



Warkworth Continuation 2014

2

Response to Submissions

Prepared for Warkworth Mining Limited | November 2014

VOLUME 2 — Appendices



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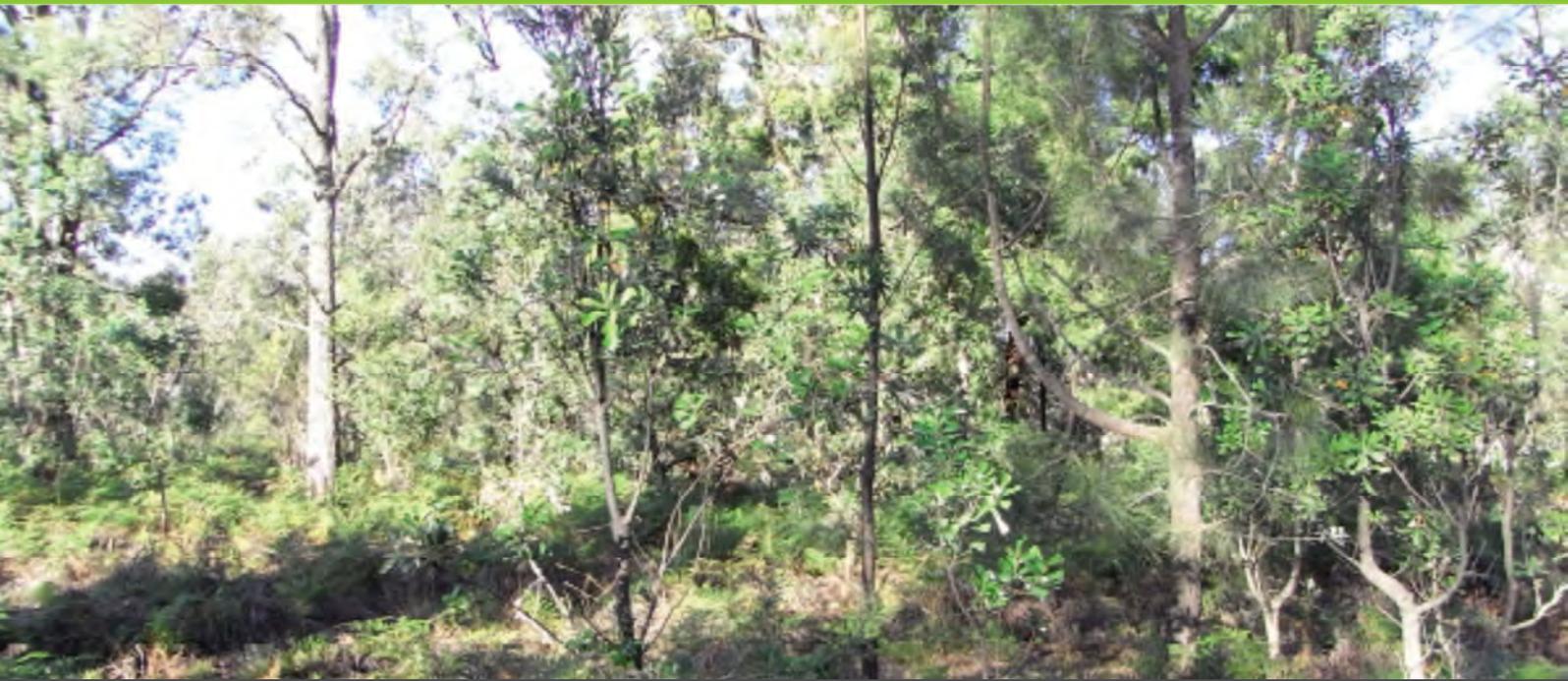
Appendix A

Warkworth Sands Woodland Restoration Manual



Appendix A — Warkworth Sands Woodland Restoration Manual

A



WARKWORTH MINE

Warkworth Sand Woodlands Restoration Manual

Prepared for Coal & Allied Industries Limited

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Cover photograph: Warkworth Sands Woodland

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1. Introduction

1.1 Purpose of this Manual

This Warkworth Sands Woodland (WSW) Restoration Manual is intended to provide detailed hands-on guidance, based on research and lessons-learned from previous experience, on how to successfully restore modified plant communities in a sustainable and effective manner. Preparation of a best management practice restoration manual for WSW is a consent requirement for Warkworth Mine Development Consent, DA300-9-2002-i granted by the NSW government in 2003. Under this same consent, areas of WSW are permitted to be disturbed. This Manual directs the application of the salvaged resources from the disturbed areas. These resources are highly valuable and can greatly assist in the restoration of WSW, as it enables the translocation of unique ecological characteristics, such as genetics, soil organisms and species diversity.

It also introduces the work of Noss (1990), SERIS (2004), Nichols (2005), EMR (2006), Perrow and Davy (2008), Thackway and Lesslie (2008) and Thackway (2012). This work relates to Vegetation State Assets and Transitions (VAST), an effective framework to monitor and report on the restoration of modified plant communities.

1.2 Aim and scope of this Manual

The primary aims of this manual are to:

- 1) provide a sound basis for guiding for best management practices to restore the WSW; and
- 2) set out a process for tracking the recovery of WSW sites toward a reference state as a result of appropriate applied land management restoration interventions.

Underpinning the Manual is the need to understand the effects that previous anthropogenic impacts have had over time, in transforming the vegetation structure, species composition and regenerative capacity of the former pre-clearing extent of the WSW. That information can provide useful clues for restoration, regarding what ecological characteristics have been modified and how they were modified.

The areas of WSW located within the Southern and Northern Biodiversity Areas (BAs) are the primary focus of this restoration manual. Figure 1 and 2 presents the location of these BAs and the distribution of WSW within them. The figures present the distribution of WSW classified into crest, swale and grassland, based on work completed by Cumberland Ecology in 2013.

These areas have been under passive restoration since 2003. As reported in the Coal and Allied's Annual Environmental Management Reports, grazing was excluded from the Southern BA in 2003 and Northern BA in 2008, and annual weed and feral animal programs have been implemented on an annual basis. It has been observed that areas which have been highly modified are not recovering from previous human impacts. In these cases active restoration intervention will be needed to stimulate an area's regenerative capacity, these areas are classified and mapped as grassland areas (Cumberland Ecology 2013).

Within these BAs the University of New England (UNE) completed research trials to test the survival of key WSW species as part of the Warkworth Sands Woodland Research Program. This information has been used to inform the preparation of the Manual and key findings from unpublished trial results have been used to select species for the re-establishment activities.

It is important to appreciate the limitations of restoration and caution is needed not to raise the expectations of stakeholders to believe that fully functioning WSW can be readily created in the short-term by active restoration interventions (e.g. transporting soil and plant material from the disturbed site). The

level of intervention should be tailored to the capacity of an areas regenerative capacity and high levels of intervention may result in short-term results that are unsustainable.

Restoration scientists acknowledge that recreation of a fully functioning plant community remains a challenging and long-term venture. However, it is more likely to succeed where a combination of active and passive restoration techniques are adopted and implemented under optimal climatic conditions. It also requires the equivalent ecological characteristics to be present at both the transformation (re-establishment) and the reference (benchmark) sites. VAST defines 10 ecological characteristics relating the vegetation structure, species composition and regenerative capacity. This Manual will rely on BioBanking as a rigorous field methodology to collect and monitor changes in the key vegetation structure and species composition characteristics. Other key ecological characteristics relating to regenerative capacity (i.e. landscape function), that are not collected by the BioBanking surveys, can be compiled from relevant published papers and reports and expert elicitation. VAST should be used to track the trajectory of the transformation sites in their attainment of the reference sites ecological characteristics. This information is used as an interim baseline to guide the application of passive and active restoration techniques. Progress implementation and revisions of the Manual will also be informed by on-ground adaptive management.

1.3 Context and structure of the Manual

This Manual is set in the context of a well-informed stakeholder group, with considerable investment in ecological research and a wealth of accessible ecological information about the WSW communities.

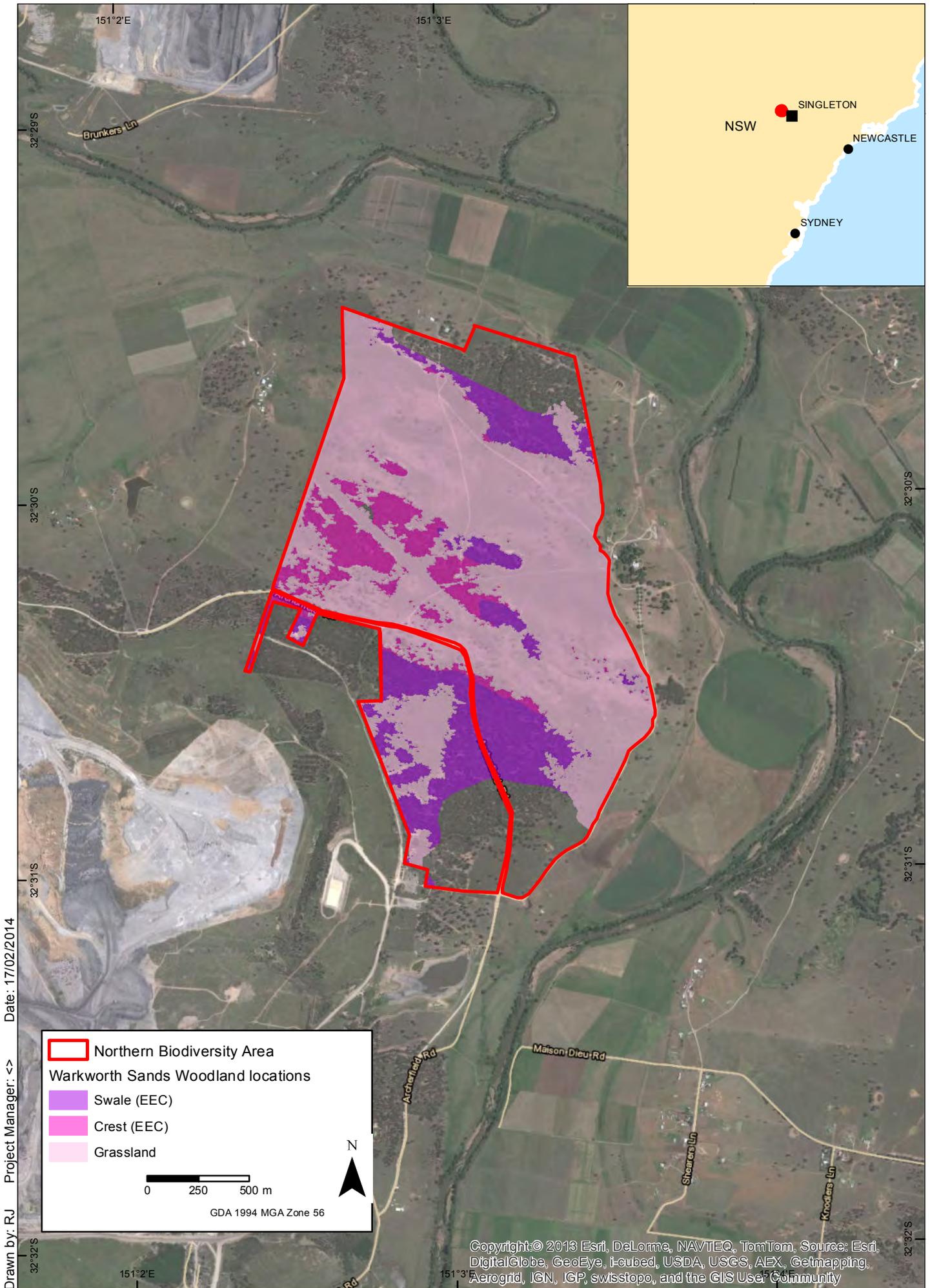
That background can be summarised as follows:

1. Viable passive and active management restoration options for restoring the WSW communities; and
2. Detailed analyses of local and regional biophysical data and information collected by the University of New England and other research agencies regarding conservation management strategies for restoring WSW.

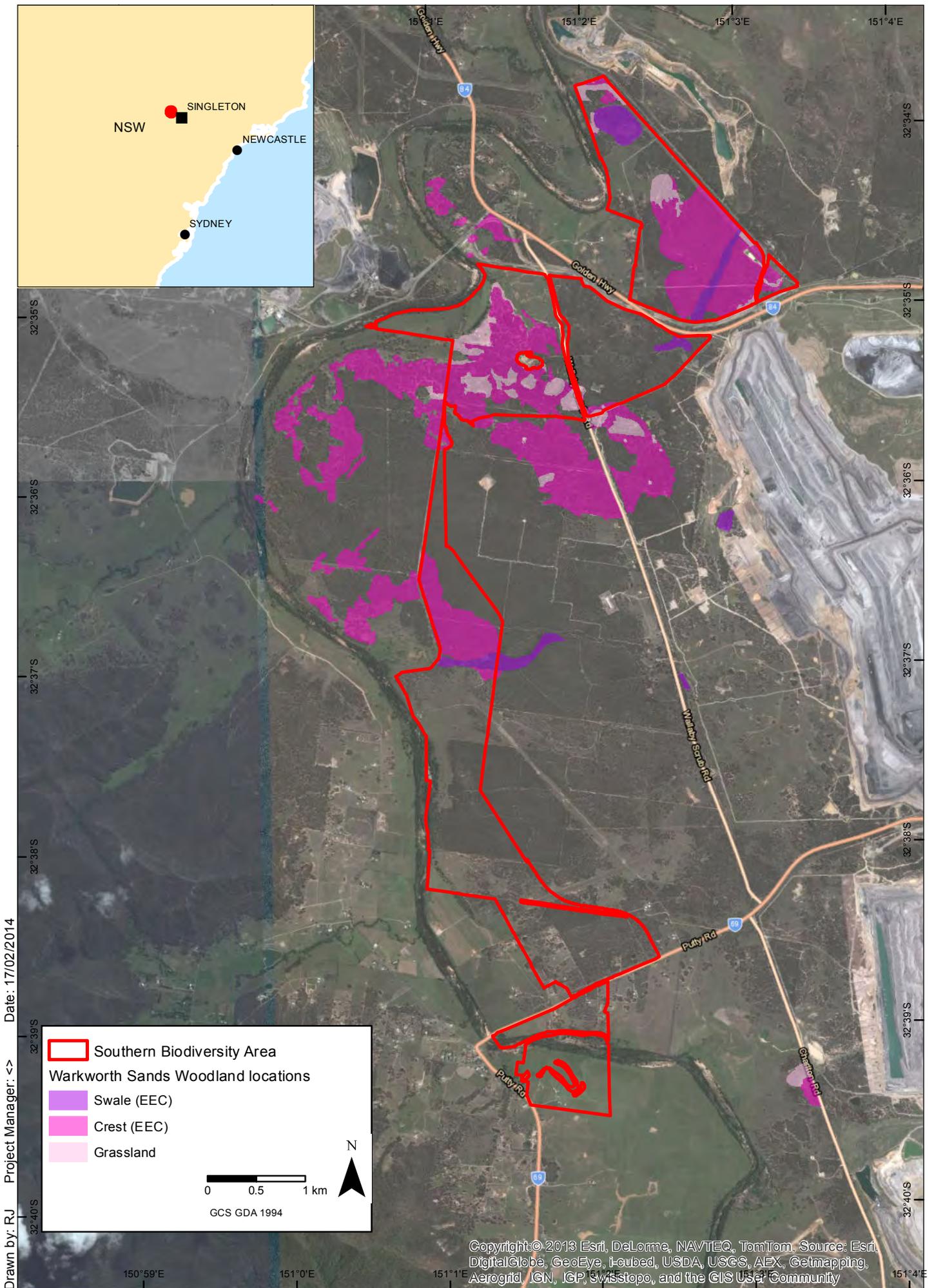
The intent of this Manual is to guide improvement in the condition of WSW plant communities. The Manual provides a framework for integrated restoration management, monitoring, assessment and reporting of the condition of WSW over time. This Manual is written from the perspective of community ecology, rather than species ecology.

Ecological restoration requires a basic working knowledge of land management practices and what effect these practices have had on key ecological characteristics of a reference plant community. Where restoration is required, it is usually because land management practices have transformed a vegetation community into a degraded stable state relative to a reference state.

To be successful, active restoration of a modified plant community requires an understanding of the magnitude of ‘causes and effects’. It is necessary to understand what effect land management practices over time have had on a plant community’s key ecological characteristics, including its vegetation structure, species composition and its regenerative capacity (i.e. functions), in regard to the background climate, geology, landform, hydrology, soil, fire and other natural disturbance regimes. Of course, where the regenerative capacity of the plant community has been removed or highly modified as a result of historic land management practices, it will be necessary to have an understanding of the ecology and the biology of key individual plant species for re-assembling a plant community. Unmodified plant communities are inherently more resilient to low levels of anthropogenic disturbance.



Northern Biodiversity Area – location and distribution of Warkworth Sands Woodland
 Warkworth Sands Woodland Restoration Manual



Southern Biodiversity Area – location and distribution of Warkworth Sands Woodland
Warkworth Sands Woodland Restoration Manual

This restoration manual will guide this approach and, to that end, has been structured to include the following chapters:

- Biodiversity Areas – description of the WSW Endangered Ecological Community (EEC) and location of WSW sites for restoration;
- Land Management Units – describes how the VAST transition condition classes are to be applied to track the restoration of the WSW areas;
- Restoration principles – details on the passive and active restoration techniques;
- Monitoring – describes the VAST report card supported by BioBanking field sites; and
- Risk management – strategies to ensure successful management of a restoration program.

1.4 Definitions of terms

Critical to gaining agreed understandings among key stakeholders are definitions.

Land use: describes what the land is used for i.e. grazing of native pasture.

Land management practices: describes the ‘how’ of land use (i.e. how the land is managed to deliver the goods and services associated with a particular land use).

Restoration: the act of bringing a degraded ecosystem back into, as nearly as possible, its original condition.

Rehabilitation: the act of partially or, more rarely, fully replacing structural or functional characteristics of an ecosystem that have been diminished or lost, or the substitution of alternative qualities or characteristics than those originally present with the proviso that they have more social, economic or ecological value than existed in the disturbed or degraded state.

Amelioration: the act or process of using land management practices to repair damage to an ecosystem, including vegetation structure, species composition and regenerative capacity.

Passive restoration: promotes the assisted natural regeneration of a plant community using minimal intervention land management practices. These practices assume that the current plant community retains moderate to high levels of regenerative capacity (resilience) i.e. management focussed on controlling threatening processes only.

Active restoration: involves direct land management interventions such as augmenting a site with soil and plant material. Active restoration is usually required where there is significant anthropogenic impact to a plant community’s regenerative capacity. Some form of management control, which will promote *passive* restoration, needs to be in place before any attempt at *active* restoration is made, otherwise the active interventions have a high risk of failure and consequently will be a waste of resources.

1.5 Review and Reporting

The Manual will be reviewed in 2015 to incorporate additional baseline data and the key learning gained from the 2014 re-establishment of 77.6 hectares (ha) within the Southern and Northern Biodiversity Areas (BAs). The Manual will guide the implementation of the re-establishment and offset management plans. The sharing of information will be facilitated through an online Biodiversity Management Areas Portal. This Portal has been designed to centralise and share information among authorised users and will include spatial data, an image library, reports and other non-spatial data, as well as project management information. The portal will enable the sharing of this information, leading to a better understanding, improved management and long term protection of WSW.

2. Biodiversity Areas

2.1 Warkworth Sands Woodlands description and distribution

WSW is listed as an Endangered Ecological Community (EEC) under the NSW *Threatened Species Conservation Act 1995* (TSC Act); it is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The community is confined to aeolian sand deposits in the vicinity of Warkworth, south-east of Singleton in the mid Hunter Valley (NSW Scientific Committee 2011).

WSW is a unique vegetation community due to the presence of a sand substrate. The sand substrate is believed to have formed during the Pleistocene epoch, some 18,000-15,000 years ago, from the sandy alluvium of the Wollombi Brook, possibly from erosion in Wollemi and Yengo National Parks (Galloway 1963).

The presence of a relatively deep sand substrate has allowed for the development of a plant community that is characterised by species that usually occur on coastal, Aeolian dunes. These include the Coast Banksia (*Banksia integrifolia*), Wedding Bush (*Pimelea linifolia*) and Rough Barked Apple (*Angophora floribunda*).

It was estimated that the WSW community had a pre-European distribution of approximately 6,000 ha, however current estimates have varied since the community was gazetted under the TSC Act, with extant areas ranging from 800 hectares (ha) (NSW Scientific Committee 2002); 1,133.4 ha (Peake 2006); 464.8 ha (Umwelt 2011); and, 400 ha (Bell 2012). The WSW community has also been subjected to sand mining, through the removal of the surface (~1-2m) fine sand material, which is highly valued in the building industry.

While sandmass plant communities do occur elsewhere in New South Wales, only the Agnes Banks sandmass and subsequent vegetation communities from Western Sydney are of a similar age (Ryan *et al.* 1996). This makes the Warkworth Sands community unique. Another unique characteristic of the community is the occurrence of coastal plant species, such as the Coastal Banksia (*Banksia integrifolia*), which have their next closest occurrence at a distance of 100 km to the east in coastal communities.

Other sandmass plant communities that occur in the lower Hunter Valley include Kurri Sand Swamp Woodland (NSW NPWS 2008) and Quorrobolong Scribbly Gum Woodland (NSW NPWS 2002), however each of these communities occur on deeply weathered sandstone (Peake *et al.* 2002), rather than the river sediments that occur at Warkworth.

2.2 Impacts of historic land management in transforming the Warkworth Sand Woodlands

The WSW communities have been intensively used and managed, since the mid-1830s. Historically the Northern and Southern BAs were managed variously for agricultural and forestry outcomes. Depending on the prevailing social and economic setting over this period, a land manager would have used land management practices to change the ecological function of an area to deliver a selected mix of ecosystem services over time.

As a result the woodlands show evidence of transformation (i.e. modified and fragmented) from the former pre-clearing extent of these woodlands. Initially, the drivers for landscape transformation were agricultural and forestry production and more recently by coal mining and biodiversity conservation.

Since the former cattle properties in the Northern and Southern BAs have been purchased and destocked by Coal & Allied, the effects of prior land management practices on the condition of the vegetation are evident, and without active restoration will continue to be observed for long periods. As these former farming properties are being managed for conservation purposes there is a need to guide and target appropriate restoration programs (i.e. restoration strategies and land management interventions), including monitoring, evaluation, reporting and improvement.

This long history of disturbance has been documented by Clements (2012), presented in Annex 1 are aerial photos from 1963 and 2000 covering the Southern and Northern BAs. Major disturbance from land clearing, grazing and orchard is clearly evident from these images. It is clear to see that areas now mapped as WSW grassland can still be readily identified. These areas obviously do not have the regenerative capacity to naturally regenerate like the surrounding areas. This history of disturbance may also explain the differences in vegetation expressions, such as the *Callitris* dominated areas and has led much of the debate around the differences in sub-communities.

2.3 Warkworth Sands Woodland sub-communities

WSW sub communities have been observed and mapped by several ecologists and this delineation provides direction for the restoration program.

Keith (2004) includes WSW as part of the Sydney Sand Flats Dry Sclerophyll Forests, which are described as restricted and unique in the State to the Sydney and Newcastle regions.

DnA Environmental (2012) described three forms of WSW community. These forms are characterised by the following canopy species that occur within this community:

- Rough-barked Apple (*Angophora floribunda*) and Coastal Banksia (*Banksia integrifolia*);
- Blakely's Red Gum / Forest Red Gum (*Eucalyptus blakelyi* / *tereticornis*) and Coastal Banksia (*Banksia integrifolia*); and
- Black Cypress Pine (*Callitris endlicheri*) and White Cypress Pine (*Callitris glaucophylla*).

Cohen and Nanson (2009, 179) describe the Warkworth Sands state that most likely falls into the Warkworth soils group. This soils group is characterised by two types of aeolian silicious sand deposits; sand dunes and thin sandsheets with gentle undulations, reflecting the underlying rock surface. The dunes are distributed on high river terraces of either Wollombi Brook or the Hunter River and range in height from 1 – 6 m and are generally aligned NW-SE.

Story *et al.* (1963) describe two land units associated within the Warkworth land system in the central lowlands of the Hunter Valley. Their description is useful because it agrees with the Cohen and Nanson (2009) description of the geomorphology of Warkworth soils group and, in addition, provides a description of the plant community associated with the two types of aeolian silicious sand deposits (Table 1).

Table 1. Description of two land units within the Warkworth Land system (Story *et al.* 1963)

Unit	Land Forms	Soil	Vegetation
1	Linear sand dunes 3-20 ft high [1 to 7 m], resting on high river terrace; aligned NWSE; generally stable but subject to blowouts; swamp seepage zones at margin.s	Sandy aeolian regosols (Warkworth) of single grain structure; very little organic matter in surface.	Anomalous woodland, trees usually scattered, 12-40 ft. high [4-13 meters], <i>Banksia integrifolia</i> , <i>Angophora floribunda</i> , <i>E. tereticornis</i> , <i>Callitris enlicheri</i> , much cleared and under grassland of <i>Aristida</i> and <i>Eragrostis</i> spp, with <i>Imperata cylindrica</i> , <i>Pteridium aquilinum</i> [now <i>P. esculentum</i>] and <i>Stenotaphrum secundatum</i> where damp: shrubs uncommon.
2	Low long linear dunes; less than 3ft. high [1 m], 100-200 yd apart and up to 0.5 mile long, aligned NW-SE; thin sand sheets with gentle undulations, reflecting the underlying rock surface.	Sandy aeolian regosols (Warkworth) over shallow clay at shallow to moderate depth.	Dense heath 5 ft. high [about 1.5 m], of many species; scanty grasses; trees scattered, up to 40 ft high [12.5 meters], <i>E. agglomerata</i> , <i>E. crebra</i> , <i>E. tereticornis</i> .

A key state-wide description of NSW plant community types (BioMetric), defines a single WSW community, however, it should be noted that the above two communities form sub-components of the main description (Table 2).

Table 2. WSW community described using the Biometric tool

Attribute type	Attribute description
Veg Type ID	HU600
Vegetation type	Rough-barked Apple - Coast Banksia shrubby woodland on Warkworth Sands of the central Hunter Valley, Sydney Basin
Dominant canopy spp	Rough-barked Apple (<i>Angophora floribunda</i>), Coast Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>)
Main associated spp	Forest Red Gum (<i>Eucalyptus tereticornis</i>), Slaty Red Gum (<i>Eucalyptus glaucina</i>), Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>)
Landscape position	Occurs on aeolian sand deposits of the central Hunter Valley floor south east of Singleton.
Characteristic mid-storey spp	<i>Acacia filicifolia</i> , <i>Melaleuca thymifolia</i> , Coffee Bush (<i>Breynia oblongifolia</i>), <i>Hovea linearis</i> spp
Characteristic groundcover spp	Bracken (<i>Pteridium esculentum</i>), Blady Grass (<i>Imperata cylindrica</i> var. <i>major</i>), Kidney Weed (<i>Dichondra repens</i>), <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Pimelea linifolia</i> subsp. <i>linifolia</i> , <i>Glycine clandestina</i>
Other diagnostic features	
Profile source	NSW Scientific Committee (2002)
Full reference details	NSW Scientific Committee (2002). Warkworth Sands woodland in the Sydney Basin Bioregion - endangered ecological community listing. NSW Scientific Committee - Final determination
Vegetation formation	Dry Sclerophyll Forests (Shrubby subformation)

Attribute type	Attribute description
Vegetation class	Sydney Sand Flats Dry Sclerophyll Forests
Cleared Estimate rounded to nearest 5%	50
Occurs as original vegetation type? (Y/N)	
Derived from what communities?	
EEC	yes
EEC Name	Warkworth Sands woodland in the Sydney Basin Bioregion

Source: <http://www.environment.nsw.gov.au/projects/biometrictool.htm>

Bell (2012, 51) used floristic analyses to define ‘Core WSW’ and ‘Marginal WSW’ concluding that ‘Core WSW’ occurs on deeper Aeolian sands and ‘Marginal WSW’ on very shallow and/or non-existent Aeolian sands.

Robertson’s (2013) two variants of the community: WSW (crest) and WSW (swale) are equivalent to the above two communities which are based on the depth of sand and plant community representation. The WSW grassland areas are located on sand and have some representation of the understorey components of WSW, but have been greatly disturbed by previous land management and lost the capacity to regenerate naturally. These grassland areas will be the focus of the active restoration.

Field surveys in the Northern and Southern Biodiversity Areas ground-truthed the observations made by Story *et al.*, Bell and others. That is, two plant communities can generally be recognised in the field and that these communities appear to be related to deep and shallow sand deposits. Hereafter, two plant communities will provide the focus of this Manual:

- 1) Warkworth Sands Woodland – deep sands (1-7m depth)
 - Woodland on deep sand dominated by *Angophora floribunda* +/- *E. tereticornis* in the overstorey and *Banksia integrifolia* +/- *Callitris enlicheri* in the midstorey;
- 2) Warkworth Sands Woodland – shallow sands (<1m depth)
 - Open woodland on shallow sand dominated by *E. agglomerata*, *E. crebra* +/- *E. tereticornis* in the overstorey and mixed dense shrub layer in the in the midstorey.

The current mapping of the extent, type and condition of the WSW communities is sufficient to guide improved restoration efforts, active and passive. For pragmatic reasons mapping of WSW prepared by Cumberland Ecology (2013) has been adopted in preparation of this Manual.

2.4. Extent of WSW within Biodiversity Areas

The restoration manual will guide management of the Northern and Southern BAs which are within the Sydney Basin Bioregion. Table 3 summarises the area (ha) of each expression of WSW within the biodiversity areas.

Table 3. Summary of the extent of WSW in the biodiversity areas

Biodiversity Area	WSW Crest (Ha)	WSW Swale (Ha)	WSW Grassland (Ha)	Total (Ha)
Northern	33.14	58.89	196.13	288.16
Southern	202.29	32.53	38.77	273.59
Total (Ha)	235.43	91.42	234.9	561.75

Source: Cumberland Ecology (2013).

3. Land Management Units

3.1 State and Transition Model VAST

Land management practices are used to modify vegetated landscapes. A number of research reports, including Bower (2004), describe much of the WSW within the Northern and Southern BAs as of Low or Medium vegetation condition. An issue with such assessments of condition is that they are poorly framed within a system for describing and tracking spatial and temporal change for particular plant communities.

The nature of change can be understood by monitoring and reporting the positive and negative effects that land management practices have on the vegetation structure, species composition and regenerative capacity of a plant community's reference state (VAST framework; Thackway and Lesslie 2006, 2008). Generic descriptions of these condition classes are described in Table 4. The higher the number of condition classes the more modified the class is relative to an unmodified class; in this context an active restoration program is proposed. The lower the condition class the more resilient is the woodland community; in this context a passive restoration program is proposed.

The VAST-2 framework builds on commonly used site-based indicators of vegetation condition and landscape function (e.g. Noss 1990; Gibbons and Freudenberg 2006; Perrow and Davy 2008; Thackway and Lesslie 2008; Tongway and Ludwig 2011) to derive a vegetation condition baseline (Thackway 2013).

This baseline represents the effects of historical management practices and their effects on three diagnostic attributes of vegetation condition (i.e. vegetation structure, species composition and regenerative capacity). Table 4 represents a generic model of these impacts as a series of modification classes within a state and transition model; where each state is described using diagnostic attributes.

There are ten key ecological characteristics and 22 indicators (Table 5) that are positively and negatively affected by land management practices over time (Thackway 2012, 2013). The three diagnostic attributes provide the link between Tables 4 and 5, where the ten key ecological characteristics and 22 indicators (Table 5) are hierarchically linked to diagnostic attributes (Table 4).

Developing a good understanding of how these ten key ecological characteristics relate to the condition of WSW provides a sound framework to guide an appropriate active and passive restoration program in the different condition classes found in the Northern and Southern Biodiversity Areas.

A poor understanding of how restoration practices are affected by, and interact with, these ten ecological components in the various condition classes will either hamper or enhance efforts to re-establish WSW. This approach can be applied to stratify the restoration areas.

