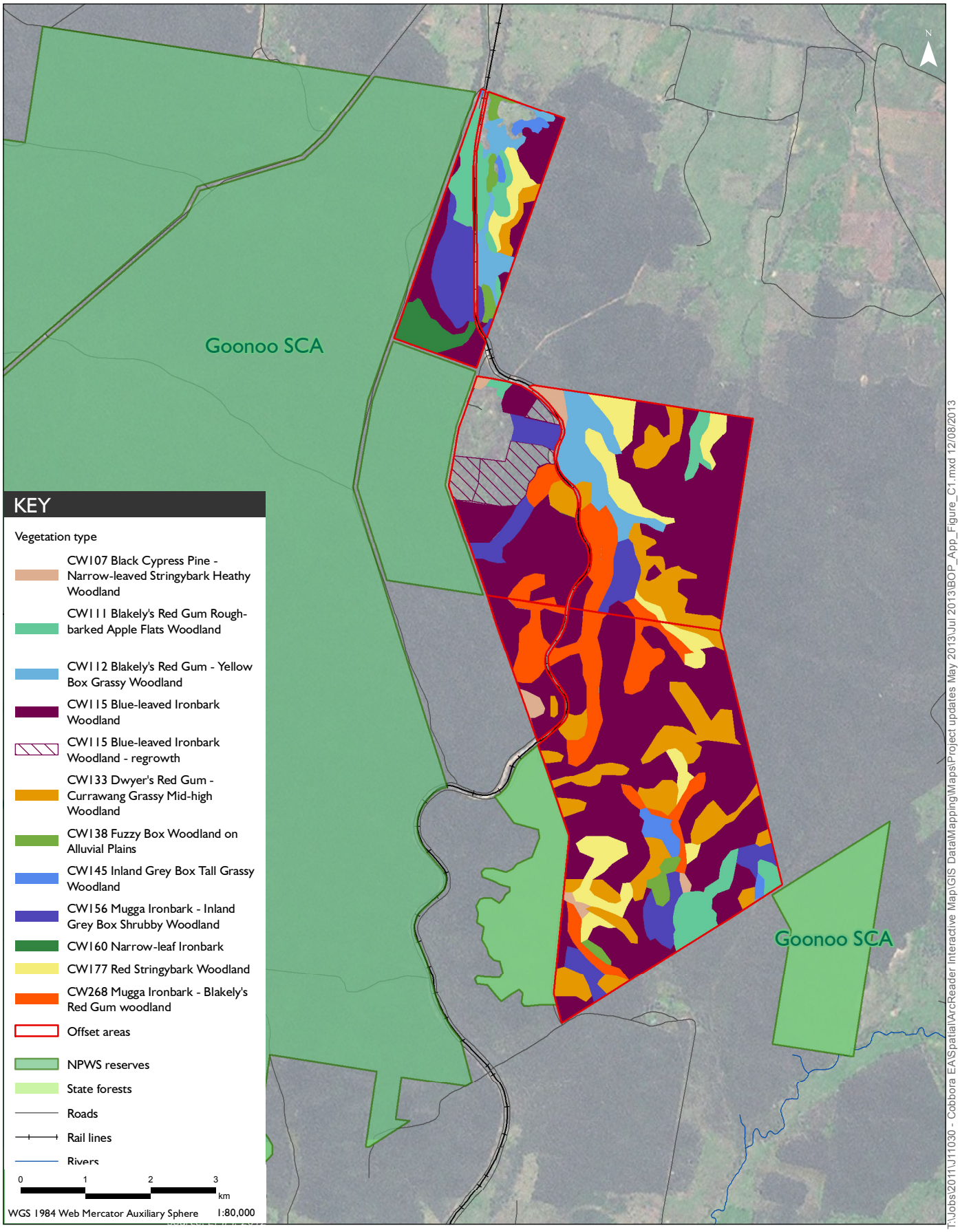
C.1.14 CW213 White Box - White Cypress Pine - Inland Grey Box woodland

White Box - White Cypress Pine - Inland Grey Box woodland was recorded along Spring Ridge Road where it graded into ironbark woodland and other box communities. It was dominated by White Box (*E. albens*) with a small tree layer of Black Cypress Pine and a grassy understorey.

This vegetation type qualifies as White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the TSC Act and White Box Yellow Box Blakeley’s Red Gum Grassy Woodland and Derived Native Grasslands critically endangered ecological community under the EPBC Act.

C.1.15 CW268 Mugga Ironbark - Blakely's Red Gum woodland

Mugga Ironbark – Blakely’s Red Gum woodland occurred on floodplains of ephemeral drainage lines in the northern offset sites adjacent to Goonoo SCA. It formed a tall open woodland dominated by Mugga Ironbark, Blakely's Red Gum and Black Cypress Pine.Grassy ground layer including Blue Flax-lily (*Dianella revoluta* var. *revoluta*), Rough Saw-sedge (*Gahnia aspera*) and other grasses.

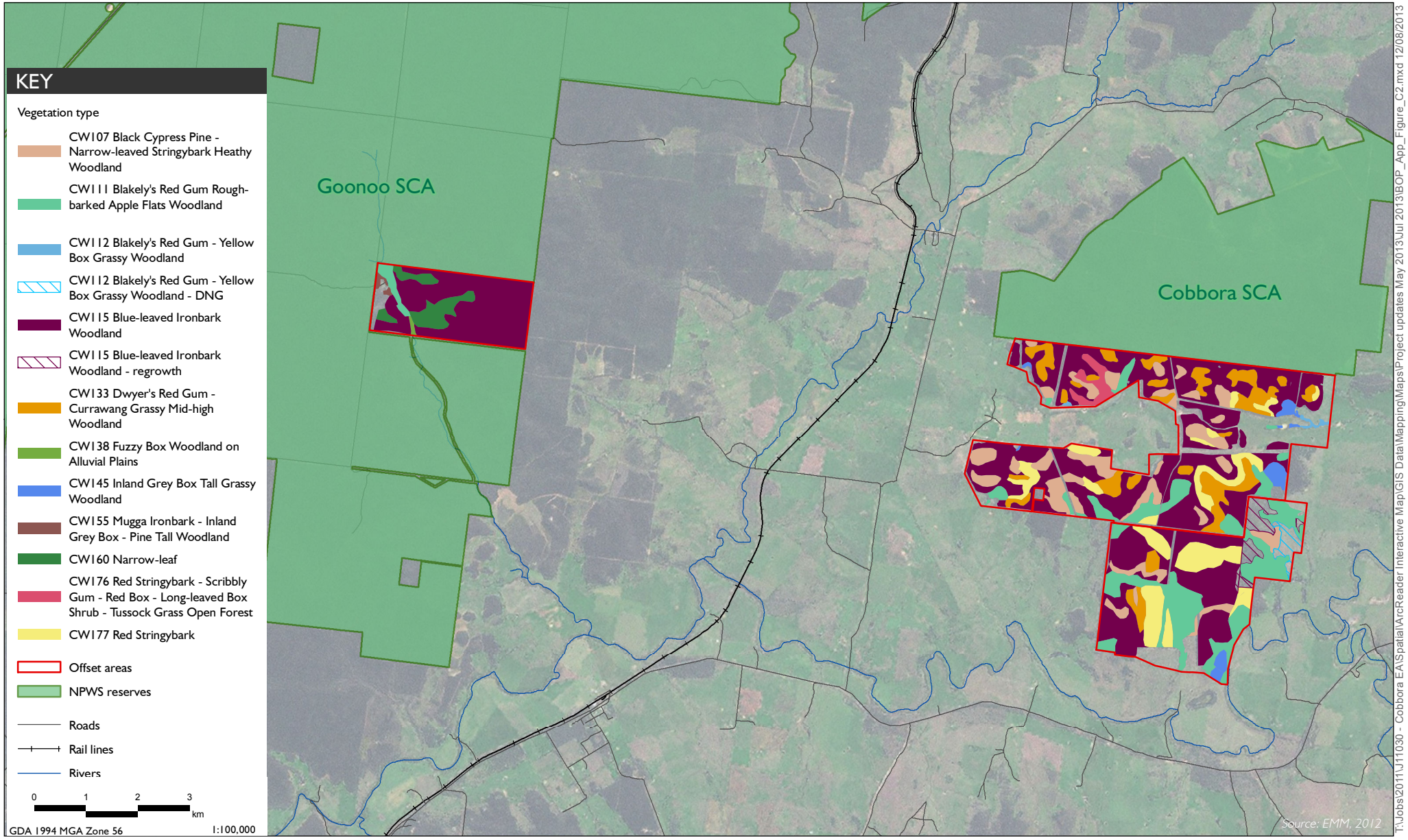


EMM
EMGA Mitchell McLennan

Vegetation types of the northern Goonoo SCA additions

Cobbora Coal Project: Biodiversity Offset Package

Figure C.1



EMM
EMGA Mitchell McLennan

Vegetation types of the Goonoo SCA (south) and Cobbora SCA additions

Cobbora Coal Project: Biodiversity Offset Package

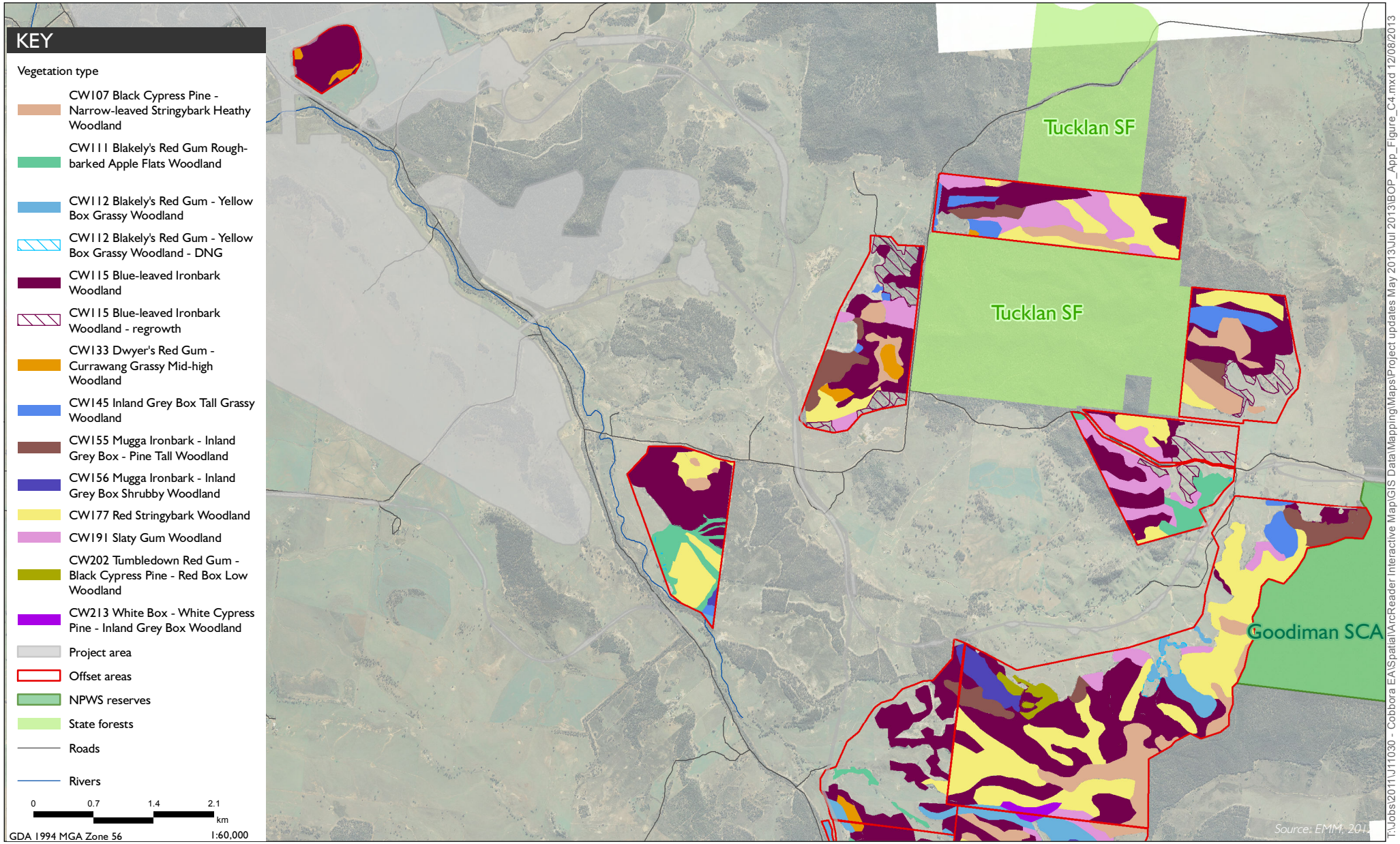
Figure C.2

EMM
EMGA Mitchell McLennan

Vegetation types of the Adelyne SCA addition

Cobbora Coal Project: Biodiversity Offset Package

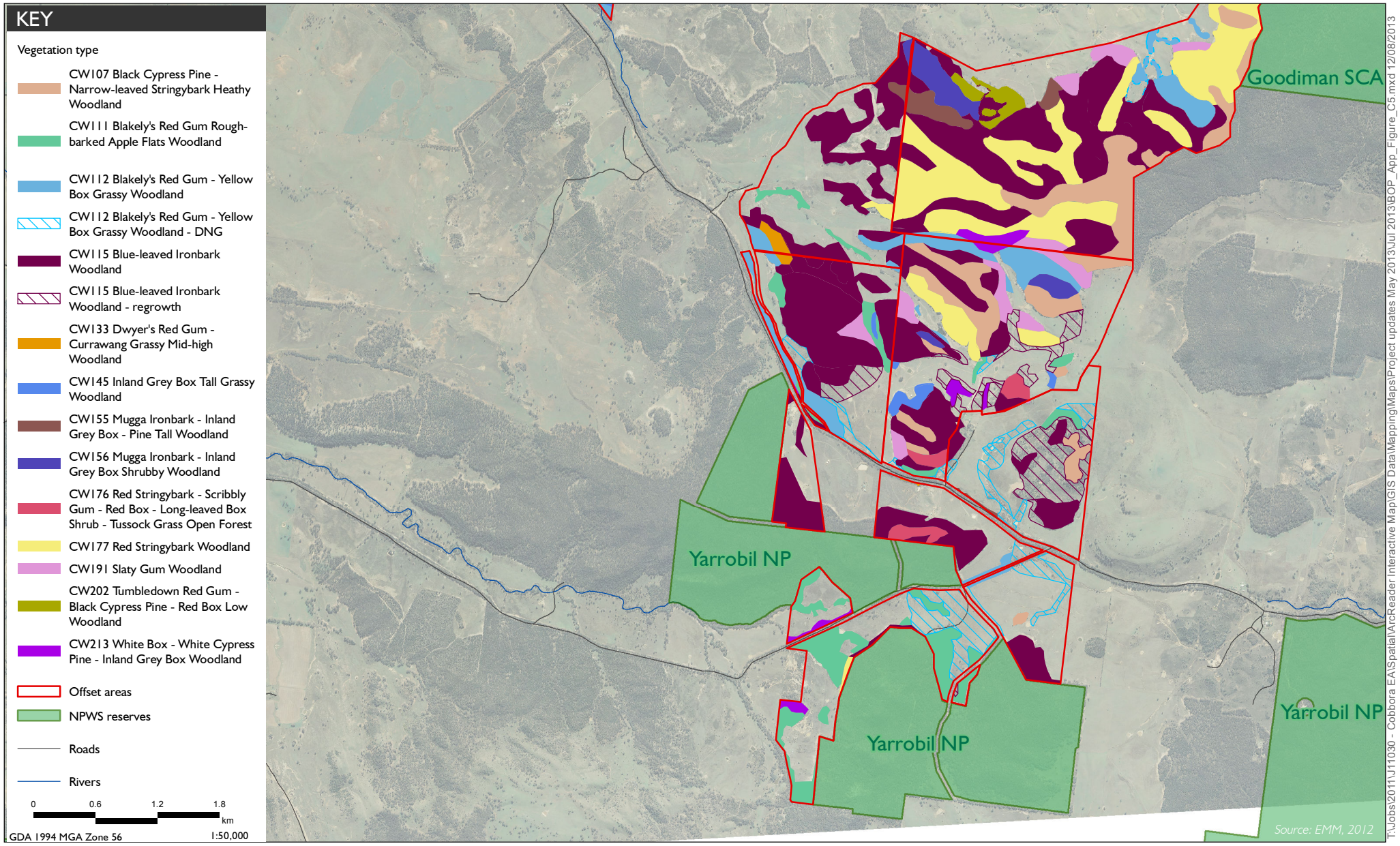
Figure C.3



Vegetation types of the Zieria Patch, Eastern Link Areas and Southern NPWS (north) additions

Cobbora Coal Project: Biodiversity Offset Package

Figure C.4



EMM
EMGA Mitchell McLennan

Vegetation types of the Southern NPWS (south) additions

Cobbora Coal Project: Biodiversity Offset Package

Figure C.5

EMM
EMGA Mitchell McLennan

SYDNEY
Ground floor, Suite 1, 20 Chandos Street
St Leonards, New South Wales, 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 1, 6 Bolton Street
Newcastle, New South Wales, 2300
T 02 4927 0506 F 02 4926 1312

BRISBANE
Suite 1, Level 4, 87 Wickham Terrace
Spring Hill, Queensland, 4000
T 07 3839 1800 F 07 3839 1866

Appendix H

Revised mine plan - air quality and greenhouse gas assessment

Cobbora Coal Project – Supplementary Air Quality and Greenhouse Gas Assessment

Prepared for:
EMGA Mitchell McLennan Pty Ltd

Prepared by:
ENVIRON Australia Pty Ltd

Date:
12 August 2013

Project Number:
AS121389

ENVIRON

Prepared by:		**Authorised by:**	
Name:	Scott Fishwick	Name:	Scott Fishwick
Title:	Manager – Air Quality	Title:	Manager – Air Quality
Phone:	+61 2 9954 8100	Phone:	+61 2 9954 8100
Email:	sfishwick@environcorp.com	Email:	sfishwick@environcorp.com
Signature:	Date: 12/08/13	Signature:	Date: 12/08/13

VERSION CONTROL RECORD

Document File Name	Date Issued	Version	Authors	Reviewer
AS121389_CCP_SupplementaryAQIA_050813	5 August 2013	Final	Scott Fishwick	PT/TM
AS121389_CCP_SupplementaryAQIA_Rev1_120813	12 August 2013	Rev 1	Scott Fishwick	PT/TM

Contents

List of Figures

List of Tables

List of Appendices

Executive Summary

An air quality and greenhouse gas assessment was undertaken for the proposed Cobbora Coal Project (the Project), an open cut coal mine proposed by Cobbora Holding Company Pty Limited (CHC), in August 2012 by ENVIRON Australia Pty Ltd. The air quality and greenhouse gas assessment (CCPAQIA) formed part of the Environmental Assessment submitted to the NSW Department of Planning and Infrastructure by EMGA Mitchell McLennan in September 2012.

Following review of the Environmental Assessment by the NSW Planning Assessment Commission and receipt of recommendations, CHC commenced revisions to the mine plan for the Project. The intention of the mine plan revisions is to reduce the amount of active mining and exposed areas at any given time in the Project life.

This report is a supplementary assessment of the revised mine plans for Year 8 and Year 20 of the Project. These represent the highest intensity operations in the northernmost and southernmost extents of the Project and therefore provide an indication of maximum potential air quality impacts.

This report should be read in conjunction with the CCPAQIA from the EA for the Project, which remains the primary reference document.

Air Quality Assessment

Air emissions associated with the Project will primarily comprise of fugitive particulate matter releases. Emissions for two key mine stages were calculated based on a combination of Australian NPI and USEPA AP-42 emission estimation documents. Air emissions were quantified for all mobile mining equipment (haul trucks, bulldozers, etc) and processes (drilling, blasting, etc), coal processing and handling, fuel combustion by mobile equipment and wind erosion.

Emissions of total suspended particulates (TSP), particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$) were quantified for revised Year 8 and Year 20 operational mine plans.

Dispersion modelling was conducted using the USEPA regulatory AERMOD model configured for the CCPAQIA.

The air quality assessment, undertaken in accordance with the Approved Methods for Modelling, provides a conservative (upper bound) estimate of the potential for air quality impacts occurring due to the Project. Emission reductions due to the best practice management measures to be implemented by the Project were accounted for where the control effectiveness of measures could be quantified. Real-time operational dust management, informed by the proposed reactive/predictive air quality control system, was not included in the model. Real-time operational dust management will assist in the control of dust emissions, particularly during meteorological conditions when potential emissions (as modelled) are high.

No incremental or cumulative exceedances of applicable air quality criteria were predicted at the surrounding private residences during Year 8.

The following criteria exceedances were predicted to occur due to cumulative concentrations during proposed Year 20 operations of the Project:

- One exceedance of the 24-hour average PM_{10} criterion at residences 1178, 1198, 1199 and 3108;
- One exceedance of the 24-hour average $PM_{2.5}$ Advisory Reporting Standard at residences 1198 and 1199; and
- Exceedance of the annual average $PM_{2.5}$ Advisory Reporting Standard at residences 1198 and 1199.

All receptors with exceedances predicted are the closest private residences to the southeast, south and southwest of the Project Mine Area B. On the basis of the modelling results for Year 20, these receptors are predicted to experience higher concentrations relative to those presented in the CCPAQIA.

Relative to the results presented within the CCPAQIA, a significant increase in model predictions for the revised mine plan occurs with the private residences to the southeast, south and southwest of the Project. For the majority of private residences to the west, north and east of the Project, the maximum model predictions are likely to be lower than, or experience negligible change from, the results presented within the CCPAQIA.

Following review of the modelling results for the revised Year 8 and Year 20 mine plans with the results presented within the CCPAQIA, it is considered the revised mine plans will:

- Reduce the spatial footprint area of impacts in any given year;
- Potentially cause higher concentrations at the closest receptors to operations due to the increase in annual extractive intensity in individual mine areas.

As committed to in the CCPAQIA, in order to address the potential for exceedances in the surrounding environment, real time dust and meteorological monitoring will be undertaken. This will allow proactive management of potential dust impacts during unusual wind or weather events.

Greenhouse Gas Assessment

The greenhouse gas (GHG) assessment conducted for the CCPAQIA has been updated for the revised mine plan and expanded to incorporate an additional scenario – in which the assumption of all product coal is sent to international end users. GHG emissions from the Project were calculated to determine the Project's contribution to NSW and Australian annual GHG emissions, emissions were estimated based on information provided by the client and relevant GHG emission factors.

To evaluate the Project's GHG emissions and determine the Project's contribution to NSW and Australian annual GHG emissions, emissions were estimated based on information provided by the CHC and relevant GHG emission factors.

GHG emissions were calculated for:

- Direct emissions produced from sources within the boundary of the Project and as a result of CHC's activities (Scope 1 emissions); and
- Indirect emissions generated in the wider economy as a consequence of CHC's activities, but which are physically produced by the activities of another organisation indirectly (Scope 2 and 3 emissions).

The GHG assessment's key findings are as follows:

- Annual Project GHG emissions (from direct and indirect sources) were estimated to be between 14Mt and 28Mt of CO_2–e/yr;
- Indirect emissions (Scope 2 and 3) are the major contributor towards the Project's GHG emissions;
- Of the indirect emissions, downstream product transport and combustion of product by end-customers constitutes approximately 99% of the emissions; and
- Direct emissions generated by the Project represent between 0.074% and 0.152% of annual NSW emissions, 0.0022% to 0.045% of Australian emissions and between 0.0002% and 0.0005% of global emissions.

Glossary of Key Acronyms and Symbols

ANFO	Ammonium Nitrate with Fuel Oil
Approved Methods for Modelling	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
BMP	Best management practice
CCPAQIA	Air Quality and Greenhouse Gas Assessment for the Proposed Cobbora Coal Project (ENVIRON, 2012)
CH_4	Methane
CHC	Cobbora Holding Company Pty Limited
CHPP	Coal Handling and Processing Plant
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-e	CO_2 equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEE	Department of Climate Change and Energy Efficiency
DEC	NSW Department of the Environment and Conservation
DGRs	Director General's Assessment Requirements
EA	Environmental Assessment
EMM	EMGA Mitchell McLennan
ENVIRON	ENVIRON Australia Pty Ltd
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
mg	Milligram (g x 10^{-3})
µg	Microgram (g x 10^{-6})
µm	Micrometre or micron (metre x 10^{-6})
m^3	Cubic metre
Mbcm	Million bank cubic metre
Mtpa	Million tonnes per annum
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory
NO_2	Nitrogen Dioxide
N_2O	Nitrous Oxide
PAA	Project Application Area
PAC	Planning Assessment Commission
PM_{10}	Particulate matter less than 10 microns in aerodynamic diameter
$PM_{2.5}$	Particulate matter less than 2.5 microns in aerodynamic diameter
OEH	Office of Environment and Heritage
ROM	Run of Mine
SO_2	Sulphur Dioxide
TEOM	Tapered Element Oscillating Microbalance
The Project	The Cobbora Coal Project
TSP	Total Suspended Particulate
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
VKT	Vehicle Kilometres Travelled

1 Introduction

ENVIRON Australia Pty Ltd (ENVIRON) was commissioned in 2011 by EMGA Mitchell McLennan (EMM) on behalf of Cobbora Holding Company Pty Limited (CHC) to prepare an Air Quality and Greenhouse Gas Assessment for the proposed Cobbora Coal Project (the Project).

The Cobbora Coal Project (the Project) is being developed by Cobbora Holding Company Pty Limited (CHC) to construct and operate a coal mine near Cobbora in Central Western NSW. The planned output is 20 million tonnes per annum (Mtpa), which, after processing, will provide about 12Mtpa of product coal for the domestic and export market.

The Project is located approximately 5km south of Cobbora, 22km southwest of Dunedoo, 64km northwest of Mudgee and 60km east of Dubbo in the central west of NSW. The Project will include an open cut mine; a coal handling and preparation plant (CHPP); a train loading facility and rail spur; and a mine infrastructure area. Supporting infrastructure will include access roads; water supply and storage; and electricity supply. A mine life of 21 years is proposed.

The Environmental Assessment (EA) for the Project was lodged with the NSW Department of Planning and Infrastructure in September 2012. The air quality and greenhouse gas assessment conducted by ENVIRON for the Project (the CCPAQIA) was included as Appendix M of the EA.

At the request of the NSW Government Minister for Planning and Infrastructure, the Project was reviewed by the NSW Planning Assessment Commission (PAC). In the Review Report prepared by the PAC in April 2013, it was recommended that further consideration be given to the need to mine three areas concurrently during the life of the Project.

To address this concern, CHC have revised the mine plan to reduce the number of active mining and exposed areas throughout the life of the Project.

ENVIRON has been engaged by CHC to assess the implications of the mine plan modifications to the air quality assessment results in the EA. This report documents the air quality assessment conducted for the revised Project mine plan, outlining the assessment methodology and results.

Additionally, the greenhouse gas assessment has been revised to include a third emissions scenario that considers the GHG emissions if 100% of product coal was exported. While this is unlikely to occur, it provides the other end point to 100% domestic use of the coal.

This report should be read in conjunction with the CCPAQIA from the EA for the Project, which remains the primary reference document.

2 Project Setting

The project setting, including the surrounding land use, topographic features and the assessment locations used are described in Section 2 of the CCPAQIA.

An updated indicative layout of the Project is presented in **Figure 1**. The area contained within the Project Application Area (PAA). The layout of the various open cut mining pits and out-of-pit waste rock emplacement areas is presented in **Figure 2**.

The region surrounding the Project contains a number of rural-residential properties situated at varying distances from the proposed mining activities. The dispersion modelling undertaken within this assessment focuses on an area of 24km by 24km, centred over the mining area (further discussion in Section 7 of the CCPAQIA).

The location of privately owned and CHC-owned dwellings situated within the model domain (24km by 24km area) is illustrated in **Figure 3**. Predictions of air pollutant concentrations and deposition levels were made at each of these locations to assess air quality compliance. The details of the privately-owned receptor locations, along with the proximity to the proposed CHPP, are presented within **Table 1**.

Since the completion of the CCPAQIA, the following residences were acquired by CHC:

- 1147, 1149, 1158, 1200, 1213, 1222, 1223, 1225, 1232, 1252, 5003 and 5025.

It is noted that some private and CHC-owned dwellings are located along the rail spur extending to the east of the area marked in **Figure 3**, with the closest privately-owned receptors located approximately 250m from the rail corridor. The emissions associated with the rail spur (including diesel-combustion related emissions and particulate matter from moving rail wagons) are minor relative to the emission generated by the proposed mining activities (further discussion on emissions from the Project provided in **Section 4**). It is therefore considered that the greatest potential impacts from Project-generated emissions to air would be experienced at the properties marked in **Figure 3**. Potential air quality impacts at properties located beyond those shown in **Figure 3** would be lower and have therefore been excluded from the assessment.

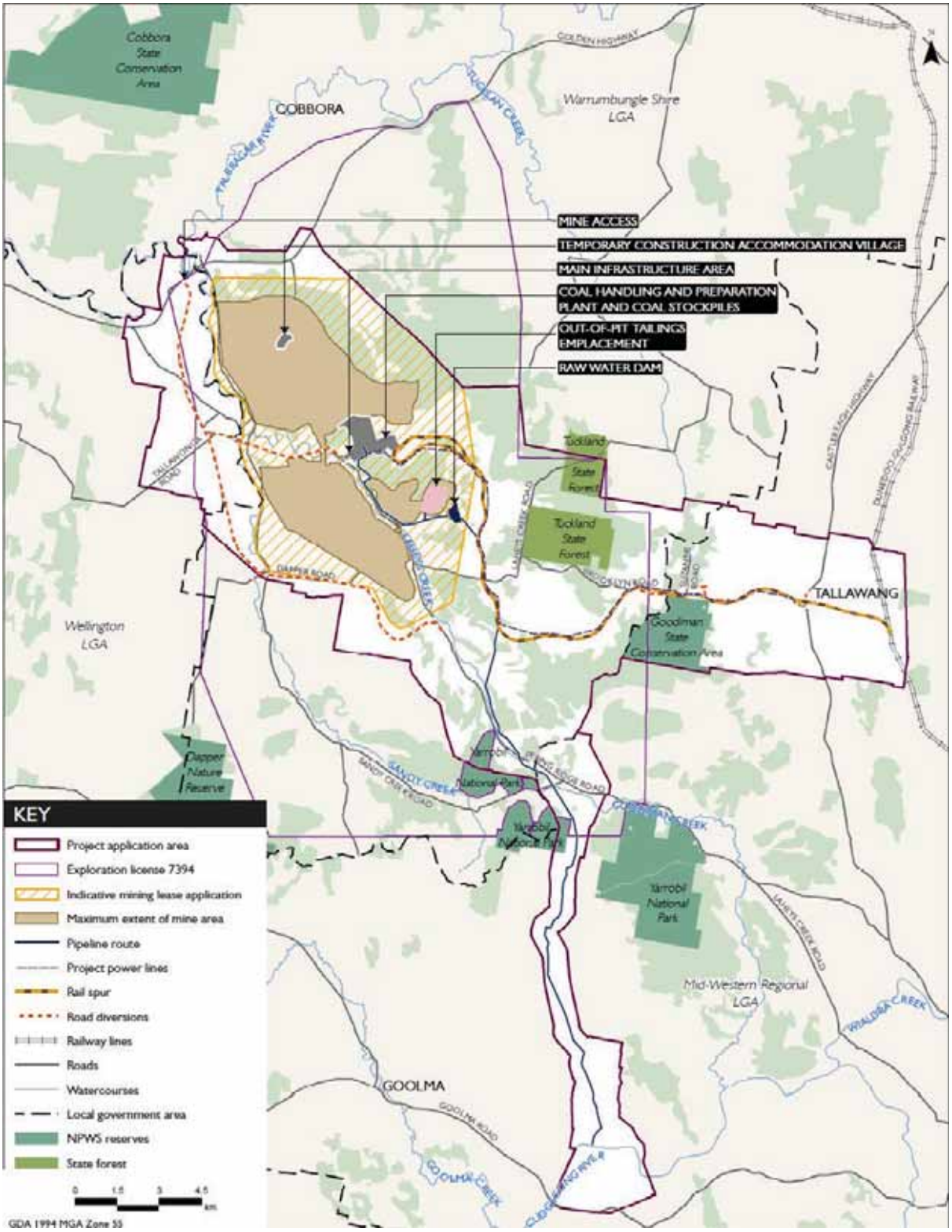


Figure 1: Indicative Project Layout

Image Source: EMM (2013)

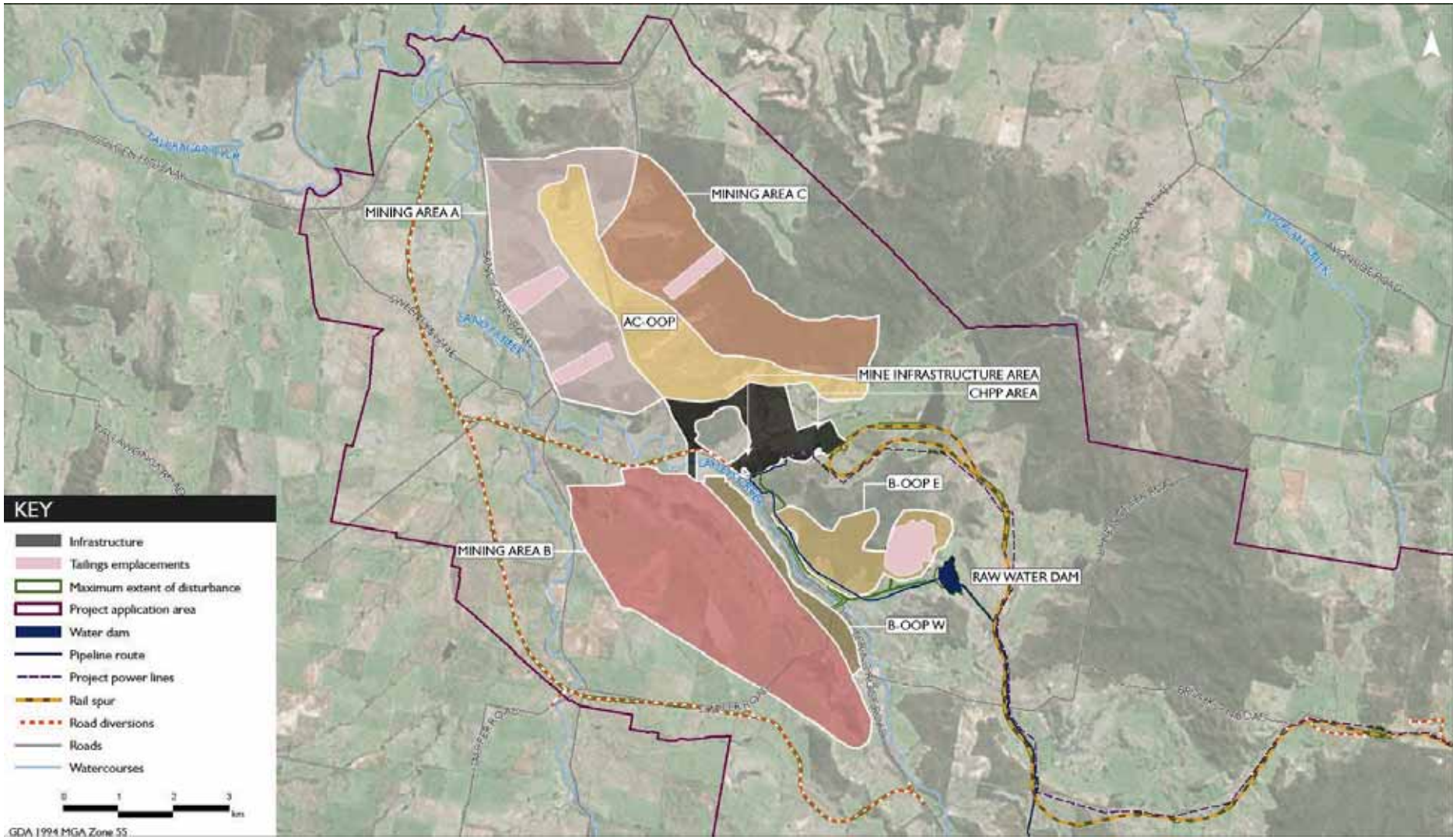


Figure 2: Layout of Proposed Mine Operations Area

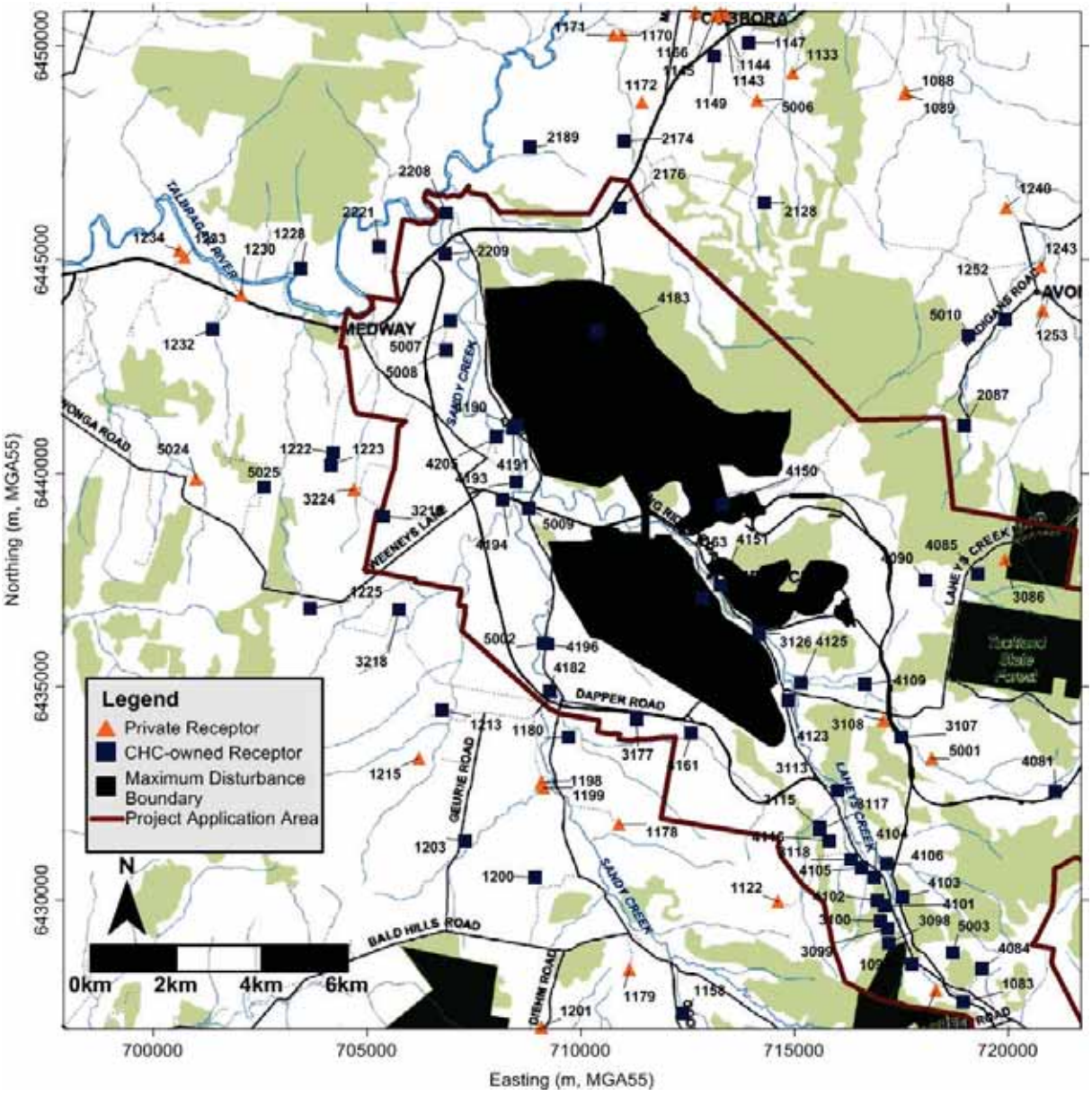


Figure 3: Receptor Locations Surrounding the Project

Table 1: Nearest Privately-Owned Dwellings (Potential Receptors)			
Receptor ID	Receptor Location (m, MGA55)		Distance from CHPP (km)
	Easting	Northing	
1088	717589	6448933	10.8
1089	717566	6448869	10.8
1094	718307	6427895	12.3
1122	714612	6429973	9.2
1133	714961	6449372	10.5
1143	713378	6450733	11.7
1144	713276	6450758	11.7
1145	713147	6450690	11.7
1166	712674	6450791	11.8
1170	710956	6450243	11.4
1171	710758	6450235	11.5
1172	711425	6448680	9.8
1178	710879	6431794	7.6
1179	711134	6428374	10.9
1198	709084	6432771	7.5
1199	709119	6432633	7.6
1201	709077	6427040	12.7
1215	706203	6433330	9.0
1230	702052	6444167	12.3
1233	700741	6445052	13.8
1234	700603	6445211	14
1240	719940	6446205	9.8
1243	720766	6444830	9.5
1253	720799	6443797	9.0
3086	719935	6437979	6.8
3108	717086	6434221	6.2
3224	704695	6439614	8.5
5001	718201	6433329	7.6
5006	714134	6448718	9.7
5024	701001	6439875	12.2

3 Air Quality Assessment Criteria, Dispersion Meteorology and Baseline Air Quality Environment

The air quality assessment criteria, dispersion meteorology and baseline air quality environment are comprehensively documented in the CCPAQIA (Sections 3, 4 and 5 respectively) and are therefore not repeated in this report.

4 Emissions Inventory and Dispersion Modelling

4.1 Overview

The CCPAQIA assessed potential air quality impacts associated with the then proposed progression of the Project. Emission estimation and dispersion modelling was conducted for Years 1, 2, 4, 8, 12, 16 and 20. The original mine plan involved the progressive extraction in both the northern (Mining Area A and C) and southern (Mining Area B) areas concurrently.

Unlike the original mine plan, the latest revision to the mine plan initially involves extractive operations in the northern areas (Mining Area A and C) before progressing to the southern areas (Mining Area B) to mine life completion. Of the mine plans provided by CHC, Year 8 and Year 20 represent the northernmost and southernmost extent of proposed operations. These two mine plan years have been selected to assess potential peak air quality impacts associated with the Project.

Air emission sources associated with modified Year 8 and Year 20 operations of the Project were identified and quantified through the application of National Pollution Inventory (NPI) emission estimation techniques and United States Environmental Protection Agency (US-EPA) AP-42 predictive emission factor equations.

Particulate releases were quantified for various particle size fractions. TSP emissions were estimated and simulated to predict dust deposition rates. Fine particulates (PM_{10} and $PM_{2.5}$) were estimated using ratios for the different particle size fractions available within the literature (principally the US-EPA AP-42), as documented in subsequent sections. Emissions of sulphur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO) and volatile organic compounds (VOCs) were quantified and assessed in the CCPAQIA. Predicted concentrations for all combustion-related gaseous pollutants across all assessed mine years were well below NSW EPA assessment criteria. Consequently, this supplementary air quality assessment does not re-evaluate emissions of gaseous combustion-related pollutants.

4.1.1 Particulate Matter Emission Sources

Air pollution emissions associated with the Project will primarily comprise of fugitive particulate matter releases. As identified in the CCPAQIA, sources of emissions during proposed operations were identified as follows:

- Wheel generated emissions from vehicle movements on unpaved roads;
- Loading and dumping of waste/topsoil material;
- Loading and dumping of Run-of-Mine (ROM) coal;
- ROM pad dumping direct and re-handle by front end loader (FEL) to hopper;
- Loading and dumping of rejects;
- Blasting;
- Drilling;
- Bulldozer operations on coal;
- Bulldozer operations on waste/topsoil;

- Coal crushing/screening;
- Coal stockpile loading;
- Coal conveying and transfer;
- Train wagon loading;
- Wind erosion of coal stockpiles;
- Wind erosion of active mining areas;
- Wind erosion of cleared areas;
- Wind erosion of waste dump/topsoil stockpile areas;
- Wind erosion of rehabilitated waste emplacement areas;
- Road maintenance by grader; and
- Wind-blown coal dust from rail wagons.

4.2 Emission Reduction Measures

4.2.1 Proposed Control Measures

A summary of all control measures proposed for the Project with quantifiable emission reduction factors based on published literature is provided in **Table 2**. These control efficiencies were taken into account in the quantification of Project-related emissions.

Additional emission mitigation measures that are associated with specific on-site operational and mine planning practices include:

- Not blasting during periods with unfavourable meteorological conditions;
- Ensuring all mobile plant travel paths (dozers, excavators, etc) are routinely watered to minimise particulate matter emissions;
- Ceasing operations or relocating operations to more sheltered areas during periods of dry, windy conditions where watering is not providing required mitigation;
- Minimising material drop height when loading and unloading haul trucks;
- Maintaining haul roads to ensure low silt-content within road surface material;
- Minimising double handling of material, wherever practicable;
- Disposing of rejects from the CHPP within the footprint of the mining area;
- Siting of CHPP and coal stockpiles within the centre of the Project Site, removed from surrounding receptors;
- Utilising empty coal haul trucks for backhauling of rejects wherever possible; and
- Progressively rehabilitating waste emplacement areas throughout the life of the Project to minimise the amount of erodible surfaces on site.

Table 2: Air Pollution Control Measures for the Project

Activity	Measure	Control Efficiency [(a)]
Wheel generated emissions from unpaved roads	Water application (75% Control Efficiency) Average vehicle travel speed on haul roads of 40km/hr[(b)]	82.5% [(c)]
Wind erosion of waste rock and topsoil stockpiles	Progressive rehabilitation of emplacements	30% (New Rehabilitation Areas) 90% (Established Rehabilitation Area)
Trucks unloading coal to hopper	3-sided enclosure with a roof and water sprays	85% [(d)]
Drilling	Drill water sprays	70%
Crushing and screening	Enclosure	70%
Coal stockpiles	Water sprays	50%
Train wagon loading point	Telescopic chute	70%

(a) Sources of control efficiency information: NPI 2012; Katestone Environmental, 2011.

(b) The WRAP Fugitive Dust Handbook (Countess Environmental, 2006) specifies in Chapter 6 that an emission reduction of 44% can be achieved by limiting vehicle travel speed on unpaved roads to approximately 40km/hr relative to 70km/hour. The emission estimation factor does not account for site specific vehicle travel speed and was based on travel speeds ranging up to 70km/hr (USEPA, 2006). While speeds may occasionally exceed 40 km/hr at the Project, CHC considers that the average travel speed will generally be lower than 40km/hr along all haul roads. On this basis, the WRAP emission reduction factor has been reduced to 30% for application in this assessment.

(c) Combined control efficiency based on the combination of Watering (75% control efficiency) and average vehicle travel speed of 40km/hr (30% control efficiency – as described in Point (b) above). Using approach of NPI (2012), the combined control factor derived for use in this assessment is 82.5% (i.e. (1-0.75) x (1-0.3) = 0.175 of uncontrolled emissions or 82.5% emission reduction factor.

(d) Combined control efficiency due to water sprays (control efficiency of 50%) and 3-sided enclosure with roof (control efficiency of 70%).

Certain of the above measures do not reduce emission but rather the impact potential of the associated activities (e.g. CHPP placement and blast controls). The effects of other measures are accounted for within the emission estimates, without necessitating control efficiencies being applied (e.g. backhauling reduces the vehicle activity rates used in the emission calculations). The control effectiveness of some of the aforementioned operational measures (e.g. ceasing or modifying operations during dry, windy conditions), could not be accurately quantified.

No emission reduction factors for rail wagons were applied in this assessment.

4.2.2 Best Management Practice Review

A best management practice (BMP) review was undertaken based on the guidance recommended by the OEH (2011). According to this guidance, NSW coal mines should aim to implement practicable best practice measures for the “top four” sources of TSP, PM_{10} and $PM_{2.5}$ emissions.

Following review of the calculated emissions from the Project, presented in **Section 4.3** of this report, the four most significant sources of particulate matter emissions across all assessed mining years are considered to be:

- The movement of vehicles along unpaved roads across the Project Site;
- The operation of bulldozers on coal and waste rock (in-pit operations, waste rock dumps and stockpile management at CHPP);
- Loading and transfer of ROM coal in active mining and ROM Pad areas; and
- Wind erosion of un-rehabilitated waste rock and topsoil emplacement areas.

The control measures proposed to be applied for each of these sources during the operation of the Project, along with the corresponding best practice measures, are listed in **Table 3**.

Table 3: Practicable Best Practice Controls for Top Sources

Highest Ranked Sources of PM Emissions	Control Method(s) Proposed	Practicable Best Practice Measures
Wheel generated emissions from unpaved roads	Water application (75% Control Efficiency) Average vehicle travel speed on haul roads of 40km/hr Routine maintenance of haul roads to ensure low silt content within road surface material	Chemical suppression
Bulldozing of coal / waste	Watering of travel route Ceasing/modifying operations during dry, windy conditions	Watering of travel route Ceasing/modifying operations during dry, windy conditions
Loading / transfer of coal	Drop height minimisation Cease/modify operations during dry, windy conditions	Drop height minimisation Cease/modify operations during dry, windy conditions
Wind erosion of waste and topsoil dumps	Progressive rehabilitation of emplacements	Progressive rehabilitation of emplacements

(a) Sources of Best Practice Measures: Katestone Environmental, 2011.