Table 4. Vegetation Assets States and Transitions framework



Increasing vegetation modification from left to right

		Native vegetation extent				Non-native vegetation extent		
		Dominant structuring plant species indigenous to the locality and spontaneous in occurrence – i.e. a vegetation community described using definitive vegetation types relative to estimated pre1750 states				Dominant structuring plant species indigenous to the locality but cultivated; alien to the locality and cultivated; or alien to the locality and spontaneous		
Diagnostic criteria	Vegetation condition state (mapping criteria)	State 0: NATURALLY BARE	State I: UNMODIFIED	State II: MODIFIED	State III: TRANSFORMED	State IV: REPLACED - ADVENTIVE	State V: REPLACED - MANAGED	State VI: REMOVED
	Current regenerative capacity (interpretative ¹)		Complete removal of in-situ regeneration capacity except for ephemerals and lower plants	Natural regenerative capacity unmodified	Natural regeneration capacity persists under past and /or current land management practices	Natural regenerative capacity limited / at risk under past and /or current land use or land management practices. Rehabilitation and restoration possible through modified land management practice	Regeneration potential of native vegetation community has been suppressed and in-situ resilience at least significantly depleted. May still be considerable potential for active restoration of key ecological processes	Regeneration potential of native vegetation community likely to be highly depleted by intensive land management. Very limited for active restoration of key ecological processes
Vegetation structure (objective ²)		Nil or minimal	Structural integrity of native vegetation community is very high	Structure is predominantly altered but intact e.g. a layer / strata and/or growth forms and/or age classes removed	Dominant structuring species of native vegetation community significantly altered e.g. a layer / strata frequently and repeatedly removed	Dominant structuring species of native vegetation community removed or predominantly cleared or extremely degraded	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental

	Vegetation composition (objective ²)	Nil or minimal	Compositional integrity of native vegetation community is very high	Composition of native vegetation community is altered but intact	Dominant structuring species present - species dominance significantly altered	Dominant structuring species of native vegetation community removed	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental
Examples	Naturally bare areas: mud; rock; river and beach sand, fresh water lakes, salt freshwater lakes	Unmodified stands of remnant Warkworth Sands Woodland (WSW)	WSW managed using sustainable grazing systems; Selective timber harvesting practices; Severely burnt (wildfire) WSW not of a natural frequency and/or intensity	Heavily grazed WSW; Obvious thinning of trees for pasture production; Weedy native remnant patches; Degraded roadside reserves; Degraded aeolian dune systems;	Severe invasions of introduced weeds; Invasive native woody species found outside their normal range; Isolated native trees/shrubs/grass species in the above examples	Horticulture; Tree cropping; Orchards; Reclaimed mine sites; Environmental and amenity plantings; Improved pastures. (includes heavy thinning of trees for pasture); Cropping; Isolated native trees/shrubs/ grass species in the above examples	Water impoundments; Urban and industrial landscapes; quarries and mines; Transport infrastructure	

Notes:

1. The link between land management practices and regenerative capacity is an area of active research. This relationship is better understood at a site than at the landscape scale.
2. Measuring deviation from a reference state for key indicators of vegetation structure, species composition and regenerative capacity involves the collection observations and measurements for each plant community (Thackway 2012).
3. Note particularly the examples in Section 3.3 referring to WSW

Table 5. Ten key ecological components and the associated performance indicators

Key ecological characteristics (10)	Key Performance Indicators (22)	VAST diagnostic criteria (Table 4)
1. Fire regime	1. Area /size of fire foot prints	Regenerative capacity
	2. Interval between fire starts	
2. Soil hydrology	3. Plant available water holding capacity	
	4. Ground water dynamics	
3. Soil physical state	5. Effective rooting depth of the soil profile	
	6. Bulk density of the soil through changes to soil structure or soil removal	
4. Soil nutrient state	7. Nutrient stress – rundown (deficiency) relative to reference soil fertility	
	8. Nutrient stress – excess (toxicity) relative to reference soil fertility	
5. Soil biological state	9. Organisms responsible for maintaining soil porosity and nutrient recycling	
	10. Surface organic matter, soil crusts	
6. Reproductive potential	11. Reproductive potential of overstorey structuring species	
	12. Reproductive potential of understorey structuring species	
7. Overstorey structure	13. Overstorey top height (mean) of the plant community	Vegetation structure
	14. Overstorey foliage projective cover (mean) of the plant community	
	15. Overstorey structural diversity (i.e. a diversity of age classes) of the stand	
8. Understorey structure	16. Understorey top height (mean) of the plant community	
	17. Understorey ground cover (mean) of the plant community	
	18. Understorey structural diversity (i.e. a diversity of age classes) of the plant	
9. Overstorey composition	19. Densities of overstorey species functional groups	Species Composition
	20. Relative number of overstorey species (richness) of indigenous :exotic species	
10. Understorey composition	21. Densities of understorey species functional groups	
	22. Relative number of understorey species (richness) of indigenous :exotic species	

Source: Thackway (2012)

For consistency the numbering of the ten key ecological characteristics in Table 5 are maintained through this Manual. Particular restoration programs will be needed in different soil landscape settings depending on the severity of impacts of prior land management practices on these key ecological characteristics. The footprint of the main agricultural and forestry management regimes can be observed and /or measured as changes affecting the reference state for each WSW community type.

3.2 Reference and Transformation monitoring sites

Fundamental to the application of the VAST-2 system is an evaluation of the similarities and difference between a Reference site and its corresponding Transformation site evaluated using key ecological characteristics and performance indicators of species composition, structure and regenerative capacity for each WSW community.

Reference sites were defined as representative WSW community types present in the Northern and Southern BAs. Transformation sites are a modified condition class of the Reference plant community type.

Land management interventions will be used at a Transformation site to ameliorate key ecological characteristics that have been historically modified from their reference state by land management practices. In the case of WSW this involved agricultural and forestry management regimes.

The intent of implementing the restoration guidelines in this Manual is to apply land management practices to the Transformation with the aim that these interventions will transition it toward the Reference site (Thackway 2012).

A Reference site also provides:

- A series of benchmarks for the ten ecological criteria, enabling comparisons to be made with Transformation sites with known histories of anthropogenic change;
- A record of changes in species composition, vegetation structure and regenerative capacity under different climatic conditions and natural disturbance events; and
- A range of data which can be used to assist with the planning, implementation and maintenance of other similar sand restoration projects.

3.2.1 Establishing Reference and Transformation sites

Five Reference sites were established and surveyed by Niche Environment and Heritage in mid-December 2013 using the BioBanking field survey method (<http://www.environment.nsw.gov.au/projects/biometrictool.htm>). The layout of a field site comprises a 50 meter transect and 20 meter square plot. These sites were permanently marked with star pickets, photographed and GPS geocoded.

Only one Transformation site was surveyed using the BioBanking method. The purpose for establishing and collecting data at one Transformation site was to illustrate the process for evaluating selected performance indicators with the matching Reference site. Their locations are shown at Figures 3 and 4.

Data collected from the five Reference and the one Transformation sites are presented in Annex 2.

Additional Transformation sites will be required to complete the design of the matched Reference and Transformation sites that will form the basis of tracking change and trend in the restoration of the WSW. Section 6.2.4 illustrates how these matched Reference and Transformation sites are used to produce a WSW report card.

3.3 Defining VAST condition classes

Within the WSW several condition classes can be observed from mapping and field survey within the area bounded by the presence of an aeolian sand substrate within the Northern and Southern BAs.

The following five examples illustrate plausible effects of land management practices on the WSW community. These assessments provide the context within which to implement a range of active and passive restoration programs to ameliorate the effects of prior land management practices. It is important to note condition classes change over time and collection of a baseline from one year may reflect the climatic conditions at the time of assessment, as more information is gathered through the re-establishment program their will be refinement of the areas and delineation of condition classes. This is particularly the case with short-lived species and some species functional traits of ground layer.

Example 1 - Modified remnant woodland (condition class II)

Description of likely land management history

Area managed as a grassy woodland using continuously or set stocked grazing with cattle. Initially the tree

cover was reduced by ringbarking and maintained by grazing pressure and regular burning. Regular burning controlled regrowth of canopy species, provided productive grass for cattle and promoted and maintained the dense ground cover of blady grass. Irregular applications of superphosphate fertiliser was used to maintain pasture productivity. An area managed for grazing continuously or set stocked with cattle would be likely to have had the following effects on the ten ecological characteristics:

Major effects	Moderate effects	Minor effects
1. Fire regime	4. Soil nutrient state	2. Soil hydrology
7. Overstorey structure	6. Reproductive potential	3. Soil physical state
8. Understorey structure	9. Overstorey composition	5. Soil biological state
10. Understorey composition		

Summary condition:

Modified remnant woodland (condition class II), locations WSW crest and swale on Northern BA.

Recommended restoration program:

Primarily, a passive restoration approach concentrating on management of weeds, ferals and fire to address #1, #7, #8 and #10. Active restoration should focus on regrowth control, as thinning of dense regrowth can stimulate understorey composition and structure (#8 and #10). Active management of surrounding grassland areas may provide source of seed to increase diversity in understorey composition and structure (#8 and #10).

Comments:

A number of research reports have observed that historic aerial photographs over time show that the cleared sands on Northern BA, once WSW, have regrown into a woodland cover since the 1960s as grazing was removed. It should be noted however that aerial photography provides evidence of only one of the ten ecological characteristics (i.e. #7 Overstorey structure). A fully restored WSW involves more than an assessment of Overstorey structure.

Monitoring should include on-ground surveys to ascertain the status and recovery of several ecological characteristics. Clement (2012) gave evidence based on an analysis of field transect data for Warkworth, indicating observed changes including early colonising species such as algal slimes (i.e. ecological characteristic #5 Soil biological state); lichens; secondary species requiring active soil fungal relationships (i.e. ecological characteristic #5 Soil biological state); and, distribution of retained seeding trees (such as *Allocasuarina luehmannii*, *Angophora floribunda*, *Banksia integrifolia*, *Callitris* spp. and *Eucalyptus* spp.) on the disturbed and partially cleared grazing land (i.e. ecological characteristics #9 Overstorey composition and #10 Understorey composition).

Clement (2012) also noted that *Diuris sulphurea* (Tiger Orchid) was recorded on the former grazing paddocks of Northern BA, indicating that at least some of the sands are relatively intact. This statement goes to an understanding of ecological characteristic #6 Reproductive potential. Such a statement needs to be interpreted with some caution.

Example 2 - Transformed woodland (condition class III)

Description of likely land management history

Area converted from woodland to native pasture (derived grassland) and managed for several decades using continuously or set stocked grazing with cattle and regularly application of fertiliser to maintain pasture productivity. Localised impacts from neighbouring by high disturbance land uses including orchards

and quarries. The impact of this management regime would be likely to have had the following impacts on the ten ecological characteristics:

Major effects	Moderate effects	Minor effects
1. Fire regime	4. Soil nutrient state	2. Soil hydrology
7. Overstorey structure	5. Soil biological state	3. Soil physical state
8. Understorey structure	6. Reproductive potential	
9. Overstorey composition		
10. Understorey composition		

Summary condition:

Transformed woodland (condition class III), locations WSW crest and swale on Southern BA. .

Recommended restoration program:

Primarily, a passive restoration approach concentrating on management of weeds, ferals and fire to address #1, #7, #8 and #10. The use of strategic patch burns to stimulate regeneration of the seed bed would address #8 and #10. Active restoration should focus on regrowth control, as thinning of dense regrowth can stimulate understorey composition and structure (#8 and #10). Active management of surrounding grassland areas may provide source of seed to increase diversity in understorey composition and structure (#8 and #10).

Example 3 - Adventive (condition class IV) derived native grasslands

Description of likely land management history

Area converted from woodland to improved pasture and intensively managed as a holding paddock adjacent to cattle yards. Supporting high numbers of cattle over several decades would be likely to have had the following effects on the ten ecological characteristics:

Major effects	Moderate effects	Minor effects
1. Fire regime	2. Soil hydrology	3. Soil physical state
6. Reproductive potential	4. Soil nutrient state	
7. Overstorey structure	5. Soil biological state	
8. Understorey structure		
9. Overstorey composition		
10. Understorey composition		

Summary condition:

Adventive (condition class IV) derived native grasslands, locations WSW grassland on Northern BA and Southern BA.

Recommended restoration program:

Active restoration concentrating on re-establishing the regenerative capacity of the plant community. Augment the site with a strip application topsoil and plant material salvaged from the disturbance site to address #4, #5, #6. The remaining untreated strips have retained some regenerative capacity and can address #10 understorey composition deficiencies. This activity should be supported by tube stock planting, targeting #8 and #10 understorey structure and composition. The planting of understory is the first priority, as these areas are protected by existing overstorey but are deficient in understory.

Example 4 Replaced and managed (condition class V) derived native grasslands

Description of likely land management history

Area converted from woodland to a fertilised improved pasture and managed for several decades by continuous or set stocked grazing with cattle. This management regime would be likely to have had the following impacts on the ten ecological characteristics:

Major effects	Moderate effects	Minor effects
1. Fire regime	2. Soil hydrology	3. Soil physical state
4. Soil nutrient state		
5. Soil biological state		
6. Reproductive potential		
7. Overstorey structure		
8. Understorey structure		
9. Overstorey composition		

Summary condition:

Replaced and managed (condition class V) derived native grasslands, locations WSW grasslands Southern BA.

Recommended restoration program:

Active restoration concentrating on re-establishing the regenerative capacity of the plant community. Augment the site with a continuous application of topsoil and plant material salvaged from the disturbance site to address #4, #5, #6. This activity should be supported by tube stock planting, targeting #7 overstorey structure. The planting of overstorey is the first priority, as it should alter the microclimate and shade out exotic species and encourage native recruitment from the seed bank within the translocated topsoil and plant material. The species selection should be based on observations of the neighbouring WSW, position in the landscape and depth of the sand.

Example 5 - Replaced and removed (condition class VI) bare substrate

Description of likely land management history

An area converted from woodland to a quarry for the extraction of sand and gravel over several decades would be likely to have had the following effects on the ten ecological characteristics:

Major effects	Moderate effects	Minor effects
1. Fire regime		
2. Soil hydrology		
3. Soil physical state		
4. Soil nutrient state		
5. Soil biological state		
6. Reproductive potential		
7. Overstorey structure		
8. Understorey structure		
9. Overstorey composition		

10. Understorey composition		
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Summary condition:

Replaced and removed (condition class VI) bare substrate, location disused quarry in Southern BA.

Recommended restoration program:

Active restoration concentrating on re-establishing the regenerative capacity of the plant community. Initially re-establish and reconstruct the sand dune landform by augmenting the site with soil and plant material from the disturbance site. A separate rehabilitation plan has been prepared for this site.

Comments:

Clement (2012) noted that it may be necessary to reconstruct the sand dune landform, and the use of windrows of native biomass, which can encourage trapping of wind-blown sand. Incorporating seed sowing of early colonising species may also be beneficial for restoration.

3.4 Operation Management Areas

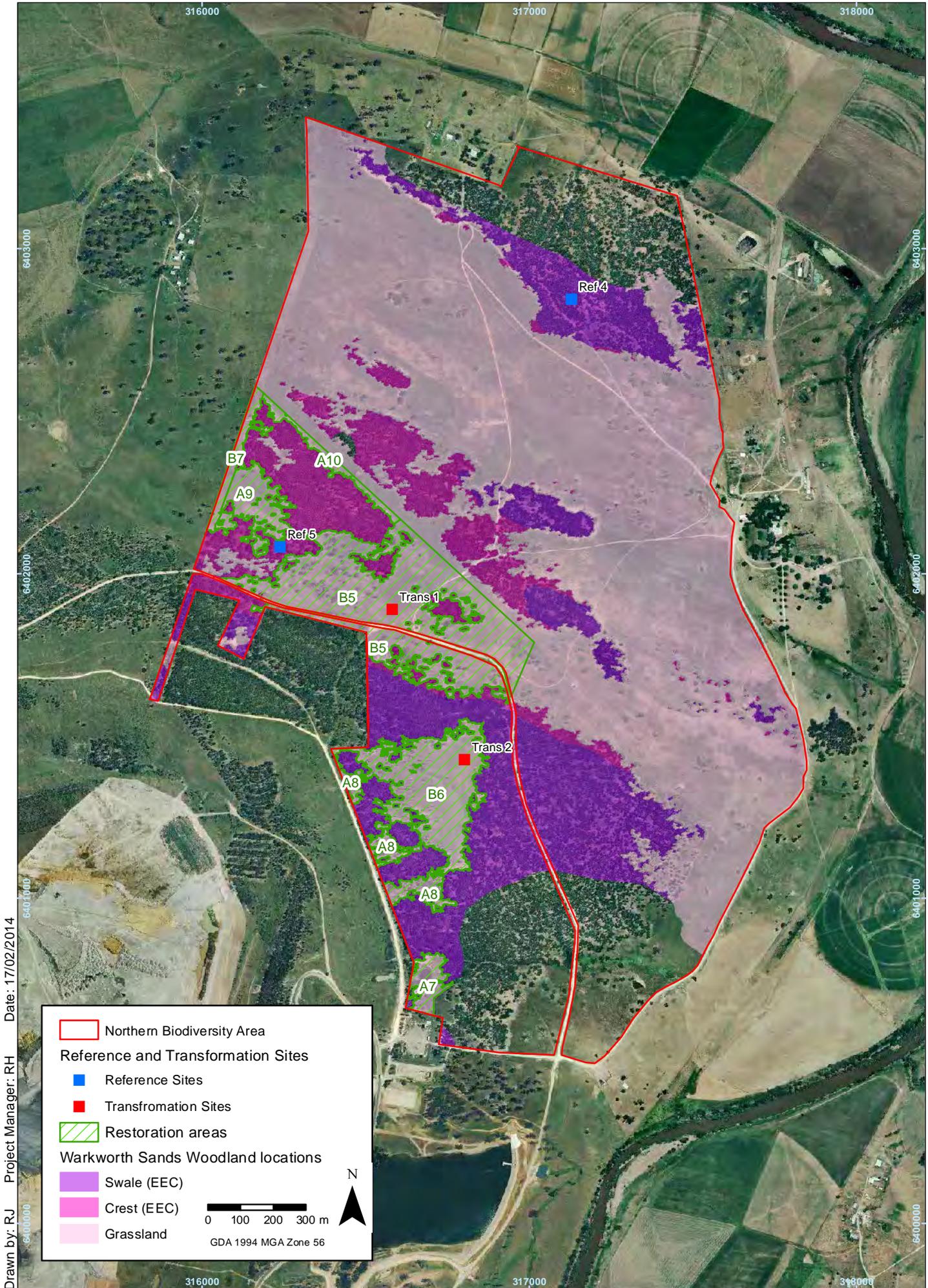
Thirteen Operation Management Areas have been defined and mapped to provide a framework for the land manager, to select and use appropriate land management practices (active and passive restoration methods) in identified Operation Management Areas with the aim of promoting the transition of WSW from a higher state to lower condition class. Section 4.1 describes the planning which underpinned the considerations in the design of the Operation Management Areas.

An Operation Management Area is a unit of land that supports a uniform plant community and exhibits a relatively consistent condition status throughout.

The locations of the Operation Management Areas are presented in Figure 3 and Figure 4.

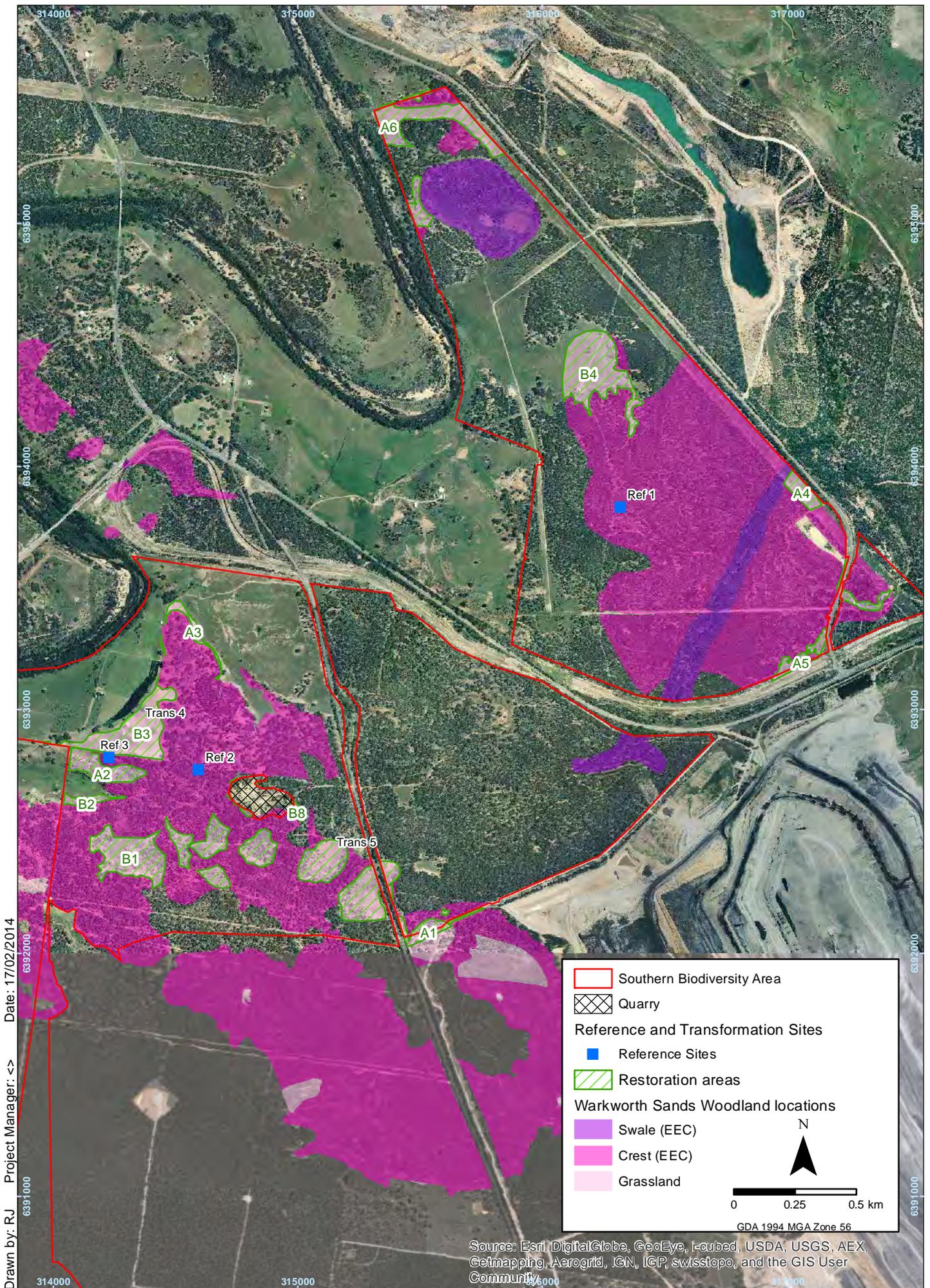
Table 6. List of Operation Management Areas in the Northern and Southern Biodiversity Areas

Passive restoration areas	Northern Biodiversity Area (ha)	Southern Biodiversity Area (ha)
A1	-	1.93
A2	-	2.21
A3	-	0.66
A4	-	1.08
A5	-	1.90
A6	-	4.96
A7	1.46	0
A8	2.37	0
A9	3.01	0
A10	1.08	0
Active restoration areas		
B1	-	14.75
B2	-	0.59
B3	-	5.20
B4	-	6.40
B5	21.06	-
B6	9.30	-
B7	1.33	-
Quarry area	-	2.96
Totals	39.60	43.00



Drawn by: RJ Project Manager: RH Date: 17/02/2014

Areas identified for restoration in the Northern Biodiversity Area
Warkworth Sands Woodland Restoration Manual



Areas identified for restoration on the Southern Biodiversity Area
Warkworth Sands Woodland Restoration Manual

4. Restoration Planning

4.1 Pathway

In designing the Operation Management Areas (Table 6) the following scoping questions were considered. The dichotomous key (Table 7) outlines some of the key questions to define a restoration pathway and determine the appropriateness of active and passive restoration in each Operation Management Area.

Table 7. Key questions for restoration pathway

1.0 Why is restoration being considered in the northern and southern biodiversity areas?		
1.1 Did the site support WSW plant community prior to restoration?		
Yes	Does the sand substrate require physical reshaping and augmentation with sand and plant material?	Go to 1.2
No	Carefully consider whether active restoration is appropriate.	Go to 1.0
1.2 What caused the modification in vegetation condition?		
Known	The causes and their effects are known and understood	Go to 1.3
Unknown	Have the causes been stopped or controlled? Consider a pilot study.	Go to 1.0
1.3 Have the causes of the modification in vegetation condition stopped or are they now under management?		
Yes	The causes of the modification in vegetation condition have stopped or are under management	Go to 1.4
No	Active restoration is likely to fail unless step(s) are first taken to control cause(s) of change to the key ecological characteristics.	Go to 1.2
1.4 Has the site retained its reproductive potential i.e. seed and /or root material?		
Yes	The regenerative capacity of the site is considered to be high	Go to 1.5
No	Consider which key ecological characteristics have been modified and to what extent and by what land management practices.	Go to 1.2
1.5 Does the substrate require amelioration?		
Yes	Are the resources available when they are needed?	
No	Site may be suitable for passive restoration.	Go to 2
2.0 Are the aims of the restoration well understood by the stakeholders?		
	If not consult with stakeholders and refine the restoration objectives and agree on a revised restoration aim.	Go to 1.1

4.2 Good practice restoration checklist

- To reduce risk, transplant using tube stock and direct drilling of a broad cross-section of the dominant structuring species that have been collected in the field from the development area. This genetic stock will be grown in a nursery to provide local provenance material for active restoration. It is assumed that the development site and Reference site share a high degree of similarity in terms of species composition and genetic complementarity.

- Use the Reference site to guide future vegetation structural density. Transplant the tube stock at the same density as the Reference site, or a little denser, to allow for natural thinning. Note that a doubling of density in tube stock planting will significantly increase costs.
- To reduce risk, transplant tube stock into well prepared sites ensuring that the transplanted plants are well protected from grazing animals and from invasive weeds and are supplied with adequate water in dry seasonal conditions.
- Where ever possible understand how prior land management has modified the ten ecological characteristics of each WSW community and ‘work with’ these more resilient natural recovery processes.
- Think of restoration in terms of expected and observed outcomes. Do not expect major recovery in the immediate or short or medium-term; think long-term.
- At every stage in the process make sure that your plans match the resources available and avoid untested assumptions regarding survivability of tube stock, invasion by weeds, damage caused by native animals, insect herbivory and wildfire.
- Monitoring should include both regular systematic surveys to measure progress of the Transformation sites relative to the Reference sites and routine checks of untreated areas of WSW communities where passive restoration is being practiced.
- The focus of systematic monitoring should be 1) to collect observations and measurements to track progress towards the recovery of the ten ecological characteristics found at Reference and Transformation sites, 2) allow evaluation of progress by comparing the ten ecological characteristics for Reference and Transformation sites and, 3) provide feedback to key stakeholders using simple practical reporting tools.
- Carry out frequent routine checks on Transformation sites so that potential problems can be identified early and adaptive management undertaken.
- Use the Reference sites as “control” sites, where no active interventions are carried out, in order to assess whether it is natural recovery or the result of your active restoration that has led to improvements in indicators at the site.

4.3 Connectivity

Figure 3 and 4 show that all areas to be actively restored are in close proximity to each other and/or existing patches of regrowth WSW. Over time this will have added benefits of creating larger patches of WSW with increased resilience and connectivity. As the areas of WSW grassland are actively restored and are largely surrounded by regrowth WSWs, there is a high probability of natural reseedling and consequent encroachment from adjacent less modified woodland over time. Natural regeneration of selected trees and shrubs is already occurring in patches as a result of cessation of cattle grazing and management of current threats.

5. Conservation management actions

5.1 Active restoration

Active restoration covers the translocation of soil and genetic material salvaged from the disturbance site, re-establishment and regrowth management. The areas selected for active restoration are the WSW grassland areas.

5.1.1 Translocation of topsoil, mulch and plant material

Access to the topsoil, mulch and plant material from the disturbance site is a highly valuable resource that can be used in re-establishment of WSW in this situation. It provides an opportunity to transfer ecological characteristic to the re-establishment sites that are deficient in these key WSW ecological characteristics. The following outlines critical factors in the use and management of these resources.

5.1.1.1 Topsoil management

Research has shown that direct transfer of stripped topsoil is most effective in maintaining the viability of soil seed bank, soil microbes, organic matter and nutrients. Results have shown the direct transfer to the restoration areas generally results in higher native species richness and recruitment compared to stockpiled topsoil. Therefore stockpiling of material is to be avoided where possible. UNE research trials also showed that the quality of the salvaged material greatly influence the successful recreation of WSW characteristic, i.e. salvage areas with high weed characteristic will transfer to the re-establishment sites.

To translocate the majority of plant propagules it is recommended that the top 10 cm is scalped.

5.1.1.2 Mulch

All overstorey and understorey vegetation at the disturbance site should be coarsely mulched to provide a potential seed source at the re-establishment sites.

To mitigate the potential lock up of nutrients in the soil, it is suggested that composted mulch be applied prior to application. This will also provide soil disturbance and prepare the restoration site.

5.1.1.3 Plant material

Seed, cuttings and plants should be salvaged from the disturbance area to further assist in the establishment of ecological characteristics in the re-establishment areas.

5.1.2 Re-establishment

Broadly, the UNE research supports the following approaches to re-establishment:

- planting should be undertaken in the autumn months when there is good soil moisture;
- tube stock must be healthy, mature (at least 25 cm tall) and have a well developed root system;
- mulch should be used as it improves survival and growth of tube stock seedlings, and should be applied at a depth of 10 cm and at least 30 cm from the base of planted seedling;
- tube stock should be planted to a depth that covers the root collar;
- tree guards should be used to control browsing; and
- watering should be conducted at time of planting as this assists with consolidation of soil around the roots.

5.1.2.1 Field diagnostics to direct active restoration

The sand depth varies continuously across the landscape. The simplest way to determine sand depth is to use a 2 m by 10 cm thick solid steel probe with pointed end to rapidly assess the depth of the sand. However, it should be noted that because small stones can be found in the soil profile, several probes with the steel rod should be used to penetrate the soil profile to ascertain the depth to hard soil or sand rock base.

Where the sand is less than 1 meter it is likely that the site was formerly:

- open woodland on shallow sand dominated by *E. agglomerata*, *E. crebra* +/- *E. tereticornis* in the overstorey and mixed dense shrub layer in the in the midstorey.

Where the sand is greater than 1 meter it is likely that the site was formerly:

- woodland on deep sand dominated by *Angophora floribunda* +/- *E. tereticornis* in the overstorey and *Banksia integrifolia* +/- *Callitris enlicheri* in the midstorey.

Where the field surveyor can identify plant species this should also be used as evidence for determining which of the two WSW communities would have been formerly present at a site before it was converted to agriculture.

5.1.2.2 Pre-establishment weed control

Due to the postponed application of composted and green mulch, chemical control of weeds should be conducted to target control of declared and environmental weed species, as described in the Green Offsets Annual Weed Control Program 2013.

5.1.2.3 Species selection and collection

Species selection is based on the WSW EEC definition and UNE survival trials, and includes species that can be propagated in a nursery and have good survivability when planted as tube stock.

Species to be targeted for seed collection, cutting and plant collection are listed in Annex 3. Seed collection must be for non-commercial purposes and meet the standards of the "Guidelines and Codes of Practice" developed by Florabank (www.florabank.org.au), except for material collected within the disturbance area. All appropriate permits for collection should be attained. Plant removal is only permitted to occur within the disturbance area.

5.1.2.4 Planting

Planting must only occur when there is suitable soil moisture, typically 1 -2 days after 25 mm of rainfall, in the autumn months. Tube stock is to be at least 250 mm in height, with a well-established root system and in good condition. The tube stock root plug is to be saturated at the time of planting. Soil conditioner is to be applied into the planting hole and all plants should be planted deep, with their root plug at least 50 mm below ground and gently firmed in to remove any air pockets in the soil.

Planting will occur post application of mulch, with the mulch at moved least 30 cm away from the base of the seedling. Watering should occur immediately after planting.

Tree guards should be installed to for protection from browsing.

Tube stock should be maintained for a period of 18 months to ensure the plant has its tree guard removed, watered if required and competition is controlled.

5.1.3 Regrowth control

Very dense stands dominated by *Callitris* and *Allocasuarina* occur at sites with heavy disturbance, locking the vegetation community in an unnatural state. These stands prevent the recruitment of other species and are unlikely to transition into the residual or unmodified condition states. Regrowth control or thinning of these stands will ensure that a diverse and sustainable woodland community is established with a similar structure, function and composition to the reference sites.

Permits under the *Native Vegetation Act 2003* will be required for thinning activities, and therefore sound ecological evidence will be required to support this activity.

5.2 Passive restoration

Passive restoration involving the amelioration of one or more of these key ecological characteristics requires knowledge and experience with the use of remedial treatments including: controlling weeds and feral animals, and fire regimes.

5.2.1 Weed control

Control of weed species is critical to restoring the condition of the WSW plant community in the Northern and Southern BAs. Weed infestations can affect vegetation structure, species composition, and regenerative capacity. Non-indigenous plants have invaded highly modified areas resulting from previous land management practices, such as land clearing and/or over grazing.

Continued implementation of the current Green Offsets weed program is recommended. Specifically, the use of selective herbicide control of Red Natal Grass, Creeping and Prickly Pear, Lantana and Mother of Millions. In addition, the management of access to the restoration sites is required to control the spread of weeds by providing wash down procedures and defining access tracks and gates.

5.2.1.1 Invasive native plant species

Blady Grass (*Imperata cylindrica*) is often indicative of reduced soil fertility or other forms of pasture degradation. Regular burning enhances this species over many other locally indigenous species because of its regenerative strategy (i.e. its underground stems).