On the basis of the information presented within **Table 3**, the control measures proposed for implementation at the Project for the four top-ranked sources of particulate matter emissions are comparable to current best practise control measures. Whereas the application of chemical suppression to unpaved haul roads is not proposed for the Project, alternative management measures are planned to achieve a comparable control effectiveness. A high level of particulate matter emission control from unpaved road emissions will be achieved through the comprehensive management of unpaved roads, including:

- minimising the scale of the operating road network;
- application of watering at the specified rate;
- restricting vehicle travel speeds; and
- the continual upkeep of the road surfaces to a high standard.

In the event that the expected outcomes are not achieved, chemical suppressants will be introduced.

The control efficiency achievable through the application of chemical suppression ranges significantly (20% to >99%) across studies, sites, applications, products applied and particle size ranges. A typical control efficiency of approximately 80% is referenced within the USEPA *AP-42 Chapter 13.2.2 Unpaved Roads* (November 2006). It is noted that the emission reduction factor adopted for this assessment, accounting for the combined emission reductions from watering and reduced average vehicle speed, is 82.5%.

4.3 Project-related Particulate Matter Emissions

The emissions inventory for the Project is comprehensively documented in **Appendix A**. A summary of Project-related emissions is given in **Table 4**, **Table 5** and **Table 6** for TSP PM_{10} and $PM_{2.5}$ respectively, ordered by year of mine development and source type. Proposed control measures, as documented in the previous section, have already been taken into account in the emission estimates.

Table 4: Annual TSP Emissions by Source and Mine Year

Emissions Source	Annual TSP Emissions (tpa)	
	Year 8	Year 20
Wheel generated (unpaved roads)	1,585.9	3,309.1
Loading/unloading of waste/topsoil	170.9	329.9
Loading of coal	956.6	842.4
ROM pad unloading/rehandle to hopper	368.3	324.3
Loading/unloading of rejects	126.1	111.1
Blasting	108.2	974.5
Drilling	13.2	62.4
Bulldozer - coal	755.1	755.1
Bulldozer - waste/topsoil	355.4	405.7
Coal crushing/screening	240.0	211.3
Coal stockpile loading	24.0	24.0
Coal conveying and transfer	31.6	28.9
Wind erosion - coal stockpiles	144.9	193.0
Wind erosion - pit areas	168.8	203.0
Wind erosion - cleared areas	32.2	31.6
Wind erosion - waste emplacement/topsoil areas	177.4	143.4
Wind erosion - new rehabilitation areas	314.8	256.3
Wind erosion - established rehabilitation areas	13.5	189.4
Rail wagon coal dust	16.5	16.5
Rail locomotive emissions	1.0	1.0
Total	**5,604.4**	**8,412.9**

Table 5: Annual PM_{10} Emissions by Source and Mine Year		
Emissions Source	**Annual PM_{10} Emissions (tpa)**	
	Year 8	**Year 20**
Wheel generated (unpaved roads)	396.8	826.4
Loading/unloading of waste/topsoil	80.9	156.0
Loading of coal	137.6	121.2
ROM pad unloading/rehandle to hopper	53.0	46.6
Loading/unloading of rejects	27.0	23.7
Blasting	56.3	506.7
Drilling	7.0	32.8
Bulldozer - coal	238.7	238.7
Bulldozer - waste/topsoil	92.4	104.9
Coal crushing/screening	96.0	84.5
Coal stockpile loading	10.2	10.2
Coal conveying and transfer	14.9	13.6
Wind erosion - coal stockpiles	72.4	96.5
Wind erosion - pit areas	84.4	101.5
Wind erosion - cleared areas	16.1	15.8
Wind erosion - waste emplacement/topsoil areas	88.7	71.7
Wind erosion - new rehabilitation areas	157.4	128.2
Wind erosion - established rehabilitation areas	6.7	94.7
Rail wagon coal dust	8.2	8.2
Rail locomotive emissions	0.2	0.2
Total	**1,644.9**	**2,682.1**

Table 6: Annual $PM_{2.5}$ Emissions by Source and Mine Year		
Emissions Source	**Annual $PM_{2.5}$ Emissions (tpa)**	
	Year 8	**Year 20**
Wheel generated (unpaved roads)	39.6	82.6
Loading/unloading of waste/topsoil	1.2	2.4
Loading of coal	18.2	16.0
ROM pad unloading/rehandle to hopper	7.0	6.2
Loading/unloading of rejects	2.4	2.1
Blasting	3.2	29.2
Drilling	0.4	1.9
Bulldozer - coal	16.6	16.6
Bulldozer - waste/topsoil	36.2	41.9
Coal crushing/screening	36.0	31.7
Coal stockpile loading	1.5	1.5
Coal conveying and transfer	0.3	0.3
Wind erosion - coal stockpiles	10.9	14.5
Wind erosion - pit areas	6.3	7.6
Wind erosion - cleared areas	1.2	1.2
Wind erosion - waste emplacement/topsoil areas	6.7	5.4
Wind erosion - new rehabilitation areas	11.8	9.6
Wind erosion - established rehabilitation areas	0.5	7.1
Rail wagon coal dust	1.2	1.2
Rail locomotive emissions	0.2	0.2
Total	**201.4**	**279.2**

4.4 Air Dispersion Modelling

The AERMOD model prepared for Year 8 and Year 20 and detailed in the CPPAQIA was updated to account for changes in equipment locations, pit shell topography and other modifications to the Project associated with the revised mine plan. Further details on model selection and applied methodology are provided in Section 7 and Appendix B of the CPPAQIA. Source configuration maps are provided in **Appendix A** of this report.

Dispersion simulations were undertaken and results analysed for TSP, PM_{10}, $PM_{2.5}$ and dust deposition for the modified Year 8 and Year 20 mine plans. As stated previously in **Section 4.1**, given that SO_2, NO_x, CO and VOC emissions were predicted to be well below the applicable assessment criteria across all assessed years in the CPPAQIA, no modelling was conducted for these pollutants within this supplementary assessment.

Model results are expressed as the maximum predicted concentration/deposition rate for each averaging period at the selected assessment locations over the baseline year modelled. Results are provided in the following formats:

- Summary of key modelling results for each mine year presented in **Section 6**;
- Tabulated results of particulate concentrations and dust deposition rates at the closest private and CHC-owned residential receptors locations are presented in **Appendix B**. Tabulated results include Project-only increments, and cumulative

concentrations/deposition (i.e. Project-only increment + measured background concentrations/deposition);

- Isopleth plots, illustrating spatial variations in Project-related incremental TSP, PM_{10}, $PM_{2.5}$ and dust deposition are provided in **Appendix C**; and
- Isopleth plots, illustrating spatial variations in Project-related cumulative (Project + background) TSP, PM_{10}, $PM_{2.5}$ and dust deposition are provided in **Appendix D**.

The receptors selected within this assessment for reporting of results represent the closest private and CHC-owned residences to the proposed mining areas. Due to the nature of the majority of emission releases from the Project (ground to low level, fugitive releases with limited thermal buoyancy), it is considered that these receptors represent the locations most likely to experience impact from Project-related emissions.

Isopleth plots of the maximum 24-hour average concentrations presented in **Appendix C** and **Appendix D** do not reflect the dispersion pattern on any individual day, but rather illustrate the maximum daily concentration simulated at each grid intercept given the range of meteorological conditions occurring over the modelling period.

5 Air Quality Assessment

Air quality assessments undertaken in accordance with the Approved Methods for Modelling generally provide a conservative (upper bound) estimate of the potential for air quality impacts occurring due to a project.

During this assessment modelling scenarios were established for the Project to provide an upper bound assessment of Project-related air emissions and related risks, taking into account existing air quality. Whereas existing PM_{10} concentrations measured at the Cobbora Project Site are within the OEH 24-hour impact assessment criterion on most days (including all days during the assessment year), concentrations may approach or exceed this criterion due to regional events such as dust storms and bushfires. Such occurrences are infrequent and typical of broader regional trends in PM_{10} concentrations, as recorded at OEH regional air quality monitoring stations.

The Approved Methods for Modelling provides guidance for dealing with elevated background concentrations when assessing cumulative impacts associated with proposed developments. In accordance with the Approved Methods for Modelling, the likelihood of exceedances of the impact assessment criterion occurring due to the Project is conservatively evaluated. Additionally, the extent to which the Project applies best management practices to minimise air emissions is reviewed and demonstrated in **Section 4.2**.

Emission reductions due to the best practice management measures to be implemented by the Project were accounted for in the assessment where it was possible to quantify the control effectiveness of measures. The control effectiveness of real-time operational dust management, through the implementation of a reactive/predictive air quality control system (as documented in Section 9 of the CCPAQIA), could not accurately be quantified. Reduced risks due to the implementation of this measure are therefore not accounted for in the predicted risks presented in this section.

5.1 Assessment of Particulate Matter

Incremental and cumulative TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates predicted to occur due to the operational emissions generated by the Project are presented in **Appendix B** for each assessed mining year.

A summary of the results for each mining year, with discussion regarding potential predicted exceedance of the applicable assessment criteria, is provided below.

5.1.1 Year 8

The results for Year 8 are presented within **Table B1** in **Appendix B**. Incremental air pollutant concentrations and dust deposition rates due solely to the Project were predicted to be within OEH and NEPM criteria at all surrounding private residences.

Additionally, no exceedances were predicted across the remaining private receptors for cumulative concentrations of all particulate matter pollutants, taking existing air quality into account, during proposed Year 8 operations.

5.1.2 Year 20

The results for Year 20 are presented within **Table B2** in **Appendix B**. Incremental air pollutant concentrations and dust deposition rates due solely to the Project were predicted to be within OEH and NEPM criteria at all surrounding private residences.

The following criteria exceedances were predicted to occur due to cumulative concentrations during proposed Year 20 operations of the Project, taking existing air quality into account:

- One exceedance of the 24-hour average PM_{10} criterion at residences 1178, 1198, 1199 and 3108;
- One exceedance of the 24-hour average $PM_{2.5}$ Advisory Reporting Standard at residences 1198 and 1199; and
- Exceedance of the annual average $PM_{2.5}$ Advisory Reporting Standard at residences 1198 and 1199.

No other exceedances were predicted across the remaining private receptors for all particulate matter pollutants assessed during Year 20.

5.1.3 Discussion of Results

Incremental air pollutant concentrations and dust deposition rates associated with Year 8 and Year 20 were predicted to be within OEH and NEPM criteria at all surrounding private residences.

Taking existing background airborne particulate matter concentrations into account, no resultant cumulative concentrations were in exceedance of applicable assessment criteria at surrounding privately owned residences during Year 8. It is noted that one exceedance of the OEH 24-hour average PM_{10} criterion were predicted at three private residences during Year 20.

A conservative (upper bound) estimate of background $PM_{2.5}$ concentrations was derived from the site-specific PM_{10} dataset for use in the assessment. The derived existing annual average $PM_{2.5}$ concentrations of 4.7µg/m^3, comprises over 50% of the annual average $PM_{2.5}$ Advisory Reporting Standard of 8µg/m^3, and is considered a potential over-estimate of background concentrations. Using this upper bound estimate of background concentrations, annual average cumulative concentrations were predicted to be higher than the NEPM Advisory Reporting Standard at two surrounding private residences during Year 20. Additionally, two predicted exceedances of the 24-hour average $PM_{2.5}$ Advisory Reporting Standard are predicted at two private residences.

Exceedances were predicted at up to 35 of the CHC-owned properties across the assessed mine years. It is noted that residents and mine employees renting CHC-owned properties will be protected from health impacts by managing mining operations. Houses will not be leased as residences if health based criteria are likely to be exceeded.

Risk reductions due to the implementation of a reactive/predictive air quality control system (as documented in Section 9 of the CCPAQIA), were not accounted for in the predictions discussed in this section. Given that OEH criteria exceedances are predicted to occur infrequently at private residences the reactive/predictive system is considered necessary to

address the risks identified. The acquisition of nearby private land and dwellings represents a further measure to minimise the likelihood of air quality-related impacts on the surrounding environment.

5.1.4 Comparison with Original AQIA

Due to difference in both the number of mine years assessed and the mine plan versions, the direct comparison of model predictions presented within the CCPAIQA and current assessment is not possible. However, on the basis that the revised Year 8 and Year 20 mine plans are considered to be the northernmost and southernmost extents of mining operations in the provided revised mine plans, the comparison of maximum predicted concentrations by receptor and pollutant between the CCPAQIA (across all assessed years) and current modelling study (across Year 8 and Year 20) provide the most useful indicator of potential changes in air quality impacts.

For the selected surrounding private residences, **Table 7** presents the difference in predicted concentration/deposition rate/frequency of exceedances between the results presented within the CCPAQIA and the results generated from the modelling for revised mine plan. Red shading indicates residences where the maximum value has increased in magnitude for the revised mine plan relative to the results in the CCPAQIA, while blue shading indicates a decrease from the original modelling.

It can be seen from the results in **Table 7** that predicted significant increase in model predictions for the revised mine plan occurs with the private residences to the southeast, south and southwest of the Project (specifically 1122, 1178, 1179, 1198, 1199, 1201, 1215, 3086, 3108, and 5001). For the majority of private residences to the west, north and east of the Project, the maximum model predictions are likely to be lower than, or experience negligible change from, the results presented within the CCPAQIA.

The predicted increase is associated with the proposed confinement of operations to Mining Area B during Year 20 that is a feature of the revised mine plan after Year 13. This change increases the emissions intensity for Mine Area B operations which results in higher predicted impacts at the closest residences. Conversely, the reduction in concurrent active mining areas sees a reduction in impacts for receptors to the vicinity of Mining Areas A and C.

While only two years were assessed through modelling for the revised mine plan, assuming that the results of the dispersion modelling conducted for the revised Year 8 and Year 20 are indicative of the northernmost and southernmost extents of the Project respectively, the results obtained from the modelling conducted provide a representation of maximum impacts for the surrounding receptors in any given year. Relative to the results presented in the CCPAQIA, the model results presented in this report indicate that the revised mine plans will:

- Reduce the spatial footprint area of impacts in any given year;
- Potentially cause higher concentrations at the closest receptors to operations due to the increase in annual extractive intensity in individual mine areas.

5.1.5 Vacant Land Impact Assessment

The Department of Planning often place within the conditions of consent for a project that particulate emissions do not exceed the NSW OEH assessment criteria for particulate matter (TSP, PM_{10} and dust deposition) on more than 25 percent of privately-owned vacant land. In order to provide an indication of performance against this requirement, the maximum cumulative footprint of 24-hour average PM_{10} associated with all assessed mine years was overlayed over land ownership information provided by EMM/CHC. The 24-hour average PM_{10} footprint had the greatest spatial extent of the assessed particulate matter pollutants and averaging periods.

Based on the review of the maximum 24-hour cumulative PM_{10} impact footprint, one land owner is predicted to experience a maximum 24-hour average PM_{10} concentration greater than the 50µg/m^3 across more than 25% of the total rateable property area at some time during the life of the Project.

A list of these properties, along with the spatial extent of the maximum 24-hour average PM_{10} concentration footprint and the location of the affected properties, is presented in **Appendix E**.

Table 7: Change in Maximum Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project – CCPAQIA vs Revised Mine Plan

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
1088	-2.0	-1.1	-1.3	-1.4	-0.5	-0.1	-3.2	NC	NC	-1.8	NC	NC	-0.7	-0.1
1089	-2.0	-0.9	-1.3	-1.3	-0.5	-0.1	-3.2	NC	NC	-1.8	NC	NC	-0.7	-0.1
1094	NC	-1.0	NC	-0.3	NC	NC	-1.2	NC	NC	-0.5	NC	NC	-0.2	NC
1122	0.2	0.5	NC	-0.6	NC	NC	-1.0	NC	NC	-0.5	NC	NC	-0.2	NC
1133	-1.8	-0.7	-1.4	-2.4	-0.7	-0.1	-3.0	NC	NC	-1.9	NC	NC	-0.9	-0.1
1143	-1.8	-4.0	-1.3	-1.7	-0.6	NC	-2.9	NC	NC	-1.8	NC	NC	-0.8	NC
1144	-1.8	-3.9	-1.3	-2.0	-0.6	NC	-2.9	NC	NC	-1.8	NC	NC	-0.8	NC
1145	-1.8	-3.6	-1.3	-1.8	-0.6	NC	-3.0	NC	NC	-1.8	NC	NC	-0.8	NC
1166	-1.8	-1.9	-1.3	-1.7	-0.6	NC	-2.9	NC	NC	-1.8	NC	NC	-0.8	NC
1170	-2.3	-2.8	-1.6	-1.5	-0.7	NC	-3.5	NC	NC	-2.1	NC	NC	-0.9	NC
1171	-2.4	-2.9	-1.6	-1.5	-0.7	NC	-3.6	NC	NC	-2.1	NC	NC	-0.9	NC
1172	-2.7	-1.5	-1.9	-2.7	-1.0	-0.1	-3.9	NC	NC	-2.5	-0.1	NC	-1.2	-0.1
1178	4.6	11.8	1.9	-1.6	0.6	0.1	3.4	9.4	1	1.3	-0.4	NC	0.4	0.1
1179	0.2	3.8	NC	-0.4	-0.1	NC	-1.0	NC	NC	-0.5	NC	NC	-0.3	NC
1198	6.5	10.1	2.1	6.2	1.3	0.1	5.3	9.3	1	1.6	7.2	1	1.1	0.1
1199	5.7	8.4	1.7	5.4	1.1	0.1	4.5	8.6	1	1.2	7.1	1	1.0	0.1
1201	0.1	0.5	NC	-0.4	NC	NC	-1.1	NC	NC	-0.5	NC	NC	-0.2	NC
1215	5.1	16.9	1.7	-0.5	NC	0.2	3.9	4.3	NC	1.2	0.2	NC	-0.2	0.2
1230	-4.4	-5.5	-2.8	-5.2	-1.4	NC	-5.6	-8.4	-1	-3.3	-5.5	NC	-1.6	NC
1233	-3.9	-1.6	-2.4	-3.7	-1.1	NC	-5.1	-0.3	NC	-2.9	-1.2	NC	-1.3	NC
1234	-3.8	-0.3	-2.3	-3.0	-1.1	NC	-5.0	-0.1	NC	-2.8	-1.0	NC	-1.2	NC
1240	-2.6	-4.9	-1.6	-1.1	-0.7	-0.1	-3.8	NC	NC	-2.1	NC	NC	-0.8	-0.1

Table 7: Change in Maximum Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project – CCPAQIA vs Revised Mine Plan

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
1243	-3.5	-6.6	-2.0	-4.9	-0.9	NC	-4.7	NC	NC	-2.6	-0.6	NC	-1.1	NC
1253	-4.2	-9.5	-2.3	-4.7	-0.9	NC	-5.4	NC	NC	-2.8	-0.1	NC	-1.1	NC
3086	0.8	-2.2	0.2	-0.8	NC	NC	-0.4	NC	NC	-0.3	NC	NC	-0.2	NC
3108	1.2	19.2	0.2	0.8	-0.3	NC	NC	12.5	1	-0.3	NC	NC	-0.5	NC
3224	-9.6	-7.7	-5.1	-7.4	-1.9	-0.1	-10.8	-17.8	-2	-5.6	-8.2	-1	-2.0	-0.1
5001	-0.1	3.3	-0.3	-0.5	-0.3	NC	-1.3	NC	NC	-0.8	NC	NC	-0.5	NC
5006	-2.1	-0.6	-1.5	-1.7	-0.7	-0.1	-3.3	NC	NC	-2.0	NC	NC	-0.9	-0.1
5024	-6.1	-1.6	-3.4	-2.9	-1.3	NC	-7.3	-4.8	NC	-3.9	-4.4	NC	-1.5	NC

NOTE: NC – No / negligible Change

Red shading = predicted increase from CHPPAQIA to revised mine plan

Blue shading = predicted increase from CHPPAQIA to revised mine plan

6 Mitigation and Monitoring

Proposed and recommended mitigation and monitoring techniques for the Project are detailed in **Section 9** of the CCPAQIA. These measures remain highly relevant.

In particular, the reactive air quality management system discussed within the CCPAQIA should be implemented to manage operational emissions and minimise potential for exceedance events at the nearest surrounding receptors.

7 Greenhouse Gas Assessment

As stated in **Section 1**, the CCPAQIA incorporated a greenhouse gas (GHG) assessment for the Project. Details of this assessment are presented within Section 10 of the CCPAQIA, including legislation, methodology, emission estimation techniques and results.

The GHG assessment in the CCPAQIA calculated annual GHG emissions for two scenarios:

- Scenario A – product coal to both the domestic and international markets; and
- Scenario B - product coal to the domestic market only.

For the purpose of this report, CHC has requested that a third scenario be assessed:

- Scenario C - product coal to the international market only.

While Scenario C is unlikely to occur, it provides the other end point to 100% domestic use of the coal (Scenario B). All methodology is consistent with the CCPAQIA GHG assessment, with only results for the above three scenarios presented within this report.

7.1 GHG Emissions Inventory and Environmental Impact

7.1.1 Emissions Inventory

This section details the Scope 1, 2, 3 and the total GHG emissions for the Project.

Table 8 details the annual Scope 1 and 2 GHG emissions by source type for each mine year. **Table 9** lists the annual Scope 3 GHG emissions by mine year and source for Scenario A – product coal to both the domestic and international markets, **Table 10** lists the annual Scope 3 GHG emissions by mine year and source for Scenario B – product coal to the domestic market only and **Table 11** lists the annual Scope 3 GHG emissions by mine year and source for Scenario C – product coal to the international market only. **Table 12**, **Table 13** and **Table 14** show the cumulative Scope 1, 2 and 3 emissions and the total GHG emissions for each year of the Project for Scenario A, B and C respectively. All results are expressed in tonnes of carbon dioxide equivalent per year (t CO_2-e/yr).

Table 8: Cobbora Coal Project – Calculated Annual GHG Emissions – Scope 1 and 2				
Mine Year	**Scope 1 Emissions (t CO_2-e/yr) by Source**			**Scope 2 Emissions (t CO_2-e/yr)**
	Onsite Diesel Combustion	**Explosives Detonation**	**Fugitive Coal Seam Gas**	**Purchased Electricity Consumption**
Year 1	96,329	3,576	19,626	77,964
Year 2	145,474	2,883	23,073	155,928
Year 3	156,966	3,698	27,580	155,928
Year 4	157,396	4,578	33,280	155,928
Year 5	167,772	5,422	30,361	155,928
Year 6	170,184	5,552	35,496	155,928
Year 7	181,486	5,747	35,497	155,928
Year 8	181,539	5,290	35,496	155,928
Year 9	188,232	5,909	34,389	155,928
Year 10	187,714	5,857	34,169	155,928
Year 11	198,509	5,861	34,024	155,928
Year 12	199,590	5,894	35,584	155,928
Year 13	200,128	6,206	35,496	155,928
Year 14	200,335	6,046	35,496	155,928
Year 15	200,574	7,503	35,521	155,928
Year 16	200,014	8,180	35,575	155,928
Year 17	199,587	7,021	35,502	155,928
Year 18	197,888	8,531	35,496	155,928
Year 19	197,083	8,412	35,497	155,928
Year 20	196,721	9,109	31,259	155,928
Year 21	102,189	5,890	19,418	155,928

Note: Fugitive Coal Seam Emissions calculated by Method 2 – Direct Onsite Measurements.

Table 9: Cobbora Coal Project – Calculated Annual GHG Emissions – Scope 3 – Scenario A							
Mine Year	**Scope 3 Emissions (t CO_2-e/yr) by Source**						
	Upstream Emissions	**Transport to Domestic Market**	**Transport to International Market**	**Coal Combustion - Domestic**	**Coal Combustion - International**	**Employee Travel**	**Electricity Use**
Year 1	7,346	91,609	102,423	10,566,808	3,310,403	70	14,892
Year 2	11,094	107,699	120,413	12,422,809	3,891,857	89	29,784
Year 3	11,970	128,738	143,935	14,849,516	4,652,104	94	29,784
Year 4	12,003	152,945	171,000	17,641,785	5,526,875	114	29,784
Year 5	12,794	152,945	171,000	17,641,785	5,526,875	121	29,784
Year 6	12,978	152,945	171,000	17,641,785	5,526,875	121	29,784
Year 7	13,840	152,945	171,000	17,641,785	5,526,875	125	29,784
Year 8	13,844	152,945	171,000	17,641,785	5,526,875	126	29,784
Year 9	14,354	152,945	171,000	17,641,785	5,526,875	134	29,784
Year 10	14,315	152,945	171,000	17,641,785	5,526,875	134	29,784
Year 11	15,138	152,945	171,000	17,641,785	5,526,875	138	29,784
Year 12	15,221	152,945	171,000	17,641,785	5,526,875	138	29,784
Year 13	15,262	152,945	171,000	17,641,785	5,526,875	140	29,784
Year 14	15,277	152,945	171,000	17,641,785	5,526,875	140	29,784
Year 15	15,296	152,945	171,000	17,641,785	5,526,875	140	29,784
Year 16	15,253	152,945	171,000	17,641,785	5,526,875	140	29,784
Year 17	15,220	152,945	171,000	17,641,785	5,526,875	138	29,784
Year 18	15,091	152,945	171,000	17,641,785	5,526,875	138	29,784
Year 19	15,029	152,945	171,000	17,641,785	5,526,875	137	29,784
Year 20	15,002	152,945	171,000	17,641,785	5,526,875	137	29,784
Year 21	7,793	152,945	171,000	17,641,785	5,526,875	137	29,784

Table 10: Cobbora Coal Project – Calculated Annual GHG Emissions – Scope 3 – Scenario B							
Mine Year	**Scope 3 Emissions (t CO_2-e/yr) by Source**						
	Upstream Emissions	**Transport to Domestic Market**	**Transport to International Market**	**Coal Combustion - Domestic**	**Coal Combustion - International**	**Employee Travel**	**Electricity Use**
Year 1	7,346	93,019	-	13,877,211	-	70	14,892
Year 2	11,094	109,357	-	16,314,666	-	89	29,784
Year 3	11,970	130,719	-	19,501,620	-	94	29,784
Year 4	12,003	155,299	-	23,168,660	-	114	29,784
Year 5	12,794	155,299	-	23,168,660	-	121	29,784
Year 6	12,978	155,299	-	23,168,660	-	121	29,784
Year 7	13,840	155,299	-	23,168,660	-	125	29,784
Year 8	13,844	155,299	-	23,168,660	-	126	29,784
Year 9	14,354	155,299	-	23,168,660	-	134	29,784
Year 10	14,315	155,299	-	23,168,660	-	134	29,784
Year 11	15,138	155,299	-	23,168,660	-	138	29,784
Year 12	15,221	155,299	-	23,168,660	-	138	29,784
Year 13	15,262	155,299	-	23,168,660	-	140	29,784
Year 14	15,277	155,299	-	23,168,660	-	140	29,784
Year 15	15,296	155,299	-	23,168,660	-	140	29,784
Year 16	15,253	155,299	-	23,168,660	-	140	29,784
Year 17	15,220	155,299	-	23,168,660	-	138	29,784
Year 18	15,091	155,299	-	23,168,660	-	138	29,784
Year 19	15,029	155,299	-	23,168,660	-	137	29,784
Year 20	15,002	155,299	-	23,168,660	-	137	29,784
Year 21	7,793	155,299	-	23,168,660	-	137	29,784

Table 11: Cobbora Coal Project – Calculated Annual GHG Emissions – Scope 3 – Scenario C							
Mine Year	**Scope 3 Emissions (t CO_2-e/yr) by Source**						
	Upstream Emissions	**Transport to Domestic Market**	**Transport to International Market**	**Coal Combustion - Domestic**	**Coal Combustion - International**	**Employee Travel**	**Electricity Use**
Year 1	7,346	-	457,489	-	15,889,936	70	14,892
Year 2	11,094	-	537,845	-	18,680,915	89	29,784
Year 3	11,970	-	642,909	-	22,330,099	94	29,784
Year 4	12,003	-	763,800	-	26,529,000	114	29,784
Year 5	12,794	-	763,800	-	26,529,000	121	29,784
Year 6	12,978	-	763,800	-	26,529,000	121	29,784
Year 7	13,840	-	763,800	-	26,529,000	125	29,784
Year 8	13,844	-	763,800	-	26,529,000	126	29,784
Year 9	14,354	-	763,800	-	26,529,000	134	29,784
Year 10	14,315	-	763,800	-	26,529,000	134	29,784
Year 11	15,138	-	763,800	-	26,529,000	138	29,784
Year 12	15,221	-	763,800	-	26,529,000	138	29,784
Year 13	15,262	-	763,800	-	26,529,000	140	29,784
Year 14	15,277	-	763,800	-	26,529,000	140	29,784
Year 15	15,296	-	763,800	-	26,529,000	140	29,784
Year 16	15,253	-	763,800	-	26,529,000	140	29,784
Year 17	15,220	-	763,800	-	26,529,000	138	29,784
Year 18	15,091	-	763,800	-	26,529,000	138	29,784
Year 19	15,029	-	763,800	-	26,529,000	137	29,784
Year 20	15,002	-	763,800	-	26,529,000	137	29,784
Year 21	7,793	-	763,800	-	26,529,000	137	29,784

Table 12: Cobbora Coal Project – Calculated Annual GHG Emissions – Scenario A				
Mine Year	**Annual GHG Emissions (t CO_2-e/yr) by Scope**			**Total Annual GHG Emissions (t CO_2-e/yr)**
	Scope 1	**Scope 2**	**Scope 3**	
Year 1	119,530	77,964	14,093,551	14,291,045
Year 2	171,429	155,928	16,583,745	16,911,102
Year 3	188,244	155,928	19,816,140	20,160,311
Year 4	195,254	155,928	23,534,506	23,885,688
Year 5	203,555	155,928	23,535,304	23,894,787
Year 6	211,232	155,928	23,535,488	23,902,648
Year 7	222,730	155,928	23,536,355	23,915,013
Year 8	222,325	155,928	23,536,360	23,914,612
Year 9	228,530	155,928	23,536,877	23,921,336
Year 10	227,739	155,928	23,536,838	23,920,505
Year 11	238,394	155,928	23,537,665	23,931,987
Year 12	241,068	155,928	23,537,748	23,934,744
Year 13	241,830	155,928	23,537,791	23,935,549
Year 14	241,877	155,928	23,537,807	23,935,612
Year 15	243,597	155,928	23,537,825	23,937,350
Year 16	243,768	155,928	23,537,782	23,937,478
Year 17	242,110	155,928	23,537,748	23,935,785
Year 18	241,915	155,928	23,537,618	23,935,461
Year 19	240,992	155,928	23,537,556	23,934,475
Year 20	237,089	155,928	23,537,528	23,930,545
Year 21	127,498	155,928	23,530,319	23,813,745

Table 13: Cobbora Coal Project – Calculated Annual GHG Emissions – Scenario B				
Mine Year	**Annual GHG Emissions (t CO_2-e/yr) by Scope**			**Total Annual GHG Emissions (t CO_2-e/yr)**
	Scope 1	**Scope 2**	**Scope 3**	
Year 1	119,530	77,964	13,992,538	14,190,032
Year 2	171,429	155,928	16,464,990	16,792,347
Year 3	188,244	155,928	19,674,186	20,018,358
Year 4	195,254	155,928	23,365,860	23,717,042
Year 5	203,555	155,928	23,366,658	23,726,141
Year 6	211,232	155,928	23,366,842	23,734,002
Year 7	222,730	155,928	23,367,709	23,746,367
Year 8	222,325	155,928	23,367,714	23,745,966
Year 9	228,530	155,928	23,368,231	23,752,690
Year 10	227,739	155,928	23,368,192	23,751,859
Year 11	238,394	155,928	23,369,019	23,763,341
Year 12	241,068	155,928	23,369,102	23,766,098
Year 13	241,830	155,928	23,369,145	23,766,903
Year 14	241,877	155,928	23,369,161	23,766,966
Year 15	243,597	155,928	23,369,179	23,768,704
Year 16	243,768	155,928	23,369,136	23,768,832
Year 17	242,110	155,928	23,369,102	23,767,139
Year 18	241,915	155,928	23,368,972	23,766,815
Year 19	240,992	155,928	23,368,910	23,765,829
Year 20	237,089	155,928	23,368,882	23,761,899
Year 21	127,498	155,928	23,361,673	23,645,099

Table 14: Cobbora Coal Project – Calculated Annual GHG Emissions – Scenario C				
Mine Year	**Annual GHG Emissions (t CO_2-e/yr) by Scope**			**Total Annual GHG Emissions (t CO_2-e/yr)**
	Scope 1	**Scope 2**	**Scope 3**	
Year 1	119,530	77,964	16,369,733	16,567,228
Year 2	171,429	155,928	19,259,727	19,587,084
Year 3	188,244	155,928	23,014,855	23,359,027
Year 4	195,254	155,928	27,334,701	27,685,883
Year 5	203,555	155,928	27,335,499	27,694,982
Year 6	211,232	155,928	27,335,683	27,702,843
Year 7	222,730	155,928	27,336,549	27,715,207
Year 8	222,325	155,928	27,336,554	27,714,807
Year 9	228,530	155,928	27,337,072	27,721,530
Year 10	227,739	155,928	27,337,033	27,720,700
Year 11	238,394	155,928	27,337,860	27,732,182
Year 12	241,068	155,928	27,337,943	27,734,938
Year 13	241,830	155,928	27,337,986	27,735,744
Year 14	241,877	155,928	27,338,001	27,735,807
Year 15	243,597	155,928	27,338,020	27,737,545
Year 16	243,768	155,928	27,337,977	27,737,673
Year 17	242,110	155,928	27,337,942	27,735,980
Year 18	241,915	155,928	27,337,813	27,735,656
Year 19	240,992	155,928	27,337,750	27,734,670
Year 20	237,089	155,928	27,337,723	27,730,740
Year 21	127,498	155,928	27,330,514	27,613,940

The total Scope 1, 2 and 3 for all sources of the Project for each mine year are presented within **Figure 4**, **Figure 5** and **Figure 6** for Scenario A, B and C respectively. The significance of each emissions source type to annual emissions, average across all years of the Project, is illustrated within **Figure 7**, **Figure 8** and **Figure 9** for Scenario A, B and C respectively.

From the estimated GHG emissions, the following can be observed:

- As shown in the results of the GHG emission calculations and as illustrated within **Figure 4**, **Figure 5** and **Figure 6**, the major contributor towards the Project-related GHG emissions are Scope 3 emissions, followed by Scope 1 and Scope 2 emissions. It is reiterated that Scope 3 emissions are those generated beyond the operational control of CHC and are not directly attributable to the operation of the Project.
- Scope 3 emissions contribute approximately 99% of the GHG emissions generated by the Project for all three emission scenarios.
- Based on analysis of the Scope 3 emissions by source type, transportation to and combustion of product coal by domestic and international customers contributes between approximately 99% of the Scope 3 emissions for the Project for all emission scenarios.
- Of calculated Scope 1 emissions, the combustion of diesel fuel represents the most significant source, contributing between 80% and 85% to total annual Scope 1 emissions across the mine years.
- Scope 2 emissions associated with the consumption of purchased electricity contribute approximately 1% to annual GHG emissions.

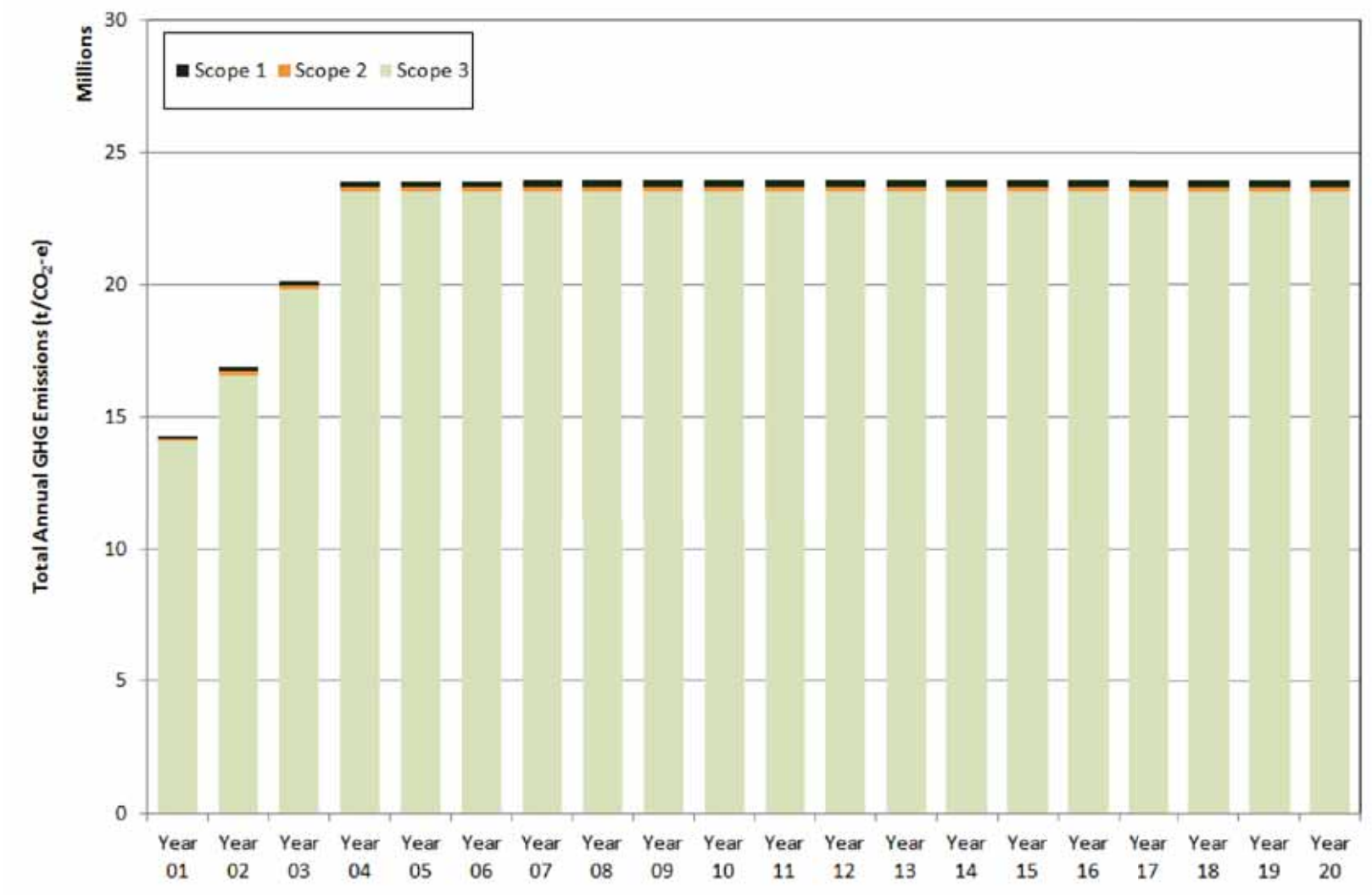


Figure 4: Total Annual Scope 1, 2 and 3 GHG Emissions by Mine Year – Scenario A

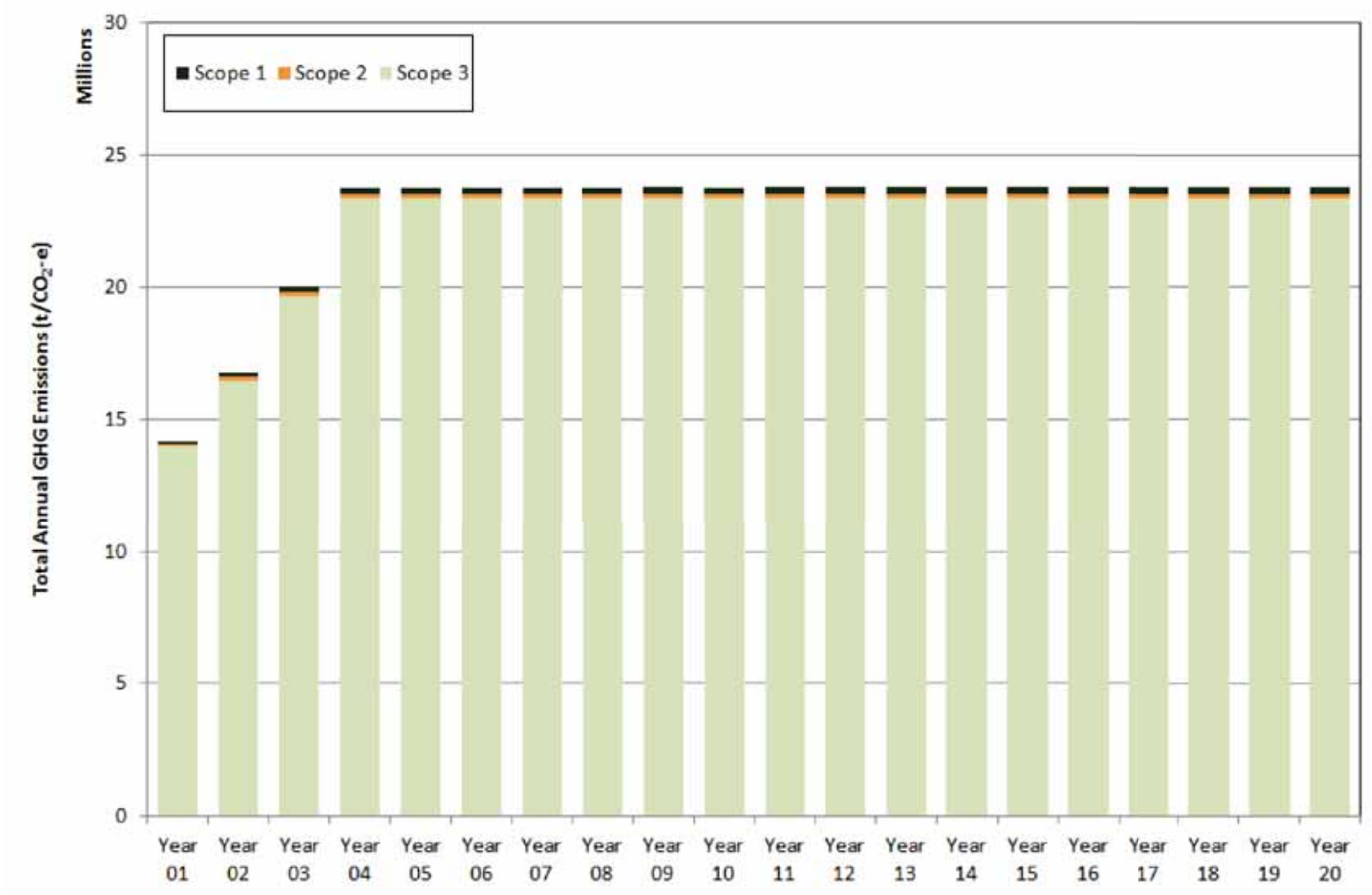


Figure 5: Total Annual Scope 1, 2 and 3 GHG Emissions by Mine Year – Scenario B

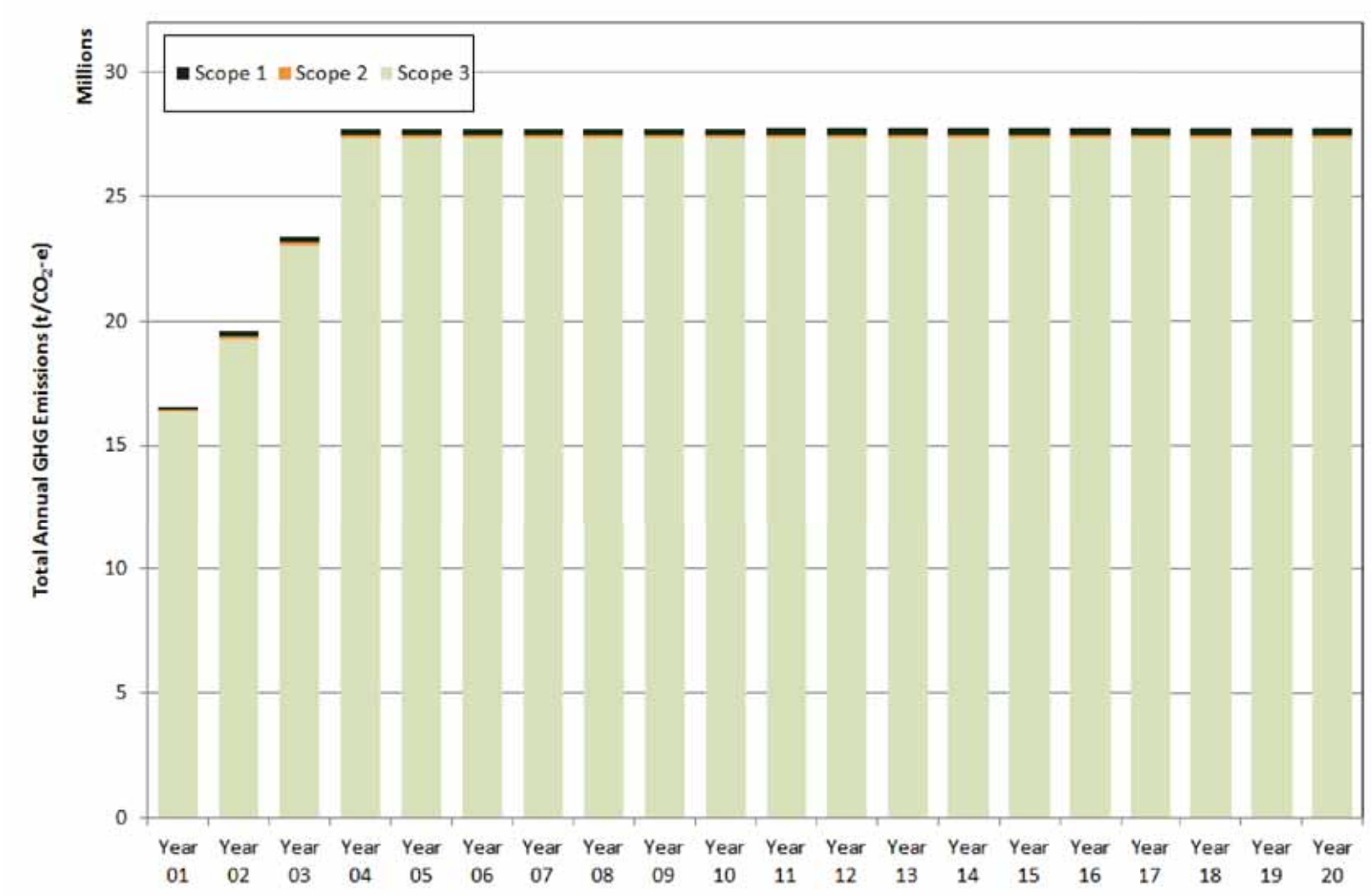


Figure 6: Total Annual Scope 1, 2 and 3 GHG Emissions by Mine Year – Scenario C

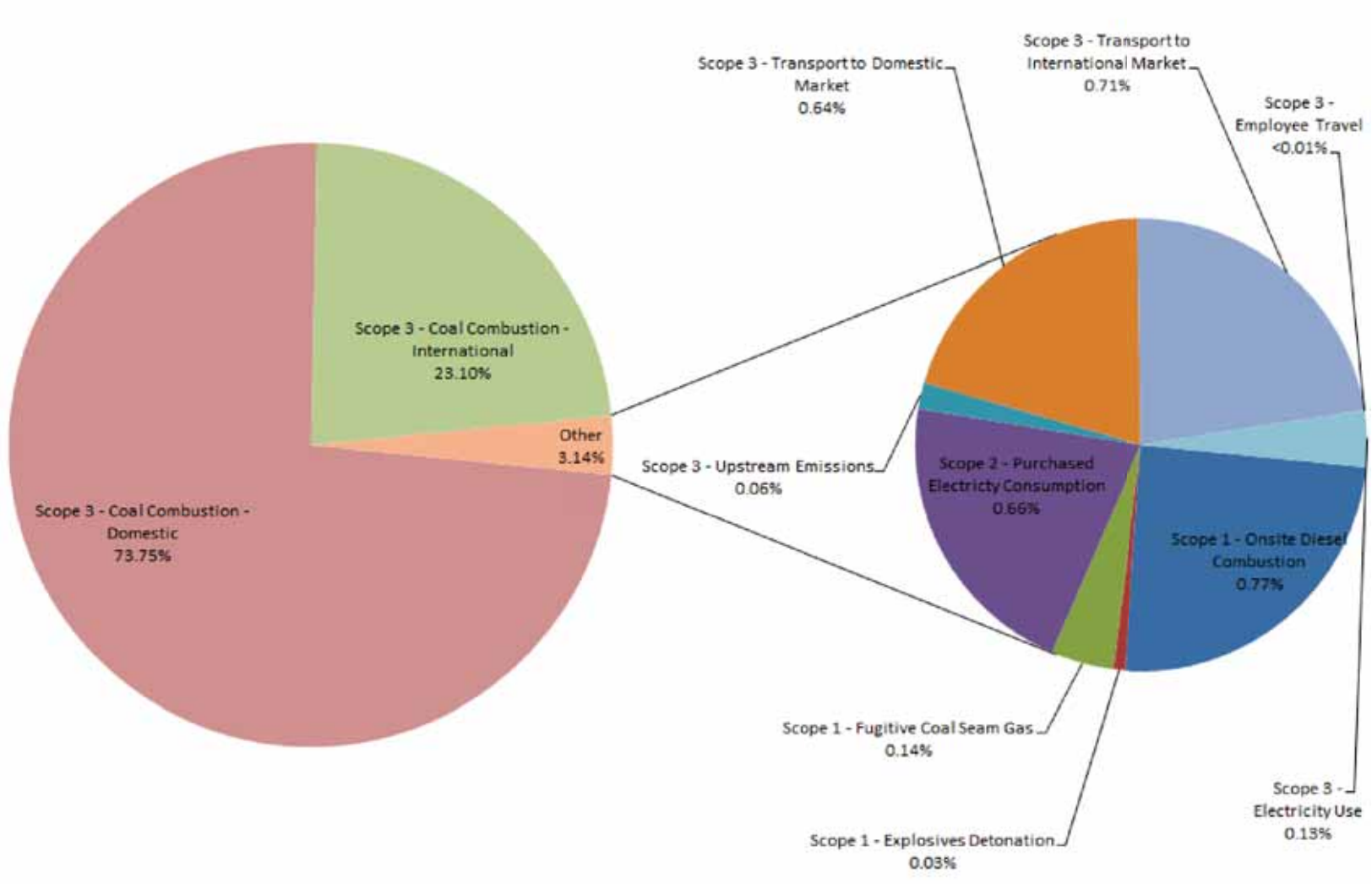


Figure 7: Speciated Annual Scope 1, 2 and 3 GHG Emissions – Average Across Project Life – Scenario A