Prior management of WSW communities, including their conversion to native and improved pasture for cattle grazing, would appear to have included the use of regular burning. Many native species of shrubs and native groundcovers are not tolerant of a combination of burning and grazing. Regular burning is known to encourage a dominance of fire tolerant, warm-season perennial grasses such as Blady Grass (*Imperata cylindrica*). While the intent of agricultural land manager's use of regular controlled fire was likely to reduce blady grass, evidence from other regions of Australia suggests that in the short-term it produces palatable regrowth pastures, but in the longer term it dramatically reduces the species composition and the regenerative capacity of the groundcover. Surveys by Niche of the Northern BA indicate that cleared areas that are dominated by Blady Grass are the result of prior of burning and grazing management practices.

Wedlock and Elphinstone (2012) provide several solutions for blady grass management and control, noting that there is not one single approach. These practices include changing from the traditional spring burning practice to autumn burning, or reducing the burning frequency to every second or third year. Other practices include: selectively slashing the patches in the late summer / autumn; using cattle to trample in native seed while selectively grazing the blady grass green shoot during the winter, while during the next summer rest the paddock from grazing to allow the desirable species to set seed and fix nitrogen; in subsequent seasons use cattle to graze the blady grass patches during the winter (the extra trampling

effect of the cattle will help to suppress the remaining blady grass over a couple of seasons). The use of cattle will require the use of temporary electric fences and water points, and frequent movement of the stock.

More widely, evidence from regenerative agricultural practices of grazing cattle, using time-based cell grazing, is known to favour the development of a mulched soil surface, which is destroyed by regular burning. The recruitment of native forbs and grasses is favoured by a mulched soil surface.

Priority will be given to:

- excluding wildfire fire from blady grass areas after the active restoration process commences;
- using strategic grazing (i.e. time-based cell grazing) with cattle to control blady grass and to develop a mulched soil surface;
- encouraging the establishment and re-establishment of native forbs, grasses and shrubs into the mulched soil surface; and
- managing the recovering plant community (Transformation sites) to increase their vegetation structure, species composition and regenerative capacity.

5.2.2 Pest animal control

Some pest (or feral) animals pose a threat to restoration programs. Continued implementation of the current Green Offsets feral animal control program is recommended. Annual checking of fences and gates is also recommended to ensure exclusion of neighbouring domestic animals.

5.2.3 Fire management

The use of fire as a management tool in the context of restoration has real potential to stimulate a net benefit in terms of enhancing vegetation structure, species composition and regenerative capacity of the WSW.

There are obvious benefits in the long-term protection and maintenance of the WSW in term of managing the risk of severe wildfire because the Northern and Southern BAs are geographically separated. Consequently, if there was a severe bushfire in one of the BAs it would be unlikely to impact the other BA.

The effect of managed fire, as an active and passive agent in ecological restoration will be considered and evaluated through the monitoring programs. This information will be used to guide adaptive management to further enhance the vegetation structure, species composition and regenerative capacity of the WSW using fire.

6. Monitoring Program

The monitoring program incorporates Reference and Transformation sites. Reference sites are used to set a benchmark for assessing re-establishment outcomes and provide sites for assessing key performance criteria that are used to track change and trend associated with the restoration interventions. For each WSW community two sites are selected for monitoring and reporting the outcomes of the restoration interventions, Reference and Transformation sites. Change and trend resulting from the restoration intervention involves comparing the Transformation site to the Reference site over time.

This Manual outlines a system for tracking change and trend in the recovery of WSW communities, known as Vegetation Assets States and Transitions (Thackway and Lesslie 2006, 2008; Thackway 2012, 2013).

6.1 Performance criteria and key performance indicators

Proposed performance criteria relevant to restoration of WSW are presented in Table 5 and these directly relate to the key ecological characteristics identified by Thackway (2012). Key performance indicators measured at Transformation sites will be evaluated relative to the Reference sites to assess and report net benefit of the restoration interventions.

These ten key ecological components and the associated set of 22 key performance indicators form the basis of a report card for monitoring and reporting change and trend over time to evaluate progress toward a particular condition state of target.

All key performance indicators are quantified by range values measured from the Reference sites which form both an *upper* and *lower* limit. A description of the key performance indicators and how they relate to the key ecological characteristics is provided in Thackway (2012).

As noted previously, the transformation of a plant community is described using indicators regenerative capacity, vegetation structure and species composition. Ideally, all 22 performance indicators (Table 5) should be populated using quantitative data measured at sites over time. This is not the case with WSW, hence it is important to distinguish which indicators are based on quantitative data from those which are based on qualitative observations. This manual describes the tracking of change by collecting quantitative attribute measures of vegetation structure and species composition (i.e. Bio banking plot data) and qualitative observations of regenerative capacity.

Progress toward restoration targets will be strongly affected by prior impacts of land use and land management practices (Thackway and Lesslie 2006, 2008), where there is evidence of intensive land use activities it is highly desirable to understand what these practices were, and how they might have impacted the indicators of regenerative capacity.

The VAST-2 method explicitly relies on expert elicitation to fill data gap/s in performance indicators using specialist ecological knowledge and experience and/or quantitative data from equivalent soil-landscape association/s (Thackway 2012). Where it is appropriate to use quantitative data from equivalent soil-landscape association it is important to state this in the analysis.

While this manual does not stipulate particular methods for the collection of quantitative data to populate the indicators of regenerative capacity. It is worth noting, that the six ecological characteristics that describe regenerative capacity provide a sound ecological checklist which can be used by land managers, such as RTCA, to initiate targeted research projects/programs to better understand why predicted targets

for vegetation structure and species composition may not be responding to changes in land management practices, as expected or predicted. Where that is the case, this indicator checklist will assist the land manager to design appropriate experiments involving changes in land management practices (i.e. active restoration interventions) so that observed vs expected outcomes can be better understood and lessons learnt can be applied more widely.

It is also important to note that the ten ecological characteristics and the key performance indicators are dynamic throughout time, to best represent seasonal and climatic conditions. Whilst the particular season for undertaking the monitoring is relatively unimportant, it is imperative that both Reference and Transformation sites are monitored at the same period in time using the BioBanking method, to reduce seasonal variations.

6.2 Proposed WSW report card

The outcomes of active and passive restoration affect particular indicators and in turn the key ecological characteristic.

6.2.1 What to monitor and report?

For the purposes of reporting, changes in the condition of the two WSW communities should be used as the reporting unit:

1. Woodland on deep sand dominated by *Angophora floribunda* +/- *E. tereticornis* in the overstorey and *Banksia integrifolia* +/- *Callitris enlicheri* in the midstorey
2. Open woodland on shallow sand dominated by *E. agglomerata*, *E. crebra* +/- *E. tereticornis* in the overstorey and mixed dense shrub layer in the in the midstorey

The proposed report card is based on reporting the performance of ten ecological characteristics compared to the reference state referred to elsewhere in this Manual. Attribute data collected using the BioBanking field survey method will be used to populate the key performance indicators relating to vegetation structure and species composition (Table 8).

6.2.2 Source of data and information

Table 8 shows how these BioBanking vegetation structure and species composition attributes will be used to populate the relevant performance indicators.

The remaining VAST vegetation structure and species composition indicators (Table 8) which are not collected using the BioBanking method (e.g. structural diversity and height), will be populated using published and unpublished information including expert elicitation. Attribute data required to populate the VAST indicators relating to regenerative capacity (i.e. landscape function) will be compiled from relevant published papers and reports and expert elicitation, i.e. where these data and information have not formally or systematically been collected. Key to this process will be observations of the land manager and field ecologists familiar with the restoration program. Because the VAST indicators are hierarchical there is a direct relationship between the performance indicators and 10 key ecological characteristics (Table 8).

6.2.3 Method to prepare the report card

The general process underpinning the report card is presented in Figure 5. The land manager and ecologist are integral to developing the report card. This process produces a continuous string of information providing a temporal report card of the cause and effect of changes on vegetation condition.

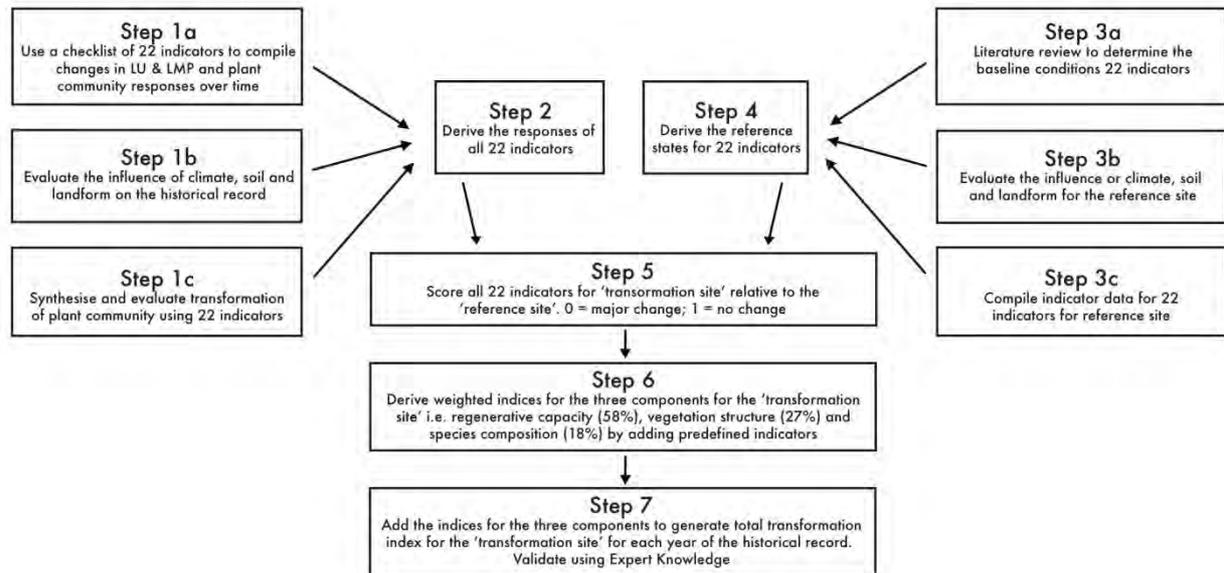


Figure 5. General process for tracking changes in vegetation condition over time

Table 8. Relationships between attributes from BioBanking and the VAST key ecological characteristics and performance indicators

VAST diagnostic criteria (3)	Key ecological characteristics (10)	Key Performance Indicators (22)	Sources of data and information to populate VAST indicators	
			BioBanking field attributes (Annex 2)	Reattribution from relevant sites plus expert elicitation
Regenerative capacity	Fire regime	1. Area /size of fire foot prints		Relevant local quantitative and qualitative data
		2. Interval between fire starts		Relevant local quantitative and qualitative data
	Soil hydrology	3. Plant available water holding capacity		Relevant local quantitative and qualitative data
		4. Ground water dynamics		Relevant local quantitative and qualitative data
	Soil physical state	5. Effective rooting depth of the soil profile		Relevant local quantitative and qualitative data
		6. Bulk density of the soil through changes to soil structure or soil removal		Relevant local quantitative and qualitative data
	Soil nutrient state	7. Nutrient stress – rundown (deficiency) relative to reference soil fertility		Relevant local quantitative and qualitative data
		8. Nutrient stress – excess (toxicity) relative to reference soil fertility		Relevant local quantitative and qualitative data
	Soil biological state	9. Organisms responsible for maintaining soil porosity and nutrient recycling		Relevant local quantitative and qualitative data
		10. Surface organic matter, soil crusts	Litter Cover % Bare Ground Cover % Cryptogam Cover %	
	Reproductive potential	11. Reproductive potential of overstorey structuring species		Relevant local quantitative and qualitative data
		12. Reproductive potential of understorey structuring species		Relevant local quantitative and qualitative data

VAST diagnostic criteria (3)	Key ecological characteristics (10)	Key Performance Indicators (22)	Sources of data and information to populate VAST indicators	
			BioBanking field attributes (Annex 2)	Reattribution from relevant sites plus expert elicitation
Vegetation structure	Overstorey structure	13. Overstorey top height (mean) of the plant community		Relevant local quantitative and qualitative data
		14. Overstorey foliage projective cover (mean) of the plant community	Native Over-storey %: Native Mid-storey %	
		15. Overstorey structural diversity (i.e. a diversity of age classes) of the stand		# Hollows # Trees
	Understorey structure	16. Understorey top height (mean) of the plant community		Relevant local quantitative and qualitative data
		17. Understorey ground cover (mean) of the plant community	Native Ground Cover Grasses % Native Ground Cover Shrubs% Native Ground Cover Other % Exotic Plant Cover	
		18. Understorey structural diversity (i.e. a diversity of age classes) of the plant		Relevant local quantitative and qualitative data
Species Composition	Overstorey composition	19. Densities of overstorey species functional groups	Exotic Plant Cover %	
		20. Relative number of overstorey species (richness) of indigenous :exotic species	Species list: indigenous :exotic	
	Understorey composition	21. Densities of understorey species functional groups	Native Ground Cover Grasses % Native Ground Cover Shrubs % Native Ground Cover Other% Exotic Plant Cover %	
		22. Relative number of understorey species (richness) of indigenous :exotic species	Species list: indigenous :exotic	

Graphs will be used to show change and trend in the performance of the restoration of WSW status and condition components i.e. regenerative capacity, vegetation structure and species composition over time. Examples of these graphs can be found at <http://aceas-data.science.uq.edu.au/portal/>. Graphs represent summaries of change and trend, where the indicators are treated equally and independently, by assigning scores from 0 to 1. Indicators are hierarchically structured into attribute groups and assigned weighted scores. The weighted components (diagnostic attributes) comprise regenerative capacity (55%), vegetation structure (27%) and species composition (18%).

Regenerative capacity is assigned a much higher weighting because experience shows that where the key ecological processes have not been obviously modified over time a plant community is resilient. Where the key ecological processes have been removed or replaced it is necessary to use active restoration methods to re-establish these processes if a plant community is to be regarded as self-replacing and /or self-repairing in the face of natural disturbance (Thackway 2012).

6.2.4 Example report card

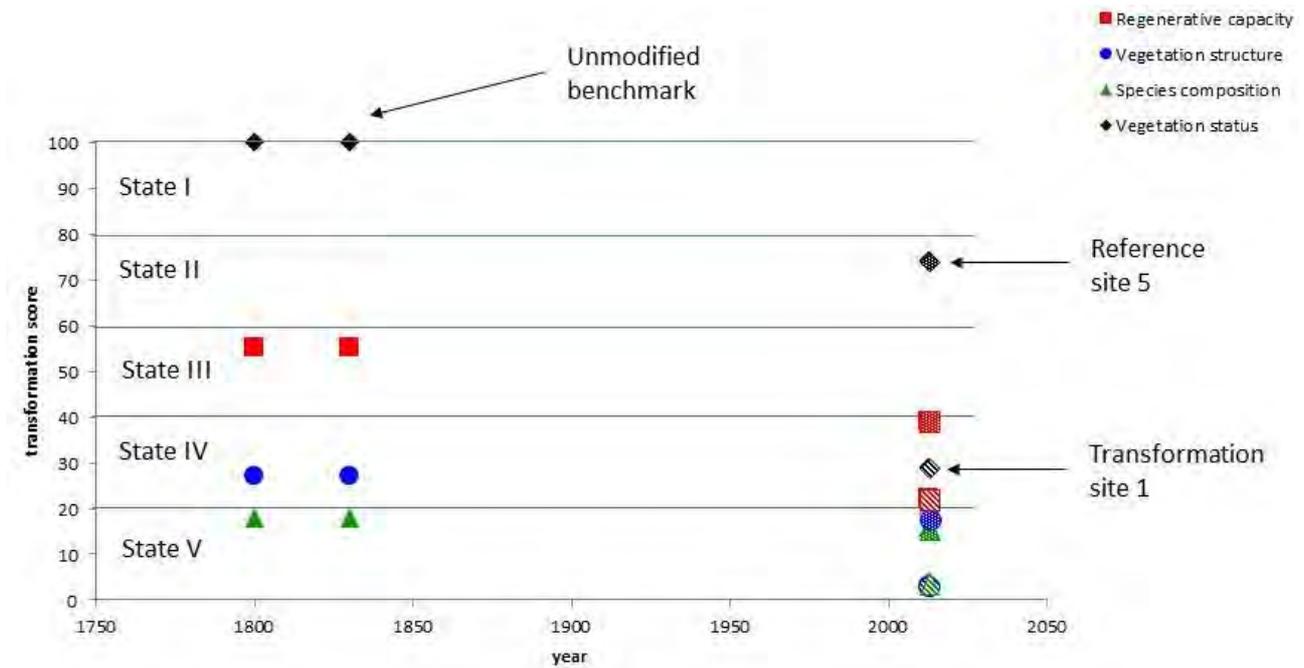
Figure 6 presents an example report card using the VAST system for WSW on deep sand dominated by *Angophora floribunda* +/- *E. tereticornis* in the overstorey and *Banksia integrifolia* +/- *Callitris enlicheri* in the midstorey in the northern BA. The figure shows the relationship between an unmodified site (VAST state I), Reference site 5 and the Transformation site 1.

Currently, Transformation site 1 is classified as VAST state IV with a transformation score of 29% and the Reference site 5 is classified as VAST state II, with a transformation score of 74%.

Figure 6 represents a baseline for tracking change and trend of the Transformation site 1 toward Reference site 5.

Data and information used to populate the ten Vegetation structure and Species composition indicators were collected by Niche Environment and Heritage in mid-December 2013 (Annex 2), plus from relevant literature. Data and information used to populate the twelve indicators of Regenerative capacity were compiled using a desktop exercise from a structured spatiotemporal literature review and stakeholder interviews.

As noted above Section 3.2.1 additional Transformation sites will be established to match the other four Reference sites, described in Annex 2. Field data will need to be collected for these four new Transformation sites before a similar graph can be produced for the other four Reference sites described in Annex 2.



Legend. The solid fill symbols depict an unmodified benchmark.
The stippled symbols depict the Reference site 5.
The cross hatched symbols depict the Transformation site.

Figure 6. Transformation of WSW on deep sand dominated by *Angophora floribunda* +/- *E. tereticornis* in the overstorey and *Banksia integrifolia* +/- *Callitris enlicheri* in the midstorey in the northern BA

Additional information in the report card might include:

- Maps showing landscape level examples of connectivity gains over time (i.e. less modification and less fragmentation);
- Case studies of mismatches between expected vs observed outcomes and document the reasons why (e.g. wildfire, drought, weeds, feral animals); and
- Examples of species-based benefits resulting from changes and trends in condition (e.g. decreased extent and density of undesirable plant species such as prickly pear cactus or creeping pear (*Opuntia humifusa*)).

7. Managing risks in the WSW restoration program

7.1 Introduction

What threats and risks can be avoided to improve the chances of success of the WSW restoration program? What are the most important factors when assessing risk; physical, biological or social? This section outlines a structured approach below with the aim of minimising risks at the planning stage, by incorporating appropriate responses or mitigation procedures to the perceived risks. Managing risks in WSW restoration program would involve developing a Risk Management Plan, the aim of which is to improve the chances of the restoration project achieving the desired aims.

Threats can be grouped into locally manageable risks (local human impacts), and externally derived threats that cannot be managed locally. Threats that are external to a restoration program's control include drought, wildfire, and severe storms. These threats should be considered so as to mitigate likely their impacts.

There is a margin of error in the assessment and mitigation of risks. One way to deal with the large margin of error is to replicate the restoration efforts over a series of sites within an area and to spread the restoration interventions among a number of suitable areas.

7.2 Assessing the most important risks in the project design phase

Four hierarchical components underpin the development of a Risk Management Plan for the WSW restoration program.

7.2.1 Definition of aims and objectives

The aims of the WSW restoration program determine the range of risks to take into account. The WSW restoration program primarily aims to improve vegetation structure, species composition and regenerative capacity in the BAs, which have been modified and fragmented as a result of prior agricultural and forestry land management. To fulfill this objective will require the land manager to implement a range from *passive* indirect measures, to *active* direct measures, all with the purpose of redressing the modification of the key ecological characteristics known to have been modified at the sites.

7.2.2 Understand the social and natural context

The natural and social settings of the proposed Northern and Southern BAs define the range of risks that need to be considered in the restoration program. This requires the land manager to consider the natural and social setting for each management unit, including the natural and anthropogenic historical setting, and the ecology of the site as input to making risk predictions for that management unit. The social context also refers to the degree to which the key stakeholders are involved, and are in agreement with, the restoration program's aims and conservation management strategies.

7.2.3 Assessment of possible risks

Scoping and field assessment by a specialist was completed during the design phase. Risk factors were collated and assessed at the initial scoping stage by the project coordinator in consultation with relevant ecologists, project managers, decision-makers, and other stakeholders. Critical ecological and biological factors were assessed by experienced ecologists able to interpret the ecological characteristics that are present, absent or have been modified in the proposed WSW sites in the Northern and Southern BAs. This included a rudimentary assessment of effects of historical land use and management practices on the

ecological characteristics within the Northern and Southern BAs. The intent of assessing and interpreting the change and trend associated with historical land management of a site is to guide the implementation of a restoration program and in the future allow the restored site to be more resilient to natural disturbances.

7.2.4 Screening and prioritising risks

The process of developing a risk management profile is to enable the land manager to be prepared to address biological, environmental, and social risk factors where and when they arise. By prioritising these risks it enables the land manager to proceed strategically, which can include the decision not to proceed.

This process enables the land manager to adapt to changing conditions (e.g. factors originally classed as low risk could become high risk factors during the restoration program's life). Part of the risk management plan is provision for regular review and evaluation of progress and an assessment of the vegetation condition at the site. This allows projects within the restoration program to be reactive to changing threats, which may mean modifying the schedule to better match seasonal conditions.

Risks with the greatest potential for loss and the greatest probability of occurring should be addressed first, and risks with lower probability of occurrence and lower resultant loss should be dealt with in descending order.

7.3 Five steps for managing risks in the WSW restoration program

Step 1. Understand the spatial and temporal implications of the restoration program's aims

The aim of this step is to assess whether the aims of WSW restoration program are conflicting and to prioritise which aims are the most important. Commonly documented aims include; mitigation of further damage or degradation, promoting recovery of key ecological characteristics, and assisting recovery of key species or ecosystem processes.

Avoiding this step may have implications regarding difficulties of securing adequate and appropriate resource commitments necessary to complete the project because another aim might be perceived as more important. Therefore, it is critical in this step is to develop a risk management strategy which clarifies and promotes key and appropriate risk management messages in consultation with key stakeholders and decision makers.

Step 2. Define risks associated with the natural and social setting of the restoration program

The aim of this step is to develop a comprehensive list of the risks associated with the viability of a restoration project in order to understand the best pathways for recovery of the WSWs. Key factors that influence these pathways include social, physical and biological processes that have shaped the WSW communities and have been variously modified through use and management over time. Those related to the natural setting include:

1. History of natural and anthropogenic disturbances at a Transformation site;
2. Connectivity and spatial relationships of a Transformation site with respect to the wider remnant although modified patches of WSWs;
3. Issues of ecological integrity of the soil and plant material to be used in the augmentation process;
4. Local social and political issues can influence the long term sustainability and viability of a Transformation site. It is necessary to identify relevant human related factors concerned with

governance, decision making, and ownership issues affecting the site in the short, medium and longer term; and

5. Management issues can have a major influence on the success of a restoration project. These factors include information systems for the collation, access and discovery, systems for tracking and reporting change and trend in a timely manner, training and capacity of personnel, stakeholder engagement and resources for implementing monitoring protocols.

Step 3. Assess and rank the risks to your project

The aim of this step is to assess and rank the main risks in terms of their potential severity and probability of occurrence. Typically rankings assign low, medium and high levels to risks. However, it should be noted that although this is important it can sometimes be difficult to justify. This process requires the project manager to make educated guesses in order to prioritise the risks and develop a risk management plan. Such a pragmatic approach will prove critical to implementing the restoration program and determining when it is necessary to invoke the prioritised list to manage the delivery of a successful restoration project.

Step 4. Develop response options for mitigating the medium and high risks

The aim of this step is to develop a list of appropriate responses or mitigation measures to match the ranked risks that were identified in Step 3. In any given restoration project multiple specific risks can occur at various spatial and temporal scales within a site and, more broadly, within a region and over time. The intent of mitigation is to minimize perceived risks.

Step 5. Developing a Risk Management Plan for the WSW restoration program

The aim of this step is to integrate information from the earlier steps and develop a Risk Management Plan for the WSW restoration program. This process should be used to review and revisit the aims of the restoration projects in the two Biodiversity Areas or the risks of treating a Transformation site using a particular restoration procedure /method. This step can also highlight the value of reducing the level of risk from the most significant of the perceived threats. Fundamental to implementing this step is the central role of monitoring in informing and guiding adaptive management; risk mitigation is not an optional extra. The intent of a Risk Management Plan is to improve the chances of the WSW restoration project achieving the desired aims.

Arguably a key part of the Risk Management Plan can be to argue for the systematic monitoring to fill gaps in our scientific understanding and thereby reduce uncertainties. An added benefit of filling gaps through monitoring of the net benefit of restoration interventions is sharing new findings with key stakeholders.

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9. Annexes

Annex 1. Historical aerial photography of the Biodiversity Areas (Clements 2012)

Annex 1.1 Southern BA 1963 Aerial Image (from Clements 2012)



-  Southern Biodiversity Areas
-  Orchards
-  Proposed Disturbance Area

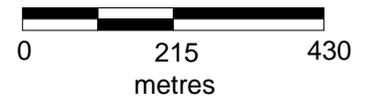
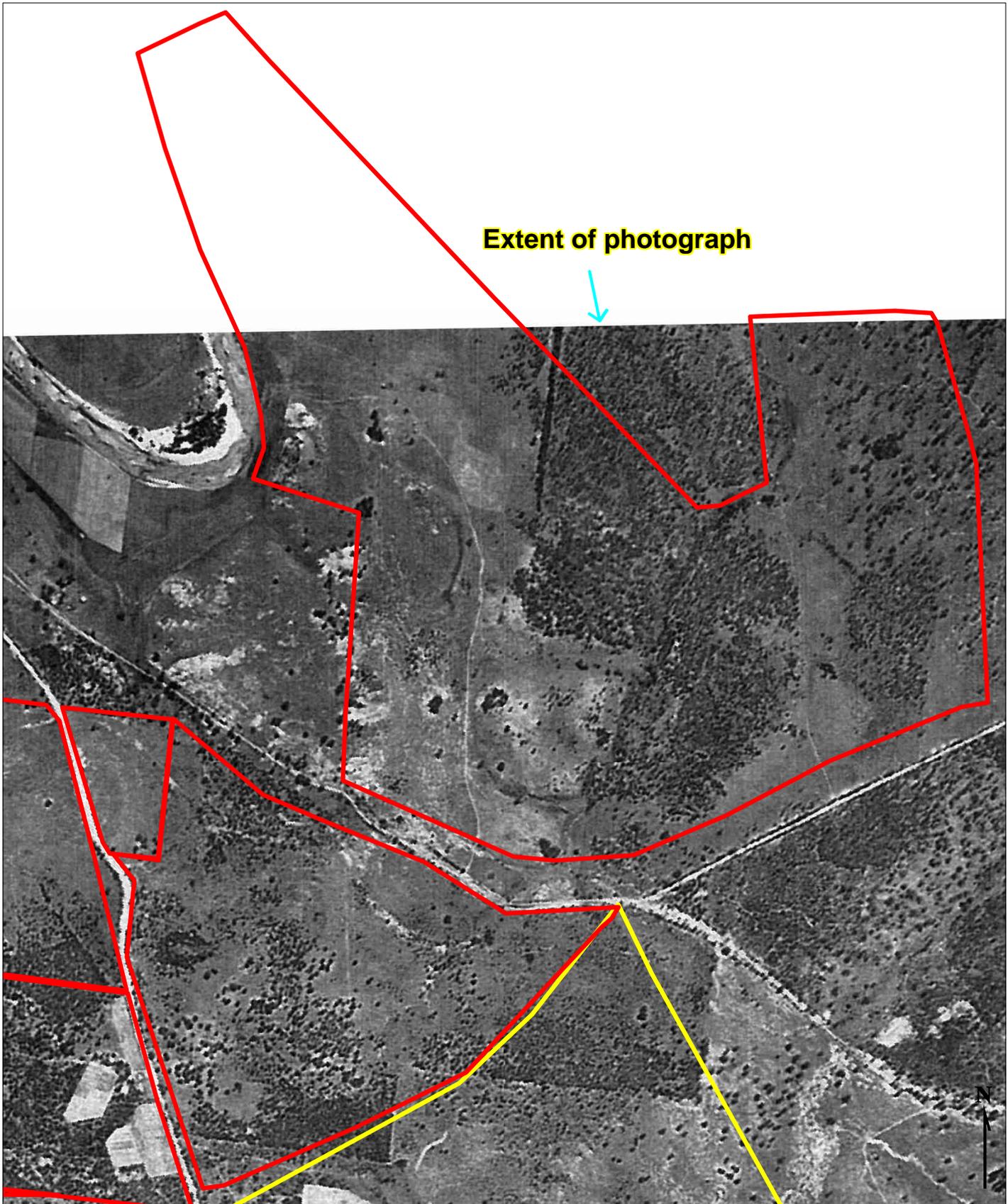


Figure 7a-1.
The Southern Biodiversity Offset Areas
(HMA2 and Springwood) overlaid on the 1963 aerial photograph

Annex 1.2 Southern BA 1963 Aerial Image (North of Golden Hwy) (from Clements 2012)



-  Southern Biodiversity Areas
-  Proposed Disturbance Area

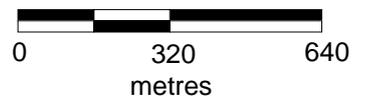
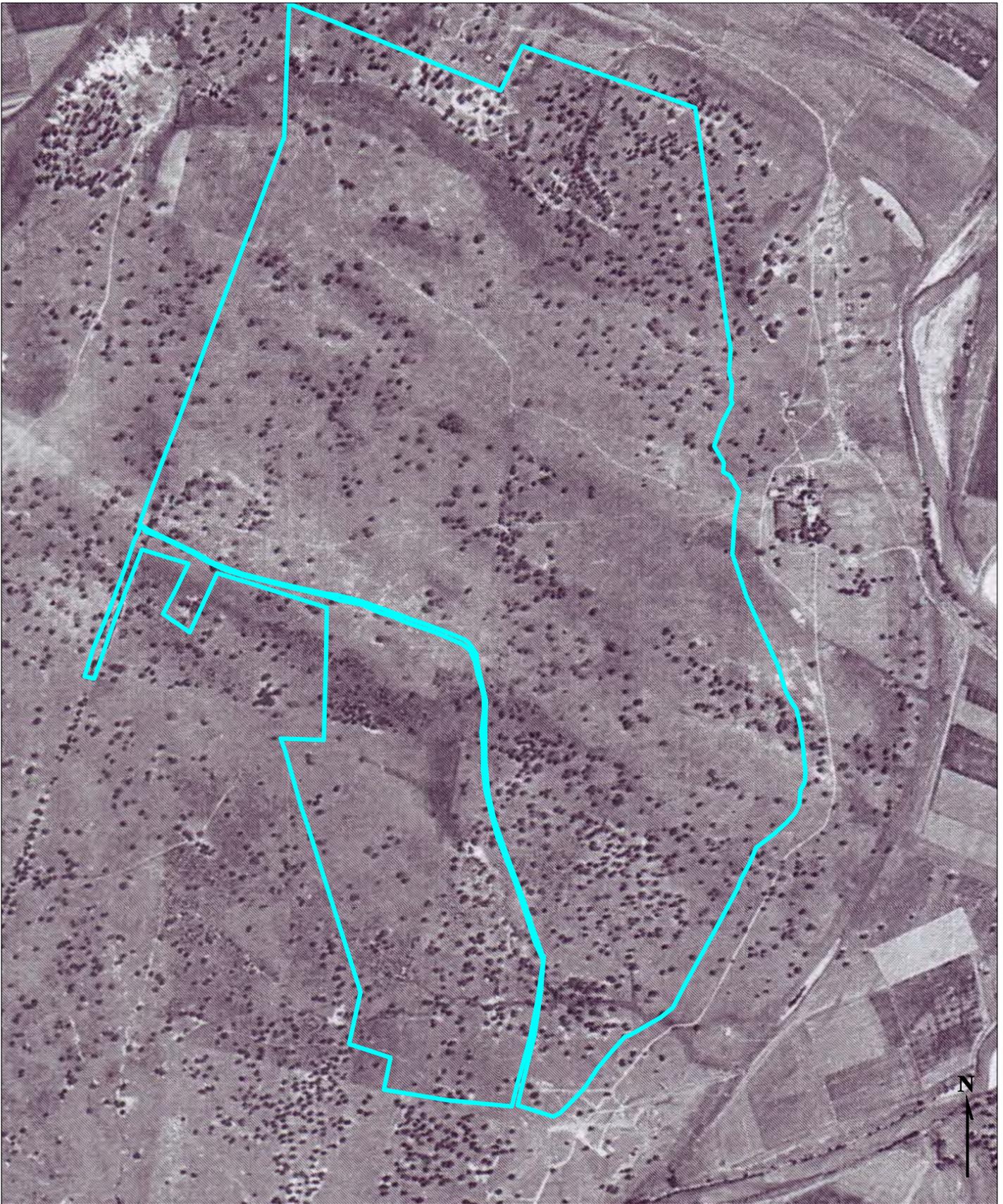