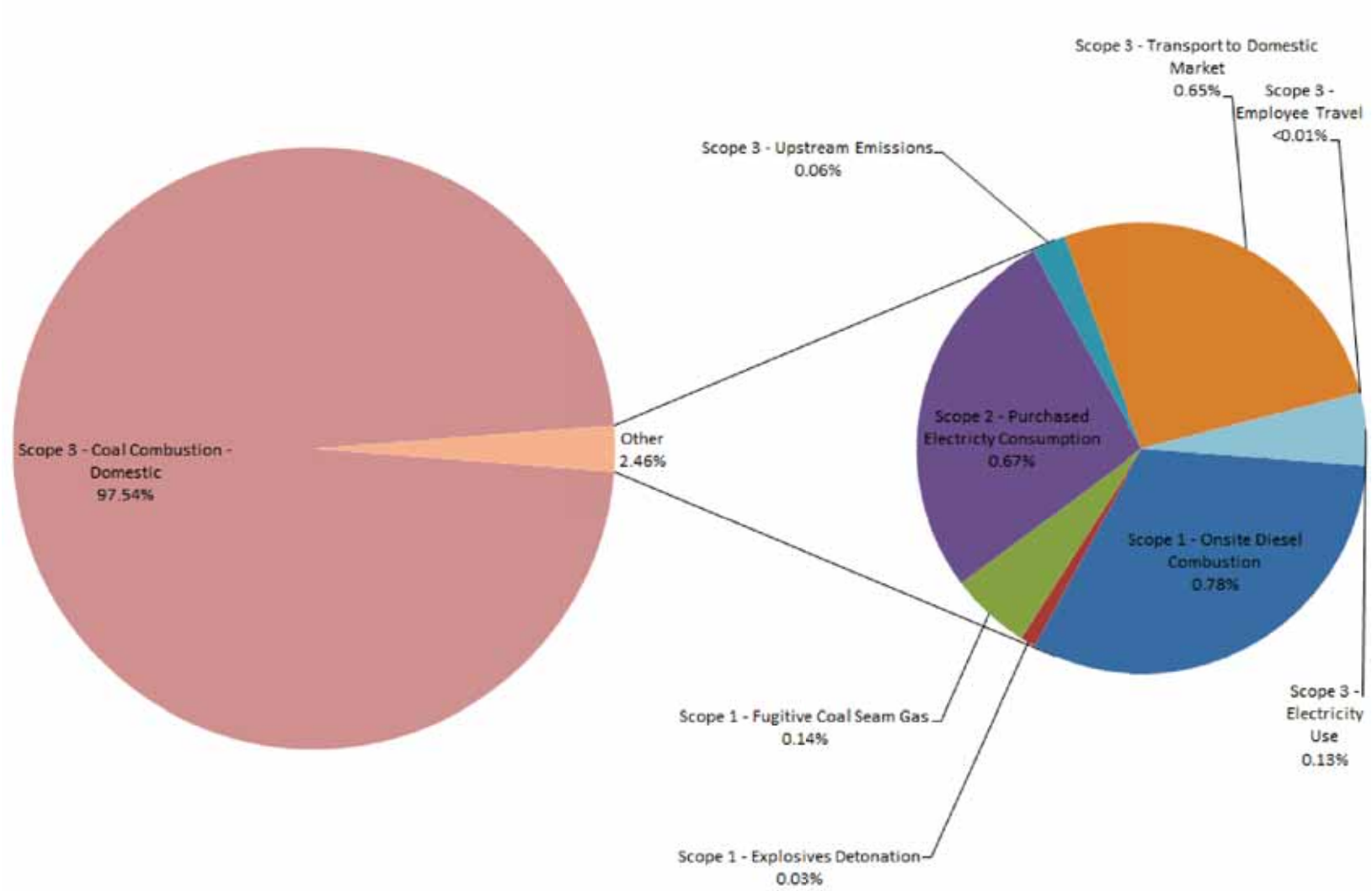


Figure 8: Speciated Annual Scope 1, 2 and 3 GHG Emissions – Average Across Project Life – Scenario B

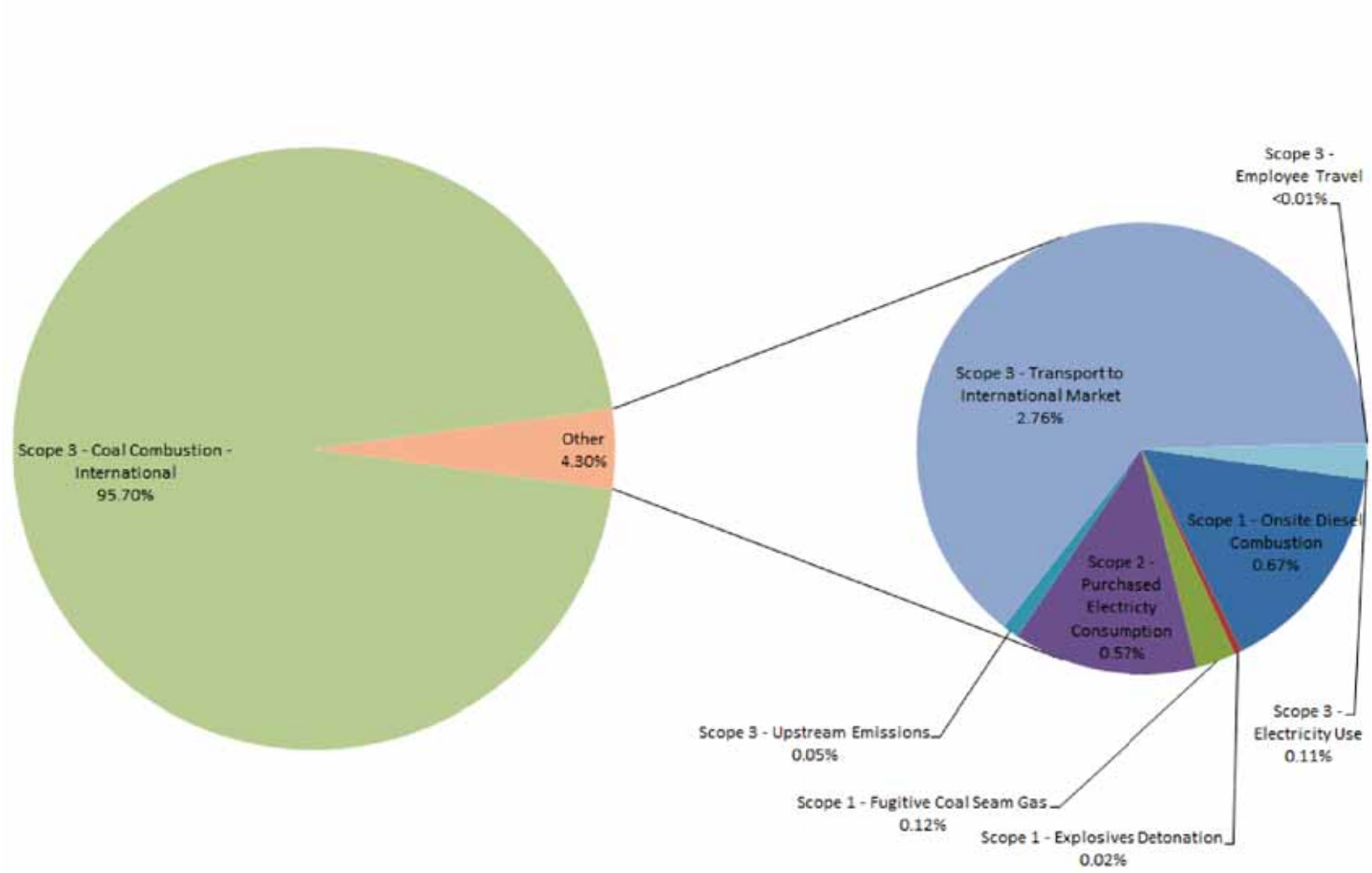


Figure 9: Speciated Annual Scope 1, 2 and 3 GHG Emissions – Average Across Project Life – Scenario C

7.1.2 Impacts of GHG Emissions on the Environment

The extent of the warming produced by a given rise in GHG concentrations depends on 'feedback' processes in the climate system, which can either amplify or dampen a change (CSIRO, 2011, p.15). According to the CSIRO (2011) the net effect of all climate feedbacks, given global GHG emissions, is to amplify the warming caused by increasing CO_2 and other GHGs of human origin. The best estimate of annual average warming by 2030 (above 1990 temperatures) is given as being around 1.0ºC across Australia, with warming of 0.7°C to 0.9ºC in coastal areas and 1°C to 1.2ºC inland (CSIRO, 2011, p. 35). In regard to rainfall, the CSIRO notes that drying is likely in southern areas of Australia, especially in winter, and in southern and eastern areas in spring. This is due to a contraction in the rainfall belt towards the higher latitudes of the southern hemisphere. More extreme rainfall events are predicted for most locations, with the drying and increased evaporation resulting in a decline in soil moisture over parts of Australia. An increase in fire-weather risk is given as being likely with warmer and drier conditions (CSIRO, 2011).

Potential environmental effects in Australia associated with climate change due to global GHG emissions, are documented to include loss of biodiversity, water security issues in parts of Australia, increased drought and fire incidents, and risks of sea level rise and coastal flooding (IPCC, 2007).

Given the complexity of climate feedback processes, the non-linear relationship between GHG emissions and climate changes, and uncertainties in climate change projections, the specific impact of GHG emissions from the Project on the climate system, and as a consequence the broader environment, cannot be quantified with any certainty. The relative significance of GHG emissions from the Project may however be qualitatively evaluated by considering the magnitude of such emissions compared to total GHG emissions released within NSW, nationally and globally.

The most recently published annual GHG emissions for NSW and Australia have been resourced from the Australia National Greenhouse Accounts – State and Territory Greenhouse Gas Inventories 2010/2011 (DIICCSRTE, 2013). According to this inventory, annual GHG emissions for NSW and Australia in 2010/2011 totalled 159.0 Mt and 558.1 Mt CO_2-e/yr respectively. Global annual GHG emissions for 2004 totalled 49,000 Mt according to the Climate Change 2007: Synthesis Report, compiled by the Intergovernmental Panel on Climate Change (IPCC, 2007). At the time of undertaking this assessment, this estimate comprised the latest global GHG emissions data available.

The significance of Project-related GHG emissions in comparison to NSW, Australian and global annual GHG emissions is presented within **Table 15**, **Table 16** and **Table 17** for Scenario A, B and C respectively. Emissions have been compared in terms of GHG emissions directly generated by the operation of the Project (Scope 1) and beyond the operational boundary of the Project (Scope 2 and 3). Further, in comparing Project GHG emissions with NSW and Australian annual totals, only emissions generated in Australia have been incorporated into calculations. Downstream emissions generated from off-shore product transport and the combustion of product coal by international end customers (Scenario A and C only) have been included in the comparison with global emissions only.

It can be seen from the results within **Table 15** and **Table 16** that direct emissions (Scope 1) generated by the Project represent between 0.074% and 0.152% of annual NSW emissions,

0.0022% to 0.045% of Australian emissions and between 0.0002% and 0.0005% of global emissions.

Table 15: Comparison of Annual Project GHG Emissions with NSW and Australian (2009) and Global (2004) GHG Emissions – Scenario A						
Mine Year	**Significance of Direct Project Emissions (Scope 1)**			**Significance of Indirect Project Emissions (Scope 2 and 3)**		
	vs NSW	**vs Australia**	**vs Global**	**vs NSW**	**vs Australia**	**vs Global**
Year 1	0.075%	0.0214%	0.0002%	6.8%	1.93%	0.029%
Year 2	0.108%	0.0307%	0.0003%	8.0%	2.28%	0.034%
Year 3	0.118%	0.0337%	0.0004%	9.5%	2.72%	0.041%
Year 4	0.123%	0.0350%	0.0004%	11.3%	3.22%	0.048%
Year 5	0.128%	0.0365%	0.0004%	11.3%	3.22%	0.048%
Year 6	0.133%	0.0378%	0.0004%	11.3%	3.22%	0.048%
Year 7	0.140%	0.0399%	0.0005%	11.3%	3.22%	0.048%
Year 8	0.140%	0.0398%	0.0005%	11.3%	3.22%	0.048%
Year 9	0.144%	0.0409%	0.0005%	11.3%	3.22%	0.048%
Year 10	0.143%	0.0408%	0.0005%	11.3%	3.22%	0.048%
Year 11	0.150%	0.0427%	0.0005%	11.3%	3.22%	0.048%
Year 12	0.152%	0.0432%	0.0005%	11.3%	3.22%	0.048%
Year 13	0.152%	0.0433%	0.0005%	11.3%	3.22%	0.048%
Year 14	0.152%	0.0433%	0.0005%	11.3%	3.22%	0.048%
Year 15	0.153%	0.0436%	0.0005%	11.3%	3.22%	0.048%
Year 16	0.153%	0.0437%	0.0005%	11.3%	3.22%	0.048%
Year 17	0.152%	0.0434%	0.0005%	11.3%	3.22%	0.048%
Year 18	0.152%	0.0433%	0.0005%	11.3%	3.22%	0.048%
Year 19	0.152%	0.0432%	0.0005%	11.3%	3.22%	0.048%
Year 20	0.149%	0.0425%	0.0005%	11.3%	3.22%	0.048%
Year 21	0.080%	0.0228%	0.0003%	11.3%	3.22%	0.048%

Note: Only emissions generated in Australia are compared against NSW and Australian emission totals

Table 16: Comparison of Annual Project GHG Emissions with NSW and Australian (2009) and Global (2004) GHG Emissions – Scenario B						
Mine Year	**Significance of Direct Project Emissions (Scope 1)**			**Significance of Indirect Project Emissions (Scope 2 and 3)**		
	vs NSW	**vs Australia**	**vs Global**	**vs NSW**	**vs Australia**	**vs Global**
Year 1	0.075%	0.0214%	0.0002%	8.8%	2.52%	0.029%
Year 2	0.108%	0.0307%	0.0003%	10.5%	2.98%	0.034%
Year 3	0.118%	0.0337%	0.0004%	12.5%	3.55%	0.041%
Year 4	0.123%	0.0350%	0.0004%	14.8%	4.21%	0.048%
Year 5	0.128%	0.0365%	0.0004%	14.8%	4.21%	0.048%
Year 6	0.133%	0.0378%	0.0004%	14.8%	4.21%	0.048%
Year 7	0.140%	0.0399%	0.0005%	14.8%	4.21%	0.048%
Year 8	0.140%	0.0398%	0.0005%	14.8%	4.21%	0.048%
Year 9	0.144%	0.0409%	0.0005%	14.8%	4.22%	0.048%
Year 10	0.143%	0.0408%	0.0005%	14.8%	4.22%	0.048%
Year 11	0.150%	0.0427%	0.0005%	14.8%	4.22%	0.048%
Year 12	0.152%	0.0432%	0.0005%	14.8%	4.22%	0.048%
Year 13	0.152%	0.0433%	0.0005%	14.8%	4.22%	0.048%
Year 14	0.152%	0.0433%	0.0005%	14.8%	4.22%	0.048%
Year 15	0.153%	0.0436%	0.0005%	14.8%	4.22%	0.048%
Year 16	0.153%	0.0437%	0.0005%	14.8%	4.22%	0.048%
Year 17	0.152%	0.0434%	0.0005%	14.8%	4.22%	0.048%
Year 18	0.152%	0.0433%	0.0005%	14.8%	4.22%	0.048%
Year 19	0.152%	0.0432%	0.0005%	14.8%	4.22%	0.048%
Year 20	0.149%	0.0425%	0.0005%	14.8%	4.22%	0.048%
Year 21	0.080%	0.0228%	0.0003%	14.8%	4.21%	0.048%

Note: Only emissions generated in Australia are compared against NSW and Australian emission totals

Table 17: Comparison of Annual Project GHG Emissions with NSW and Australian (2009) and Global (2004) GHG Emissions – Scenario C						
Mine Year	**Significance of Direct Project Emissions (Scope 1)**			**Significance of Indirect Project Emissions (Scope 2 and 3)**		
	vs NSW	**vs Australia**	**vs Global**	**vs NSW**	**vs Australia**	**vs Global**
Year 1	0.075%	0.0214%	0.0002%	0.1%	0.03%	0.029%
Year 2	0.108%	0.0307%	0.0003%	0.2%	0.05%	0.034%
Year 3	0.118%	0.0337%	0.0004%	0.2%	0.05%	0.041%
Year 4	0.123%	0.0350%	0.0004%	0.2%	0.06%	0.048%
Year 5	0.128%	0.0365%	0.0004%	0.2%	0.06%	0.048%
Year 6	0.133%	0.0378%	0.0004%	0.2%	0.06%	0.048%
Year 7	0.140%	0.0399%	0.0005%	0.2%	0.06%	0.048%
Year 8	0.140%	0.0398%	0.0005%	0.2%	0.06%	0.048%
Year 9	0.144%	0.0409%	0.0005%	0.2%	0.06%	0.048%
Year 10	0.143%	0.0408%	0.0005%	0.2%	0.06%	0.048%
Year 11	0.150%	0.0427%	0.0005%	0.2%	0.06%	0.048%
Year 12	0.152%	0.0432%	0.0005%	0.2%	0.06%	0.048%
Year 13	0.152%	0.0433%	0.0005%	0.2%	0.06%	0.048%
Year 14	0.152%	0.0433%	0.0005%	0.2%	0.06%	0.048%
Year 15	0.153%	0.0436%	0.0005%	0.2%	0.06%	0.048%
Year 16	0.153%	0.0437%	0.0005%	0.2%	0.06%	0.048%
Year 17	0.152%	0.0434%	0.0005%	0.2%	0.06%	0.048%
Year 18	0.152%	0.0433%	0.0005%	0.2%	0.06%	0.048%
Year 19	0.152%	0.0432%	0.0005%	0.2%	0.06%	0.048%
Year 20	0.149%	0.0425%	0.0005%	0.2%	0.06%	0.048%
Year 21	0.080%	0.0228%	0.0003%	0.2%	0.06%	0.048%

Note: Only emissions generated in Australia are compared against NSW and Australian emission totals

8 Conclusions

8.1 Air Quality Assessment

An air quality assessment was undertaken for the Project. The assessment was undertaken to investigate the potential change in air quality impacts associated with the modification to the mine plan for the Project. The modification to the mine plan involves the revision of mine sequencing to minimise the number of concurrent active mining areas during the life of the Project. Emissions of TSP, PM_{10} and $PM_{2.5}$ were quantified for the revised Year 8 and Year 20 mine plans in order to assess the spatial variation of potential impacts on the surrounding environment from the operation of the Project.

The air quality assessment, undertaken in accordance with the Approved Methods for Modelling, provides a conservative (upper bound) estimate of the potential for air quality impacts occurring due to the Project. Emission reductions due to the best practice management measures to be implemented by the Project were accounted for where the control effectiveness of measures could be quantified. Real-time operational dust management, informed by the proposed reactive/predictive air quality control system, could however not be accounted for in the model predictions. Reduced risks due to the implementation of this measure were therefore not accounted for in the model predictions.

No incremental or cumulative exceedances of applicable air quality criteria were predicted at the surrounding private residences during Year 8.

The following criteria exceedances were predicted to occur due to cumulative concentrations during proposed Year 20 operations of the Project:

- One exceedance of the 24-hour average PM_{10} criterion at residences 1178, 1198, 1199 and 3108;
- One exceedance of the 24-hour average $PM_{2.5}$ Advisory Reporting Standard at residences 1198 and 1199; and
- Exceedance of the annual average $PM_{2.5}$ Advisory Reporting Standard at residences 1198 and 1199.

All receptors with exceedances predicted are the closest private residences to the southeast, south and southwest of the Project Mine Area B. On the basis of the modelling results for Year 20, these receptors are predicted to experience higher concentrations relative to those presented in the CCPAQIA.

Following review of the modelling results for the revised Year 8 and Year 20 mine plans with the results presented within the CCPAQIA, it is considered the revised mine plans will:

- Reduce the spatial footprint area of impacts in any given year;
- Potentially cause higher concentrations at the closest receptors to operations due to the increase in annual extractive intensity in individual mine areas.

As committed to in the CCPAQIA, in order to address the potential for exceedances in the surrounding environment, real time dust and meteorological monitoring will be undertaken. This will allow proactive management of potential dust impacts during unusual wind or weather events.

8.2 Greenhouse Gas Assessment

The GHG assessment conducted for the CCPAQIA has been updated for the revised mine plan and expanded to incorporate an additional scenario – in which the assumption of all product coal is sent to international end users. GHG emissions from the Project were calculated to determine the Project's contribution to NSW and Australian annual GHG emissions, emissions were estimated based on information provided by the client and relevant GHG emission factors.

The assessment's key findings were as follows:

- Annual Project GHG emissions (from direct and indirect sources) were estimated to be between 14Mt and 28Mt of CO_2–e/yr;
- Indirect emissions (Scope 2 and 3) are the major contributor towards the Project's GHG emissions;
- Of the indirect emissions, downstream product transport and combustion of product by end-customers constitutes approximately 99% of the emissions; and
- Direct emissions generated by the Project represent between 0.074% and 0.152% of annual NSW emissions, 0.0022% to 0.045% of Australian emissions and between 0.0002% and 0.0005% of global emissions.

9 References

The following documents and resources have been used in the production of this report:

Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (2013). *Australian National Greenhouse Accounts – State and Territory Greenhouse Gas Inventories (2010-2011)*.

Australian Government AGO (2007) *National Greenhouse Gas Inventory: Analysis of Recent Trends and Greenhouse Indicators 1990 To 2005*

Connell Hatch (2008). Environmental Evaluation on Fugitive Coal Dust Emissions from Coal trains Goonyella, Blackwater and Moura Coal Rail Systems, Final Report, Project undertaken on behalf of Queensland Rail limited, 31 March 2008.

Countess Environmental (2006) *WRAP Fugitive Dust Handbook.*

CSIRO (2011) *Climate Change: Science and Solutions for Australia*

ENVIRON (2012). Air Quality and Greenhouse Gas Assessment for the Proposed Cobbora Coal Project. Project undertaken by ENVIRON Australia Pty Ltd for EMGA Mitchell McLennan on behalf of Cobbora Holding Company, 29 August 2012.

Ferreira A.D., Viegas D.X. and Sousa A.C.M (2003). Full-scale measurements for evaluation of coal dust release from train wagons with two different shelter covers, Journal of Wind Engineering and Industrial Aerodynamics, 91 (2003), 1271-1283.

IPCC (2007) *Climate Change 2007: Synthesis Report*

Katestone Environmental (2011). NSW Coal Mining Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining, Report compiled on behalf of NSW Department of Environment, Climate Change and Water.

National Greenhouse Accounts Factors (NGAF) Workbook – January 2008, issued by the Department of Climate Change and Energy Efficiency (DCCEE);

NHMRC (1996). Ambient Air Quality Goals Recommended by the National Health and Medical Research Council, National Health and Medical Research Council, Canberra.

NPI (2012). *Emission Estimation Technique Manual Mining, Version 3.1 January 2012.*

NSW DEC (2005). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, Department of Environment and Conservation, New South Wales.

NSW OEH (2011), *Coal Mine Particulate Matter Control Best Practice – Site Specific determination guideline.*

Pitts O. (2005). Improvement of NPI Fugitive Particulate Matter Emission Estimation Techniques, Final Report, Sinclair Knight Merz, RFQ No. 0027/2004.

Second International Maritime Organisation (IMO) – Greenhouse Gas (GHG) Study 2009, published by IMO, hereafter referred to as 'IMO-GHG Study'.

USEPA Emissions Factors & AP-42, *Compilation of Air Pollutant Emission Factors (as referenced),* http://www.epa.gov/ttnchie1/ap42/

USEPA (1998). AP-42 Emission Factors for Western Surface Coal Mining, *United States Environmental Protection Agency*.