Figure 7a-2.
The Southern Biodiversity Areas (HMA3 and NDA2) overlaid on the 1963 aerial photograph

Annex 1.3 Northern BA 1963 Aerial Image (from Clements 2012)

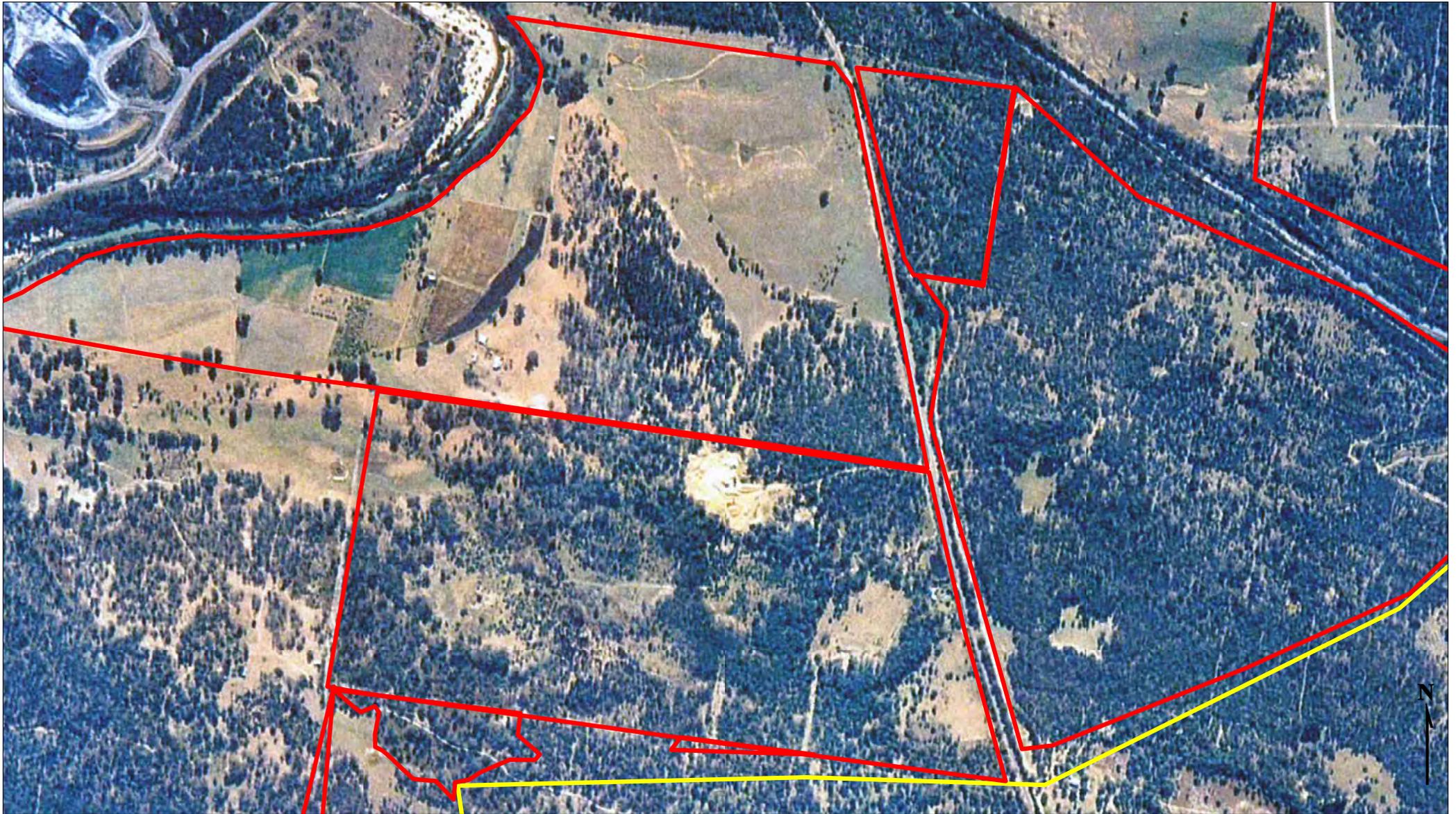


 Northern Biodiversity Area (Archerfield)


0 295 590
metres

Figure 7a-4
The Northern Biodiversity Area overlaid on the 1963 aerial photograph

Annex 1.4 Southern BA 2000 Aerial Image (from Clements 2012)



-  Southern Biodiversity Areas
-  Proposed Disturbance Area

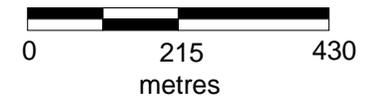
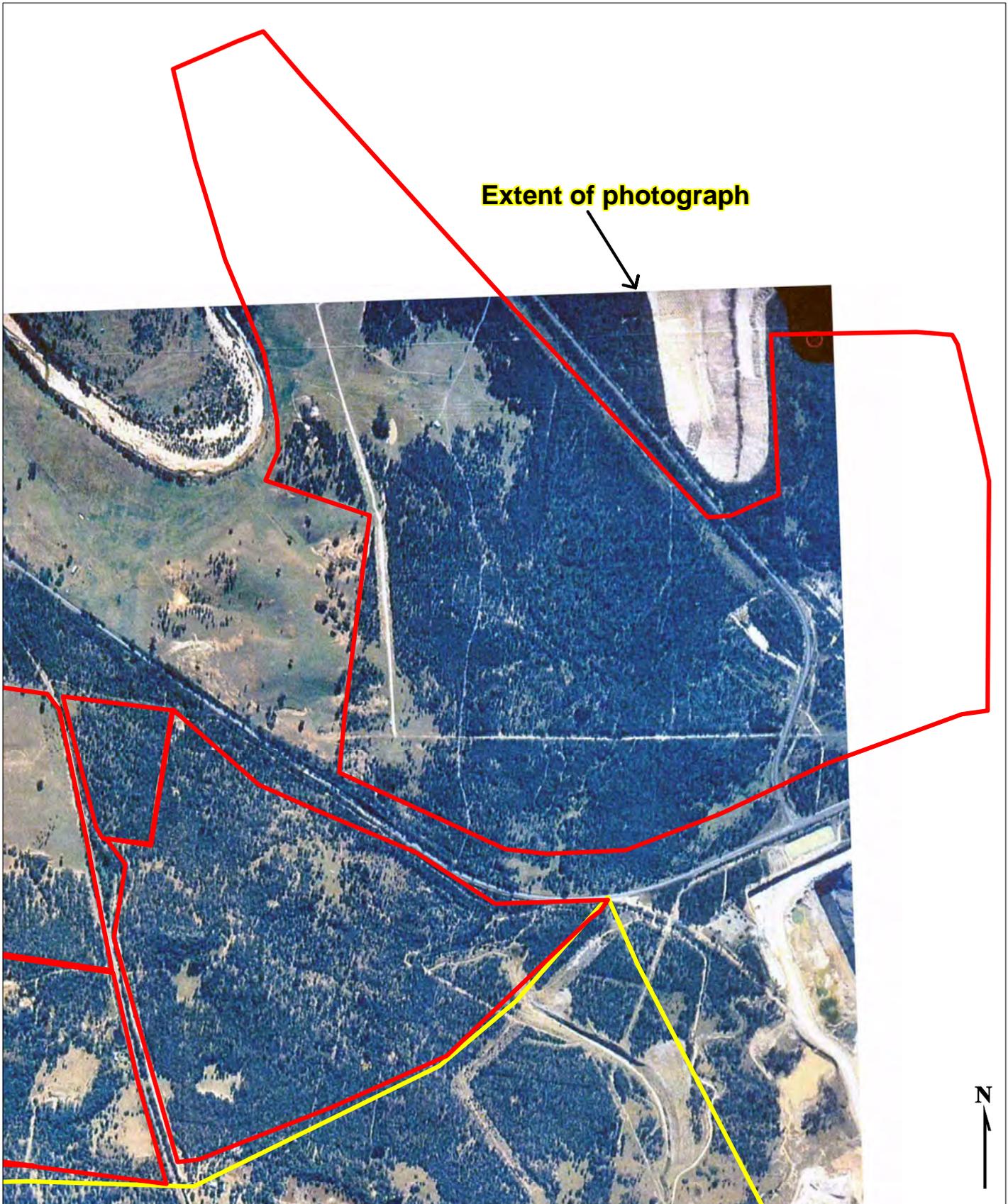


Figure 7e-1.
The Southern Biodiversity Offset Areas
(HMA2 and Springwood) overlaid on the 2000 aerial photograph

Annex 1.5 Southern BA 2000 Aerial Image (North of the Golden Hwy) (from Clements 2012)



-  Southern Biodiversity Areas
-  Proposed Disturbance Area

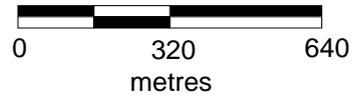
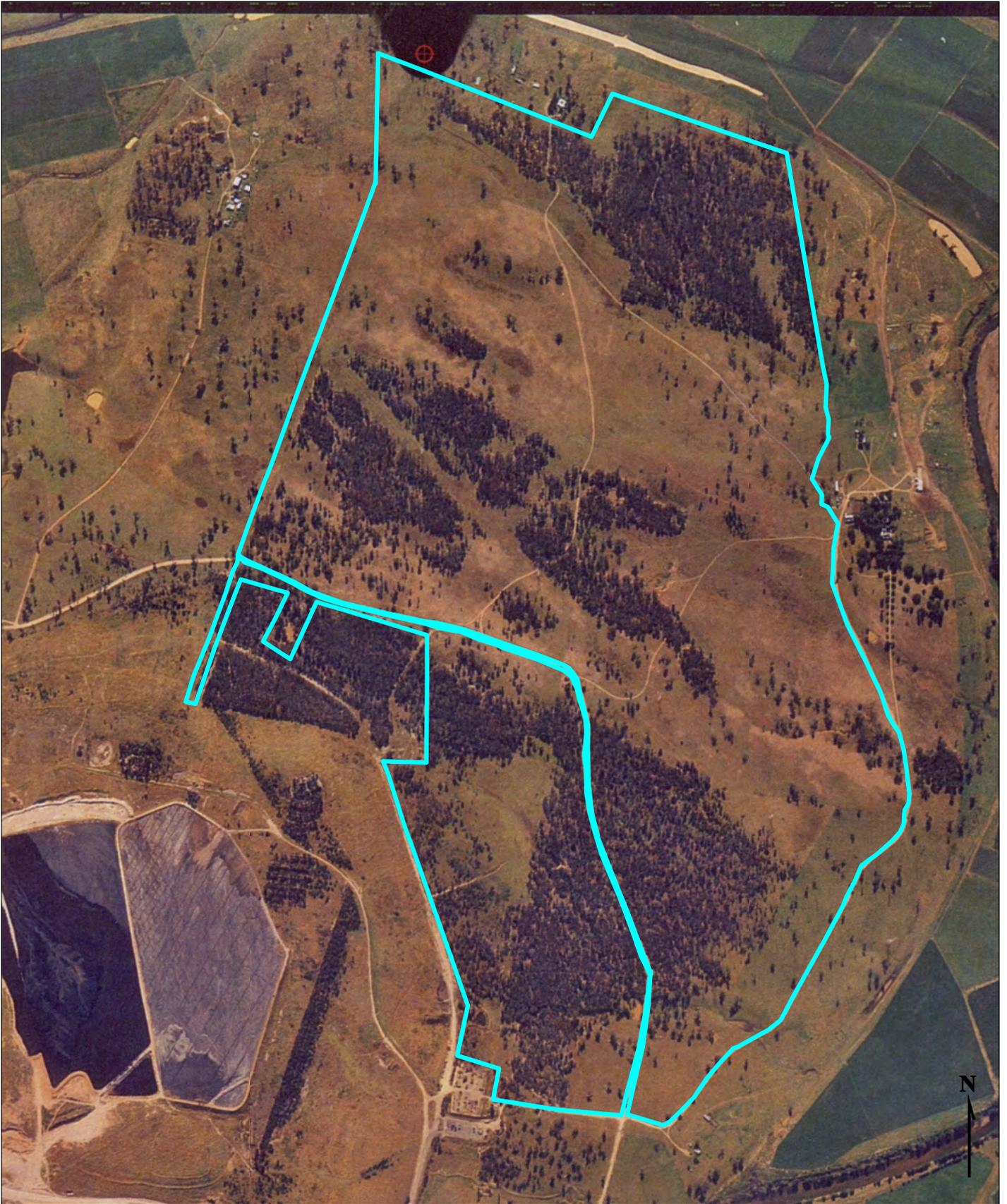


Figure 7e-2.
The Southern Biodiversity Areas (HMA3 and NDA2) overlaid on the 2000 aerial photograph

Annex 1.6 Northern BA 2000 Aerial Image (from Clements 2012)



Northern Biodiversity Area

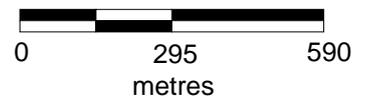


Figure 7e-4
The Northern Biodiversity Area overlaid on the 2000 aerial photograph

Annex 2. Vegetation structure, species composition and field data

Annex 2.1 Analysis of vegetation structure and species composition

The following dot points summarise the similarities and differences between the species list collected in the field in the Northern Biodiversity area and the list of “Abundant and/or characteristic taxa” and “Less common taxa” as described by Peake et al. (2002).

- Peake et al. (2002) defined WSW by listing 27 “Abundant and/or characteristic taxa” and 21 “Less common taxa”, although they note that “...not all species are present in every single stand...”;
- Although only seven of the 27 *Abundant and/or characteristic taxa* and four of the 21 *Less common taxa* are shared with Reference site 5 and Transformation site 1, this is only based on two sites and the number of representative species is likely to increase if more sites are included. Additionally, Reference Site 5 is located on a crest, so is likely to have less species than the community as a whole (i.e. when crest and swale sites are combined);
- Of the 21 species recorded between Reference site 5 and Transformation site 1, 13 species are common between the two sites. Six species are unique to the Reference site 5 and the 3 species are unique to Transformation site 1. Reference Site 5 recorded 19 native species and the Transformation site 16 native species.; and
- Of the seven exotic species identified in the Reference site 5 and Transformation site 1, five are shared on both sites, which suggests that Reference site 5 is influenced by edge effects from the nearby grassland areas (i.e. these two sites have had a similar anthropogenic disturbance history).

To determine the progress of each Transformation site toward a Reference state, a single species list for all Reference sites for each plant community is needed to allow comparisons to be made between observed and expected numbers of species between Reference and Transformation sites. This list of species and their cover abundance would form a benchmark list for use in the restoration of the WSW.

That list, though similar in intent to Peake et al. (2002), is expected to comprise a smaller list of species than Peake’s because it is confined to the Reference sites in the Northern and Southern BAs. Such a list could be generated from data listed in this Annex.

However, caution needs to be exercised in the use of that benchmark list. As Peake et al. (2002) noted that the NSW Scientific Committee preliminary and final determinations, observed that not all species are present in every single stand [site]...”. This could be overcome by either increasing the number of Reference and Transformation sites so that more of the *Abundant and/or characteristic taxa* are represented, or determine what an appropriate number of *Abundant and/or characteristic taxa* are for a single site. In addition, this issue is likely to be further exacerbated by the swale and dune expressions of a community, which presumably have lower numbers of species (and different species) on their own, compared with the community as a whole.

Annex 2.1 Field data from the reference and transformation sites

BioBanking site data

The following data were transcribed from BioBanking field data sheets collected in the field by Niche Environment and Heritage.

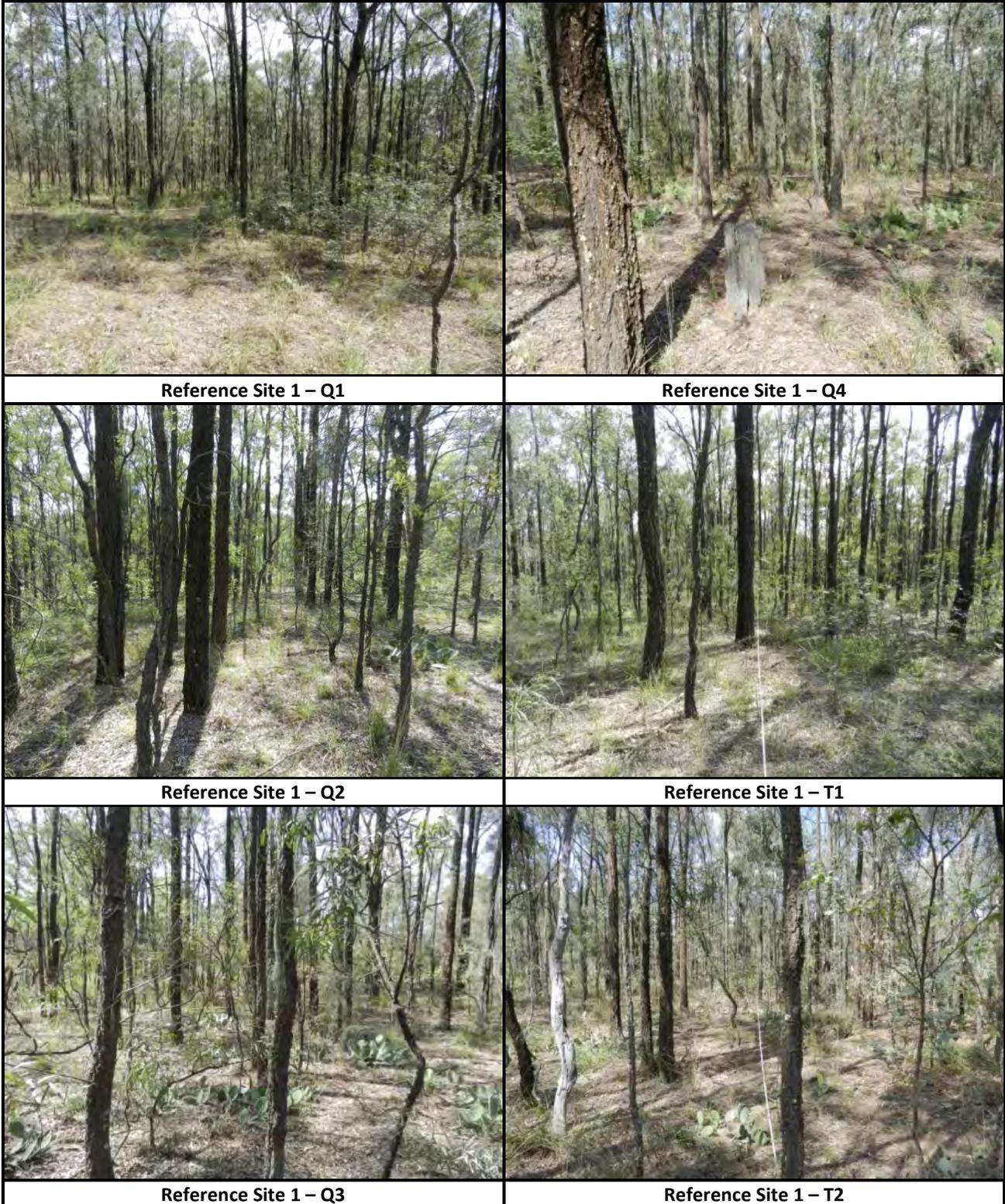
Plot Name	Date	NOS %	NMS %	NGCG %	NGCS %	NGCO %	EPC %	LC %	RC %	BGC %	CC %	Logs (m)	# Hollows	# Trees	Easting	Northing
Reference 1	11-12-13	22	5	74	4	20	8	92	0	18	0	5	0	120	316318	6393834
Reference 2	11-12-13	9	9.5	46	0	12	4	66	0	34	0	38	1	33	314594	6392754
Reference 3	11-12-13	21.5	16.5	42	2	4	6	92	0	8	0	61	0	59	314228	6392804
Reference 4	12-12-13	17	0	46	0	10	6	92	0	0	0	20	2	71	317129	6402846
Reference 5	12-12-13	21	0.5	68	6	28	6	100	0	4	0	0	0	23	316237	6402082
Transform. 1	12-12-13	0	0	20	2	6	96	0	0	62	0	0	0	0	316579	6401890
Transform.. 2	29-11-13	0	0	96	0	0	14	-	-	-	-	0	0	0	316800	6401427
Transform.. 3	29-11-13	0	0	60	0	0	96	-	-	-	-	0	0	0	316149	6394376
Transform. 4	29-11-13	0	0	52	0	0	20	-	-	-	-	0	0	0	314367	6392959
Transform. 5	29-11-13	0	0	68	0	0	24	-	-	-	-	0	0	0	315151	6392430

NOS: Native Over-storey
 NMS: Native Mid-storey
 NGCG: Native Ground Cover Grasses
 NGCS: Native Ground Cover Shrubs
 NGCO: Native Ground Cover Other
 EPC: Exotic Plant Cover
 LC: Litter Cover
 RC: Rock Cover
 BGC: Bare Ground Cover
 CC: Cryptogam Cover

Reference Site 1

Native Species
<i>Eucalyptus crebra</i>
<i>Allocasuarina luehmannii</i>
<i>Acacia longissima</i>
<i>Breynia oblongifolia</i>
<i>Brachyloma daphnoides</i>
<i>Hibbertia linearis</i>
<i>Grevillea montana</i>
<i>Acacia amblygona</i>
<i>Cheilanthes sieberi</i>
<i>Pomax umbellata</i>
<i>Dianella revoluta</i>
<i>Commelina cyanea</i>
<i>Chrysocephalum apiculatum</i>
<i>Einadia trigonos</i>
<i>Glossocardia bidens</i>
<i>Glycine tabacina</i>
<i>Glycine clandestina</i>
<i>Lomandra longifolia</i>
<i>Lomandra glauca</i>
<i>Laxmannia compacta</i>
<i>Stylidium eglandulosum</i>
<i>Oxalis perennans</i>
<i>Cymbopogon refractus</i>
<i>Echinopogon caespitosus</i>
<i>Imperata cylindrica</i>
<i>Aristida ramosa</i>
<i>Lomandra multiflora</i>
<i>Eragrostis brownii</i>
<i>Aristida vagans</i>
<i>Panicum simile</i>
<i>Cynodon dactylon</i>
Exotic Species
<i>Opuntia humifusum</i>
<i>Melinis repens</i>
<i>Richardia stellaris</i>
<i>Senecio madagascariensis</i>
<i>Eragrostis curvula</i>

Reference Site 1 photos



Reference Site 2

Native Species
<i>Angophora floribunda</i>
<i>Callitris endlicheri</i>
<i>Acacia filicifolia</i>
<i>Breynia oblongifolia</i>
<i>Brachyloma daphnoides</i>
<i>Hibbertia linearis</i>
<i>Grevillea montana</i>
<i>Notelaea microcarpa</i>
<i>Banksia integrifolia</i>
<i>Pteridium esculentum</i>
<i>Cheilanthes sieberi</i>
<i>Veronica plebeia</i>
<i>Entolasia marginata</i>
<i>Einadia trigonos</i>
<i>Oxalis perennans</i>
<i>Glycine clandestina</i>
<i>Pimelea linifolia</i>
<i>Imperata cylindrica</i>
<i>Aristida ramosa</i>
<i>Calandrinia balonensis</i>
<i>Lomandra multiflora</i>
Exotic Species
<i>Opuntia humifusum</i>
<i>Melinis repens</i>
<i>Taraxicum officinale</i>
<i>Senecio madagascariensis</i>
<i>Bidens pilosa</i>
<i>Cynoglossum australe</i>
<i>Cyperus aggregatus</i>
<i>Heliotropium amplexicaule</i>
<i>Opuntia aurantiaca</i>
<i>Lepidium bonariense</i>
<i>Stellaria media</i>

Reference Site 2 photos



Reference Site 3

Native Species
<i>Eucalyptus tereticornis</i>
<i>Acacia filicifolia</i>
<i>Banksia integrifolia</i>
<i>Breynia oblongifolia</i>
<i>Melaleuca thymifolia</i>
<i>Hibbertia linearis</i>
<i>Pimelea linifolia</i>
<i>Allocasuarina luehmannii</i>
<i>Solanum prinophyllum</i>
<i>Pteridium esculentum</i>
<i>Pomax umbellata</i>
<i>Cheilanthes sieberi</i>
<i>Oxalis perennans</i>
<i>Commelina cyanea</i>
<i>Aristida vagans</i>
<i>Cynodon dactylon</i>
<i>Notelaea microcarpa</i>
<i>Einadia trigonos</i>
<i>Hypoxis hygrometrica</i>
<i>Angophora floribunda</i>
<i>Aristida ramosa</i>
<i>Imperata cylindrica</i>
<i>Brachychiton populneus</i>
<i>Paspalum distichum</i>
Exotic Species
<i>Opuntia humifusum</i>

Reference Site 3 photos



Reference Site 3 – Q1



Reference Site 3 – Q4



Reference Site 3 – Q2



Reference Site 3 – T1



Reference Site 3 – Q3



Reference Site 3 – T2

Reference Site 4

Native Species
<i>Eucalyptus crebra</i>
<i>Eucalyptus tereticornis</i>
<i>Cassinia arcuata</i>
<i>Aristida ramosa</i>
<i>Cymbopogon refractus</i>
<i>Cynodon dactylon</i>
<i>Entolasia marginata</i>
<i>Paspalum distichum</i>
<i>Solanum prinophyllum</i>
<i>Microlaena stipoides</i>
<i>Commelina cyanea</i>
<i>Cheilanthes sieberi</i>
<i>Oxalis perennans</i>
<i>Einadia trigonos</i>
<i>Aristida vagans</i>
Exotic Species
<i>Opuntia humifusum</i>
<i>Opuntia aurantiaca</i>
<i>Galenia pubescens</i>
<i>Bidens pilosa</i>
<i>Lycium ferocissimum</i>
<i>Senecio madagascariensis</i>
<i>Melinis repens</i>
<i>Cotula australis</i>

Reference Site 4 photos



Reference Site 5

Native Species
<i>Angophora floribunda</i>
<i>Allocasuarina luehmannii</i>
<i>Melichrus urceolatus</i>
<i>Hibbertia linearis</i>
<i>Pteridium esculentum</i>
<i>Pimelea linifolia</i>
<i>Chrysocephalum apiculatum</i>
<i>Commelina cyanea</i>
<i>Glycine clandestina</i>
<i>Ajuga australis</i>
<i>Imperata cylindrica</i>
<i>Oxalis perennans</i>
<i>Lomandra multiflora</i>
<i>Glycine tabacine</i>
<i>Themeda australis</i>
<i>Cymbopogon refractus</i>
<i>Fimbristylis dichotoma</i>
<i>Laxmannii gracilis</i>
<i>Wahlenbergia graniticola</i>
Exotic Species
<i>Opuntia aurantiaca</i>
<i>Melinis repens</i>
<i>Hypochaeris radicata</i>
<i>Senecio madagascariensis</i>
<i>Petrorhagia nanteuillii</i>
<i>Acetosella vulgaris</i>

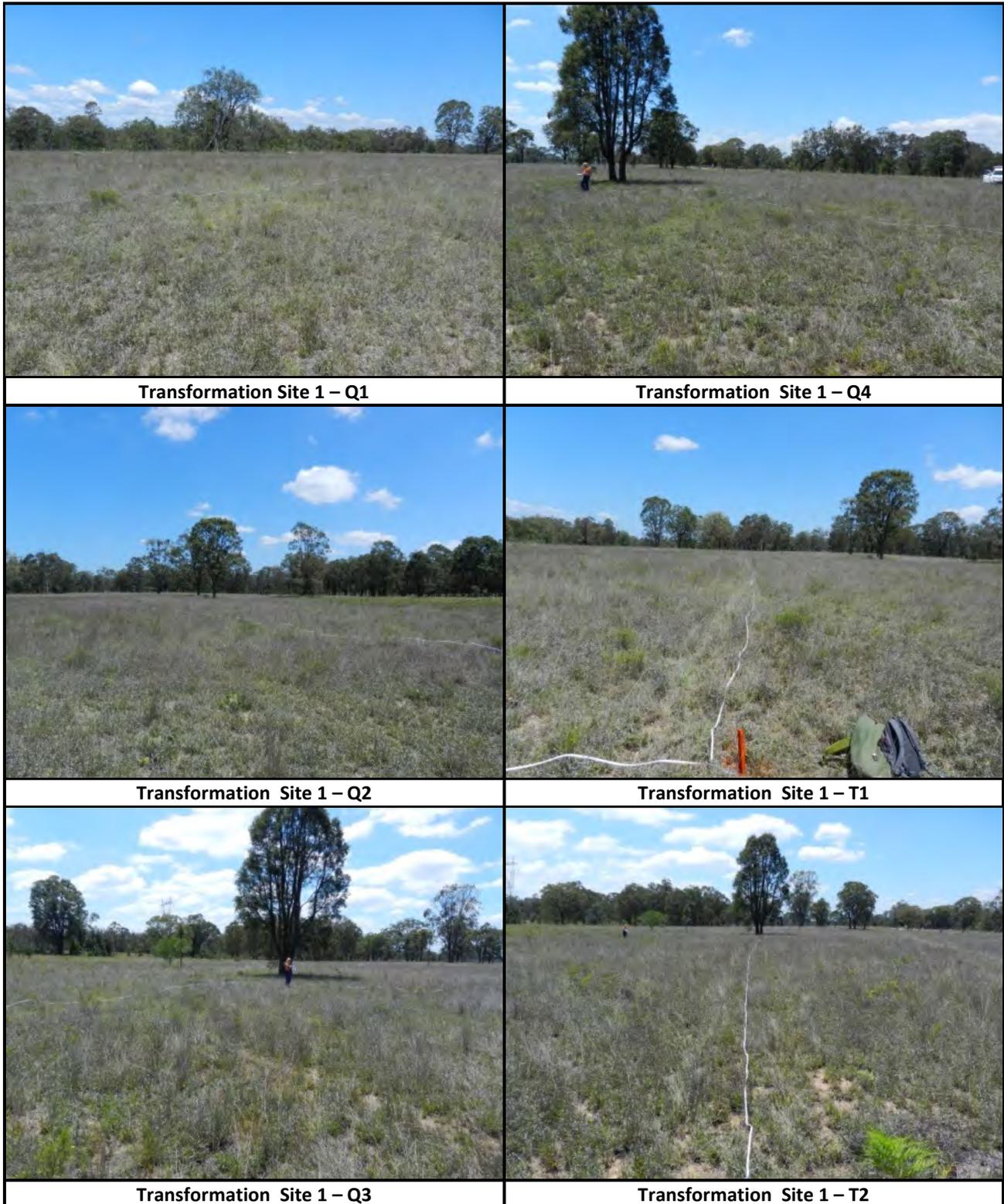
Reference Site 5 photos



Transformation Site 1

Native Species
<i>Angophora floribunda</i>
<i>Hibbertia linearis</i>
<i>Melichrus urceolatus</i>
<i>Pteridium esculentum</i>
<i>Themeda australis</i>
<i>Aristida ramosa</i>
<i>Chrysocephalum apiculatum</i>
<i>Lomandra leucocephala</i>
<i>Wahlenbergia graniticola</i>
<i>Ajuga australis</i>
<i>Cymbopogon refractus</i>
<i>Lomandra multiflora</i>
<i>Aristida vagans</i>
<i>Pimelea linifolia</i>
<i>Fimbristylis dichotoma</i>
<i>Laxmannii gracilis</i>
Exotic Species
<i>Opuntia humifusum</i>
<i>Melinis repens</i>
<i>Senecio madagascariensis</i>
<i>Acetosella vulgaris</i>
<i>Hypochaeris radicata</i>
<i>Opuntia aurantiaca</i>

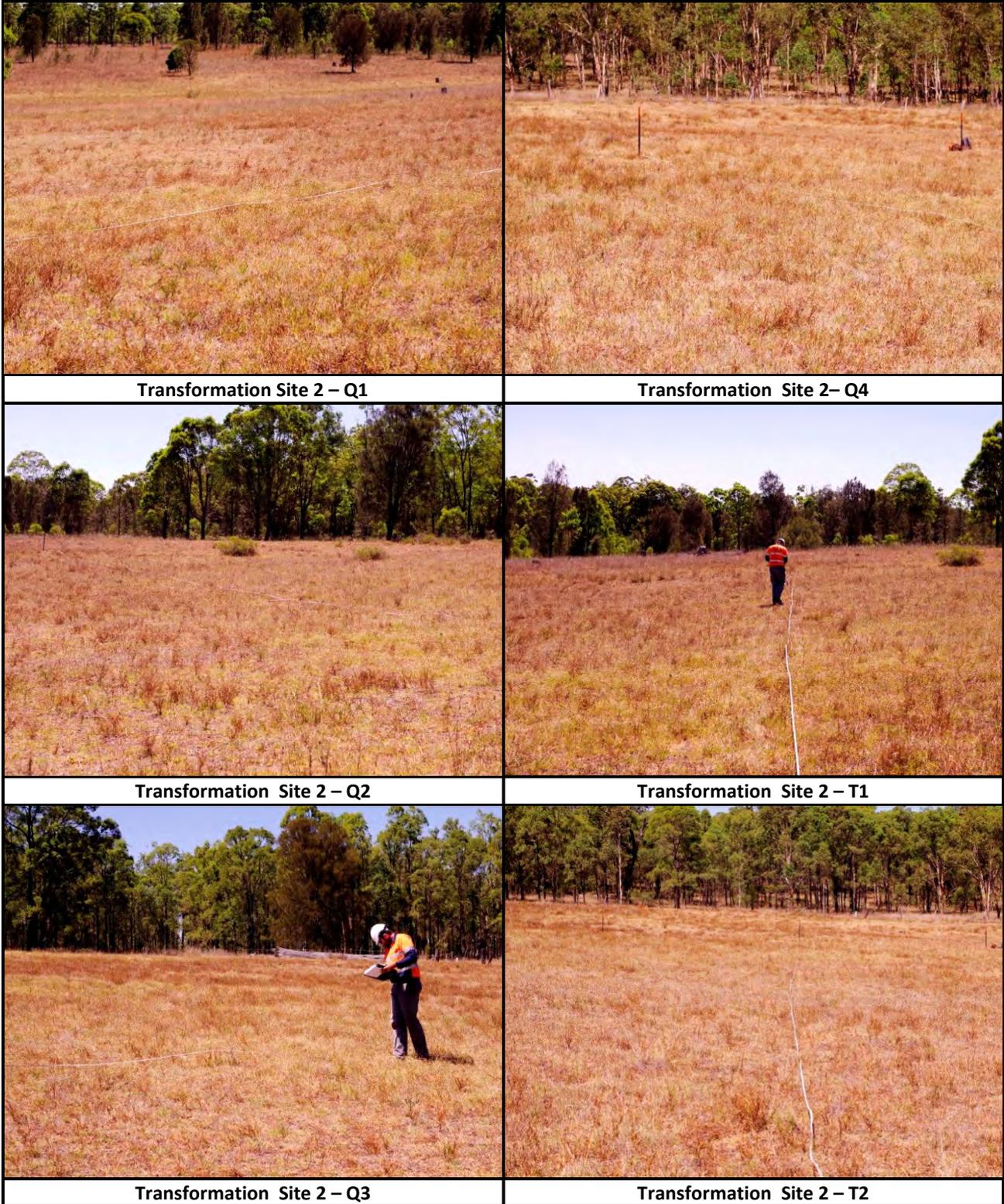
Transformation Site 1 photos



Transformation Site 2

Native Species
<i>Cynodon dactylon</i>
<i>Cymbopogon refractus</i>
<i>Sporobolus creber</i>
<i>Eragrostis leptostachya</i>
<i>Sida sp.</i>
<i>Juncus usitatus</i>
Exotic Species
<i>Senecio madagascariensis</i>
<i>Plantago sp.</i>
<i>Alternanthera pungens</i>
<i>Setaria sp</i>
<i>Opuntia humifusa</i>
<i>Verbena bonariensis</i>
<i>Sida rhombifolia</i>
<i>Conyza sp.</i>

Transformation Site 2 photos



Transformation Site 3

Native Species
Cynodon dactylon
Cymbopogon refractus
Sporobolus creber
Chrysocephalum apiculatum
Cheilanthes sieberi
Exotic species
Heliotropium amplexicaule
Galenia pubescens
Alternanthera pungens
Hypochaeris radicata
Opuntia humifusa
Setaria sp.
Senecio madagascariensis
Conyza sp.
Eragrostis curvula
Oenothera stricta
Eragrostis sp
Lepidium sp

Transformation Site 3 photos



Transformation Site 3 – Q1



Transformation Site 3 – Q4



Transformation Site 3 – Q2



Transformation Site 3 – T1



Transformation Site 3 – Q3



Transformation Site 3 – T2

Transformation Site 4

Native Species
<i>Cynodon dactylon</i>
<i>Perotis rara</i>
<i>Eragrostis brownii</i>
<i>Aristida vagans</i>
<i>Hibbertia linearis</i>
<i>Cheilanthes sieberi</i>
<i>Oxalis sp.</i>
<i>Boerhavia dominii</i>
Exotic species
<i>Senecio madagascariensis</i>
<i>Acetosella vulgaris</i>
<i>Opuntia aurantiaca</i>
<i>Richardia stellaris</i>
<i>Conyza sp.</i>
<i>Heliotropium amplexicaule</i>
<i>Melinis repens</i>

Transformation Site 4 photos



Transformation Site 4 – Q1



Transformation Site 4 – Q4



Transformation Site 4 – Q2



Transformation Site 4 – T1



Transformation Site 4 – Q3



Transformation Site 4 – T2

Transformation Site 5

Native Species
<i>Cynodon dactylon</i>
<i>Banksia integrifolia</i>
<i>Perotis rara</i>
<i>Cheilanthes sieberi</i>
<i>Chrysocephalum apiculatum</i>
<i>Dianella caerulea</i>
Exotic species
<i>Senecio madagascariensis</i>
<i>Acetosella vulgaris</i>
<i>Opuntia aurantiaca</i>
<i>Heliotropium amplexicaule</i>
<i>Melinis repens</i>
<i>Opuntia humifusa</i>
<i>Verbascum vergatum</i>
<i>Heterotheca grandiflora</i>
<i>Oenothera stricta</i>
<i>Richardia stellaris</i>
<i>Conyza sp.</i>
<i>Senecio madagascariensis</i>
<i>Hypochaeris radicata</i>

Transformation Site 5 photos



Transformation Site 5 – Q1



Transformation Site 5 – Q4



Transformation Site 5 – Q2



Transformation Site 5 – T1



Transformation Site 5 – Q3



Transformation Site 5 – T2

Annex 3. WSW Species list

Annex 3.1 Target species for seed collection

Scientific Name	Common Name	Collection times and notes	UNE trial results
Canopy / Mid storey			
<i>Acacia filicifolia</i>	Fern-leaved wattle	December	Above average survival and ranked 3 rd .
<i>Allocasuarina littoralis</i>	Black She-oak	December - March	Above 70% survival
<i>Allocasuarina luehmannii</i>	Bulloak	December - January.	Not tested
<i>Angophora floribunda</i>	Rough-barked Apple	December - March	50-60% survival and ranked 6 th .
<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	Coast Banksia	January - March	50-60% survival and ranked 9 th .
<i>Eucalyptus blakelyi/tereticornis</i>	Forest Red Gum	July - March	70% survival and ranked 2 nd .
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	October - November	Above average and ranked 4 th
Shrubs			
<i>Acacia falcata</i>	-	September - December	Above average and ranked 8 th .
<i>Breynia oblongifolia</i>	Coffee Bush	October to March. Seed should be fresh when sown.	Above average and ranked 1 st .
<i>Hovea linearis</i>	-	October to January. Releases seed very soon after maturity.	
<i>Jacksonia scoparia</i>	Winged Broom-pea	October - December	
<i>Leucopogon muticus</i>	Blunt Beard-heath	August to November	
<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle	Seed present all year.	Poor survival
Ground cover			
<i>Calotis cuneifolia</i>	Purple Burr-daisy	Flowers spring-summer. Collect in summer. Break up flowering heads before sowing	
<i>Cheilanthes sieberi</i>	Poison Rock Fern	-	
<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass	Flowers in spring-summer. Collect seed in late summer to autumn.	
<i>Hardenbergia violacea</i>	Purple Coral Pea	November - December. Releases seed very soon after maturity.	
<i>Lomandra leucocephala</i>	Woolly Mat-rush	Flowers in spring-summer. Collect seed in summer	
<i>Lomandra multiflora</i>	Many-flowered Mat-rush	Flowers in spring-summer. Collect seed in summer	
<i>Pomax umbellata</i>	-	Flowers in spring. Collect fruit/seed in summer.	
<i>Solanum prinophyllum</i>	Forest Nightshade	Fruit/seed available most of the year. Specific seed extraction/storage requirements.	

Annex 3.2 Other seed to be collected

Scientific Name	Common Name	Collection times and notes	UNE trial results
Canopy / mid storey			
<i>Callitris endlicheri</i>	Black Cypress Pine	Seed present all year. Best collected December – June	
Shrubs			
<i>Indigofera australis</i>	Australian Indigo	November - December. Releases seed very soon after maturity.	
<i>Hakea laevipes</i>		Nov - April	Above average survival, ranked 7 th .
<i>Notelaea longifolia</i> & <i>Notelaea microcarpa</i>	-	Collect fruit in summer/autumn.	
Ground covers			
<i>Aristida calycina</i>	-		
<i>Aristida ramosa</i>	Purple Wiregrass		
<i>Aristida vagans</i>	Threeawn Speargrass		
<i>Aristida warburgii</i>	-		
<i>Chrysocephalum apiculatum</i>	Common Everlasting	Flowers spring-summer. Collect in summer. Break up flowering heads before sowing	
<i>Desmodium varians</i>	-	Seed collection spring and summer. Releases seed very soon after maturity.	
<i>Echinopogon intermedius</i>	Erect Hedgehog Grass	Flowers in spring-summer. Collect seed in late summer to autumn.	
<i>Einadia trigonos</i>	Fishweed	Collect seed January - April	
<i>Entolasia stricta</i>	Wiry Panic	Flowers most of the year.	
<i>Glycine clandestina</i>	-	Seed collection spring and summer. Releases seed very soon after maturity.	
<i>Hypoxis hygrometrica</i>	Golden Weather-grass	Flowers spring to autumn.	
<i>Imperata cylindrica</i>	Blady grass	Flowers in summer. Collect seed in late summer to autumn	
<i>Lomandra glauca</i>	Pale Mat-rush	Flowers in spring-summer. Collect seed in summer	
<i>Microlaena stipoides</i>	Weeping Grass	Flowers in summer. Collect seed in late summer to autumn	

Annex 3.3 WSW Species to be collected for cuttings

Scientific Name	Common Name	Notes
Shrubs		
<i>Brachyloma daphnoides</i>	Daphne Heath	Flowers spring to summer. Very difficult to propagate from seed.
<i>Grevillea montana</i> (Threatened species)	-	Seed collection spring and summer. Releases seed very soon after maturity
<i>Hibbertia linearis</i>	-	Very difficult to propagate and seed quantity and viability is often low.
<i>Persoonia linearis</i>	Narrow-leaved Geebung	Very difficult to propagate from seed. Usually grown from cuttings.
<i>Pimelea linifolia</i>	Slender Rice-flower	Collect seed in summer. Very difficult to propagate from seed. Usually grown from cuttings.
Ground cover		
<i>Ajuga australis</i>	Austral Bugle	
<i>Commelina cyanea</i>	Native Wandering Jew	Can be grown from cuttings

Annex 3.4 WSW species to be transplanted and repotted

Scientific Name	Common Name	Notes
Ground cover		
<i>Dianella revoluta</i>	Blue Flax Lily	Collect fruit in spring –summer. Seed is viable for 6-12 months.
<i>Lomandra leucocephala</i>	Woolly Mat-rush	Flowers in spring-summer. Collect seed in summer
<i>Lomandra multiflora</i>	Many-flowered Mat-rush	Flowers in spring-summer. Collect seed in summer

Niche Environment and Heritage

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Appendix B

Local Offsets Management Plan



Appendix B — Local Offsets Management Plan

B

“Draft” Local Offset Management Plan

Warkworth Mine, NSW

Pending approval of the Warkworth Continuation Project 2014



This document has been prepared in conjunction with Cambium Group and utilising reports prepared by Cumberland Ecology and DnA Environmental prepared for the Warkworth Extension Project 2010 and University of New England research.

Document Title	Version	Date effective	Comment

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Abbreviations and Definitions

BA	Biodiversity Area
CC	Completion Criteria
CE	Critically Endangered
CEEC	Critically Endangered Ecological Community
DoE	Australian Government Department of the Environment
DPE	NSW Department of Planning and Environment
EEC	Endangered Ecological Community
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ha	Hectare
HLLS	Hunter Local Land Services
HMA	Habitat Management Area
km	Kilometre
MNES	Matter of National Environmental Significance
MTO	Mount Thorley Operations
MTW	Mount Thorley Warkworth
NDA	Non Disturbance Area
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
Offset Area	Area secure by legally binding mechanism.
OMP	Offset Management Plan
PC	Performance Criteria
RCA	Rapid Condition Assessment
RTCA	Rio Tinto Coal Australia
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
WML	Warkworth Mining Limited
WS Grassland	Warkworth Sands Grassland
WSW	Warkworth Sands Woodland

1 Introduction

Coal & Allied Operations Limited (Coal & Allied), which is managed by Rio Tinto Coal Australia (RTCA), has prepared this Local Offset Management Plan (OMP) for the Warkworth Mine, which is owned by Warkworth Mining Limited (WML), to guide the long term protection and management of the Southern and Northern Biodiversity Areas (BAs).

The Local OMP establishes conservation objectives and key performance criteria and indicators for the BAs and outlines conservation management actions and monitoring programmes that have been formulated based on the existing ecological condition of the BAs and to achieve the conservation objectives. The Local OMP has been drafted for the Warkworth Continuation Project 2014.

Figure 1 indicates the location of the Warkworth Mine and the local and regional BAs.

1.1 Background

The Warkworth Mine is approximately 15 kilometres (km) southwest of Singleton in the Hunter Valley, New South Wales (NSW). In 2004 the Warkworth Mine and the adjoining Mount Thorley Operations (MTO) were integrated and operate as Mount Thorley Warkworth (MTW) for mining purposes. The MTW coal mine is operated and managed by Coal & Allied.

Warkworth Mine is owned by WML and holds three approvals, two Commonwealth and one for NSW, to construct and operate an open cut coal mine, including two mine extensions in 2004 and 2012. Table 1 lists the current approvals for Warkworth Mine, the links to the online document and date of last modification. The Warkworth Mine is currently seeking approval from the NSW government to extend their disturbance footprint under the Warkworth Continuation Project 2014, to match the approved disturbance footprint approved by the Commonwealth government under the EPBC 2009/5081 approval.

Table 1 Summary of current approvals for Warkworth Mine

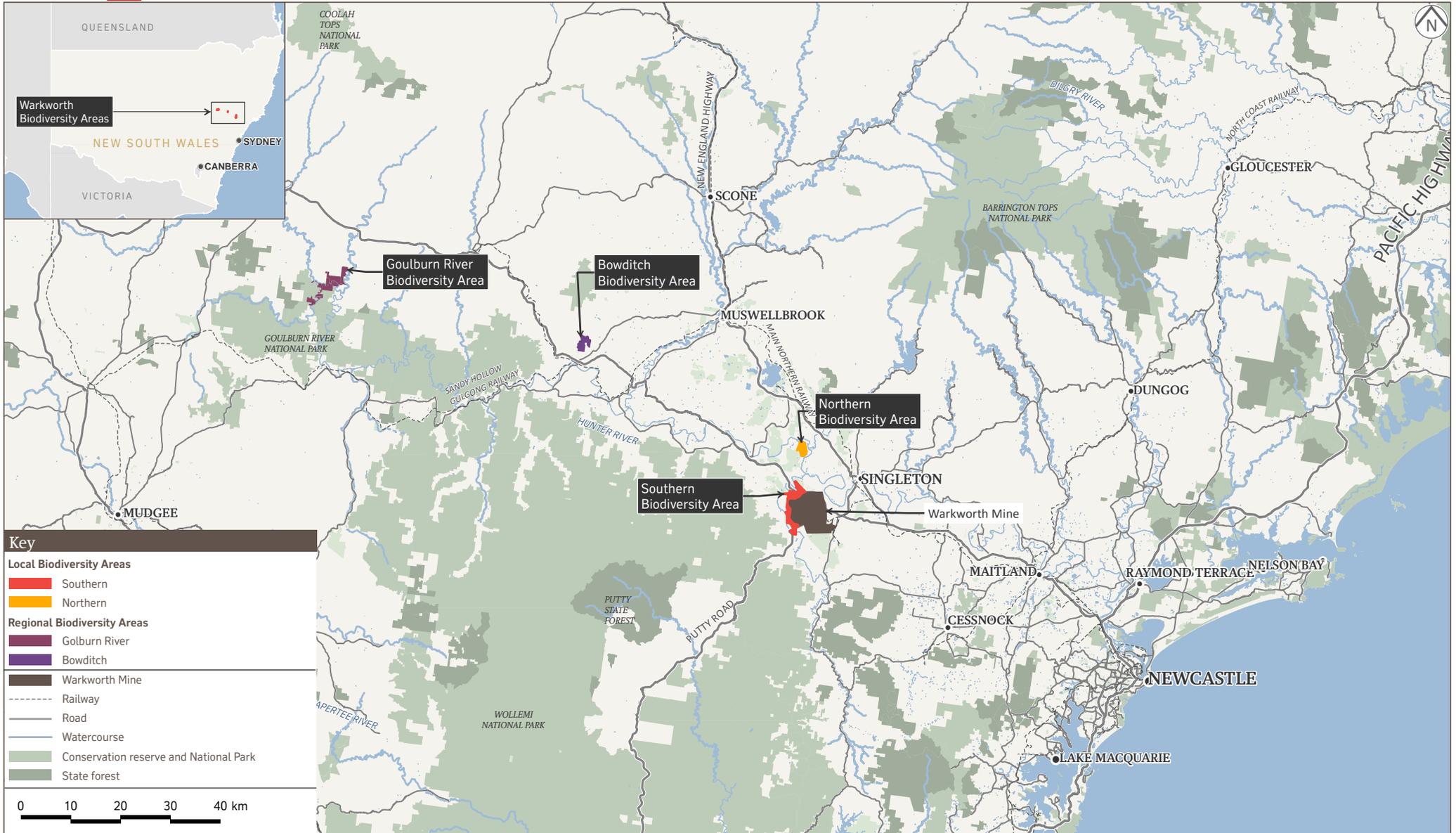
Approval	Internet link to full approval conditions
NSW DA 300-9-2002i	https://majorprojects.affinitylive.com/public/9c42cc7cc35f4a9d11bbd6d304702c36/4.Warkworth%20Coal%20Mine%20Mod%206%20Consolidated%20Consent.pdf Last modified January 2014
EPBC 2002/629	http://www.environment.gov.au/epbc/notices/assessments/2002/629/2002-629-variation-approval-conditions-2.pdf Last modified December 2013
EPBC 2009/5081	http://www.environment.gov.au/epbc/notices/assessments/2009/5081/2009-5081-variation-approval-conditions.pdf Last modified December 2013

Warkworth Mine has Commonwealth and NSW approval conditions to offset the impact of their mining activities upon Matters of National Environmental Significance (MNES) as prescribed in the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and threatened communities under the NSW *Threatened Species and Conservation Act 1995* (TSC Act).

Location of the Local and Regional Biodiversity Areas

Local Offset Management Plan

Figure 1



The EPBC Act offsets aim to protect and enhance the habitat for woodland birds, specifically the Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*), both are MNES. The TSC Act offsets aim to protect, enhance and restore the listed Endangered Ecological Communities (EEC) of Central Hunter Grey Box-Ironbark Woodland (CHGBIW) and Warkworth Sands Woodland (WSW).

1.1.1 Warkworth Mine Offsets

The Warkworth Mine's impacts on biodiversity values are to be offset through the management of both local and regional offset areas located within the Southern, Northern, Goulburn and Bowditch BAs. The regional offset areas to be managed in accordance with the Regional Offset Management Plan.

Table 2 provides an overview of all the BAs required for both regulators. Detailed descriptions and maps of the Local BAs are provided in Chapter 2.

Table 2 Summary of Biodiversity Areas by locality and relevant consent

Locality	Biodiversity Area	Area (ha)	NSW				Commonwealth	
			TBA	DA-300-9-2002i	EPBC 2002/629	EPBC 2009/5081		
Local	Southern	WSW Offset Area	81.4	✓	✓			
		Putty Road Offset Area	96.4	✓	✓		✓	
		2014 WS Grassland Re-establishment	39.0	✓	✓			
		Quarry Rehabilitation	2.7	✓	✓			
		Offset Area *	777	✓				
		Infrastructure	17.9					
	<i>Southern sub-total</i>	<i>1,114</i>						
Northern		2014 WS Grassland Re-establishment	39.0	✓				
		Offset Area*	303	✓				
		Infrastructure	2.5					
	<i>Northern sub-total</i>	<i>344</i>						
Regional	Goulburn River	Warkworth Offsets (co-located with 140 ha of Hunter Valley South Offsets)	1,066.0			✓		
	Bowditch	Warkworth Offsets	520.0			✓		
		Regional sub-total	1,586					
Total			2,929					

*Pending approval of Warkworth Continuation Project 2014

1.2 Compliance tracking

This section is to be included on completion of the current approval process for the Warkworth Continuation Project 2014.

1.3 Offset Security

The BAs are to be secured using a legally binding mechanisms to provide enduring protection, through a Biobanking Agreement under the TSC Act. The Putty Road and WSW offset areas are to be secured under a Biobanking agreement in 2015. The WSW offset area is currently protected under a deed of agreement with the NSW Department of Planning and Environment (DPE).

1.4 Function of the Offset Management Plan

The Local OMP will provide the framework for management of the BAs with the aim to protect and enhance biodiversity values through the implementation of conservation management strategies.

1.4.1 Structure

For the Local OMP to be successful, it needs to define the management areas, provide clear conservation objectives, detail the conservation management strategies to be implemented and measure success. To that end the Local OMP comprises the following chapters:

- Biodiversity Areas: This chapter describes the BAs, providing a description of the baseline condition and existing biodiversity values;
- Conservation Objectives and Key Performance Indicators: This chapter outlines the primary conservation objectives for the Local OMP, as well as the key performance indicators and completion criteria that have guided the development of conservation management strategies and the monitoring programme;
- Conservation Management Strategies: This chapter outlines the primary management strategies to be implemented across the BAs;
- Monitoring: This chapter details the programmes to measure short, medium and long term impacts of the Local OMP conservation management strategies. These assessments will provide quantitative data to guide adaptive management, monitor long term trends in biodiversity values and attainment of Key Performance Indicators;
- Risk management: This chapter describes the risk matrix to cross check activities against key risks to ensure the Local OMP is comprehensive.

1.4.2 Information Management

Successful implementation of the Local OMP will rely upon the sharing of skills, knowledge and resources, as well as careful monitoring of activities.

The sharing of information will be facilitated through the online Biodiversity Offsets Portal. This Portal has been designed to centralise and share information among authorised users and will include spatial data, an image library, reports and other non-spatial data as well as project management information such as stakeholder details and safety information. The Portal will greatly improve communication among stakeholders, transparency of management and monitoring activities and will ensure data security and integrity (e.g. preventing risks of data loss due to staff turnover and minimising the risk of using superseded information). Ultimately, this will result in improved decision making and adaptive management that is responsive to seasonal conditions and current operational challenges.

The Portal will also provide access to an Interactive Map that will allow users to visualise data in a geo-spatial context, assisting in data interpretation. This data will include aerial imagery, site information (e.g. cadastral, site access, topographic, infrastructure, geology) and data relating to management and monitoring activities. The Interactive Map will allow users to query information, turn layers on and off, mark up and print maps. This is an easy to use but powerful tool that does not require knowledge of Geographic Information Systems on the part of the user.

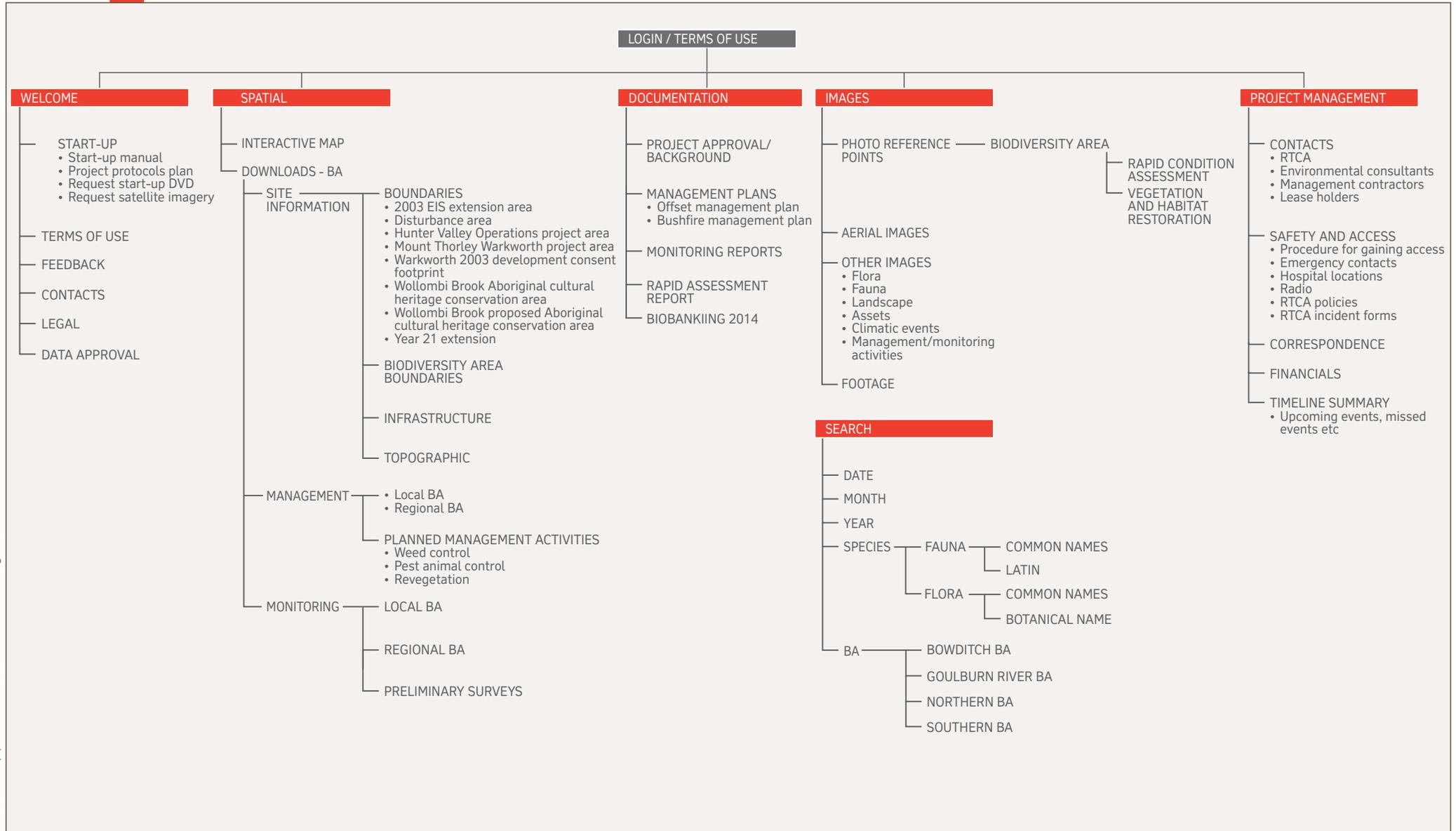
The following Figure 2 provides an outline of the Portal and elements of the database that will form an important component in the overall planning, management and compliance of the BAs.

Key documents will also be available on the RTCA website.

Portal Structure

Local Offset Management Plan

Figure 2



1.4.3 Key Project Stakeholders and Roles

The key project stakeholders are identified by their roles in Table 3.

Table 3 Key roles and stakeholders

Roles	Responsible Entity	Details
NSW Regulator: Administers the Development Consent DA 300-9-2002i. Approves OMP and receives annual reports.	Department of Planning & Environment	Singleton Office Compliance (Mining) Mining & Industry Projects Department of Planning & Infrastructure http://www.planning.nsw.gov.au
Commonwealth Regulator: Approval Conditions for EPBC Act – approval reference EPBC 2009/5081. Approve Offset Management Plan.	Australian Government Department of the Environment	PostApproval@environment.gov.au
Project proponent and land owner: Prepare plans and operational documents. Supervise management, review monitoring reports and adapt management.	Warkworth Mining Limited /Coal & Allied	Principal Advisor - Offsets cnacommunityrelations@riotinto.com 1800 727 745
Biodiversity Auditor: Monitor the ecological monitoring and improvement in extent and condition of the biodiversity values.	Person/s engaged by Coal & Allied to undertake monitoring programme.	Coal & Allied will engage suitably qualified person/s.
Regulate control of noxious weeds	Upper Hunter Weeds Authority	Works Coordinator, Upper Hunter Weeds Authority Ph. 02 6549-3802 www.muswellbrook.nsw.gov.au/Council-services/Environment/Weeds/ uhwa@muswellbrook.nsw.gov.au
Regulate control of pest animals	Hunter Local Land Services	Hunter Local Land Services (Scone) Ph. 02 6545 1311 www.hunter.lls.gov.au

1.4.4 Adaptive Management and Reporting

The Local OMP will be reviewed in 2017 to update information on the condition and extent of the ecological communities across the BAs and refine conservation management strategies, based on information and data collected through the monitoring programme. The plan may be updated on an irregular basis to amend changes to contact details, agency names, or other secondary information, noting that regulators may not be advised of these minor amendments. The revised documents will be available through the Biodiversity Offsets Portal and the RTCA website.

Annual reports will be the critical tool to review performance of the Local OMP and adapt conservation management strategies. The reports will include a summary of monitoring data and management highlights in the BAs and the outcome of those actions, including identifying any need for improved management.

The Annual reports will be prepared and submitted to DoE and DPE (as part of the MTW Annual Environmental Review) and will include the following information as a minimum:

- Name and contact details of the Landholder and/or Leaseholder;
- List of conservation management activities undertaken, detailing scope of works, skill and expertise of the responsible entity/ies completing the works and performance;
- Monitoring results - all data will be correctly labelled with date, location and GPS points;
- An assessment of the progress in attainment of the conservation objectives and key performance indicators;
- An assessment of any new risks or potential threats to the BAs and actions to be undertaken to manage these threats and/or risks; and
- Where the proponent is proposing that the completion criteria have been achieved and the report is being submitted as the final report, the proponent must provide evidence that all conservation objectives and have been achieved in full.

2 Biodiversity Areas

The Local OMP includes two BAs, namely the Southern and Northern BAs, which are located close to Warkworth Mine in the Hunter Valley, NSW. The Southern BA is located approximately 15km to the south west of Singleton, NSW, and the Northern BA is located around 12km to the north-west of the township. The land is managed by Coal & Allied and owned by Coal & Allied and MTW joint venture partners.

Open cut coal mining operations occur close to all BAs. The strip of land located to the west Wallaby Scrub Road and along the eastern boundary of the Southern BA boundary, which is situated outside the BA and the Warkworth Mine disturbance footprint, is to be managed in accordance with the Local OMP to protect the MNES and EEC located in this area.

The BAs are located within the Sydney Basin Bioregion, with Wollemi National Park situated to the south-west and west. The BAs contribute to a south to north biodiversity corridor across the Hunter Valley floor. Biodiversity corridors are connected or stepping stones of native vegetation that provide connectivity at a landscape scale for flora and fauna. They are important in the ongoing conservation and protection of flora and fauna, as they enable migration, improved resilience to environmental and climatic variability and support genetic diversity. The Southern BA forms a near continuous north/south tract of vegetation and is connected to the Wambo Mine conservation and cultural heritage area to the west. The Northern BA situated approximately 5km north of the Southern BA and forms a valuable stepping stone to increase connectivity across the Hunter Valley floor.

2.1 Description

2.1.1 Southern Biodiversity Area

The BA is accessible from Putty Road, Wallaby Scrub Road and the private Lemington Haul Road and is approximately 1,014ha in size. All entry gates are locked to control access.

The Southern BA includes as shown in Figure 3:

- 81.4ha for WSW Offset Area;
- 96.4ha Putty Road Offset Area;
- 39ha of the 2014 WS Grassland re-establishment areas; and
- 2.7ha Quarry Rehabilitation area.

There is 777ha of suitable vegetation to offset the impacts of the Warkworth Continuation Project 2014, as shown in Table 4.

The Southern BA is intersected by Putty Road in the south, and Wallaby Scrub Road and the Golden Highway in the north. Wollombi Brook flows through the southern tip (near the township of Bulga), from where it continues to flow in a northerly direction near the western boundary of the BA.

The land surrounding the Southern BA is owned by a number of different parties. The majority of the land to the north of the Southern BA is owned by Coal & Allied. Adjacent land to the west is owned by Peabody (Wambo Mine). The remaining adjacent land to the west and to the south is privately owned.

Portions of the Southern BA have previously been disturbed for a number of land uses, primarily agriculture. Significant regeneration is evident across the Southern BA, and some areas remain cleared. The land within the Southern BA forms a near continuous north/south tract of vegetation. Small ephemeral drainage lines are located throughout, and there are numerous small dams scattered throughout the area.

The Southern BA includes the Wollombi Brook Aboriginal Cultural Heritage Conservation Area.

A former Royal Australian Air Force (RAAF) base is located within the southern section of the Southern BA, on the western side of Wallaby Scrub Road, immediately north of its intersection with Putty Road. Most of the planned facilities were never constructed and only two dominant features remain: two intersecting runways and a dilapidated kitchen building. In compliance with legal obligations the location of these sites is not shown in this document.