USEPA (2006). *AP-42 Emission Factor Database*, Chapter 13.2.5 Industrial Wind Erosion, United States Environmental Protection Agency, November 2006.

USEPA (2006). *AP-42 Emission Factor Database*, Chapter 13.2.2 Unpaved Roads, United States Environmental Protection Agency, November 2006.

USEPA (2006). AP-42 Emission Factor Database, Chapter 13.2.4 Aggregate Handling, United States Environmental Protection Agency, November 2006.

Appendix A

Project Emissions Inventory for Air Quality Assessment and Source Configuration

Introduction

Air emission sources associated with the Project were identified and quantified primarily through the application of United States Environmental Protection Agency (USEPA) AP-42 predictive emission factor equations. Referencing of AP-42 emission factors is a requirement within OEH's *Coal Mine Particulate Matter Control Best Practice, Site-specific determination guideline*, November 2011.

Particulate releases were quantified for various particle size fractions, with the TSP fraction being estimated and simulated to provide an indication of dust deposition rates. Fine particulates (PM_{10} and $PM_{2.5}$) were estimated using ratios for the different particle size fractions available within the literature (principally the USEPA AP-42).

Mine Progression Years for Emission Scenarios

Mine staging plans for each significant phase of the Project were provided by CHC, accounting for Years 8 and 20. The amount of material to be extracted and processed for each of these years is presented within **Table D1**.

Table A1. Material Handling by Key Operational Years

Material Type	Year 8	Year 20
Topsoil stripped (ha)	161.0	111.0
Waste (MBCM)[1]	39.0	75.5
ROM Coal (Mtpa)	20.0	20.0
Product Coal (Mtpa)	12.0	12.0

Note 1: MBCM – million bank cubic metre. A density of 2t/m^3 of waste has been assumed to calculate annual waste tonnage amounts.

Sources of Particulate Matter Emissions

Air emissions associated with the Project will primarily comprise of fugitive particulate matter releases. Sources of emission were identified as follows:

- Wheel generated emissions from vehicle movements on unpaved roads;
- Loading and dumping of waste/topsoil material;
- Loading and dumping of Run-of-Mine (ROM) coal;
- ROM pad dumping direct and rehandle by front end loader (FEL) to hopper;
- Loading and dumping of rejects;
- Blasting;
- Drilling;
- Bulldozer operations on coal;
- Bulldozer operations on waste/topsoil;
- Coal crushing/screening;
- Coal stockpile loading;

- Coal conveying and transfer;
- Train wagon loading;
- Wind erosion of coal stockpiles;
- Wind erosion of active mining areas;
- Wind erosion of cleared areas;
- Wind erosion of waste dump/topsoil stockpile areas;
- Wind erosion of rehabilitated waste emplacement areas;
- Road maintenance by grader; and
- Wind-blown coal dust from rail wagons.

Particulate Matter Emission Factors Applied

The emission factor equations applied within the assessment are documented in this subsection. Project-specific inputs applied, including material properties, activity rates, meteorological data (rainfall, wind speed) and particulate matter control efficiencies, are documented in the subsequent subsection.

Unpaved Roads

The emissions factors for unpaved roads, as documented within AP-42 Chapter 13.2.2 "Unpaved Roads" November 2006, was applied as follows:

$$E = k\ (s/12)^a (W/3)^b$$

Where:
E = emissions factor (lb/Vehicle Mile Travelled)
s = surface material silt content (%)
W = mean vehicle weight (short ton)

The following constants are applicable:

Constant	TSP (assumed from PM_{30})	PM_{10}	$PM_{2.5}$
K (lb/VMT)	4.9	1.5	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45

Note: PM_{30} is particulate matter less than 30 µm in aerodynamic diameter

The mean vehicle weight is converted from metric tonnes to short tons (as required by USEPA Equation) by a factor of 1.1023.

The metric conversion from lb/VMT to g/VKT is as follows:

1lb/VMT = 0.2819kg/VKT

This emission factor was applied to the following sources:

- Movement of haul trucks for waste rock, topsoil, ROM coal and CHPP rejects; and
- Movement of light vehicles across haul road network.

Topsoil Scraping Activities

Emissions factors for topsoil scraping activities are taken from AP-42 Chapter 11.9 entitled "Western Surface Coal Mining" dated October 1998. Given that no $PM_{2.5}$ factors are defined in this workbook, the $PM_{2.5}$ ratios used in the OEH's 2008 Greater Metropolitan Region Emissions Inventory were applied.

Material	Units	TSP	PM_{10}	$PM_{2.5}$
Waste rock	kg/tonne	0.029	0.0093	TSP x 0.0468

Bulldozing

The emissions factors for bulldozing operations were taken from AP-42 Chapter 11.9 "Western Surface Coal Mining" October 1998.

Material	Units	TSP	PM_{10}	$PM_{2.5}$
Coal	kg/hr	$\frac{35.6(s)^{1.2}}{(M)^{1.5}}$	$\frac{8.44(s)^{1.5}}{(M)^{1.4}} \times 0.75$	$\frac{35.6(s)^{1.2}}{(M)^{1.4}} \times 0.022$
Waste rock	kg/hr	$\frac{2.6(s)^{1.2}}{(M)^{1.3}}$	$\frac{0.45(s)^{1.5}}{(M)^{1.4}} \times 0.75$	$\frac{2.6(s)^{1.2}}{(M)^{1.3}} \times 0.105$

Where: s = material silt content (%)
M = material moisture content (%)

These emissions factors were applied to the following sources:

- Operation of bulldozers on coal in pit (coal factor);
- Operation of bulldozers on coal stockpiles in CHPP (coal factor);
- Operation of bulldozers on waste rock material in pit (waste rock factor); and
- Operation of bulldozers in rehabilitation areas (waste rock factor).

Drilling

The emissions factor for drilling operations was taken from AP-42 Chapter 11.9 entitled "Western Surface Coal Mining" dated October 1998. There are no PM_{10} and $PM_{2.5}$ emission factors for drilling, with the PM_{10} to TSP and $PM_{2.5}$ to TSP ratio for blasting used for PM_{10} and $PM_{2.5}$ respectively.

Material	Units	TSP	PM_{10}	$PM_{2.5}$
waste rock and Coal	kg/hole	0.59	TSP x 0.52	TSP x 0.03

These emission factors were applied to the following sources:

- Pre-blast drilling of waste rock and ROM coal in operational pits.

Blasting

The emission factors for blasting were taken from AP-42 Chapter 11.9 "Western Surface Coal Mining" October 1998.

Material	Units	TSP	PM_{10}	$PM_{2.5}$
Coal or waste rock	kg/blast	$0.00022(A)^{1.5}$	TSP x 0.52	TSP x 0.03

Where: A= horizontal area (m^2) with blasting depth ≤ 21 m.

These emission factors were applied to the following sources:

- Blasting of waste rock and ROM coal in operational pits.

Trucks Loading

The emissions factors for coal loading to haul trucks were taken from AP-42 Chapter 11.9 "Western Surface Coal Mining" October 1998.

Material	Units	TSP	PM_{10}	$PM_{2.5}$
Coal	kg/t	$\frac{0.58}{(M)^{1.2}}$	$\frac{0.0596}{(M)^{0.9}} \times 0.75$	TSP x 0.019
Waste rock	kg/t	Refer to Material Handling Emission Factor		

Where: M = material moisture content (%)

The coal emission factors were applied to the following sources:

- Extraction and loading of coal to haul trucks;

- Loading of CHPP rejects to haul trucks.

Trucks Dumping

The emission factors for unloading of coal by haul trucks were taken from AP-42 Chapter 11.9 "Western Surface Coal Mining" October 1998.

Material	Units	TSP	PM_{10}	$PM_{2.5}$
Coal	kg/t	$\frac{0.58}{(M)^{1.2}}$	$\frac{0.0596}{(M)^{0.9}} \times 0.75$	TSP x 0.019
Waste rock	kg/t	Refer to Material Handling Emission Factor		

Where: M = material moisture content (%)

The coal emission factors were applied to the following sources:

- Unloading of coal from haul trucks to ROM pad and hopper.

Grading

The emissions factors for grading were taken from AP-42 Chapter 11.9 "Western Surface Coal Mining" October 1998.

Units	TSP	PM_{10}	$PM_{2.5}$
kg/VKT	$0.0034\ (S)^{2.5}$	$0.0056\ (S)^{2.0}$ x 0.6	TSP x 0.031

Where: VKT= Vehicles kilometres travelled
S = mean vehicle speed (km/h)

These emission factors were applied to the following sources:

- Routine maintenance of haul roads.

Materials Handling

Particulate matter emissions from material transfer operations were calculated through the application of the USEPA predictive emission factor equation for continuous and batch drop loading and tipping operations (AP-42, Section 13.2.4), given as follows:

$$E = k(0.0016) * \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right)$$

where,

E = Emissions (kg/tonne transferred)

U = mean wind speed (m/s)

M = material moisture content (%)

k = 0.74 for TSP, 0.35 for PM_{10} and 0.053 for $PM_{2.5}$

Emission rates were calculated on an hourly basis to reflect hourly variations in wind speed.

These emission factors were applied to the following sources:

- Extraction and loading of waste rock/topsoil to haul trucks;
- Unloading of waste rock/top soil to emplacement areas;
- Various transfer points about the processing and CHPP area (conveyor points, loading to transfer bins, etc).

It is noted that as this equation is applicable for a batch drop process. When applied for the waste extraction and truck loading process (i.e. two processes), the factor has been doubled.

Front End Loaders

The USEPA does not provide emissions factors for front end loading and so the truck loading by batch loading factors from AP-42 Chapter 11.9 "Western Surface Coal Mining" October 1998 were adopted for use in the assessment.

Material	Units	TSP	PM_{10}	$PM_{2.5}$
Coal	kg/t	$\frac{0.58}{(M)^{1.2}}$	$\frac{0.596}{(M)^{0.9}} \times 0.75$	TSP x 0.019

Where: M = material moisture content (%)

These emission factors were applied to the following sources:

- Rehandle of coal from ROM pad to hopper (5% of total ROM coal);

Crushing and Screening

No emission factors are available for coal crushing and screening operations. An upper bound approach was adopted with reference made to emissions factors for crushing and screening contained within AP-42 Chapter 11.24 "Metallic Minerals Processing" dated January 1995. The emissions factors presented in this document offer a high moisture and low moisture content factor with high moisture defined as a moisture content greater than 4%. As the moisture content of coal is typically above 4%, the high moisture content values were applied.

There were no $PM_{2.5}$ factors defined in Chapter 11.24 and so the $PM_{2.5}$ ratios outlined in Category 3 of AP-42 Appendix B.2 "Generalized Particle Size Distribution" were applied. Category 3 covers material handling and processing of aggregate and unprocessed ore. This includes emissions from milling, grinding, crushing, screening, conveying, cooling and drying of material.

The TSP and PM_{10} screening emissions factors were obtained from AP-42 Chapter 11.19.2 "Crushed Stone Processing and Pulverized Mineral Processing" dated August 2004. There were no $PM_{2.5}$ factors defined in this chapter, with $PM_{2.5}$ fractions from Category 3 of AP-42 Appendix B.2 "Generalized Particle Size Distribution" applied.

Activity	Units	TSP	PM_{10}	$PM_{2.5}$
High moisture primary crushing	kg/t	0.01	0.004	TSP x 0.15
High moisture secondary crushing	kg/t	0.03	0.012	TSP x 0.15

These emission factors were applied to the following sources:

- Primary and secondary screening of ROM coal before CHPP.

Wind Erosion from Active Coal Stockpiles

Wind-blown dust from coal stockpiles was estimated by applying the complex, predictive emission estimation procedure documented within AP-42 Chapter 13.2.5 "Industrial Wind Erosion" November 2006, as described below.

The predictive emission factor equation for industrial wind erosion is given as follows:

$$E = k \sum_{i=1}^{N} Pi$$

Where,

k = particle size multiplier (k = 1 for TSP, 0.5 for PM_{10} and 0.075 for $PM_{2.5}$)

N = number of disturbances per year

Pi = erosion potential corresponding to the observed (or probable) fastest mile of wind for the i^{th} period between disturbances (g/m^2), calculated by:

$$P = 58(u^* - ut^*) + 25(u^* - ut^*)$$

$$P = 0 \text{ for } u^* \leq ut^*$$

Where,

u* = friction velocity (m/s)

ut* = threshold friction velocity (m/s)

The following steps were followed in applying this equation:

Step 1 – The fastest mile of wind was determined between disturbances.

The coal stockpiles were conservatively assumed to be subject to disturbance on a continuous (hourly) basis to provide an upper bound estimate of emissions (i.e. N=8760). Emissions were calculated on an hourly basis for the base case emission inventory year based on measured site-specific wind speed data for this year.

The fastest mile of wind, required for this methodology, was calculated from the hourly average wind speed based on the gust factor range documented by Pitts (2005). Fastest mile wind speeds are given by Pitts (2005) as being in the range of approximately 1.18 to 1.27 times the hourly wind speed. A factor of 1.27 was used to provide an upper bound estimate of emissions.

Step 2 – The friction velocity was derived for several stockpile sub-areas to account for different wind exposures.

Given that coal stockpiles typically penetrate the surface wind layer (i.e. piles with height-to-base ratios exceeding 0.2), it is necessary to consider that different areas of a stockpile have different exposures to the wind. The friction velocity (u*) must therefore be calculated taking into account the surface wind speed distribution (u_s^+) which is estimated as follows:

$$u_s^+ = \frac{u_s}{u_r} u_{10}^+$$

where,

u_s^+ = surface wind speed distribution (m/s)

u_s = surface wind speed (m/s), measured at 25 cm from the pile's surface

u_r = approach wind speed (m/s), or reference wind speed measured at a height of 10 m.

u_{10}^+ = gust wind speed at reference height of 10m for periods between disturbances (m/s)

The shape of the pile and its orientation to the prevailing wind determine wind exposure patterns (u_s/u_r ratios) at the pile surface. AP-42 Chapter 13.2.5 "Industrial Wind Erosion" November 2006" documents wind exposure patterns for two coal stockpile configurations based on wind tunnel studies undertaken. The two pile shapes are a conical pile and an oval pile with a flat top, both with 37 degree side slopes. The percentage of the pile surface areas represented by normalised surface wind speeds (u_s/u_r) ratio, as listed within the AP-42 Chapter 13.2.5, is given in the table below.

Pile Sub-area (u_s/u_r)	Percent of Pile Surface Area				
	Pile A	Pile B1	Pile B2	Pile B3	Generic
0.2	40%	36%	31%	28%	27%
0.6	48%	50%	51%	54%	54%
0.9	12%	14%	15%	14%	15%
1.1	0%	0%	3%	4%	4%

Note: Values are adopted from AP-42 Chapter 13.2.5 Industrial Wind Erosion

Allowing for variations in actual stockpile shapes, a generic set of pile surface areas was established for application in the emission estimates (as shown in above table). In deriving this generic set, reference was made to the maximum areas across stockpile types covered by sub-areas with higher u_s/u_r ratios.

Based on the surface wind speed distribution (u_s+), the friction velocity (u*) was calculated for each pile sub-area, taking into account the non-uniform wind exposure of stockpiles, by applying the following equation (USEPA, 2006):

$$u^* = \frac{0.4u_s^+}{(\frac{25}{\ln 0.5})} = 0.10u_s^+$$

Step 3 – A threshold friction velocity was determined.

Reference was made to the literature to identify threshold friction velocities for use in the erosion potential calculations. The threshold friction velocity for coal piles is listed by AP-42 Chapter 13.2.5 as 1.12 m/s, which was adopted in this assessment.

Step 4 – Calculation of annual erosion potential for the entire pile

The erosion potential (P) was calculated for each stockpile sub-area, for each hour, based on the calculated friction velocity (u*) and the selected threshold friction velocity (ut*) as follows:

$$P = 58(u^* - ut^*)^2 + 25(u^* - ut^*)$$

$$P = 0 \text{ for } u^* \leq ut^*$$

The erosion potentials were then summed across stockpile sub-areas and across hours to give the total annual erosion potential for the entire pile.

This emission factor derived from the above approach was applied to the following sources:

- ROM, product and emergency stockpiles; and
- ROM pad area.

Wind Erosion of Overburden Emplacement Areas and Other Exposed Areas

The TSP emissions factor taken from the USEPA AP-42 Chapter 11.9 "Western Surface Coal mining" October 1998 was applied in the quantification of wind-blown dust from overburden emplacement areas and other exposed areas (but excluding coal stockpiles). In designating PM_{10} and $PM_{2.5}$ emission factors, reference was made to the PM_{10}/TSP and $PM_{2.5}$/TSP ratios specified within AP-42 Chapter 13.2.5 "Industrial Wind Erosion" November 2006. Emission factors, expressed in metric tonnes per hectare of exposed area per year (t/ha/yr), are given in the table below.

Units	TSP	PM_{10}	$PM_{2.5}$
t/ha/year	0.85	TSP x 0.5	TSP x 0.075

The TSP emission factor is specified for use with seeded land, stripped overburden and graded overburden. This factor was derived based on upwind downwind sampling of exposed areas at coal mines in the US. Pitts (2005) noted that these coal mines, documented within the background document to AP-42 Chapter 11.9 "Western Surface Coal Mining" October 1998, are located within reasonably dry areas (rainfall in the range of 280 to 430 mm/year) characterised by relatively high wind speeds (four sites with average wind speeds of 4.8 to 6 m/s, and one with 2.3 m/s). Pitts (2005) therefore concluded that the equation appears to be based on reasonably dry and windy sites. As the Cobbora area experiences a mean rainfall of 590 mm per year, the application of this emission factor is considered conservative.

The annual emissions calculated by this method were divided up across the modelling period and scaled proportionally according to hourly wind speed. The wind erosion potential equation listed within the USEPA Industrial Wind Erosion method was drawn upon to distribute the annual wind erosion emissions by wind speed.

These emission factors were applied to the following sources:

- Wind erosion from stripped areas, waste rock emplacement areas, topsoil stockpiles and active mining areas; and
- Freshly rehabilitated and fully rehabilitated waste emplacement areas (30% and 90% control efficiency factors applied respectively).

Loading of Stockpiles and Train Wagons

The National Pollution Inventory (NPI) Emission Estimation Technique Manual for Mining (NPI, 2012), provides emission estimation factors for the loading of coal to stockpiles and train wagons. These factors were adopted for use in the assessment. $PM_{2.5}$ emissions were assumed to be 15% of the PM_{10} emission factor

Source	Units	TSP	PM_{10}	$PM_{2.5}$
Loading stockpiles	kg/t	0.004	0.0017	PM_{10} x 0.15
Loading train wagons	kg/t	0.0004	0.00017	PM_{10} x 0.15

Where: M = material moisture content (%)

These emission factors were applied to the following sources:

- Loading of coal to ROM, emergency and product Stockpiles; and
- Loading of coal to train wagons.

Coal Dust from Rail Wagons

Queensland Rail Limited (QR) recently commissioned a comprehensive study into fugitive dust emissions from a number of their coal rail transportation systems in the Queensland coal fields. This study comprised a literature review, a network of air quality monitoring equipment and atmospheric dispersion and numerical modelling. During this assessment conducted by Connell Hatch (2008), reference was made to a paper by Ferreira *et al.* (2003) which focused on the release of coal dust from train wagons. The study by Ferreira *et al.* (2003) conducted measurement of TSP emissions from coal wagons over a 350km journey, and found that for such a distance, a 60t semi-covered wagon would lose approximately 0.001% of its load. (Semi-covered wagons were defined as wagons having 0.5m wide automatic doors running the length of the wagon. When in the closed position, there is a gap of about 1m wide between the two doors.) Further testing by Ferreira *et al.* (2003) showed that if the wagon was uncovered, emissions could be increased by up to five times that of a semi-covered wagon. Based on the specifics of the study conducted by Ferreira *et al.*, emission factors of 1.7g/km/wagon and 8.6g/km/wagon were derived for semi-covered and uncovered wagons respectively.

The findings of Ferreira *et al.* (2003) were used to derive emission factors for the dispersion modelling assessment conducted for the QR study. The resulting predicted concentrations paired well with the track-side air quality monitoring conducted during the QR study, suggesting that the conclusions of the Ferreira *et al.* (2003) study were acceptable for estimating the fugitive coal dust emissions from rail wagons.

Connell Hatch (2008) estimated that almost 90% of coal dust emissions from rail wagons was emitted from the wagon surface with parasitic loads from sills and bodies, door leakage and residual coal in unloaded wagons representing more minor sources. It is therefore pertinent to focus on dust emissions from rail wagons in this assessment.

In the absence of AP-42 emissions estimation methods, the findings of Ferreira *et al.* have been adopted to estimate coal dust emissions from trains transporting coal from the Project. To provide an upper bound estimate of emissions, a TSP emission factor of 8.57g/km/wagon was applied. PM_{10} and $PM_{2.5}$ ratios from the USEPA AP-42 predictive emission factor

equation for industrial wind erosion (Section 13.2.5) were applied, i.e. TSP x 0.5 for PM_{10} and TSP x 0.075 for $PM_{2.5}$. Emissions were estimated for the first 16km of the Rail spur to address cumulative impacts with other Project emissions.

Project Related Input Data and Particulate Matter Emission Estimates

Material property inputs used in the emission estimates are summarised in **Table A.2**. Project-related activity data is provided in **Table A.3**, with particulate matter control efficiencies given in **Table A.4**.