Grazing of cattle and livestock resumed at the former RAAF base around 1956 (Weir & Phillips, 2007).

2.1.2 Northern Biodiversity Area

The Northern BA is approximately 344ha in size and can be accessed via Comleroi Road. It is located on the western side of a loop on the Hunter River, near the confluence with Glennies Creek.

The Northern BA is located approximately 7km north of the Warkworth Mining Lease and in close proximity to the Hunter Valley Operations.

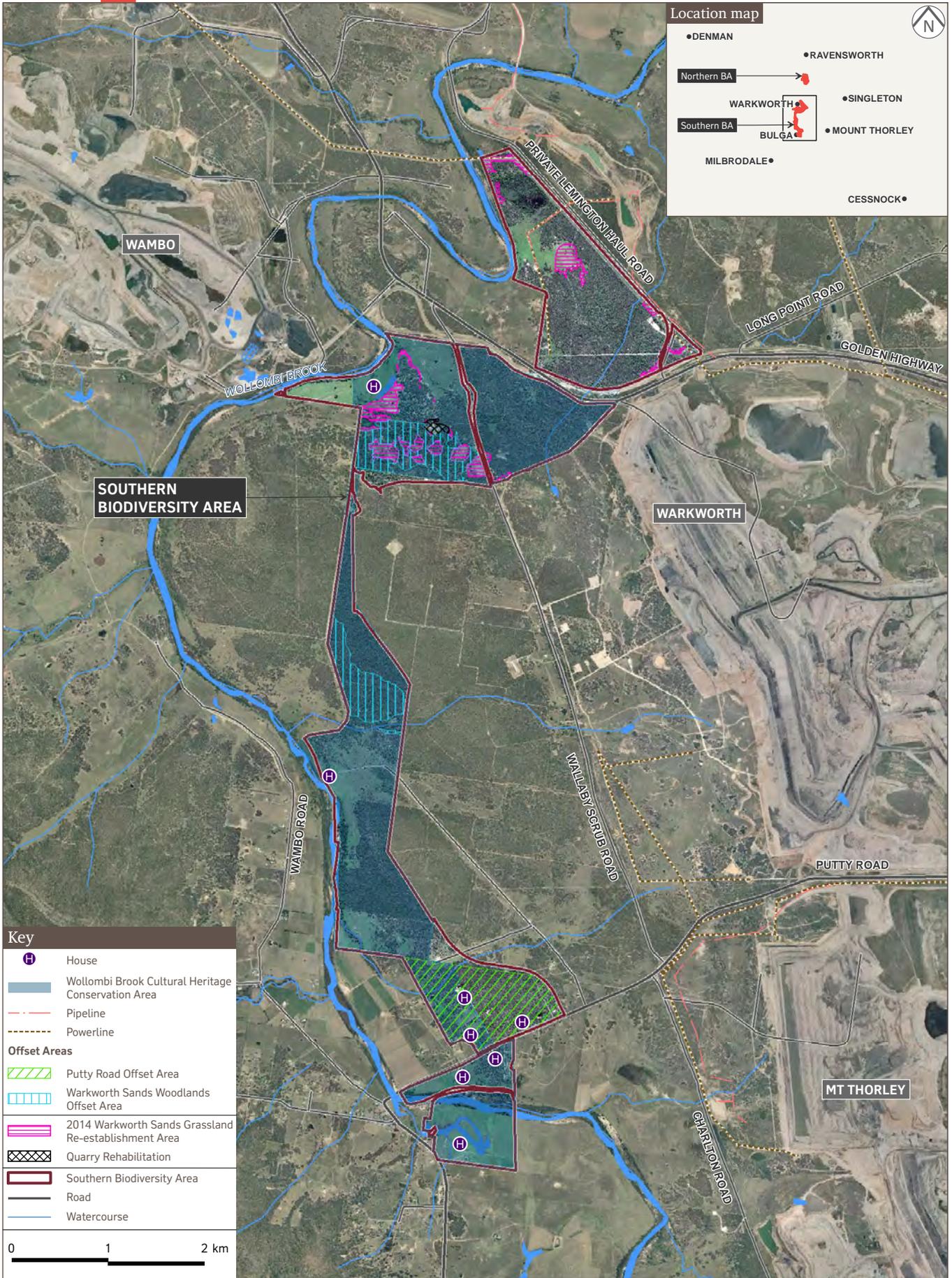
The Northern BA includes 39ha of 2014 WS Grassland re-establishment areas as shown in Figure 4. There is 303ha of suitable vegetation to offset the impacts of the Warkworth Continuation Project 2014, as shown in Table 5.

The Northern BA is dominated by sand geology that supports the Warkworth Sands Woodland vegetation community. The majority of the land to the south and west of the Northern BA is owned by Coal & Allied. The remaining adjacent land to the east and north is privately owned.

The Northern BA has historically been utilised for agricultural purposes. Significant native vegetation occurs within the Northern BA, however it is highly fragmented due to past agricultural land use. The extensive past land clearing has resulted in a mixture of cleared pasture and regrowth woodland/open woodland of various ages. It includes remnant patches of vegetation dominated by canopy species such as Rough-barked Apple (*Angophora floribunda*) and scattered Coastal Banksia (*Banksia integrifolia*), together with scattered isolated trees and understorey on cleared former grazing land. The main native pioneer species on the more disturbed land include Common Bracken (*Pteridium esculentum*), Showy Guinea-flower (*Hibbertia linearis*) and Common Everlasting (*Chrysocephalum apiculatum*). A dominant exotic pioneer species in the open areas is Red Natal Grass (*Melinis repens*).

The removal of livestock in 2008 has resulted in significant regeneration. Several cultural heritage sites exist in the BA, these have been mapped for conservation purposes and in accordance with legal requirements their locations cannot be shown in this document.

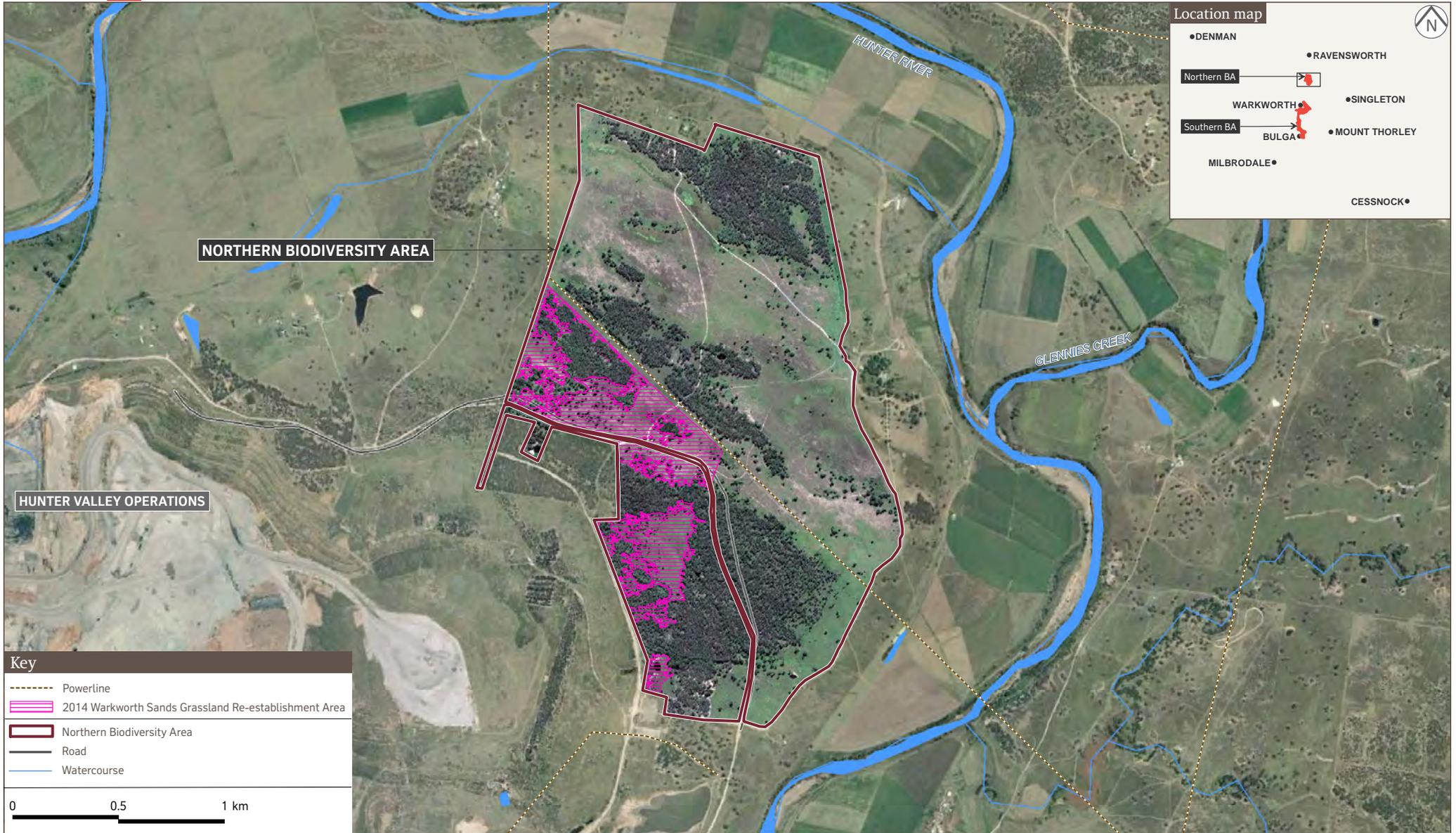
Figure 3



Northern Biodiversity Area - Infrastructure and 2014 Warkworth Sands Woodland Re-establishment Areas

Local Offset Management Plan

Figure 4



2.2 Vegetation communities

The vegetation community descriptions and mapping have been sourced from surveys and verification completed by Cumberland Ecology and DnA Environmental.

2.2.1 Southern Biodiversity Area

The following vegetation communities have been recorded and mapped across the Southern BA:

Vegetation Communities	Area (ha)
Central Hunter Grey Box – Ironbark Woodland	448.4
Central Hunter Grey Box – Ironbark Grassland	170.3
Warkworth Sands Woodland	137.4
Warkworth Sands Grassland	41.2
White Box Woodland	28
Yellow Box Woodland	7
Hunter Valley Vine Thicket	0.5
Hunter Lowlands Redgum Forest	32.5
River Red Gum Floodplain Woodland	9.5
Hunter Valley River Oak Forest	25.5
Exotic Grassland	72
Total	992

Table 4 lists the area of each vegetation community within the Southern BA by offset areas. Figure 5 shows the distribution of the vegetation communities within the Southern BA.

Table 4 Southern BA vegetation communities by offset area

Offset Area	Vegetation Communities	Total (ha)
WSW Offset Area	Warkworth Sands Woodland	81.4
Putty Road Offset Area (96.4ha)	Central Hunter Grey Box - Ironbark Woodland	68.4
	Central Hunter Grey Box - Ironbark Grassland	26.3
	Infrastructure	1.8
2014 WS Re-establishment Area	Warkworth Sands Grassland	39
Quarry	Bare ground	2.7
Offset Area* (794.9ha)	Warkworth Sands Woodland	56
	Central Hunter Grey Box - Ironbark Woodland	380
	Regenerating Central Hunter Grey Box - Ironbark Woodland	18.5
	White Box Woodland	28
	Yellow Box Woodland	7
	Hunter Valley Vine Thicket	0.5
	Hunter Lowlands Redgum Forest	32.5
	River Red Gum Floodplain Woodland	9.5
	Hunter Valley River Oak Forest	25.5
	Warkworth Sands Grassland	2.5
	Central Hunter Grey Box - Ironbark Grassland	144
	Exotic	72
	<i>Subtotal Offset Area vegetation</i>	<i>777</i>
	Infrastructure	17.9
Total		1,114

*Pending approval of Warkworth Continuation Project 2014

2.2.2 Northern Biodiversity Area

The following vegetation communities have been recorded in the Northern BA and include:

Vegetation Communities	Total (ha)
Central Hunter Grey Box - Ironbark Woodland	103.5
Central Hunter Grey Box - Ironbark Grassland	23
Warkworth Sands Woodland	19.5
Warkworth Sands Grassland	195.5
Total	342

Table 5 lists the area of each vegetation community within the Northern BA by offset area. Figure 6 shows the distribution of these vegetation communities.

Table 5 Northern BA vegetation communities by offset areas

Offset Area	Vegetation Communities	Total (ha)
2014 WS Re-establishment Area	Warkworth Sands Grassland	39
Offset Area*	Warkworth Sands Woodland	19.5
	Central Hunter Grey Box - Ironbark Woodland	104
	Warkworth Sands Grassland	156.5
	Central Hunter Grey Box - Ironbark Grassland	23
	Infrastructure	2.5
Total		344.5

*Pending approval of Warkworth Continuation Project 2014

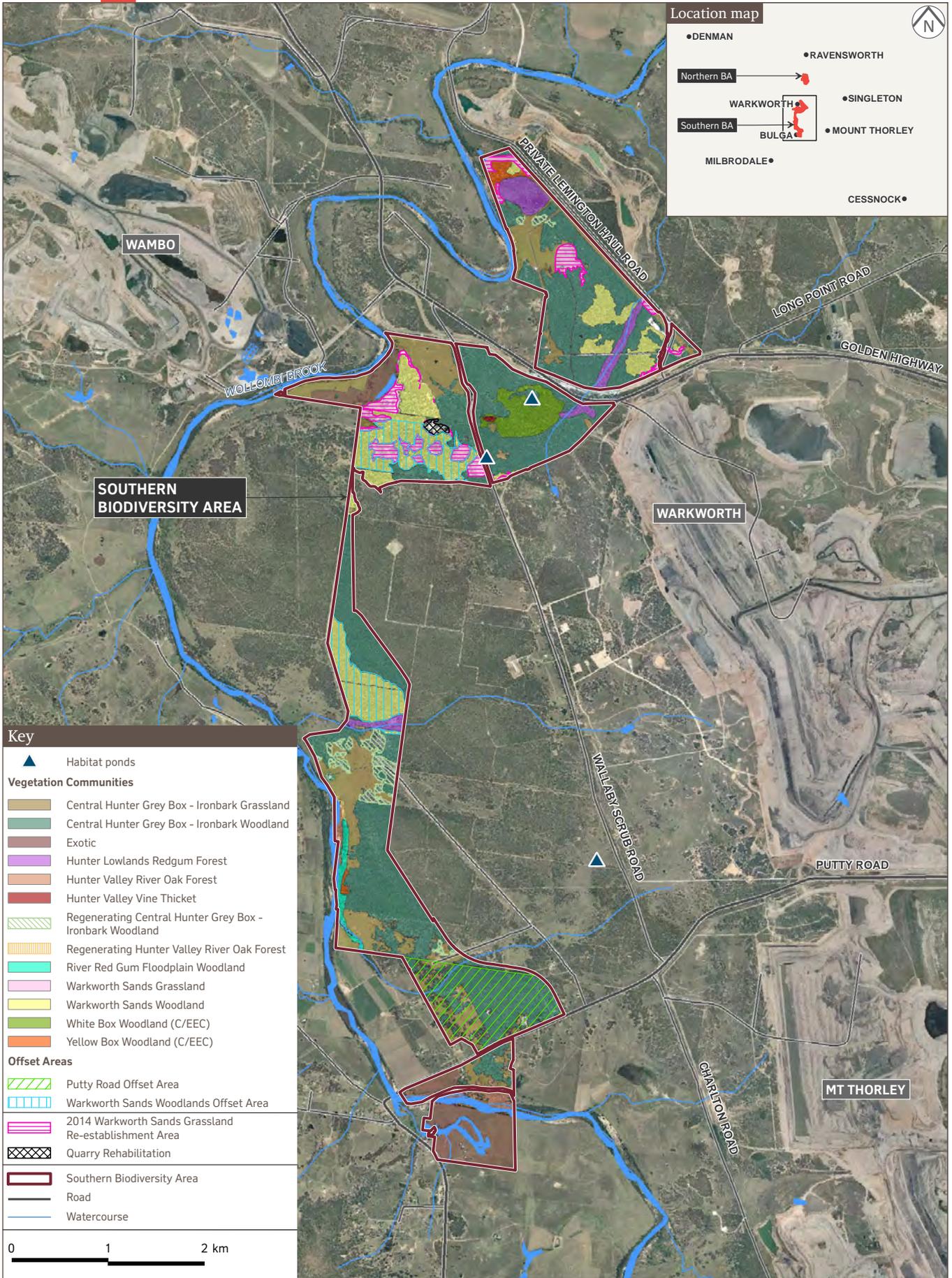


Photo: Regents Honeyeater (Chris Tzaros)

Vegetation Communities at the Southern Biodiversity Area

Local Offset Management Plan

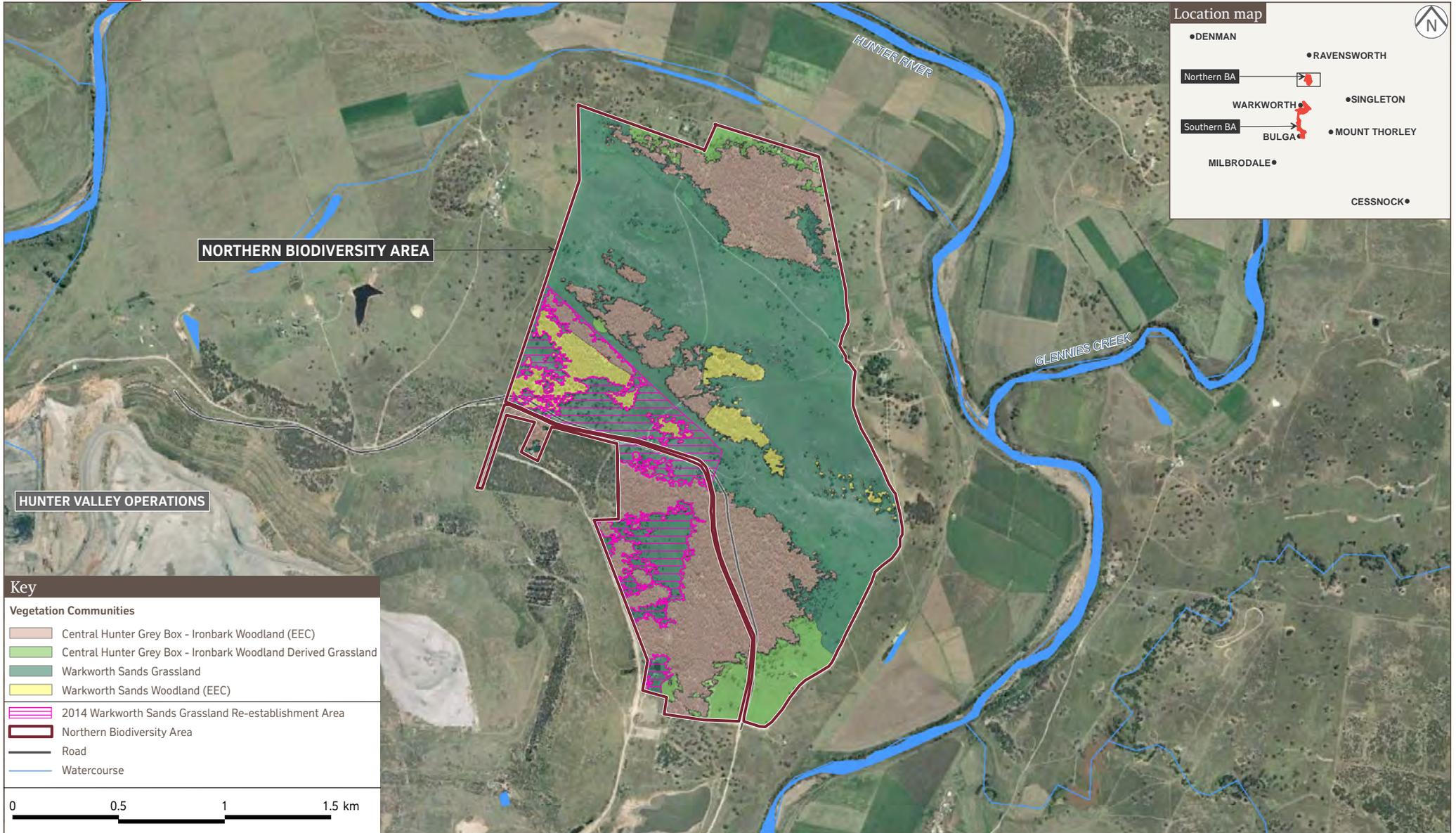
Figure 5



Vegetation Communities at the Northern Biodiversity Area

Local Offset Management Plan

Figure 6



2.2.3 Descriptions of Ecological Communities

Central Hunter Grey Box-Ironbark Woodland

The Central Hunter Grey Box-Ironbark Woodland is listed as EEC under the TSC Act.

The Central Hunter Grey Box-Ironbark Woodland dominant canopy species are Grey Box (*Eucalyptus molucanna*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). There are also local abundances of Bulloak (*Allocuarina luehmannii*) and White Feather Honey Myrtle (*Melaleuca decora*) in the midstorey. Common understorey species include Fan Wattle (*Acacia amblygona*), *Acacia falcata*, Native Blackthorn (*Bursaria spinosa*) and Coffee Bush (*Breynia oblongifolia*). Common groundcover species include Purple Burr-Daisy (*Calotis cuneifolia*), Blue Trumpet (*Brunoniella australis*), Kidney Weed (*Dichondra repens*), Blue Flax Lily (*Dianella revoluta*), Threeawn Speargrass (*Aristida vagans*), Wattle Matt-rush (*Lomandra filiformis*), Common Fringe-sedge (*Fimbristylis dichotoma*) and Rock Fern (*Cheilanthes sieberi*).



Central Hunter Grey Box-Ironbark Woodland – Southern BA (Donna Johnston)



Central Hunter Grey Box-Ironbark Woodland – Northern BA (Donna Johnston)

Central Hunter Ironbark – Spotted Gum – Grey Box Forest

The Central Hunter Ironbark – Spotted Gum – Grey Box Forest is only located within the Green Offset BA. The dominant canopy species are Narrow-leaved Ironbark (*Eucalyptus crebra*), Spotted Gum (*Corymbia maculata*) and Grey Box (*Eucalyptus moluccana*). Bulloak (*Allocasuarina luehmannii*) is a common mid-storey species. The common understorey species in this community are Fan Wattle (*Acacia amblygona*) and Gorse Bitter Pea (*Daviesia ulicifolia*). Common groundcover species include Blue Trumpet (*Brunoniella australis*), Common Everlasting (*Chrysocephalum apiculatum*), Wattle Matt-rush (*Lomandra filiformis*), Many-flowered Mat-rush (*Lomandra multiflora*), Blue Flax-lily (*Dianella longifolia*), Three-awn Speargrass (*Aristida vagans*), Rock Fern (*Cheilanthes sieberi*) and Variable Glycine (*Glycine tabacina*).

Central Hunter Grey Box-Ironbark Grassland

This community typically lacks the dominant canopy species of Grey Box (*Eucalyptus molucanna*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). The groundcover is generally dominated by native grass species, however some herbs also occur. There is a low to moderate incursion of weed species within this community, particularly along areas that have been disturbed.

Significant regeneration is evident in some areas of this community.



Central Hunter Grey Box-Ironbark Grassland – Southern BA (Donna Johnston)



Central Hunter Grey Box-Ironbark Grassland – Northern BA (Donna Johnston)

Warkworth Sands Woodland

The WSW community is listed as an EEC under the TSC Act. Vegetation mapped as WSW conforms to the NSW Scientific Committee (2002) final determination. The final determination describes WSW as being confined to aeolian sand deposits in the vicinity of Warkworth, south-east of Singleton in the mid Hunter Valley. The determination characterises the community by the assemblage of species that are listed in Table 6. The determination recognises one community, however indicates that the community has sub communities where there is a dominant abundance of the species of the WSW. This is generally where a thin sandy veneer overlies the Permian substrate. The NSW Biometric Vegetation Type Database (OEH, 2012), which provides a state wide overview and definitions of NSW plant community types, also defines a single WSW community as ‘Rough-barked Apple - Coast Banksia shrubby woodland on Warkworth Sands of the central Hunter Valley, Sydney Basin’.

Table 6 Species assemblage listed in the NSW Scientific Committee final determination (2002) to characterise Warkworth Sand Woodland

Scientific Name	Common Name	Strata
<i>Acacia falcate</i>	Hickory Wattle	Shrub
<i>Acacia filicifolia</i>	Fern-leaved wattle	Canopy / Mid storey
<i>Ajuga australis</i>	Austral Bugle	Ground cover
<i>Allocasuarina littoralis</i>	Black She-oak	Canopy / Mid storey
<i>Allocasuarina luehmannii</i>	Bulloak	Canopy / Mid storey
<i>Amyema pendulum</i>	Mistletoe	Shrub
<i>Angophora floribunda</i>	Rough-barked Apple	Canopy / Mid storey
<i>Aristida calycina</i>		Ground cover
<i>Aristida ramosa</i>	Purple Wiregrass	Ground cover
<i>Aristida vagans</i>	Threeawn Speargrass	Ground cover
<i>Aristida warburgii</i>		Ground cover
<i>Banksia integrifolia</i>	Coast Banksia	Canopy / Mid storey
<i>Brachyloma daphnoides</i>	Daphne Heath	Shrub
<i>Breyenia oblongifolia</i>	Coffee Bush	Shrub
<i>Callitris endlicheri</i>	Black Cypress Pine	Canopy / Mid storey
<i>Calotis cuneifolia</i>	Purple Burr-daisy	Ground cover
<i>Cheilanthes sieberi</i>	Poison Rock Fern	Ground cover
<i>Chrysocephalum apiculatum</i>	Common Everlasting	Ground cover
<i>Desmodium varians</i>		Ground cover
<i>Dianella revolute</i>	Blue Flax Lily	Ground cover
<i>Dichondra species A</i>	Kidney Grass	Ground cover
<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass	Ground cover
<i>Echinopogon intermedius</i>	Erect Hedgehog Grass	Ground cover
<i>Einadia trigonos</i>	Fishweed	Ground cover

Scientific Name	Common Name	Strata
<i>Entolasia stricta</i>	Wiry Panic	Ground cover
<i>Eucalyptus blakelyi/tereticornis</i>	Forest Red Gum	Canopy / Mid storey
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	Canopy / Mid storey
<i>Eucalyptus glaucina</i>	Slaty Red Gum	Canopy / Mid storey
<i>Exocarpos cupressiformis</i>	Cherry Ballart / Native Cherry	Canopy / Mid storey
<i>Exocarpos strictus</i>	Pale-fruit Ballart / Dwarf Cherry	Canopy / Mid storey
<i>Hardenbergia violacea</i>	Purple Coral Pea	Ground cover
<i>Hibbertia linearis</i>	Showy Guinea-flower	Shrub
<i>Hovea linearis</i>	-	Shrub
<i>Hypoxis hygrometrica</i>	Golden Weather-grass	Ground cover
<i>Imperata cylindrical</i>	Blady grass	Ground cover
<i>Indigofera australis</i>	Australian Indigo	Shrub
<i>Jacksonia scoparia</i>	Winged Broom-pea	Shrub
<i>Lomandra glauca</i>	Pale Mat-rush	Ground cover
<i>Lomandra leucocephala</i>	Woolly Mat-rush	Ground cover
<i>Lomandra muticus</i>		Ground cover
<i>Melaleuca decora</i>	White Feather Honey-myrtle	Shrub
<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle	Shrub
<i>Persoonia linearis</i>	Narrow-leaved Geebung	Shrub
<i>Pimelea linifolia</i>	Wedding Bush / Slender Rice-flower	Shrub
<i>Pomax umbellata</i>		Ground cover
<i>Pteridium esculentum</i>	Common Bracken	Ground cover
<i>Solanum prinophyllum</i>	Forest Nightshade	Ground cover
<i>Vittadina sulcata</i>		Ground cover

Field surveys in the Northern and Southern BAs observed dominant canopy species including Rough-barked Apple (*Angophora floribunda*) and the small tree Coastal Banksia (*Banksia integrifolia*). Other small trees recorded in the canopy of this community include Bulloak (*Allocasuarina luehmannii*), Black She-Oak (*Allocasuarina littoralis*), Blakely's Red Gum/Forest Red Gum intergrades (*Eucalyptus blakelyi/tereticornis*), Black Cypress Pine (*Callitris endlicheri*) and White Cypress Pine (*Callitris glaucophylla*).

Common understorey species included Coffee Bush (*Breynia oblongifolia*), *Hibbertia linearis*, Slender Rice Flower (*Pimelea linifolia*), Silver-stemmed Wattle (*Acacia parvipinnula*) and Dogwood (*Jacksonia scoparia*). The groundcover is characterised by Bracken (*Pteridium esculentum*). Common grasses in this community are Three-awn Speargrass (*Aristida vagans*), Weeping Meadow Grass (*Microlaena stipoides*), Purple Wiregrass (*Aristida ramosa*), Brown's Lovegrass (*Eragrostis brownii*), Blady Grass (*Imperata cylindrical*) and Hairy Panic (*Panicum effusum*). Other common groundcovers include Rock Fern (*Cheilanthes sieberi*), Berry Saltbush (*Einadia hastata*), Pomax (*Pomax umbellata*) and Variable Glycine (*Glycine tabacina*).

WS Grassland

The WS Grassland areas are located on sand and have some representation of the understorey components of WSW, but have been greatly disturbed by previous land management and have demonstrated limited capacity to regenerate naturally. These grassland areas will be the focus of the active restoration or re-establishment.



WSW –Southern BA (Donna Johnston)



WS Grassland – Southern BA (Donna Johnston)

White Box Woodland

The mapped White Box Woodland is consistent with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland CEEC (Box Gum Grassy Woodlands) listed under the EPBC Act and EEC listed under the TSC Act. The common canopy species occurring in the White Box form of this community include White Box (*Eucalyptus albens*), Grey Box (*Eucalyptus molucanna*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). Kurrajong (*Brachychiton populneus*) occasionally occurs within the small tree stratum. Common understorey species include Coffee Bush (*Breynia oblongifolia*) and *Acacia falcata*. Common groundcover species include Common Everlasting (*Chrysocephalum apiculatum*), Climbing Saltbush (*Einadia nutans subsp. linifolia*), Kidney Weed (*Dichondra repens*), Corrugated Sida (*Sida corrugata*), Purple Wiregrass (*Aristida ramosa*), Barbed Wire Grass (*Cymbopogon refractus*), Kangaroo Grass (*Themeda australis*) and Rock Fern (*Cheilanthes sieberi*).

Yellow Box Woodland

The mapped Yellow Box Woodland is consistent with the Box Gum Grassy Woodlands CEEC listed under the EPBC Act and EEC listed under the TSC Act. The canopy of the Yellow Box form of the community is dominated by Yellow Box (*Eucalyptus melliodora*), Rough-barked Apple (*Angophora floribunda*), Forest Red Gum (*Eucalyptus tereticornis*) and the occasional River Red Gum (*Eucalyptus camaldulensis*). The Yellow Box form of the community contains a higher proportion of exotic weeds than the White Box form.



WSW – Northern BA (Donna Johnston)



Box Gum Grassy Woodland – Southern BA (Donna Johnston)

River Red Gum Floodplain Woodland

The River Red Gum Floodplain Woodland is listed as EEC under the TSC Act.

Stands on major floodplains are generally dominated by River Red Gum (*Eucalyptus camaldulensis*) in combinations with Forest Red Gum (*Eucalyptus tereticornis*), Yellow Box (*Eucalyptus melliodora*) and Rough-barked Apple (*Angophora floribunda*). Within the community stands of River Oak (*Casuarina cunninghamiana subsp. cunninghamiana*) and Swamp Oak (*Casuarina glauca*) may occur.

Hunter Valley Vine Thicket

The Hunter Valley Vine thicket is listed as EEC under the TSC Act.

This community typically forms a low forest, usually less than 10 m tall, with a closed canopy dominated by small trees. The canopy may include Red Olive Plum (*Elaeodendron australe*), Wilga (*Geijera parviflora*), Native Olive (*Notelaea microcarpa* var. *microcarpa*), Western Rosewood (*Alectryon oleifolius* subsp. *elongatus*), White Cedar (*Melia azedarach*) and Kurrajong (*Brachychiton populneus* subsp. *populneus*). A shrub and vine layer are present, though groundcover is generally sparse.



River Red Gum Floodplain Woodland – Southern BA
(Donna Johnston)



Hunter Valley Vine Thicket – Southern BA
(Donna Johnston)

Hunter Valley River Oak Forest

Open riparian forests characterised by an overstorey dominated by River Oak (*Casuarina cunninghamiana*) and a ground layer which is typically grassy and may be dominated by Couch grass (*Cynodon dactylon*) and Slender Bamboo grass (*Austrostipa verticillata*).

Significant regeneration is evident in some areas of this community.

Hunter Lowlands Red Gum Forest

The community of Hunter Lowlands Red Gum Forest is listed as an EEC under the TSC Act. The community occurs on the Southern and Green Offsets BAs. The dominant canopy species within this community are Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*E. crebra*), Rough-barked Apple (*Angophora floribunda*) Spotted Gum (*Corymbia maculata*) and Grey Box (*Eucalyptus moluccana*) with Bulloak (*Allocasuarina luehmannii*) being common as a midstorey species.



Hunter Valley River Oak Forest – Southern BA
(Donna Johnston)



Hunter Lowlands Red Gum Forest – Southern BA
(Donna Johnston)

2.3 Threatened Species

Despite the modified state of the BAs, a number of threatened flora and fauna species have been recorded within each BA. Threatened species records for the Southern and Northern BAs are shown in **Error! Reference source not found.** and Figure 8 respectively.

There is potential habitat within the Southern BA for a number of other threatened flora species previously recorded in the locality. These include Hairy Geebung (*Persoonia hirsuta*), Illawarra Greenhood (*Pterostylis gibbosa*) and *Cymbidium canaliculatum* (*Cymbidium canaliculatum* in the Hunter Catchment).

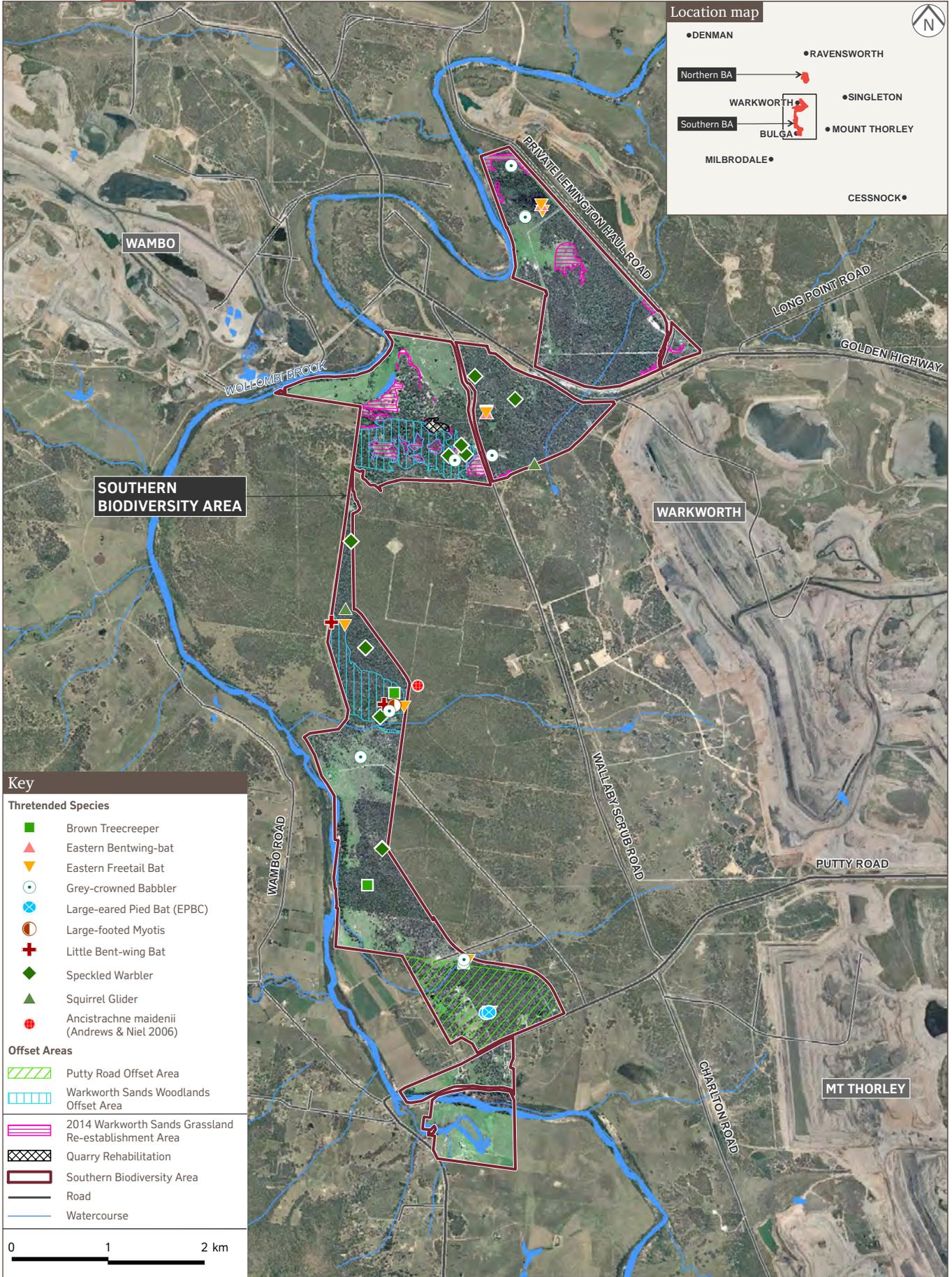
There is also potential habitat within the BAs for a range of threatened fauna species. These include:

- Giant Burrowing Frog (*Heleioporus australiacus*);
- Green and Golden Bell Frog (*Litoria aurea*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Little Bentwing-bat (*Miniopterus australis*);
- Large-footed Myotis (*Myotis macropus*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Barking Owl (*Ninox connivens*);
- Black Bittern (*Ixobrychus flavicollis*);
- Black Breasted Buzzard (*Hamirostra melanosternon*);
- Black-chinned Honeyeater (*Melithreptus gularis*);
- Blacknecked Stork (*Ephippiorhynchus asiaticus*);
- Blue-billed Duck (*Oxyura australis*);
- Brown Treecreeper (*Climacteris picumnus victoriae*);
- Diamond Firetail (*Stagonopleura guttata*);
- Gang Gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black-cockatoo (*Calyptorhynchus lathamii*);
- Great Egret (*Ardea alba*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*);
- Hooded Robin (*Melanodryas cucullata*);
- Little Eagle (*Hieraaetus morphnoides*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Masked Owl (*Tyto novaehollandiae*);
- Painted Honeyeater (*Grantiella picta*);
- Powerful Owl (*Nonox strenua*);
- Red Goshawk (*Erythrorhynchus radiates*);
- Regent Honeyeater (*Xanthomyza phrygia*);
- Scarlet Robin (*Petroica boodang*);
- Speckled Warbler (*Pyrrholaemus saggitatus*);
- Spotted Harrier (*Circus assimilis*);
- Square –tailed Kite (*Lophoictinia isura*);
- Swift Parrot (*Lathamus discolor*);
- Turquoise Parrot (*Neophema pulchella*);
- Varied Sittell (*Daphoenositta chrysoptera*); and
- White-bellied Sea- Eagle (*Haliaeetus leucogaster*).

Threatened Species recorded at the Southern Biodiversity Area

Local Offset Management Plan

Figure 7



Threatened Species recorded at the Northern Biodiversity Area
Local Offset Management Plan

Figure 8



2.4 Baseline Biodiversity Assessment

A baseline biodiversity assessment for the Northern and Southern BAs is to be completed in 2014, as described in the monitoring programme in Chapter 5. The monitoring programme aims to track improvement in the baseline condition of biodiversity values by tracking attributes and comparing them to both a reference site and the NSW Biometric benchmark.

This data will assist in the development of state and transition models for the WSW and Central Hunter Grey Box – Ironbark Woodland communities. Typically, state and transition models are used to develop and apply adaptive management strategies and assist land managers to:

- stratify the areas of land according to varying ecological potential in order to identify management and restoration targets;
- assess the risk of degradation and take active measures to avoid it; and
- identify constraints and actions that can drive an ecological community to transition into another state.

The WSW Restoration Manual (Niche, 2014) outlined the use of the Vegetation Assets State and Transitions (VAST) framework to observe the transition of WSW community to higher condition states. This framework is to be used to develop state and transition models for the WSW and ironbark communities. The framework uses commonly used site-based indicators of vegetation condition and landscape function to assess the impacts of historic land management practices and their impacts upon three diagnostic attributes of vegetation condition: vegetation structures, species composition and regenerative capacity. The data collected in the monitoring programme will be used to verify condition and stratify areas of the communities within the VAST framework, Table 7 provides the interim framework developed for WSW as part of the WSW Restoration Manual. The data collected through the monitoring programme will improve this framework and drive transition of the communities to higher condition states.

The ecological monitoring programme is the key component of this plan to capture data on the diagnostic attributes. The vegetation and habitat plots are based on the Bio banking plots, but include the collection of additional information on species composition and cover abundance, canopy regeneration and health, habitat features and soils. The data will be used to allocate a state value to the areas of the WS and ironbark communities. This will be used to provide an overall performance of the OMP. In addition individual data plots will also be used to indicate the success of re-establishment activities as described in Chapter 4. Chapter 3 provides the overall Key Performance Indicators (KPIs) for the plan. In the absence of the baseline biodiversity assessment an interim assessment has been used to demonstrate the function of these KPIs. This assessment included Rapid Condition Assessments and the bio banking plot data collected for WSW.

Table 7 Vegetation Assets States and Transitions framework

Increasing vegetation modification from left to right

Vegetation condition state (mapping criteria)		Native vegetation extent				Non-native vegetation extent		
		Dominant structuring plant species indigenous to the locality and spontaneous in occurrence – i.e. a vegetation community described using definitive vegetation types relative to estimated pre1750 states				Dominant structuring plant species indigenous to the locality but cultivated; alien to the locality and cultivated; or alien to the locality and spontaneous		
State 0: NATURALLY BARE		State I: UNMODIFIED	State II: MODIFIED	State III: TRANSFORMED	State IV: REPLACED - ADVENTIVE	State V: REPLACED - MANAGED	State VI: REMOVED	
areas where native vegetation does not naturally persist and recently naturally disturbed areas where native vegetation has been entirely removed. (i.e. open to primary succession)		native vegetation community structure, composition, and regenerative capacity intact – no significant perturbation from land use/land management practice	native vegetation community structure, composition and regenerative capacity intact - perturbed by land use/land management practice	native vegetation community structure, composition and regenerative capacity significantly altered by land use/land management practice	native vegetation replacement – species alien to the locality and spontaneous in occurrence	native vegetation replacement with cultivated vegetation	vegetation removed - alienation to non-vegetated land cover	
Diagnostic criteria	Current regenerative capacity (interpretative)	Complete removal of in-situ regeneration capacity except for ephemerals and lower plants	Natural regenerative capacity unmodified	Natural regeneration capacity persists under past and /or current land management practices	Natural regenerative capacity limited / at risk under past and /or current land use or land management practices. Rehabilitation and restoration possible through modified land management practice	Regeneration potential of native vegetation community has been suppressed and in-situ resilience at least significantly depleted. May still be considerable potential for active restoration of key ecological processes	Regeneration potential of native vegetation community likely to be highly depleted by intensive land management. Very limited for active restoration of key ecological processes	Nil or minimal regeneration potential. Restoration potential dependent on reconstruction approaches
	Vegetation structure (objective*)	Nil or minimal	Structural integrity of native vegetation community is very high	Structure is predominantly altered but intact e.g. a layer / strata and/or growth forms and/or age classes removed	Dominant structuring species of native vegetation community significantly altered e.g. a layer / strata frequently and repeatedly removed	Dominant structuring species of native vegetation community removed or predominantly cleared or extremely degraded	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental
	Vegetation composition (objective*)	Nil or minimal	Compositional integrity of native vegetation community is very high	Composition of native vegetation community is altered but intact	Dominant structuring species present - species dominance significantly altered	Dominant structuring species of native vegetation community removed	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental
Examples	Naturally bare areas: mud; rock; river and beach sand, fresh water lakes, salt freshwater lakes	Unmodified stands of remnant Warkworth Sands Woodland (WSW)	WSW managed using sustainable grazing systems; Selective timber harvesting practices; Severely burnt (wildfire) WSW not of a natural frequency and/or intensity	Heavily grazed WSW; Obvious thinning of trees for pasture production; Weedy native remnant patches; Degraded roadside reserves; Degraded aeolian dune systems;	Severe invasions of introduced weeds; Invasive native woody species found outside their normal range; Isolated native trees/shrubs/grass species in the above examples	Horticulture; Tree cropping; Orchards; Reclaimed mine sites; Environmental and amenity plantings; Improved pastures. (includes heavy thinning of trees for pasture); Cropping; Isolated native trees/shrubs/ grass species in the above examples	Water impoundments; Urban and industrial landscapes; quarries and mines; Transport infrastructure	

2.4.1 Rapid Condition Assessment

A Rapid Condition Assessment (RCA) technique was used as a preliminary assessment of woodland condition within the BAs. The RCA is derived from the ‘Save the Bush Toolkit’ technique (Wakefield and Goldney, 1997), which identifies the presence or absence of key habitat components and threatening processes. This technique is not applicable to all types of native vegetation (e.g. native grasslands, wetlands or pastures) but is a quick and reliable way to assess the condition of woodland communities. Details of the assessments are provided in Chapter 5.

Table 8 provides the number of RCA sites and photo monitoring plots within each vegetation community, along with the average health rating, measured in November 2013. The average health rating was assessed as 16/20, indicating the areas are healthy and sustainable under current management. Figure 9 and Figure 10 show the location of these sites. These sites are to be remeasured annually; they were deliberately located near tracks for easy future access and to act as early indicators of emerging threats. As the greatest risks from threats are often arise from more easily accessible areas. The RCA score cards can be found on the Biodiversity Offsets Portal.

Photo monitoring plots were also established at each RCA site such that a series of photos (north, east, south, west and ground) were taken at each plot. This will provide a visual record of any changes in vegetation and habitat condition. Five photo monitoring plots were also established in Central Hunter Grey Box-Ironbark Grassland and WS Grassland at the Southern BA and four in the Northern BA. The photo monitoring images can be accessed from the online Biodiversity Offset Portal

Table 8 Rapid Condition Assessment summary results

Biodiversity Area	Vegetation Community	Rapid Condition Assessment/ Photo Monitoring Plot	Photo Monitoring Plot	Plot Reference	Average Health rating
Southern	WSW	1		R_S5	15/20
	WS Grassland		2	R_S4 and R_S11	
	Central Hunter Grey Box-Ironbark Woodland	2		R_S2 and R_S6	17/20
	Central Hunter Grey Box-Ironbark Grassland		2	R_S3 and R_S10	
	Hunter Lowlands Redgum Forest	1		R_S9	16/20
	Box Gum Grassy Woodland	2		R_S7 and R_S8	17/20
	Exotic Grassland		1	R_S1	
Total		6	5		16/20
Northern	WSW	2		R_N4 and R_N5	16/20
	WS Grassland		2	R_N1 and R_N3	
	Central Hunter Grey Box-Ironbark Woodland	2		R_N2 and R_N6	17/20
	Central Hunter Grey Box-Ironbark Grassland		2	R_N7 and R_N8	
Total		4	4		16/20

2.4.2 Warkworth Sands Woodland assessment

In late 2013 botanists from Niche Environment and Heritage established 10 Vegetation Monitoring Plots in accordance with Bio-banking methods in WSW communities across the BAs to monitor the 2014 re-establishment activities. Figure 9 and Figure 10 indicate the location of these plots and species lists for each plot, can be accessed from the Biodiversity Offset Portal. The aim is to monitor the progression of grassland to woodland with five reference plots established in woodland and five transformation plots in grassland. It should be noted reference plots 1 and 4 are located on vegetation mapped as CHGBIW however is considered to be a sub community of WSW, as described in the NSW Scientific Committee (2002) final determination.

Table 9 provides the summary of data collected and compares the results to the 8 attributes described in WSW Biometric 3.1 (HU600) benchmark, all the plot data is provided at Appendix A. For the reference plots, the average attribute values were within the benchmark range for four of the eight attributes compared. The attributes that were not within the benchmark values were: percentage of native mid storey, percentage native ground cover grasses, percentage of native ground cover shrubs and number of hollows. This support the classification of the reference sites at State II (Modified) in the Vegetation Assets States and Transition framework, as present in the WSW Restoration Manual (Niche, 2014) and shown at Table 7. The vegetation structure is altered but intact, which shows that the woodland is regenerating from high level of disturbance and may be dominated by a single species limiting the recruitment of species within the other vegetation stratum. This indicates that the community maintains capacity to naturally regenerate and passive management of these areas should be appropriate. The monitoring programme will provide ongoing information to guide the long term management of these areas.

The transformation plots in the grassland areas support the classification of these areas within the State IV (Replaced – Adventive). These are communities where the vegetation community has been significantly degraded and dominant canopy species are removed. These areas will be the focus of active management to support regeneration where there is limited natural regenerative capacity. Please note that data to be collected in 2014 may be used to better define this classification.

Table 9 Bio Banking plots compared to NSW Biometric 3.1 benchmark for Warkworth Sands Woodland

Plot Name	Date	NPSR#	NOS %	NMS %	NGCG %	NGCS %	NGCO %	EPC %	LC %	RC %	BGC %	CC %	Logs (m)	# Hollows	# Trees	Easting	Northing
Reference 1	11/12/2013	31	22	5	74	4	20	8	92	0	18	0	5	0	120	316318	6393834
Reference 2	11/12/2013	21	9	9.5	46	0	12	4	66	0	34	0	38	1	33	314594	6392754
Reference 3	11/12/2013	24	21.5	16.5	42	2	4	6	92	0	8	0	61	0	59	314228	6392804
Reference 4	12/12/2013	15	17	0	46	0	10	6	92	0	0	0	20	2	71	317129	6402846
Reference 5	12/12/2013	49	21	0.5	68	6	28	6	100	0	4	0	0	0	23	316237	6402082
Average		28	18.1	6.3	55.2	2.4	14.8	6	88.4	0	12.8	0	24.8	0.6	61.2		
Transfn. 1	12/12/2013	16	0	0	20	2	6	96	0	0	62	0	0	0	0	316579	6401890
Transfn. 2	29/11/2013	6	0	0	96	0	0	14	-	-	-	-	0	0	0	316800	6401427
Transfn. 3	29/11/2013	5	0	0	60	0	0	96	-	-	-	-	0	0	0	316149	6394376
Transfn. 4	29/11/2013	8	0	0	52	0	0	20	-	-	-	-	0	0	0	314367	6392959
Transfn. 5	29/11/2013	6	0	0	68	0	0	24	-	-	-	-	0	0	0	315151	6392430
Average		8.2	0	0	59.2	0.4	1.2	50	0	0	62	0	0	0	0		
Biometric 3.1 HU600																	
Benchmark	Lower		13	10	4	5	5										
Benchmark	Upper	26	40	50	15	30	25						20	0.8			

NPSR#: Native Plant Species Richness Number of species

NGCO: Native Ground Cover Other

CC: Cryptogram Cover

NOS: Native Over-storey

EPC: Exotic Plant Cover

NMS: Native Mid-storey

LC: Litter Cover

NGCG: Native Ground Cover Grasses

RC: Rock Cover

NGCS: Native Ground Cover Shrubs

BGC: Bare Ground Cover

2.4.3 Bird survey

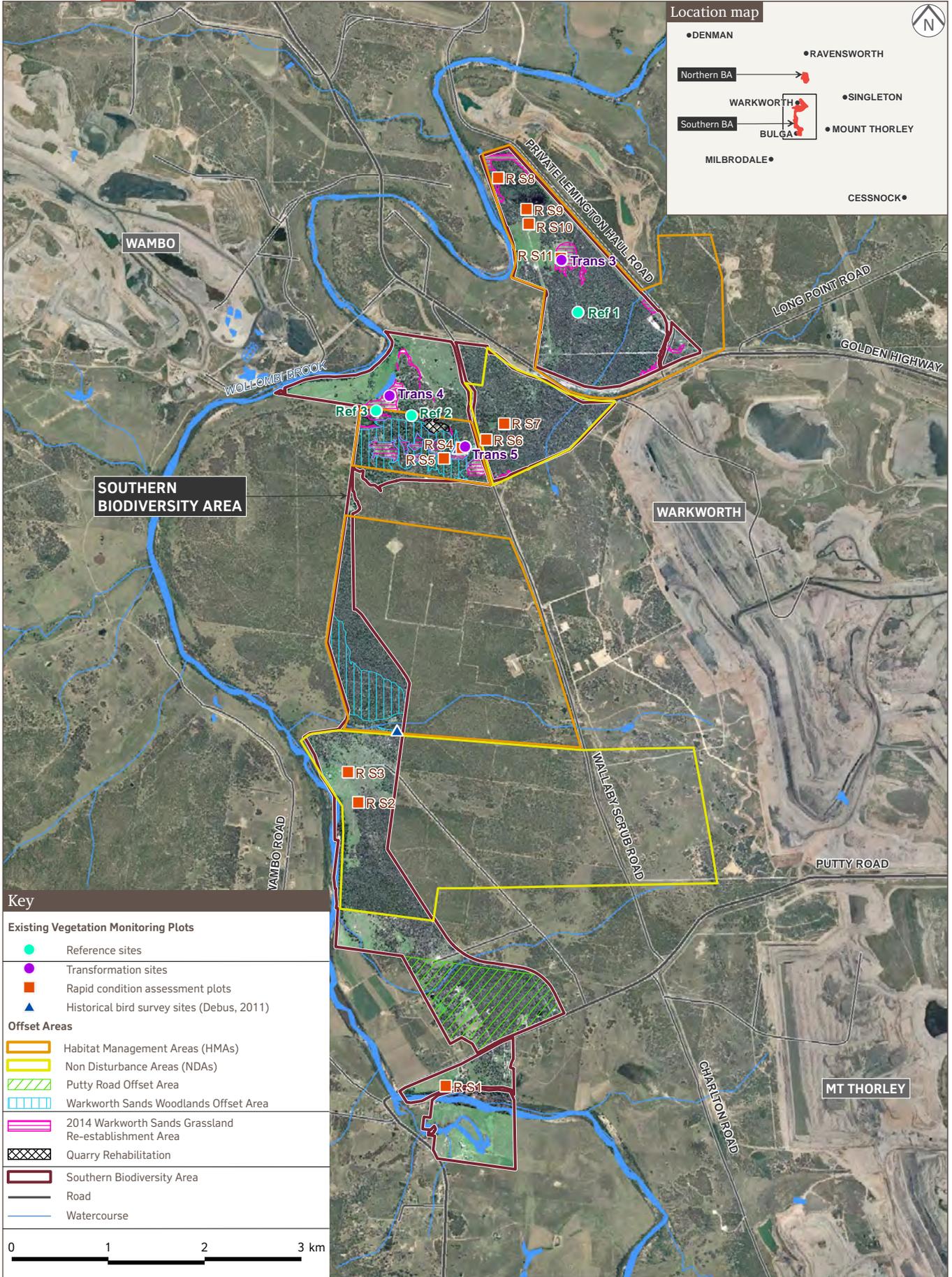
A bird monitoring programme has been in place since 2008. The aim of the ongoing bird monitoring programme is to use avifauna as indicator species to monitor the enhancement of remnant woodland/open woodland, by comparing bird populations at the same sites originally surveyed by Andrews Neil (2006). Surveys have been completed in autumn and spring 2008, winter 2009 and July 2011. The following are the results from the survey completed by Dr Stephen Debus in 2011. Figure 9 and Figure 10 show the location of the monitoring sites. Some of the sites will need to be relocated due to the impact of the mine operations.

The nine MTW sites surveyed in July 2011 were the same survey sites as those of Debus (2008, 2009), and the survey method was repeated. Each site was surveyed four times over almost consecutive days, and survey times at each site were rotated between early, mid or late morning, and mid or late afternoon. Birds were surveyed by habitat (area) search, using visual and aural cues, by a random meander through 4 ha around the survey point during 40 minutes (= 2x the standard 2-ha/20-minute search commonly used and recommended for bird surveys). In practice, tracks through the sites were used as much as possible to maximise the detectability of birds and the counting of individuals. Also, because bird foraging activity continued through the day in winter, counts continued until later in the morning and started earlier in the afternoon than in the autumn and spring surveys. For each site and replicate count, species and individuals were again counted in 10-minute intervals (taking care not to double-count individuals). Survey effort was 2.67 hrs (4 x 40 minutes) per site.

Weather conditions during the winter 2011 MTW survey (11–14 and 19–21 July) were mostly dry, but often cold and gusty in the first week, and cold, overcast, gusty and occasionally showery in the second week (counts were not conducted during rain). Mining operations had also approached more closely to site 1 (especially, where habitat clearing had intruded), and sites 3 and 4 (i.e. those sites east of Wallaby Scrub Road), meaning that there was machinery noise interference at these sites, and the 4-ha search area at sites 1 and 4 was adjusted slightly south and west to compensate.

Eight hundred and seventy individuals, of 74 species, were recorded on MTW. Please refer to Appendix B for species list. Sixty-eight species on the survey plots, and six seen or heard off site during counts or while travelling between the sites. This is a similar number of species to autumn 2008 (76) and winter 2009 (71), although fewer species than spring 2008 (85), and 100 more individuals than in autumn or spring 2008. These differences can be explained by the winter absence of spring-summer migrant species, the winter influx of certain species (Eastern Spinebill, Yellow-faced Honeyeater and Golden Whistler), and the greater detectability of some species in spring (e.g. singing, breeding). The winter influx of honeyeaters included a new species for MTW, the White-cheeked Honeyeater, and was related to the winter flowering of Coast Banksia on the Warkworth Sands. Six other new species for the MTW monitoring plots may have been winter visitors to the area. Recorded species diversity at MTW in winter 2011 may have been slightly depressed by the weather conditions, and the habitat loss or disturbance and/or the noise interference resulting from encroachment of mining activity on sites 1, 3 and 4. These sites will be relocated for the 2014 monitoring surveys. Details of the new monitoring programme are provided in Chapter 5.

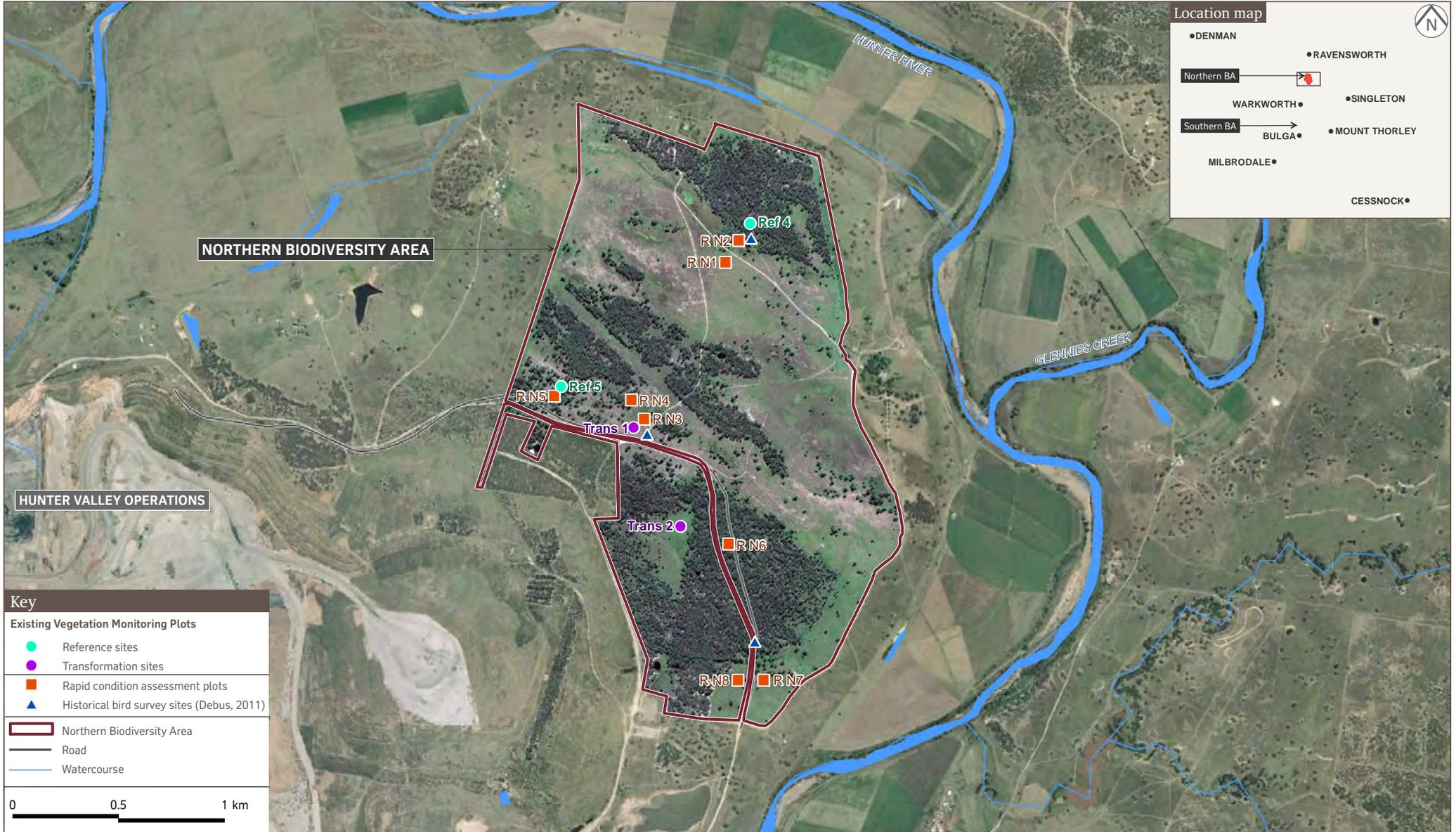
Figure 9



Existing Vegetation Monitoring Plots, Rapid Condition Assessment Plots and Historical Bird Survey Sites at the Northern Biodiversity Area

Local Offset Management Plan

Figure 10



3 Conservation Objectives and Key Performance Indicators

3.1 Conservation Objectives

The primary conservation objectives for the Local OMP are to:

- enhance biodiversity values across the BAs;
- protect the BAs under a legally binding conservation covenant;
- increase the condition of WSW and Ironbark EECs and observe a transition from grassland to woodland;
- enhance habitat and foraging opportunities for the woodland birds; and
- contribute to and enhance the existing network of protected vegetation within the Hunter Valley.

The conservation management strategies described in the following Chapter 4 outline management activities that are permissible within the BAs and aim to achieve the conservation objectives.

The methods to monitor the attainment of these objectives are described in Chapter 5; the monitoring data will be annually reviewed to adapt conservation management strategies for continual improvement.

3.2 Key Performance Indicators

Table 10 and 11 lists the key biodiversity values and the nested conservation values for the southern and northern BAs and key performance indicators. The monitoring programme, outlined in Chapter 5, will detail the attributes to be measured to provide evidence and demonstrate achievement of the Key Performance Indicators.

Table 10 Southern BA Biodiversity Values and Key Performance Indicators

Biodiversity Value	Nested Conservation Values	Description and baseline metric	Key Performance Indicator
Ironbark Woodland		447ha	Observe an increase in area, connectivity and /or ecological condition over 15years through the transition of grasslands to woodlands.
	Fauna Habitat	RCA Average Health rating – 17/20	Observe maintenance or increase habitat condition rating over 15years.
Ironbark Grassland		170ha Attributes to be measured in 2014	Observe a transition from grassland to woodland and increase in area through the transition from exotic to derived native grassland over 15 years.
WSW		137ha 4/8 benchmark attributes attained	Observe an increase in area, connectivity and /or ecological condition over 15years through the transition of grasslands to woodlands.
	Fauna Habitat	RCA Average Health rating – 15/20	Observe maintenance or increase habitat condition rating over 15years.
WS Grassland		41ha 0/8 benchmark attributes attained	Observe a transition from grassland to woodland over 15 years.
Box Gum Grassy Woodland		35ha RCA Average Health rating – 17/20	Observe maintenance or increase habitat condition rating over 15years.

Table 11 Northern BA Biodiversity Values and Key Performance Indicators

Biodiversity Value	Nested Conservation Values	Description and baseline metric	Key Performance Indicator
Ironbark Woodland		104ha	Observe an increase in area, connectivity and /or ecological condition over 15years through the transition of grasslands to woodlands.
	Fauna Habitat	RCA Average Health rating – to be measured in 2014	Observe maintenance or increase habitat condition over 15years.
Ironbark Grassland		23ha Attributes to be measured in 2014	Observe a transition from grassland to woodland over 15 years.
WSW		20ha 4/8 benchmark attributes attained	Observe an increase in area, connectivity and /or ecological condition over 15years through the transition of grasslands to woodlands.
	Fauna Habitat	RCA Average Health rating – 16/20	Observe maintenance or increase habitat condition over 15years.
WS Grassland		196ha 0/8 benchmark attributes attained	Observe a transition from grassland to woodland over 15 years.



Photo: Swift Parrot (Chris Tzaros)

4 Conservation Management Strategies

This chapter outlines the management activities and methods to protect and enhance the biodiversity values of the BAs.

To deliver sustainable conservation outcomes passive and active restoration approaches will be applied to enhance and increase the extent of Ironbark and WSW communities.

Passive restoration is defined as the promotion of natural regeneration of a plant community using minimal intervention land management practices. These practices assume that the current plant community retains moderate to high levels of regenerative capacity through minimal land management practices. The following strategies are defined as passive approach and address key threatening processes:

- Controlled actions: activities that are constrained to protect the biodiversity values;
- Weed Control;
- Vertebrate pest control;
- Access and infrastructure improvement; measures taken to control access, notify entry to a protected area and construction of infrastructure to support implementation of management strategies;
- Waste management; and
- Cultural heritage.