Table A2. Material Property Inputs for Emission Estimation (All Years)

Material Properties	Units	Value	Source of Information
Moisture content of ROM coal	%	8	Provided by CHC
Moisture content of product coal	%	10	Provided by CHC
Moisture content of topsoil	%	4	Assumed
Moisture content of road material	%	2	Assumed
Moisture content of overburden	%	4	Assumed
Moisture content of reject	%	30	Assumed
Silt content of ROM coal	%	13.7	Site specific sampling data
Silt content of product coal	%	13.7	Assumed same as ROM coal (conservative assumption)
Silt content of topsoil	%	23.9	Site specific sampling data
Silt content of road material	%	4.3	Average default value from USEPA AP-42 for coal mining
Silt content of waste rock	%	15	Assumed
Density of waste rock	tonnes/m^3	2.5	Assumed

Table A3. Project Activity Data by Mine Progression Year

Activity	Mine Area	Parameter (Unit)	Year 8	Year 20
Topsoil removal/	Mining Area A	Amount of topsoil (tonnes)	263,750	-
	Mining Area B		-	-
	Mining Area C		380,138	444,113
Waste extraction/unloading	Mining Area A	Amount of waste rock (tonnes)	39,143,730	-
	Mining Area B		-	188,850,203
	Mining Area C		58,303,375	-
ROM coal extraction/unloading	Mining Area A	Amount of ROM coal (tonnes)	8,334,487	-
	Mining Area B		-	17,612,280
	Mining Area C		11,665,526	-
Dozer on waste rock	Mining Area A	Total dozer hours	8,400	-
	Mining Area B		-	29,400
	Mining Area C		16,800	-
Dozer on ROM coal	Mining Area A	Total dozer hours	4,200	-

Table A3. Project Activity Data by Mine Progression Year				
Activity	**Mine Area**	**Parameter (Unit)**	**Year 8**	**Year 20**
	Mining Area B		-	12,600
	Mining Area C		8,400	-
Dozer on rehabilitation area	All Mine	Total hours	5,256	6,132
Haulage of waste rock / topsoil	Mining Area A	Annual VKT (total)	336,380	-
	Mining Area B		-	1,107,661
	Mining Area C		336,250	-
Haulage of ROM coal	Mining Area A	Annual VKT (total)	351,837	-
	Mining Area B		-	858,610
	Mining Area C		351,837	-
Haulage of rejects	Variable by Year	Annual VKT (total)	275,356	275,356
Grader on roads	All Roads	Annual VKT (total)	90,000	90,000
Light vehicle travel	All Roads	Annual VKT (total)	595,000	595,000
Blast size	Mining Area A	Average blast size (m^2)	10,438	-
	Mining Area B		-	50,360
	Mining Area C		15,547	-
Explosives use	Mining Area A	Total explosives use (tonnes)		-
	Mining Area B		-	50,360
	Mining Area C			-
Drill holes	Mining Area A	Number of drill holes per blast	186	-
	Mining Area B		-	900
	Mining Area C		278	-
Blasts	Mining Area A	Number of blasts per year (total)	128	-
	Mining Area B		-	392
	Mining Area C		183	-
Product coal produced	CHPP	Amount of product coal (tonnes)	12,000,000	12,000,000
Coarse rejects from CHPP	CHPP	Amount of coarse reject (tonnes)	6,440,000	5,671,154
Wind erosion areas	Cleared	Total area (ha)	37.8	37.2
	Active mining		198.5	238.8
	Active waste dump		150.5	168.7
	Rehabilitated dump (new)		529.0	430.8
	Rehabilitated dump (established)		158.4	2,228.6
	Topsoil stockpiles		58.2	-
	ROM pad		6.0	6.0
	Product coal		2.5	2.5

Table A3. Project Activity Data by Mine Progression Year				
Activity	**Mine Area**	**Parameter (Unit)**	**Year 8**	**Year 20**
	stockpile			

Table A4. Particulate Matter Control Efficiencies Applied (All Years)				
Mining Activity	**Material**	**Source**	**Control Efficiency (%)**	**Details**
Topsoil removal and stockpiling	Topsoil	Topsoil removal	0%	
	Topsoil	Excavator loading topsoil	0%	
	Topsoil	Trucks unloading topsoil	0%	
Drilling	Overburden	Drilling	70%	Drill water sprays
Blasting of overburden	Overburden	Blasting	0%	Blasting assumed to occur during daylight hours – preferable dispersion conditions
Overburden extraction and unloading	Overburden	Excavators/shovels extracting overburden	0%	
	Overburden	Dozers on Overburden	0%	
	Overburden	Excavators/shovels loading overburden to trucks	0%	
	Overburden	Trucks unloading overburden	0%	
ROM coal extraction	ROM coal	Dozers on ROM coal	0%	
	ROM coal	Front end loaders loading coal to trucks	0%	
	ROM coal	Loading ROM coal dump station (hopper)	70%	Partial enclosure (3 sides and roof)
Vehicle movements	Road material	Wheel generated dust - light vehicles	75%	Watering
	Road material	Wheel generated dust – haul trucks	75% 30%	Watering Average vehicle travel speed of 40km/hr
Grading	Road material	Graders on roads	75%	Watering
CHPP	ROM coal	Primary crusher	70%	Enclosure
	ROM coal	Secondary crusher	70%	Enclosure
	ROM coal	Assorted transfer points	0%	
	ROM coal	Coal stockpiles	50%	Water sprays
	Product coal	Coal stockpiles	50%	Water sprays
	Product coal	Loading coal to trains	70%	Telescopic chute
Rehabilitation	Topsoil	Dozers - shaping	0%	

Table A4. Particulate Matter Control Efficiencies Applied (All Years)

Mining Activity	Material	Source	Control Efficiency (%)	Details
Exposed areas	Topsoil	Topsoil Stockpile	0%	
	Open cut	Open cut area	0%	
	Overburden	Waste dump active	0%	
	Overburden	Rehabilitated waste dump (new)	50%	Primary rehabilitation
	Overburden	Rehabilitated waste dump (established)	90%	Vegetation
	ROM coal	ROM coal stockpile	50%	Water sprays
	Product coal	Product coal stockpile	50%	Water sprays
Rail transport	Product coal	Coal dust from rail wagons	0%	

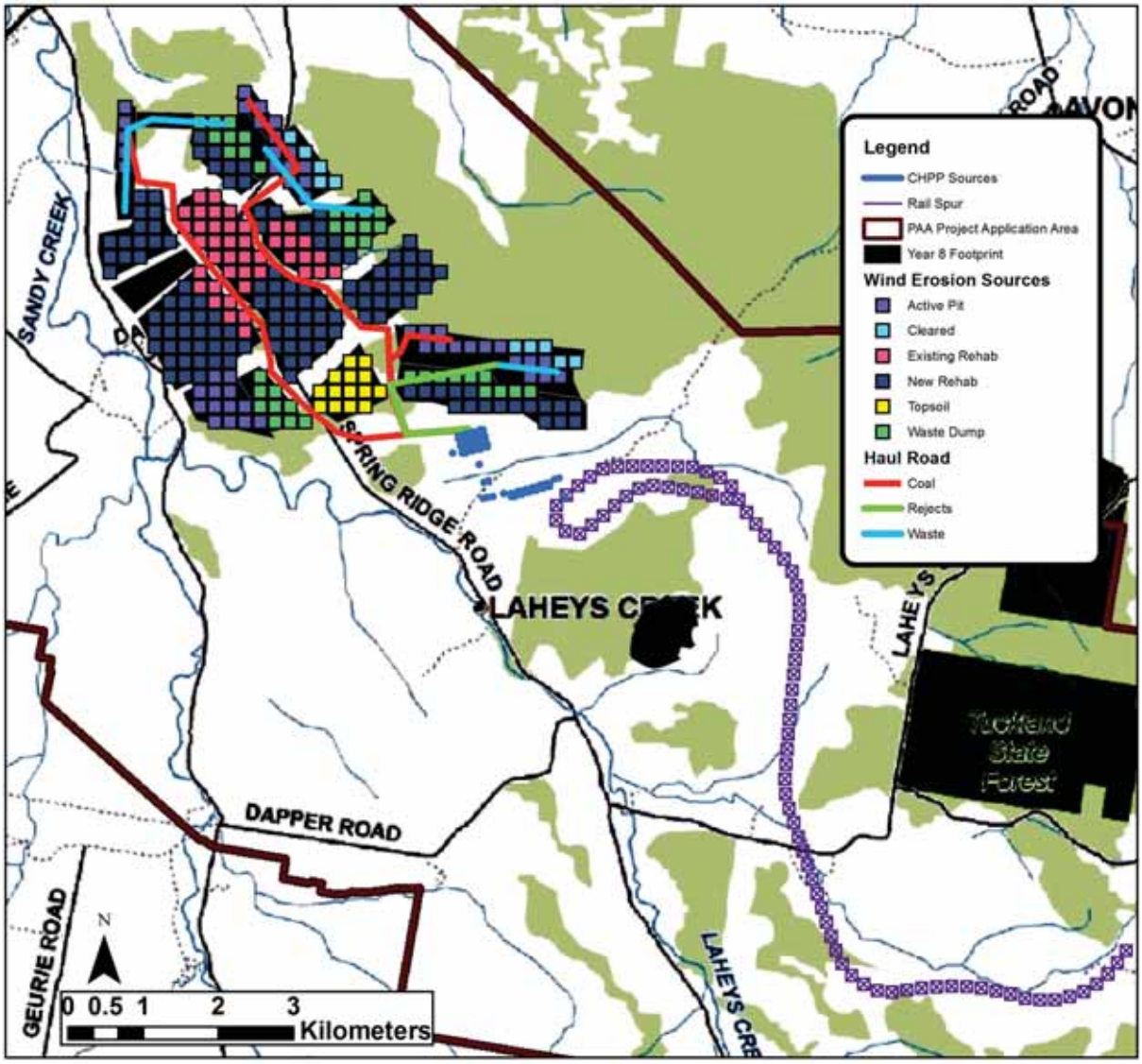


Figure A1 – Year 8 Model Emission Sources

Note: Loading, unloading and dozer sources allocated at either end of each haul road link

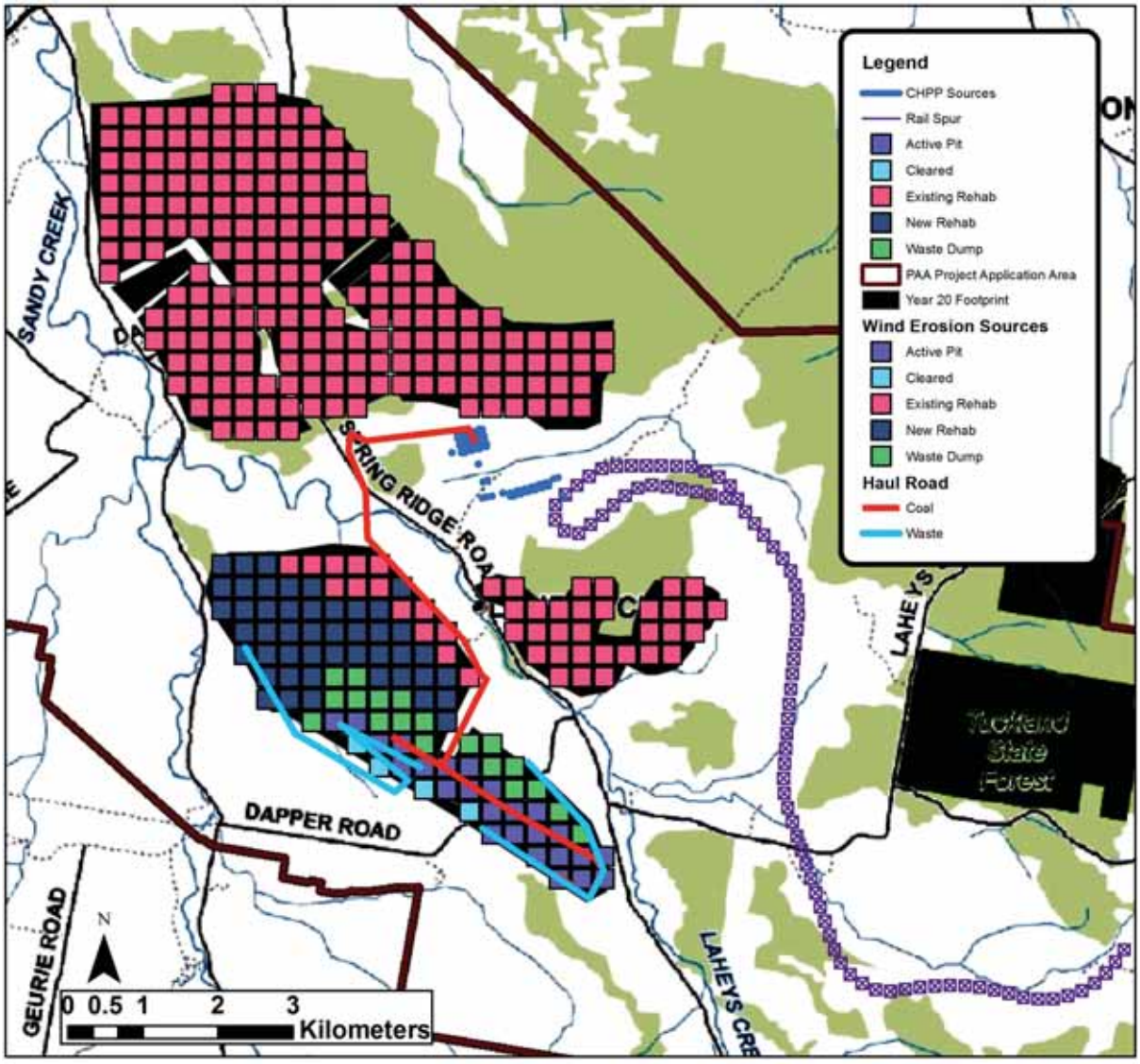


Figure A2 – Year 20 Model Emission Sources

Note: Reject haulage assigned along Coal and Waste roads
Note: Loading, unloading and dozer sources allocated at either end of each haul road link

Appendix B

Tabular Results of Dispersion Modelling – All Scenarios

Introduction

Incremental and cumulative TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates predicted to occur due to the operational emissions generated by the Project are presented in **Table B1** and **Table B2** for Year 8 and Year 20 respectively at each of the surrounding private and CHC-owned receptor locations. The CHC-owned receptors are marked by grey shaded cells.

Criteria applicable for the assessment of the predicted concentration are given in the tables. Such criteria are primarily applicable to cumulative concentrations, with criteria for deposition being issued for both incremental and cumulative dust deposition. In the absence of air quality standards for $PM_{2.5}$, reference is made to the NEPM Advisory Reporting Standard for $PM_{2.5}$ to facilitate a screening assessment of predicted $PM_{2.5}$ concentrations. Exceedances of the relevant air quality criteria are highlighted in the tables as red text in red boxes.

Table B1. Year 8 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³[(b)]	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	**NA**	**NA**	**NA**	**NA**	**NA**	**2**	**90**	**50**	**NA**	**30**	**25[(a)]**	**NA**	**8[(a)]**	**4**
1088	3.2	8.0	1.3	3.0	0.7	0.1	31.4	40.7	0	12.6	16.3	0	5.2	1.5
1089	3.2	8.2	1.3	3.1	0.7	0.1	31.4	40.7	0	12.6	16.3	0	5.3	1.5
1094	0.2	2.2	0.1	0.4	0.0	0.0	28.4	40.7	0	11.4	16.3	0	4.5	1.4
1122	0.3	1.2	0.1	0.3	0.0	0.0	28.5	40.7	0	11.4	16.3	0	4.5	1.4
1133	3.9	10.2	1.6	3.3	0.9	0.1	32.1	40.7	0	12.9	16.3	0	5.4	1.5
1143	3.1	5.3	1.3	2.9	0.8	0.0	31.4	40.7	0	12.6	16.3	0	5.3	1.4
1144	3.1	5.4	1.3	2.8	0.8	0.0	31.4	40.7	0	12.6	16.3	0	5.3	1.4
1145	3.2	5.8	1.3	2.9	0.8	0.0	31.5	40.7	0	12.6	16.3	0	5.3	1.4
1166	3.2	7.3	1.4	3.1	0.8	0.0	31.5	40.7	0	12.6	16.3	0	5.3	1.4
1170	3.8	7.8	1.6	4.0	1.0	0.0	32.0	40.7	0	12.9	16.3	0	5.5	1.4
1171	3.7	7.6	1.6	4.0	1.0	0.0	32.0	40.7	0	12.9	16.3	0	5.5	1.4
1172	5.0	11.8	2.1	4.7	1.2	0.1	33.2	40.7	0	13.4	16.3	0	5.7	1.5
1178	1.7	7.9	0.7	2.6	0.4	0.0	29.9	40.7	0	12.0	16.3	0	4.9	1.4
1179	0.6	2.7	0.2	0.6	0.1	0.0	28.8	40.7	0	11.5	16.3	0	4.6	1.4
1198	2.8	7.8	1.1	3.7	0.8	0.0	31.0	40.7	0	12.4	16.3	0	5.3	1.4
1199	2.8	8.0	1.1	3.8	0.8	0.0	31.0	40.7	0	12.4	16.3	0	5.3	1.4
1201	0.4	2.8	0.1	0.6	0.0	0.0	28.6	40.7	0	11.4	16.3	0	4.6	1.4
1215	1.2	6.7	0.5	2.0	0.2	0.0	29.5	40.7	0	11.8	16.3	0	4.7	1.4
1230	10.9	21.0	4.6	8.1	1.8	0.2	39.1	44.7	0	15.9	17.5	0	6.3	1.6
1233	6.7	19.8	2.8	6.7	1.2	0.1	34.9	43.7	0	14.1	16.7	0	5.7	1.5
1234	6.2	20.5	2.6	6.9	1.1	0.1	34.4	43.8	0	13.9	16.7	0	5.7	1.5
1240	3.4	9.8	1.4	4.9	0.8	0.1	31.6	40.7	0	12.7	16.3	0	5.3	1.5
1243	3.2	10.1	1.3	4.6	0.8	0.1	31.4	40.7	0	12.6	16.3	0	5.3	1.5

Table B1. Year 8 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³[(b)]	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	**NA**	**NA**	**NA**	**NA**	**NA**	**2**	**90**	**50**	**NA**	**30**	**25[(a)]**	**NA**	**8[(a)]**	**4**
1253	3.0	9.4	1.3	3.3	0.7	0.1	31.2	40.7	0	12.5	16.3	0	5.2	1.5
3086	0.4	2.1	0.1	0.4	0.0	0.0	28.6	40.7	0	11.4	16.3	0	4.5	1.4
3108	1.3	11.7	0.6	3.1	0.3	0.0	29.5	40.8	0	11.9	16.3	0	4.8	1.4
3224	10.8	15.0	4.5	8.4	2.2	0.2	39.0	44.5	0	15.7	20.2	0	6.7	1.6
5001	0.8	6.5	0.4	1.6	0.1	0.0	29.0	40.7	0	11.7	16.3	0	4.6	1.4
5006	4.3	10.8	1.8	4.4	1.0	0.1	32.6	40.7	0	13.1	16.3	0	5.5	1.5
5024	6.7	13.1	2.8	4.8	1.3	0.2	34.9	43.5	0	14.1	16.7	0	5.8	1.6
1083	0.2	2.5	0.1	0.5	0.0	0.0	28.4	40.7	0	11.4	16.3	0	4.5	1.4
1093	0.2	2.4	0.1	0.4	0.0	0.0	28.4	40.7	0	11.4	16.3	0	4.5	1.4
1147	3.4	7.1	1.4	2.8	0.8	0.1	31.6	40.7	0	12.7	16.3	0	5.3	1.5
1149	3.6	7.4	1.5	3.2	0.9	0.1	31.9	40.7	0	12.8	16.3	0	5.4	1.5
1158	0.4	2.3	0.2	0.6	0.1	0.0	28.6	40.7	0	11.4	16.3	0	4.6	1.4
1180	3.6	9.5	1.5	4.7	1.1	0.0	31.8	40.7	0	12.7	16.3	0	5.6	1.4
1200	1.1	5.7	0.5	1.7	0.2	0.0	29.3	40.7	0	11.7	16.3	0	4.7	1.4
1203	1.2	7.5	0.5	2.1	0.2	0.0	29.4	40.7	0	11.8	16.3	0	4.7	1.4
1213	2.5	8.5	1.0	2.8	0.5	0.0	30.7	40.7	0	12.3	16.3	0	5.1	1.4
1222	10.2	13.3	4.2	7.6	2.0	0.2	38.4	45.4	0	15.5	18.0	0	6.5	1.6
1223	10.0	13.6	4.1	7.3	2.0	0.2	38.2	45.2	0	15.4	18.4	0	6.5	1.6
1225	3.2	11.8	1.4	2.9	0.5	0.1	31.5	41.0	0	12.7	16.3	0	5.0	1.5
1228	12.3	34.6	5.2	11.0	2.0	0.2	40.6	**50.3**	**1**	16.5	17.0	0	6.5	1.6
1232	10.2	17.3	4.3	7.3	1.7	0.2	38.5	46.4	0	15.6	20.0	0	6.2	1.6
1252	3.3	11.0	1.4	3.2	0.6	0.1	31.5	40.7	0	12.7	16.3	0	5.1	1.5
2087	1.6	11.1	0.7	2.2	0.2	0.0	29.8	40.7	0	11.9	16.3	0	4.7	1.4

Table B1. Year 8 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³[(b)]	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	NA	NA	NA	NA	NA	2	90	50	NA	30	25[(a)]	NA	8[(a)]	4
2128	5.1	12.2	2.1	3.3	0.9	0.2	33.3	40.7	0	13.4	16.3	0	5.4	1.6
2174	6.5	14.4	2.8	5.8	1.5	0.1	34.8	40.7	0	14.0	16.3	0	6.0	1.5
2176	11.6	34.2	4.8	12.5	2.5	0.3	39.9	42.1	0	16.1	16.7	0	7.0	1.7
2189	8.1	14.4	3.4	7.9	1.9	0.0	36.3	40.7	0	14.7	16.3	0	6.4	1.4
2208	13.2	28.5	5.6	10.6	2.5	0.1	41.4	42.2	0	16.9	16.6	0	7.0	1.5
2209	26.5	69.8	11.1	18.0	4.0	0.4	54.8	81.0	9	22.4	22.9	0	8.5	1.8
2221	15.7	42.6	6.6	16.3	2.5	0.2	44.0	53.9	1	17.9	21.1	0	7.1	1.6
3098	0.2	1.9	0.1	0.3	0.0	0.0	28.4	40.7	0	11.4	16.3	0	4.5	1.4
3099	0.2	2.6	0.1	0.4	0.0	0.0	28.5	40.7	0	11.4	16.3	0	4.5	1.4
3100	0.2	2.3	0.1	0.4	0.0	0.0	28.5	40.7	0	11.4	16.3	0	4.5	1.4
3107	1.2	11.2	0.6	3.1	0.2	0.0	29.4	40.7	0	11.9	16.3	0	4.8	1.4
3113	1.1	6.9	0.5	1.5	0.2	0.0	29.3	40.7	0	11.8	16.3	0	4.7	1.4
3115	0.6	6.0	0.2	1.1	0.1	0.0	28.8	40.7	0	11.5	16.3	0	4.6	1.4
3117	0.5	5.6	0.2	1.0	0.1	0.0	28.7	40.7	0	11.5	16.3	0	4.6	1.4
3118	0.5	4.9	0.2	0.9	0.1	0.0	28.7	40.7	0	11.5	16.3	0	4.6	1.4
3126	7.3	27.1	3.0	16.5	2.4	0.0	35.5	44.2	0	14.3	20.1	0	6.9	1.4
3177	1.9	9.9	0.8	2.3	0.3	0.0	30.2	40.7	0	12.1	16.3	0	4.8	1.4
3218	5.6	12.5	2.3	8.8	1.4	0.1	33.9	40.8	0	13.6	16.3	0	5.9	1.5
3219	11.2	21.1	4.6	10.1	2.2	0.2	39.4	44.2	0	15.9	20.6	0	6.8	1.6
4081	0.4	3.5	0.2	0.5	0.0	0.0	28.6	40.8	0	11.5	16.3	0	4.6	1.4
4084	0.2	1.3	0.1	0.2	0.0	0.0	28.4	40.7	0	11.4	16.3	0	4.5	1.4
4085	0.5	3.2	0.2	0.7	0.0	0.0	28.7	40.7	0	11.5	16.3	0	4.6	1.4
4090	0.8	5.4	0.4	1.2	0.1	0.0	29.0	40.7	0	11.7	16.3	0	4.6	1.4

Table B1. Year 8 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	NA	NA	NA	NA	NA	2	90	50	NA	30	25[a]	NA	8[a]	4
4101	0.3	3.1	0.1	0.5	0.0	0.0	28.5	40.7	0	11.4	16.3	0	4.5	1.4
4102	0.3	3.3	0.1	0.5	0.0	0.0	28.5	40.7	0	11.4	16.3	0	4.5	1.4
4103	0.3	5.0	0.1	1.2	0.0	0.0	28.6	40.7	0	11.4	16.3	0	4.6	1.4
4104	0.4	4.6	0.2	1.0	0.1	0.0	28.6	40.7	0	11.5	16.3	0	4.6	1.4
4105	0.4	4.6	0.2	0.9	0.1	0.0	28.7	40.7	0	11.5	16.3	0	4.6	1.4
4106	0.5	7.0	0.2	1.8	0.1	0.0	28.7	40.7	0	11.5	16.3	0	4.6	1.4
4109	2.2	15.9	1.0	4.5	0.5	0.0	30.5	40.8	0	12.3	16.3	0	5.0	1.4
4116	0.5	4.9	0.2	0.8	0.1	0.0	28.7	40.7	0	11.5	16.3	0	4.6	1.4
4123	3.1	13.9	1.3	4.4	0.8	0.0	31.3	40.7	0	12.6	16.3	0	5.3	1.4
4125	3.9	18.3	1.6	7.6	1.0	0.0	32.2	40.8	0	12.9	16.3	0	5.6	1.4
4150	194.1	514.8	105.9	245.5	44.3	3.2	222.3	525.5	271	117.2	249.8	242	48.8	4.6
4151	15.0	37.8	6.4	24.5	4.9	0.1	43.2	48.5	0	17.6	29.5	2	9.5	1.5
4161	2.0	8.3	0.9	2.2	0.4	0.0	30.2	40.7	0	12.1	16.3	0	4.9	1.4
4163	12.6	25.4	5.2	20.6	4.3	0.1	40.8	41.5	0	16.5	26.4	1	8.8	1.5
4182	4.3	12.3	1.8	5.9	1.3	0.0	32.6	40.7	0	13.1	16.3	0	5.8	1.4
4183	168.8	160.9	64.0	53.8	17.3	5.2	197.0	175.3	263	75.3	59.5	144	21.9	6.6
4190	35.5	41.6	14.9	25.1	5.5	0.7	63.8	59.5	7	26.2	29.9	2	10.0	2.1
4191	35.1	40.2	14.7	25.3	5.5	0.7	63.4	58.6	6	26.0	30.2	2	10.0	2.1
4193	31.0	36.0	12.8	20.3	5.7	0.6	59.2	53.6	2	24.1	26.2	3	10.2	2.0
4194	24.3	33.6	10.0	19.4	4.9	0.5	52.5	48.7	0	21.3	26.7	2	9.4	1.9
4196	5.6	21.4	2.3	7.4	1.6	0.0	33.8	40.7	0	13.6	16.3	0	6.1	1.4
4205	29.9	34.5	12.5	20.6	5.0	0.6	58.2	57.1	2	23.8	25.7	1	9.5	2.0
5002	5.6	23.1	2.3	7.4	1.6	0.0	33.8	40.7	0	13.6	16.3	0	6.1	1.4

Table B1. Year 8 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	**NA**	**NA**	**NA**	**NA**	**NA**	**2**	**90**	**50**	**NA**	**30**	**25(a)**	**NA**	**8(a)**	**4**
5003	0.2	2.5	0.1	0.4	0.0	0.0	28.4	40.7	0	11.4	16.3	0	4.5	1.4
5007	86.2	**152.2**	**34.6**	**47.1**	**9.8**	1.7	**114.4**	**160.4**	**123**	**45.9**	**53.7**	**48**	**14.3**	3.1
5008	42.4	**63.6**	17.6	22.8	5.9	1.0	70.6	**76.2**	**22**	28.9	**29.8**	**4**	**10.4**	2.4
5008	25.9	40.4	10.6	22.3	5.5	0.5	54.2	**54.3**	**1**	21.9	**30.0**	**5**	**10.0**	1.9
5009	2.7	11.6	1.1	2.5	0.4	0.1	31.0	40.7	0	12.4	16.3	0	4.9	1.5
5010	7.7	11.8	3.2	6.4	1.6	0.2	35.9	43.9	0	14.5	18.3	0	6.1	1.6

Note: Results with red outline and bold red text indicate exceedance of assessment criteria as applicable by the NSW EPA.

NA – Not applicable. Criteria are applicable to cumulative concentrations – Incremental exceedance of cumulative criteria marked in bold red text.

(a) The NEPM Advisory Reporting Standards for $PM_{2.5}$ are referenced for screening assessment purposes.

(b) The maximum cumulative value is not a sum of the maximum increment and the maximum baseline concentrations, since these maximums may occur on different days. Rather the maximum 24-hour cumulative concentrations reflect days on which background levels plus the concurrent Project-related increment were highest.

Table B2. Year 20 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	**NA**	**NA**	**NA**	**NA**	**NA**	**2**	**90**	**50**	**NA**	**30**	**25[a]**	**NA**	**8[a]**	**4**
1088	2.1	5.0	0.8	2.5	0.6	0.1	30.3	40.7	0	12.1	16.3	0	5.1	1.5
1089	2.1	5.1	0.8	2.6	0.6	0.1	30.3	40.7	0	12.1	16.3	0	5.1	1.5
1094	0.4	2.0	0.2	0.3	0.0	0.0	28.7	40.7	0	11.4	16.3	0	4.5	1.4
1122	1.0	5.5	0.3	0.6	0.0	0.0	29.3	40.7	0	11.6	16.3	0	4.6	1.4
1133	2.0	4.0	0.8	1.9	0.5	0.0	30.2	40.7	0	12.1	16.3	0	5.1	1.4
1143	1.6	3.6	0.7	1.6	0.5	0.0	29.9	40.7	0	12.0	16.3	0	5.0	1.4
1144	1.6	3.7	0.7	1.6	0.5	0.0	29.8	40.7	0	12.0	16.3	0	5.0	1.4
1145	1.6	3.7	0.7	1.5	0.5	0.0	29.9	40.7	0	12.0	16.3	0	5.0	1.4
1166	1.6	3.7	0.7	1.4	0.4	0.0	29.8	40.7	0	12.0	16.3	0	5.0	1.4
1170	1.7	7.6	0.7	2.6	0.5	0.0	29.9	40.7	0	12.0	16.3	0	5.0	1.4
1171	1.7	7.7	0.7	2.7	0.5	0.0	29.9	40.7	0	12.0	16.3	0	5.0	1.4
1172	2.1	8.8	0.9	3.2	0.6	0.0	30.3	40.7	0	12.2	16.3	0	5.1	1.4
1178	11.6	31.9	5.0	6.6	1.8	0.2	39.8	**51.0**	**1**	16.3	16.3	0	6.3	1.6
1179	2.2	11.8	0.9	1.9	0.2	0.0	30.4	40.7	0	12.2	16.3	0	4.7	1.4
1198	22.3	39.1	9.5	18.4	4.1	0.3	50.5	**54.0**	**1**	20.8	**25.5**	**1**	**8.6**	1.7
1199	21.0	38.1	9.0	18.1	3.9	0.3	49.2	**52.2**	**1**	20.3	**25.2**	**1**	**8.4**	1.7
1201	1.0	7.0	0.4	1.1	0.1	0.0	29.2	40.7	0	11.7	16.3	0	4.6	1.4
1215	11.3	31.7	4.5	4.2	0.9	0.4	39.5	47.8	0	15.8	16.8	0	5.4	1.8
1230	3.0	17.6	1.3	3.2	0.7	0.1	31.2	40.7	0	12.6	16.3	0	5.2	1.5
1233	2.4	15.2	1.0	2.3	0.5	0.0	30.6	40.7	0	12.3	16.3	0	5.1	1.4
1234	2.3	14.9	1.0	2.1	0.5	0.0	30.6	40.7	0	12.3	16.3	0	5.0	1.4
1240	2.9	5.3	1.2	3.6	0.7	0.2	31.2	40.7	0	12.5	16.3	0	5.2	1.6
1243	3.5	11.0	1.5	4.3	0.8	0.2	31.8	40.7	0	12.8	16.3	0	5.3	1.6

Table B2. Year 20 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	NA	NA	NA	NA	NA	2	90	50	NA	30	25[a]	NA	8[a]	4
1253	3.9	11.8	1.6	3.4	0.8	0.2	32.1	40.7	0	12.9	16.3	0	5.3	1.6
3086	2.2	5.4	0.8	0.7	0.1	0.1	30.5	40.7	0	12.1	16.3	0	4.6	1.5
3108	6.5	40.4	2.6	5.5	0.6	0.2	34.7	54.2	1	13.9	16.3	0	5.1	1.6
3224	9.8	24.6	4.2	8.8	2.1	0.3	38.1	43.0	0	15.5	17.3	0	6.6	1.7
5001	2.6	19.5	1.1	3.2	0.2	0.1	30.9	40.7	0	12.4	16.3	0	4.7	1.5
5006	2.1	3.9	0.9	3.1	0.6	0.0	30.4	40.7	0	12.2	16.3	0	5.1	1.4
5024	5.6	15.7	2.4	6.5	1.2	0.1	33.8	41.3	0	13.7	16.4	0	5.7	1.5
1083	0.4	2.4	0.1	0.4	0.0	0.0	28.7	40.7	0	11.4	16.3	0	4.5	1.4
1093	0.5	3.1	0.2	0.4	0.0	0.0	28.8	40.7	0	11.5	16.3	0	4.5	1.4
1147	1.8	3.6	0.7	2.2	0.5	0.0	30.0	40.7	0	12.0	16.3	0	5.0	1.4
1149	1.8	4.0	0.8	1.8	0.5	0.0	30.1	40.7	0	12.1	16.3	0	5.0	1.4
1158	1.3	7.8	0.5	1.0	0.1	0.0	29.5	40.7	0	11.8	16.3	0	4.6	1.4
1180	40.8	61.0	17.7	24.1	6.6	0.7	69.0	74.1	20	29.0	31.0	7	11.1	2.1
1200	3.9	18.8	1.6	3.2	0.4	0.1	32.1	40.9	0	12.9	16.3	0	4.9	1.5
1203	6.3	20.0	2.6	3.6	0.8	0.1	34.5	40.9	0	13.9	16.3	0	5.3	1.5
1213	25.3	37.4	11.0	12.8	3.5	0.6	53.5	56.0	3	22.3	23.9	0	8.0	2.0
1222	7.3	29.6	3.1	7.3	1.6	0.2	35.6	42.0	0	14.4	16.5	0	6.1	1.6
1223	7.8	24.8	3.4	6.9	1.7	0.2	36.1	41.5	0	14.7	16.4	0	6.2	1.6
1225	9.4	27.1	4.1	4.6	0.8	0.5	37.6	53.4	1	15.4	17.9	0	5.3	1.9
1228	2.6	6.0	1.1	2.4	0.6	0.0	30.8	40.7	0	12.4	16.3	0	5.2	1.4
1232	3.2	19.8	1.4	4.4	0.7	0.1	31.4	40.8	0	12.7	16.3	0	5.2	1.5
1252	3.9	12.7	1.7	3.2	0.7	0.2	32.2	40.7	0	13.0	16.3	0	5.2	1.6
2087	3.2	12.4	1.3	1.8	0.2	0.3	31.5	40.7	0	12.6	16.3	0	4.7	1.7

Table B2. Year 20 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³[(b)]	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	**NA**	**NA**	**NA**	**NA**	**NA**	**2**	**90**	**50**	**NA**	**30**	**25[(a)]**	**NA**	**8[(a)]**	**4**
2128	2.4	8.7	1.0	2.7	0.4	0.1	30.6	40.7	0	12.3	16.3	0	5.0	1.5
2174	2.4	9.3	1.0	3.6	0.7	0.0	30.6	40.7	0	12.3	16.3	0	5.2	1.4
2176	3.1	10.8	1.3	7.6	1.0	0.0	31.3	40.7	0	12.6	16.3	0	5.5	1.4
2189	2.2	4.8	0.9	2.8	0.6	0.0	30.4	40.7	0	12.2	16.3	0	5.2	1.4
2208	2.5	4.2	1.0	2.6	0.7	0.0	30.7	40.7	0	12.3	16.3	0	5.2	1.4
2209	2.9	5.4	1.2	3.1	0.8	0.0	31.1	40.7	0	12.5	16.3	0	5.3	1.4
2221	2.5	5.8	1.1	2.5	0.7	0.0	30.8	40.7	0	12.4	16.3	0	5.2	1.4
3098	0.6	4.1	0.2	0.5	0.0	0.0	28.8	40.7	0	11.5	16.3	0	4.5	1.4
3099	0.7	4.4	0.2	0.6	0.0	0.0	28.9	40.7	0	11.5	16.3	0	4.5	1.4
3100	0.7	5.0	0.2	0.6	0.0	0.0	28.9	40.7	0	11.5	16.3	0	4.5	1.4
3107	4.9	33.2	2.0	4.8	0.5	0.1	33.2	47.2	0	13.3	16.3	0	5.0	1.5
3113	6.3	33.6	2.5	4.8	0.7	0.1	34.5	**50.1**	**1**	13.8	16.3	0	5.2	1.5
3115	2.8	31.8	1.0	4.3	0.2	0.1	31.0	49.3	0	12.3	16.3	0	4.7	1.5
3117	2.4	27.9	0.9	3.7	0.1	0.1	30.6	45.9	0	12.2	16.3	0	4.7	1.5
3118	2.0	21.9	0.8	3.2	0.1	0.0	30.2	42.1	0	12.0	16.3	0	4.7	1.4
3126	67.2	**99.7**	**30.1**	**40.6**	**10.8**	1.6	**95.4**	**113.1**	**130**	**41.4**	**45.3**	**58**	**15.3**	3.0
3177	49.0	**60.6**	19.1	10.4	3.0	1.6	77.2	**82.0**	**41**	**30.4**	19.6	0	7.5	3.0
3218	20.6	39.3	9.4	15.0	3.6	0.7	48.8	**54.5**	**2**	20.7	22.7	0	**8.1**	2.1
3219	12.6	30.4	5.5	9.8	2.4	0.4	40.9	44.6	0	16.8	19.4	0	6.9	1.8
4081	0.8	3.9	0.4	0.6	0.1	0.0	29.0	40.8	0	11.7	16.3	0	4.6	1.4
4084	0.5	3.9	0.1	0.5	0.0	0.0	28.7	40.7	0	11.4	16.3	0	4.5	1.4
4085	2.8	7.3	1.0	1.0	0.1	0.2	31.0	40.7	0	12.3	16.3	0	4.6	1.6
4090	4.7	15.3	1.8	2.2	0.3	0.3	33.0	40.7	0	13.1	16.3	0	4.8	1.7

Table B2. Year 20 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	NA	NA	NA	NA	NA	2	90	50	NA	30	25(a)	NA	8(a)	4
4101	0.8	5.2	0.3	0.6	0.0	0.0	29.0	40.7	0	11.6	16.3	0	4.6	1.4
4102	0.9	6.4	0.3	0.8	0.0	0.0	29.1	40.7	0	11.6	16.3	0	4.6	1.4
4103	1.0	9.9	0.3	1.3	0.0	0.0	29.2	40.7	0	11.6	16.3	0	4.6	1.4
4104	1.3	12.7	0.5	1.8	0.1	0.0	29.6	40.7	0	11.8	16.3	0	4.6	1.4
4105	1.5	15.8	0.6	2.2	0.1	0.0	29.8	40.7	0	11.9	16.3	0	4.6	1.4
4106	1.7	15.5	0.6	2.9	0.1	0.0	29.9	40.7	0	11.9	16.3	0	4.6	1.4
4109	17.5	62.1	7.3	9.7	1.9	0.4	45.8	72.3	5	18.6	16.9	0	6.5	1.8
4116	2.0	24.0	0.7	3.2	0.1	0.1	30.3	42.7	0	12.0	16.3	0	4.6	1.5
4123	170.8	258.5	68.0	36.7	11.1	4.7	199.0	267.9	229	79.3	42.7	61	15.6	6.1
4125	90.0	162.6	37.7	36.1	9.1	2.0	118.2	180.2	160	49.0	39.4	34	13.6	3.4
4150	169.6	445.0	93.0	215.2	39.3	12.2	197.8	455.7	263	104.3	219.5	232	43.8	13.6
4151	67.0	76.3	28.1	34.4	10.1	2.5	95.2	89.6	118	39.4	38.4	45	14.6	3.9
4161	95.2	118.8	36.8	15.6	5.5	2.6	123.5	132.9	165	48.1	22.7	0	10.0	4.0
4163	117.1	122.5	44.1	35.6	11.1	5.3	145.3	135.6	178	55.4	41.6	65	15.6	6.7
4182	68.4	95.7	29.5	31.0	8.6	1.5	96.7	109.8	111	40.8	37.8	23	13.1	2.9
4183	5.7	13.3	2.4	6.0	1.7	0.1	33.9	40.8	0	13.6	16.3	0	6.2	1.5
4190	10.3	19.2	4.3	15.6	2.6	0.2	38.6	41.1	0	15.6	20.7	0	7.1	1.6
4191	10.3	18.3	4.3	16.0	2.6	0.2	38.6	41.2	0	15.6	21.2	0	7.1	1.6
4193	19.0	35.5	7.9	16.0	4.1	0.5	47.2	48.6	0	19.2	23.1	0	8.6	1.9
4194	20.2	57.4	8.6	16.1	4.2	0.6	48.4	65.3	2	19.8	25.3	1	8.7	2.0
4196	95.3	124.6	40.5	39.3	10.0	2.3	123.5	137.8	185	51.8	44.0	31	14.5	3.7
4205	10.3	16.6	4.3	13.9	2.5	0.2	38.5	42.1	0	15.6	19.1	0	7.0	1.6
5002	86.8	115.4	37.0	37.0	9.5	2.1	115.0	128.8	166	48.3	42.1	23	14.0	3.5

Table B2. Year 20 – Incremental and Cumulative Particulate Matter Concentration/Deposition Results for Project (CHC-owned receptors are marked by grey shaded cells)

Residence ID	Incremental Concentration/Deposition due to Project						Cumulative Concentration/Deposition due to Project + Background Air Quality							
	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month	TSP Annual Average µg/m³	PM_{10} Maximum 24-hr µg/m³(b)	PM_{10} No. Of Days >50µg/m³	PM_{10} Annual Average µg/m³	$PM_{2.5}$ Maximum 24-hr µg/m³(b)	$PM_{2.5}$ No. Of Days >25µg/m³	$PM_{2.5}$ Annual Average µg/m³	Deposition Annual Average g/m²/month
Criteria	**NA**	**NA**	**NA**	**NA**	**NA**	**2**	**90**	**50**	**NA**	**30**	**25(a)**	**NA**	**8(a)**	**4**
5003	0.5	4.1	0.2	0.5	0.0	0.0	28.7	40.7	0	11.5	16.3	0	4.5	1.4
5007	4.1	9.2	1.7	5.4	1.1	0.1	32.3	40.8	0	13.0	16.3	0	5.6	1.5
5008	4.7	9.6	2.0	4.6	1.2	0.1	32.9	40.8	0	13.3	16.3	0	5.7	1.5
5008	25.8	**57.6**	10.9	20.5	5.4	0.7	54.0	**65.8**	**2**	22.2	**29.3**	**3**	**9.9**	2.1
5009	3.0	11.1	1.2	1.8	0.3	0.3	31.2	40.7	0	12.5	16.3	0	4.8	1.7
5010	7.1	18.7	3.1	7.6	1.5	0.2	35.4	41.9	0	14.4	16.4	0	6.0	1.6

Note: Results with red outline and bold red text indicate exceedance of assessment criteria as applicable by the NSW EPA.

NA – Not applicable. Criteria are applicable to cumulative concentrations – Incremental exceedance of cumulative criteria marked in bold red text.

(a) The NEPM Advisory Reporting Standards for $PM_{2.5}$ are referenced for screening assessment purposes.

(b) The maximum cumulative value is not a sum of the maximum increment and the maximum baseline concentrations, since these maximums may occur on different days. Rather the maximum 24-hour cumulative concentrations reflect days on which background levels plus the concurrent Project-related increment were highest.

Appendix C

Incremental Air Pollutant Isopleths

Scenarios	Pollutant	Averaging Period	Figure No.
Year 8	PM_{10}	Highest 24-hour	C1
	PM_{10}	Annual average	C2
	$PM_{2.5}$	Highest 24-hour	C3
	$PM_{2.5}$	Annual average	C4
	TSP	Annual average	C5
	Dust Deposition	Annual average	C6
Year 20	PM_{10}	Highest 24-hour	C7
	PM_{10}	Annual average	C8
	$PM_{2.5}$	Highest 24-hour	C9
	$PM_{2.5}$	Annual average	C10
	TSP	Annual average	C11
	Dust Deposition	Annual average	C12

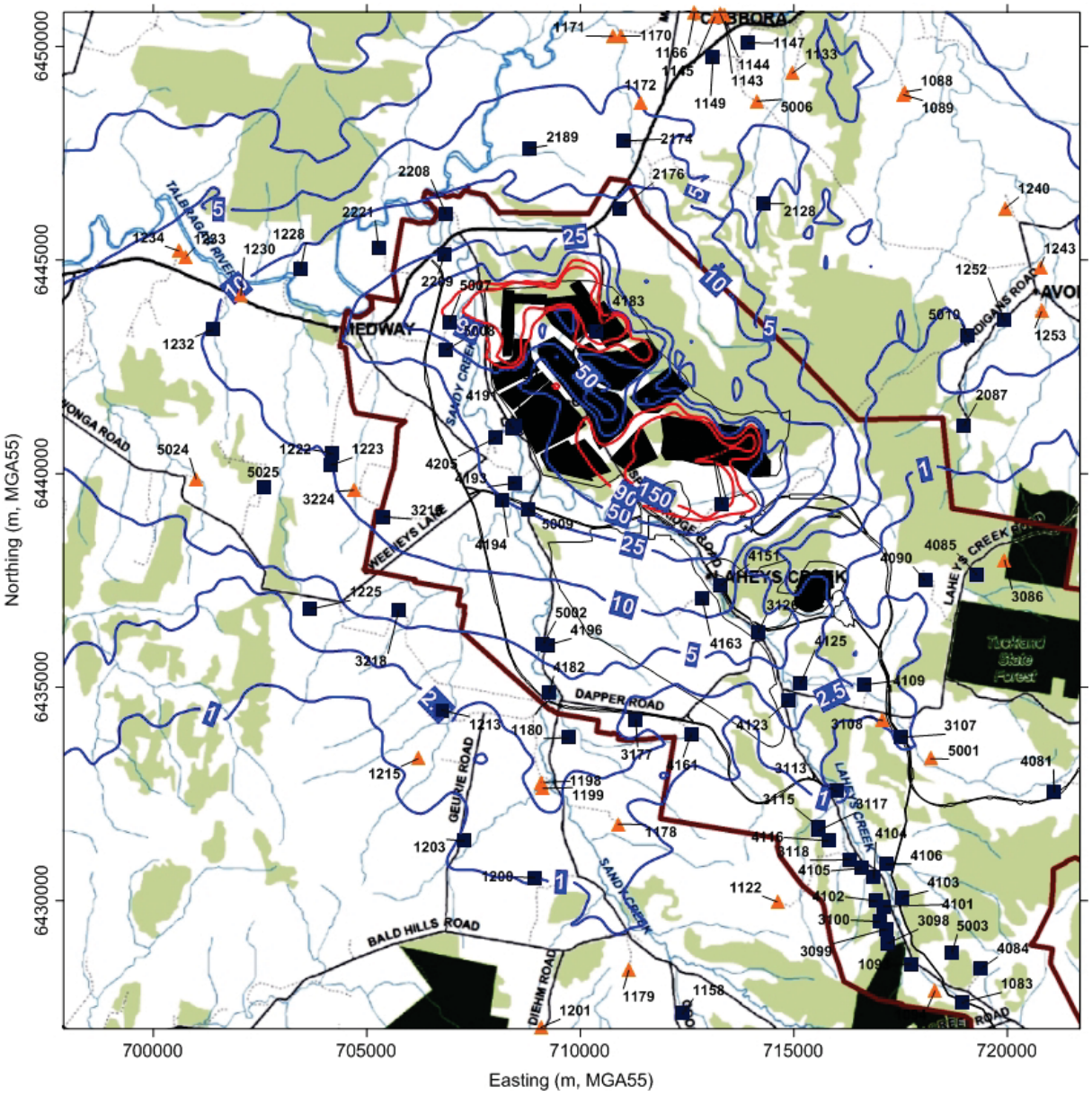


Figure C1: Incremental Annual Average TSP Concentrations (µg/m³) – Year 8

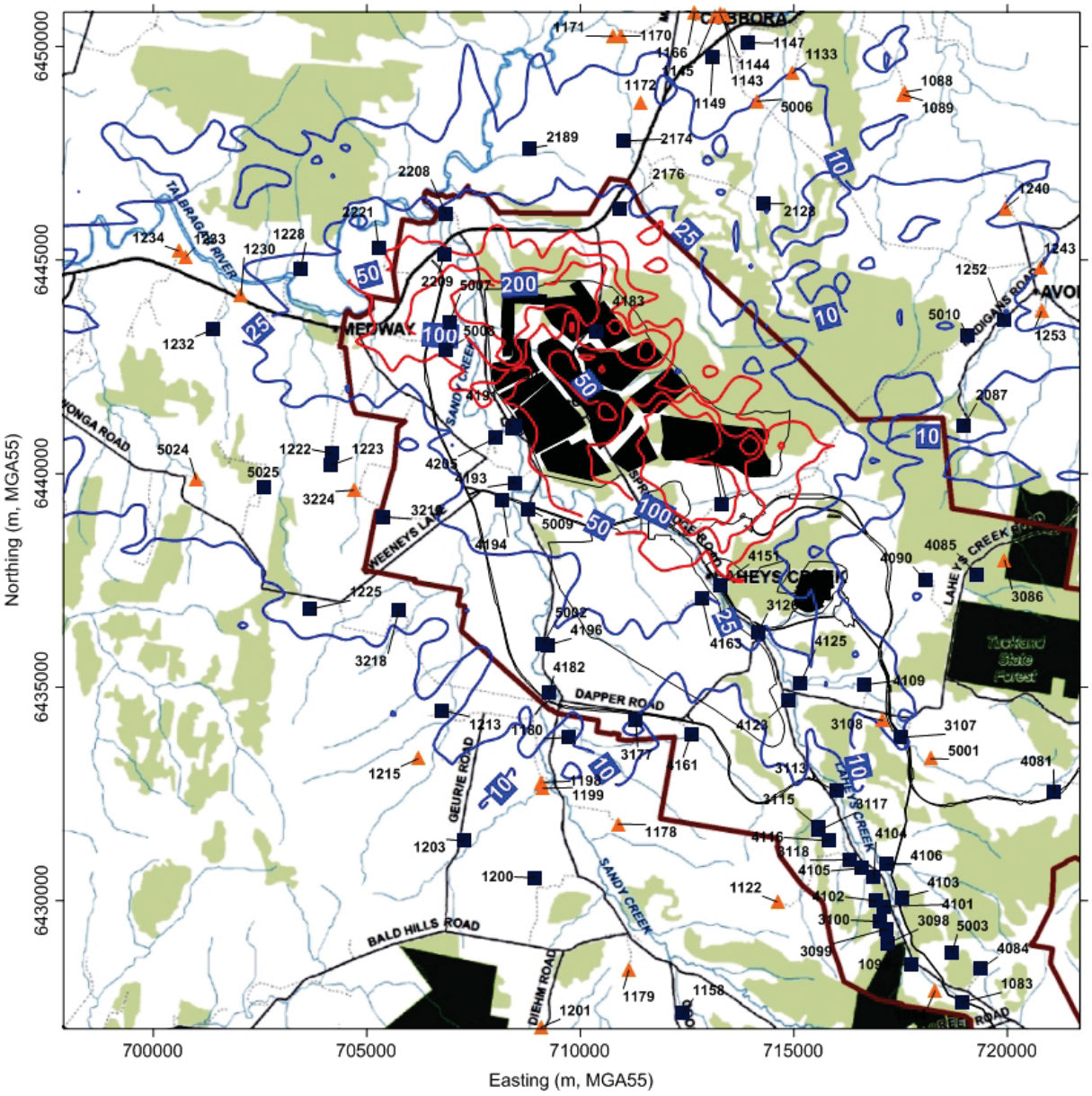


Figure C2: Incremental Maximum 24-hour Average PM_{10} Concentrations (µg/m³) – Year 8