Active restoration is defined as direct land management interventions to restore areas that have demonstrated limited capacity to naturally regenerate due to a history of prolonged disturbance. The following strategies are defined as active restoration:

- Re-establishment;
- Regrowth control;
- Erosion control;
- Habitat augmentation; and
- Fire management.

Restoration scientists acknowledge that recreation of a fully functioning plant community remains a challenging and long-term venture. However, it is more likely to succeed where a combination of active and passive restoration techniques are adopted and implemented under optimal climatic conditions. It also requires the equivalent ecological characteristics to be present in both the re-establishment sites and the reference of benchmark site. The following strategies outline the implementation of passive and active restoration techniques and the monitoring programme aims to observe the effectiveness of these strategies in achieving the equivalent ecological characteristics in the re-establishment areas.

4.1 Controlled Activities

All employees, contractors, consultants and visitors must be aware of their responsibilities when entering the BAs and Offset Areas.

Under no circumstances are the following activities permitted within the Offset Areas:

- littering or dumping;
- removal of firewood, native plants or animals;
- removal of rocks, sand or gravel;
- disturbance of cultural heritage sites;
- clearing or destruction of native vegetation (some exemptions for construction and maintenance of infrastructure (see Chapter 4.9), clearing of power line easements or regrowth control for conservation outcomes);
- hunting;

- trapping or shooting (unless controlling pest animals);
- use of fertilisers;
- aerial application of herbicide from planes or helicopters;
- grazing of livestock;
- use of livestock feed;
- keeping or bringing exotic animal including dogs, cats and European bee hives; or
- lighting camp fires.

Vehicles may cause soil compaction, dispersal of weed and vegetation disturbance. To minimise the impact of vehicles on the BAs, vehicles should be driven on defined access tracks and by authorised personnel. Vehicles should be driven to road conditions and not exceed the legal speed limits for roads or 40km/hour for internal access tracks.

Access to the BAs is controlled through locked gates and fences. Entry points are signposted to inform all visitors they are entering a protected area.

The BAs are to be protected under a Biobanking agreement and will have legal protection.

Exploration drilling may be permitted in areas of the BAs that are outside the Wollombi Brook Aboriginal Cultural Heritage Conservation Area. Prior to drilling disturbance, a detailed re-establishment plan will be prepared and implemented immediately after drilling is completed and will be assessed and approved by the appropriate authorities. The number and location of the drill sites will be reported in the Annual Environmental Report to DPE.

4.2 Re-establishment of Warkworth Sands Woodlands

This strategy outlines the active restoration approach for WS grassland to increase their vegetation condition, vegetation structure, species composition and regenerative capacity.

A total of 78ha of WS grassland located in the Southern and Northern BAs makes up the 2014 WS grassland re-establishment areas and works commenced in 2013 to restore these areas. The WSW Restoration Manual (Niche 2014) was prepared for Coal & Allied to guide monitoring and re-establishment of these areas. Its development was informed by the University of New England WSW Research Programme.

Within the Northern BA 157ha of WS grassland is suitable for re-establishment, and will be identified as the 2015 WS grassland re-establishment area. These works are to commence in 2014 so that materials salvaged from mining activities can be utilised, with planting to occur in autumn 2015 and 2016. An applied research approach is to be adopted to assess the value of using salvaged resources in the re-establishment programmes

4.2.1 Management Objective

To observe a transition of WS grassland to a woodland with similar structure and function to WSW across the BAs over a period of 15 years.

4.2.2 Method

The re-establishment of these areas where possible will follow a shelter belt approach, with re-establishment activities confined to strips that run perpendicular to the prevailing wind direction. This approach aims to create micro climates that will encourage and support natural regeneration between the strips. This minimises the amount of disturbance to avoid damage to existing regeneration and enables natural and sustainable regeneration to occur between the strips.

All re-establishment activities are to occur when suitable climatic condition prevail. The following describes the key actions in the re-establishment of WSW.

Translocation of salvaged resources

Resources salvaged from areas to be cleared for mining activity, such as topsoil, mulch, timber and plant material, are considered valuable resources for the re-establishment of a similar vegetation community in a different location. It provides an opportunity to transfer

ecological characteristics to the re-establishment site to support natural regeneration, such as seed sources and microbial soil organisms. The use of these materials is dependent upon their availability and should be used where possible.

The following outlines critical factors in the use and management of these resources:

- Topsoil management:
 - Stockpiling of material is to be avoided where possible.
 - To translocate the majority of seed it is recommended that the top ten centimetres is scalped.
- Mulch:
 - All overstorey and understorey vegetation at the disturbance site should be coarsely mulched to provide a potential seed source at the re-establishment site.
 - To mitigate the potential lock up of nutrients in the soil, composted mulch should be applied prior to application, to a depth of 5cm. This will also provide soil disturbance and prepare the restoration site.
- Timber:
 - Medium trees, with their branches intact and root removed, are to be relocated to provide seed sources, habitat and protect the soil to create an improved micro climate for restoration.
- Plant material:
 - Seeds, cuttings and plants should be salvaged from the disturbance area to further assist in the establishment of ecological characteristics in the re-establishment areas. Species that are known to be difficult to grow from seed will be targeted for cuttings and transplanting from the disturbance areas, these species include *Grevilla montana*, *Pimelea linifolia* and *Brachyloma daphnoides*.

Seed collection

It is preferable that seed for planting and seeding activities is from local or endemic provenances. It will be permissible to collect seed from remnant patches of ecological communities across the BAs. However seed collection must be for non-commercial purposes and meet the standards of the “Guidelines and Codes of Practice” developed by Florabank (www.florabank.org.au), or subsequent equivalent, and the following limitations and permissions apply:

- Collect seed in the BA only if seed of the particular species and genotype is not available elsewhere or if the seed collected is intended for seedlings that will be planted within the BA;
- Seeds may be collected from within endangered ecological communities;
- Seeds may not be collected from species individually listed on schedules 1, 1A or 2 of the TSC Act without prior written approval from the Director General, or under a licence granted under S132c of the Act or S91 of the TSC Act;
- Seeds may be collected from any protected species listed under Section 131 (Schedule 13) of the TSC Act; and
- Seeds may be collected from any other native species.

Seed collection in areas approved to be cleared for mining purposes do not have to adhere to the conditions stated above.

Planting

Planting techniques may include direct seeding or planting of tube stock. Planting will be undertaken in areas that have been highly disturbed, with limited ability to naturally regenerate and/or require soil stabilisation.

Research undertaken by the University of New England advised the following:

- planting should be undertaken in the autumn months when there is good soil moisture;

- tube stock must be healthy, mature (at least 25 cm tall) and have a well-developed root system;
- mulch should be used as it improves survival and growth of tube stock seedlings, and should be applied at a depth of 10 cm and at least 30 cm from the base of planted seedling;
- tube stock should be planted to a depth that covers the root collar;
- tree guards should be used to control browsing; and
- watering should be conducted at time of planting as this assists with consolidation of soil around the roots.

University of New England research indicates that ants have a significant impact on seed banks and can impact regeneration from seed; therefore control measures will be implemented prior to any direct seeding activity. Table 12 lists the key planting activities to increase the likelihood of planting success.

Table 12 Key Planting activities

Activity	Minimum requirement
Species selection	Species selected are to be listed on the description of the vegetation communities issued by the NSW Scientific Committee or NSW government description. Seed can be collected from site or regionally from equivalent vegetation communities.
Cultivation	Cultivation for tube stock planting should be to a depth of 500-600mm at least 6 months prior to planting and when soil moisture is low to improve sub surface soil shatter. Cultivation for direct seeding may include light soil scarification.
Composted Mulch	A layer of at least 5cm of composted mulch may be applied prior to the application of translocated resources or planting of tubestock.
Preplant weed control	Chemical control of weeds at least 1 week prior to planting or seeding. An area of at least 1m diameter around each tree or seeding patch is to be sprayed to remove all competition for site resources.
Tube stock planting	Planting must only occur when there is suitable soil moisture, typically 1 -2 days after 25mm of rainfall, in spring or autumn. Tube stock is to be at least 25mm in height, with a well-established root system and in good condition. The tube stock root plug is to be saturated at the time of planting. Soil conditioner is to be applied into the planting hole and all plants should be planted deep, with their root plug at least 50mm below ground and gently firmed in to remove any air pockets in the soil. The spacing of tube stock planting may occur in rows or clusters to create appropriate shelter effects.
Direct seeding	Seed is to be free of weed seed. Seeding must only occur when there is suitable soil moisture, typically 1 -2 days after 25mm of rainfall, in spring or autumn. Control of ants prior to seeding to reduce the impact of seed removal.
Weed mat	Tube stocks are to have weed mats installed at the time of planting to provide longer term control of competition, where composted mulch cannot be applied or there is expected to a high level of competition.
Watering	Watering is to occur at the time of planting or seeding, and if required for 6 months post planting.
Maintenance	Maintenance period should apply for at least 18months, including post plant weed control.
Replanting	Where the survival of tubestock in less than 75% the area will be replanted.

4.2.3 Implementation and reporting

Seed collection activities in the BAs and mining areas commenced in 2013 and will continue in 2014, 2015 and 2016. Seed collected will target the key stone species for WSW from the ground, shrub and canopy layers.

Translocation of resources from WSW cleared from the mining area has commenced in 2014 and will continue into 2015.

Planting of 8,000 tubestock is scheduled for spring 2014, and approximately 15,000 in autumn 2015 and 2016.

All re-establishment activities are to be reported by Coal & Allied, including location, area, method and date. Information will be stored on and accessed via the online Biodiversity

Offsets Portal. An annual re-establishment project plan is to be prepared, this plan shall include:

- management areas
- prescription for each management area, including site preparation, species of tubestock and seed, spacing of tube stock, amount of seed and maintenance; and
- schedule of activities.

All re-establishment activities are dependent upon suitable climatic condition and may be postponed as required. If this occurs, weather records will be reported to support any delay in activities.

Survival assessments are to be completed at 3 and 6 month post planting to assess the success of tubestock planting and natural regeneration from the translocation of resources. The overall transition of the areas from grassland to woodland will be assessed by vegetation and habitat plots as part of the ecological monitoring programme. Details of the monitoring programme are provided in Section 5.

4.2.4 Performance and completion criteria

The following provides the Performance Criteria (PC) and Completion Criteria (CC) for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
2014 WS grassland re-establishment in Southern BA (39ha)	Translocation of salvaged resources, seed collection, propagation and planting completed in 2014. Ecological monitoring completed in 2014.	Monitoring of survival completed, replanting completed where required and planting 2014 planting completed if postponed due to climatic factors.	Ecological monitoring completed in 2016.	Ecological monitoring demonstrates a positive trend toward the reference site or the NSW Biometric HU600 for all attributes measured over three consecutive assessments (the average of all plots).
2014 WS grassland re-establishment in Northern BA (39ha)	Translocation of salvaged resources, seed collection, propagation and planting completed in 2014. Ecological monitoring completed in 2014.	Monitoring of survival completed, replanting completed where required and planting 2014 planting completed if postponed due to climatic factors.	Ecological monitoring completed in 2016.	Ecological monitoring demonstrates a positive trend toward the reference site or the NSW Biometric HU600 for all attributes measured over three consecutive assessments (the average of all plots).
2015 WS grassland re-establishment in Northern BA (157ha)	Translocation of salvaged resources, seed collection and tubestock propagation commenced in 2014.	Translocation of salvaged resources, seed collection, tubestock propagation and planting commenced in 2015.	Monitoring of survival completed, replanting completed where required and planting 2015 planting completed if postponed due to climatic factors.	Ecological monitoring demonstrates a positive trend toward the reference site or the NSW Biometric HU600 for all attributes measured over three consecutive assessments (the average of all plots).

4.3 Re-establishment of Ironbark woodland

This strategy outlines the active restoration approach for ironbark and exotic grassland to increase their vegetation condition, vegetation structure, species composition and regenerative capacity.

A total of 26.3ha of Ironbark grassland located in the Southern BA (within the Putty Road Offset Area) will be re-established, and activities are to commence in 2014. A re-establishment plan for the re-establishment of the 72ha of exotic grassland will be prepared in 2015 to increase the extent of the Ironbark communities and the adjoining Hunter Valley River Oak Forests in the southern point of the Southern BA that is intersected by Wollombi Brook.

4.3.1 Management Objective

To observe a transition of ironbark and exotic grassland to Central Hunter Grey Box – Ironbark woodland across the BAs over a period of 15 years.

4.3.2 Method

The re-establishment of these areas where possible will follow a shelter belt approach, with re-establishment activities confined to strips that run perpendicular to the prevailing wind direction. This approach aims to create micro climates that will encourage and support natural regeneration between the strips. This minimises the amount of disturbance to avoid damage to existing regeneration and enables natural and sustainable regeneration to occur between the strips.

All re-establishment activities are to occur when suitable climatic condition prevail. The following describes the key actions in the re-establishment of Ironbark woodland.

Seed collection and planting will follow the specifications and instructions provide in Section 4.2.2.

4.3.3 Implementation and reporting

Seed collection activities in the BAs will commence in 2014 and continue in 2015, 2016 and 2017. Seed collected will target the key stone species for Ironbark woodland from the ground, shrub and canopy layers.

Planting of tubestock is scheduled for in autumn 2016, 2017 and 2018.

All re-establishment activities are to be reported by Coal & Allied, including location, area, method and date. Information will be stored on and accessed via the online Biodiversity Offsets Portal. An annual re-establishment project plan is to be prepared, this plan shall include:

- management areas
- prescription for each management area, including site preparation, species of tubestock and seed, spacing of tube stock, amount of seed and maintenance; and
- schedule of activities.

All re-establishment activities are dependent upon suitable climatic condition and may be postponed as required. If this occurs, weather records will be reported to support any delay in activities.

Survival assessments are to be completed at 3 and 6 month post planting to assess the success of tubestock planting and natural regeneration from the translocation of resources. The overall transition of the areas from grassland to woodland will be assessed by vegetation and habitat plots as part of the ecological monitoring programme. Details of the monitoring programme are provided in Section 5.

4.3.4 Performance and completion criteria

The following provides the PC and CC for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
2015 Ironbark grassland re-establishment in Southern BA (26.3ha)	Seed collection and tubestock propagation commenced in 2014.	Re-establishment Plan prepared for Commonwealth by 3 February 2015. Seed collection, planting and monitoring of survival completed in 2015.	Seed collection, planting and monitoring of survival completed in 2016. Planting and Ecological monitoring completed in 2016.	Ecological monitoring demonstrates a positive trend toward the reference site or the NSW Biometric HU551 for all attributes measured over three consecutive assessments (the average of all plots).
2015 Exotic grassland re-establishment in Southern BA (72ha)	Re-establishment plan prepared in 2014.	Seed collection and tubestock propagation commenced in 2015.	Seed collection, planting and monitoring of survival completed in 2016. Ecological monitoring completed in 2016.	Ecological monitoring demonstrates a positive trend toward the reference site or the NSW Biometric HU551 for all attributes measured over three consecutive assessments (the average of all plots).

4.4 Quarry Rehabilitation trial

There is a disused sand quarry in the Southern BA, this area is to be rehabilitated and a small trial established to investigate the feasibility of rehabilitation of WSW, using the translocation of sub surface sand, topsoil and mulch salvaged from mining operations. The aim of the trial is to assess the effectiveness and feasibility of re-establishment methods for WSW on rehabilitation areas. Kleinfelder consultants prepared a Rehabilitation Plan, Warkworth Sands Woodland Quarry in December 2013 to guide this implementation of the trial.

4.4.1 Management Objective

To rehabilitate the 2.7ha quarry and establish a trial to guide best practice rehabilitation.

4.4.2 Method

The quarry void is to be filled with sub surface sand salvaged from mining operations; the sand will be shaped to create a natural land form. The sand depth would be on average 2m deep, with a minimum depth of 1m.

Soil treatments

A 5cm layer of composted mulch is to be applied; a small section will be left as sub surface sand only as a demonstration or control area. The two soil treatments to be assessed are:

- Topsoil and green mulch salvaged from mining operations, the top 10cm is to be stripped and applied at a depth of 5cm; and
- Composted mulch to a depth of 5cm only.

The green mulch is a product of mulching all standing vegetation from the area to be cleared for mining and will create another potential source of seed.

Vegetation treatments

The three revegetation treatments include:

- Nil (control)
- Direct seeding;
- Tubestock planting; and
- Direct seeding and tubestock planting.

A total of 32 plots (20m x 15m) will be established to provide 4 replicates; the following indicates the treatments by plots.

Compost + topsoil + green mulch	Plot 1 Control	Plot 2 Direct Seeding	Plot 3 Direct Seeding + Tubestock	Plot 4 Tube stock
Compost + topsoil + green mulch	Plot 5 Direct Seeding + Tubestock	Plot 6 Tube stock	Plot 7 Direct Seeding	Plot 8 Control
Compost + topsoil + green mulch	Plot 9 Direct Seeding	Plot 10 Control	Plot 11 Tube stock	Plot 12 Direct Seeding + Tubestock
Compost + topsoil + green mulch	Plot 13 Tube stock	Plot 14 Direct Seeding + Tubestock	Plot 15 Control	Plot 16 Direct Seeding
Compost	Plot 17 Control	Plot 18 Direct Seeding	Plot 19 Tube stock	Plot 20 Direct Seeding + Tubestock
Compost	Plot 21 Direct Seeding + Tubestock	Plot 22 Control	Plot 23 Direct Seeding	Plot 24 Tube stock
Compost	Plot 25 Direct Seeding	Plot 26 Tube stock	Plot 27 Direct Seeding + Tubestock	Plot 28 Control
Compost	Plot 29 Tube stock	Plot 30 Direct Seeding + Tubestock	Plot 31 Control	Plot 32 Direct Seeding

A wooden peg will be located in the north eastern corner of each plot and marked with the plot number, this point will also be recorded by GPS.

Direct Seeding

A native seed mix comprised of key stone WSW species are to be collected from local WSW or purchased from commercial seed supplier, approximately 10kg of seed will be used. Each of the 16 plots to be directed seeded will have 62.5 grams of seed applied.

Tubestock planting

Each plot is 0.03ha in size, and assuming a target stocking of 800 stems /per ha for canopy (400 stems/ha) and shrub / ground cover (400 stems/ha) a total of 24 tubestock are to be planted into each plot, Table 13 list the species and quantities. All tubestock are to be randomly but evenly spaced through the plot.

Table 13 List of tubestock species and quantities

Scientific Name	Common Name	Number of tubestock for each plot	Total number of tubestock
Canopy		12	192
<i>Angophora floribunda</i>	Rough-barked Apple	4	64
<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	Coast Banksia	4	64
<i>Eucalyptus blakelyi/tereticornis</i>	Forest Red Gum	4	64
Shrub /Groundcover		12	192
<i>Breynia oblongifolia</i>	Coffee Bush	3	48
<i>Grevillea montana</i>	-	3	48
<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle	3	48
<i>Dinaella revolute</i>	Blue Flax Lily	3	48
Total		24	384

Site preparation and planting are to follow the instruction and prescription provided in Section 4.2.2.

4.4.3 Implementation and reporting

Seed collection activities in the BAs have been completed in 2013 and 2014.

Planting of the trial is scheduled for spring 2014 or autumn 2015.

All plots will be assessed at 3 month post planting for survival of the planted tubestock. The floristic composition and vegetation growth parameters, as shown below, shall be measured on an annual basis for the duration of the trial (minimum five years). These parameters would be measured using a combination of 20m x 15m quadrats (i.e. size of each plot) and 2 m x 2 m quadrats; a total of five 2 m x 2 m quadrats would be placed randomly within each of the 20 m x 15 m plot. The plots are to be remeasured at year 1, 2 and 3 post planting.

Parameter	Survey Type	
	20 m x 15 m plot	2 m x 2 m quadrat
Plant species richness: total number of plant species	+	+
Plant species diversity: relative abundance of each plant species (using the Braun-Blanquet cover abundance scale)	+	
Average height of each stratum (overstorey, midstorey, shrub and ground)	+	+
Total number of plants (density)		+
Estimated % foliage cover		+
Reproductive status of each species (presence of flowers/fruit)	+	
Presence of exotic species	+	

All activities are to be reported by Coal & Allied, including location, area, method and date. Information will be stored on and accessed via the online Biodiversity Offsets Portal.

All activities are dependent upon suitable climatic condition and may be postponed as required. If this occurs, weather records will be reported to support any delay in activities.

4.5 Regrowth control

Very dense stands dominated by *Callitris* and *Allocasuarina* occur at sites with heavy disturbance, locking the vegetation community in an unnatural state. These stands prevent recruitment of other species and are unlikely to transition into the residual or unmodified condition states. Regrowth control or thinning of these stands will ensure that a diverse and sustainable woodland community is established with a similar structure, function and composition to the reference sites. The use of fire will be considered to create significant disturbance to ‘unlock’ these areas.

Permits under the *Native Vegetation Act 2003* will be required for thinning activities and therefore sound ecological evidence will be required to support this activity with EECs. Information collected through the monitoring programme will be used to better identify these areas and guide appropriate management activities to transition these areas into a higher condition state

4.6 Erosion control

Soil erosion occurs when native vegetation has been removed exposing bare soils, making them susceptible to erosion where water flow is able to mechanically remove or disperse the soil. This often occurs along creek lines but can occur in bare paddocks where vegetation clearing or over grazing exposes bare soils. Bare soils in locations where high volumes of water occur can lead to severe soil erosion.

4.6.1 Management Objective

To minimise the erosion of land, watercourses and water bodies within the BAs.

4.6.2 Method

There is some potential for erosion to occur within the BAs.

Management options for the erosion control include the exclusion of domestic stock grazing, controlling vehicle access, maintenance and rehabilitation of access tracks and rehabilitation of drainage lines and riparian areas, where required.

4.6.3 Implementation and reporting

Erosion within the BAs will be monitored through routine inspections by Coal & Allied and other observations recorded during the ecological monitoring.

Erosion issues identified via this monitoring and inspection process will be treated reactively to achieve the completion criteria.

4.6.4 Performance and completion criteria

The following provides the PC and CC for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
Annual inspections and reporting	Completed, erosion identified and ameliorative measures implemented	Completed, erosion identified and ameliorative measures implemented	Completed, erosion identified and ameliorative measures implemented	Annual reports completed

4.7 Weed control

Weed species are effective competitors for resources and have the potential to exclude native species from the landscape, resulting in changes in the composition and structure of plant communities. Control of weed species is critical to restoring the natural composition, diversity and structure of the ecological communities across the BAs.

Weeds are typically non-indigenous plants which invade areas after significant disturbance, such as land clearing or over grazing. They exclude native species from the landscape, leading to a change in the composition and structure of plant communities and degrade the condition and functionality of the ecosystems.

Weed control will focus on species that exclude or have the potential to exclude, native species, disrupt recruitment of native species or impede ecological processes. Priority will be given to declared noxious weed species under the *Noxious Weeds Act 1993* and environmental weeds listed in **Table 14**. These weeds were recorded in the BAs during previous inspections related to the annual weed control programmes.

Noxious weeds will undergo the recommended level of control in accordance with their control class (as per the *Noxious Weeds Act 1993*) and where available, the relevant regional weed management plan.

Table 14 Noxious and environmental weeds recorded in the BAs

Common name	Scientific Name	Control Class	Control Measures
African boxthorn	<i>Lycium ferocissimum</i>	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed
Creeping Pear	<i>Opuntia humifusa</i>	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Green Cestrum	<i>Cesrum parqui</i>	3	The plant must be fully and continuously suppressed and destroyed
Golden Dodder	<i>Cuscuta campestris</i>	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Mother-of-millions	<i>Bryophyllum delagoense</i>	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed
Pampas Grass	<i>Cortaderia spp.</i>	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed
Paterson's Curse	<i>Echium spp.</i>	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Prickly pear	<i>Opuntia spp.</i>	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Tiger Pear	<i>Opuntia aurantiaca</i>	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Willows	<i>Salix spp.</i>	4	The plant must not be sold, propagated or knowingly distributed
Galenia	<i>Galenia pubescens</i>	N/A	
Galvanized burr	<i>Sclerolaena birchii</i>	N/A	
Peppercorn Tree	<i>Schinus areira</i>	N/A	

Source: Narla Environmental, 2012

Noxious Weed Control Categories - 3: Regionally Controlled Weeds 4: Locally Controlled Weeds

4.7.1 Management Objective

To observe a decline in the abundance of noxious and environmental weeds across the BAs over a period of three years.

4.7.2 Method

The aim is to incorporate a variety of control methods and reduce the reliance on herbicides. This integrated weed management strategy will use of a range of suitable chemical and non-chemical control methods.

It is important to keep un-infested areas clear of weeds. Outbreaks in these areas will be a priority for intensive eradication and will be closely monitored to identify re-infestation or spread. Containment zones may be established around areas with high levels of infestation. Containment zones of 50m in width to surround the area, access to this area by vehicles will be restricted to control dispersal and spread.

The preferred control methods are described in **Table 15**. The detailed prescription for implementation will be developed in consultation with Coal & Allied and the Upper Hunter

Weeds Authority, the relevant agency responsible for administering the *Noxious Weeds Act 1993*.

Table 15 Weed Control Methods

Control Method	Potential use in control regime
<p>Biological Control – is a long term control technique and may require several years to become effective. This is a complementary strategy and alone it may not eradicate the weed.</p>	<p>Lantana Rust for Lantana Cochineal and Cactoblastis for Pricky Pear.</p>
<p>Herbicide Control – is the application of chemical to kill the weed by interfering in the plants growth processes.</p>	<p>Land based control only: Spot application of herbicide is the preferred method of application. Boom spray application is permissible in LMU3 as part of ground preparation for revegetation and in LMU4 for pasture establishment.</p> <p>Herbicides: Only registered herbicides should be used for the control of the weed species and used in accordance with the directions on the label. Users have a legal obligation to read and follow the instructions on the label. Where appropriate, selective herbicides will be used to minimise impacts on native vegetation.</p> <p>Handling and application: Herbicides must be handled and applied with consideration of their toxic nature and potentially harmful effects on human health, livestock and the environment. Only accredited and trained operators are permitted to apply herbicides. During application weather condition, nozzles, equipment and operator are to be closely monitored throughout application to reduce the risk of drift and subsequent off- target damage. Coarse to very coarse nozzles should be used to increase droplets size. Suitable weather conditions for spraying are extremely important.</p> <p><u>Weather guidelines</u></p> <ul style="list-style-type: none"> • Read the product label and follow all label instructions. • Spray when wind is steady and ideally 3–15 km/h. • Avoid variable or gusty wind conditions. • Avoid calm conditions - small droplets may remain suspended for long periods. • Spray when wind blows away from sensitive areas. • Avoid spraying in temperatures above 28 °C. • Aim to spray when Delta T is between 2 and 8 and not greater than 10. • Do not spray when inversion conditions exist. • Aim to spray when the atmosphere is neutrally stable. • Most chemicals require a rain free period – check the label. • Be aware of local topographic and convective influences on wind speed and direction. • Record on-site weather conditions at spray time. <p>For more detail please refer to www.bom.gov.au/info/leaflets/Pesticide-Spraying.pdf.</p> <p>Reporting: The Pesticides Regulation 2009 requires all commercial pesticide users (that includes farmers, leaseholders and spray contractors) to keep records on their pesticide application.</p>
<p>Land Management – good land management practices can reduce the incidence and impact of weeds.</p>	<p>Weed hygiene: Only weed-free seed is to be sown. All machinery is to be cleaned and washed down to reduce the spread of weed seed. Any sources of reinfestation around a weed free site will be removed.</p> <p>Weed Identification: Coal & Allied personnel and other key stakeholders visiting the BAs will be required to report any new infestation of weeds.</p>
<p>Manual removal – removal of the weed plant and roots from the site.</p>	<p>Physical removal of new weeds, unearthing of root systems and containment and removal of seed.</p>

The *Noxious and environmental weed control hand book* (<http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/noxious-enviro-weed-control>) may provide additional technical information.

4.7.3 Implementation and reporting

Coal & Allied is responsible for the development and implementation of weed management programmes within the BAs.

Coal & Allied is currently implementing *Weed Management Plan 2012 Green Offsets Area- Mt Thorley Warkworth* prepared by Narla Environmental in 2012. Toolijooa have been engaged to complete the 2014 annual plan works.

All control activities are to be reported by Coal & Allied, including locations, method, date, duration and type and quantity of herbicide applied, reports will be accessible from the Biodiversity Offset Portal.

The impact of weeds will be observed through the monitoring programmes. This information will be used to monitor the success of the control methods.

4.7.4 Performance and completion criteria

The following provides the PC and CC for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
Weed control programme	Weed control programme implemented and results reported	Weed control programme revised (if necessary) based on previous year's results.	Weed control programme revised (if necessary) based on previous year's results.	Weed control programmed completed each year.
	Ecological monitoring data collected.	Control programme implemented and reported	Control programme implemented and reported. Ecological monitoring data collected.	Ecological monitoring data indicates an increase in the % of native ground cover grasses and shrubs in all plots over three consecutive assessments.

4.8 Vertebrate pest control

Vertebrate pests pose a threat to native fauna through competition for habitat resources, degradation of habitat and direct predation. There are legal obligations to control pest animals under the *Rural Lands Protection Act 1998*. Listed animals for control observed across the BAs include wild dog, foxes and rabbits.

Vertebrate Pests recorded in the BAs by the surveys include the House Mouse, Black Rat, Feral Cat, Wild Dog, Red Fox, Pig, Deer, Brown Hare and European Rabbit.

Vertebrate pests pose a threat to native fauna through competition for habitat resources and direct predation. Predation by the fox and feral cat are listed in Schedule 3 of the TSC Act as key threatening processes. In addition to foxes and feral cats, wild dogs have also been found to predate on native fauna.

Predation by animal pests such as the fox, feral cat and wild dog threatens a number of native fauna species including threatened species (e.g. Speckled Warbler, Grey-crowned Babbler and Squirrel Glider) (Gardner, 2002; Davidson and Robinson, 1992; NPWS, 1999). In addition, the occurrence of rabbits has been found to influence fox abundance. Where rabbit numbers are high, fox populations generally thrive and conversely when rabbit numbers drop, fox populations often decline (Williams *et. al*, 1995). Rabbit control is therefore also important.

4.8.1 Management Objective

To observe a decline in the abundance of vertebrate pest populations and evidence of damage across the BAs over a period of three years.

4.8.2 Method

An annual vertebrate pest animal control programme has been developed by Coal & Allied in conjunction with the Hunter Local Land Services (HLLS) for the BAs. Target pest species include wild dogs, foxes and rabbits.

Control methods include sandpad monitoring and baiting. Other methods may also be considered provided they are:

- species specific (wherever possible);

- cause no or little damage to the natural environment;
- are humane;
- meet relevant Work, Health, Safety and Environment regulatory requirements; and
- are regularly monitored.

4.8.3 Implementation and reporting

Coal & Allied is responsible for the development and implementation of vertebrate pest management programmes within the BAs.

Vertebrate pest control activities have commenced and will continue to control vertebrate pests across all BAs.

Records of all control activities are to be maintained by Coal & Allied, including locations, method, date, duration and type, and will be stored on the Biodiversity Offset Portal.

The impact of vertebrate pests will be observed through the monitoring programmes. This information will be used to monitor the success of the control methods.

4.8.4 Performance and completion criteria

The following provides the PC and CC for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
Pest control and monitoring	At least one control period complete. Report complete and recommendations followed.	At least one control period complete. Report complete and recommendations followed.	At least one control period complete. Report complete and recommendations followed.	All control events completed and reported
Habitat Quality	Ecological monitoring completed.		Ecological monitoring completed	Ecological monitoring data indicates an increase habitat quality attributes in all plots over three consecutive assessments.

4.9 Access and infrastructure improvement

Construction of new or maintenance of existing infrastructure (such as access/fire tracks, fences or gates) will be required to implement the conservation management strategies described, undertake monitoring programmes and provide safe access for Coal & Allied personnel, consultants and contractors.

Maintenance and construction activities may cause localised site disturbance. To protect biodiversity and cultural heritage values, the Coal & Allied Ground Disturbance Permit (GDP) process will be followed to ensure compliance with all legal and environmental protection measures.

Maintenance of fence lines is necessary to maintain security to the BAs and to exclude domestic stock from the BAs.

4.9.1 Management Objective

To maintain and construct where necessary, infrastructure that supports the implementation of the OMP, principally access for management and emergency purposes and fences to maintain security, with minimal impact on biodiversity values, erosion control measures and compliance with regulatory requirements.

4.9.2 Method

The following are the permissible actions and guidelines for the construction or maintenance of infrastructure, such as access/fire trails, fences, stockyards, water troughs and pipes:

- Vegetation clearing is permissible, as per the Native Vegetation Regulation 2013 for central regions, for:
 - (a) permanent boundary fence - ten metres either side;

- (b) permanent internal fence - ten metres total width of clearing;
 - (c) temporary fence - three metres total width of clearing; or
 - (d) road or track - six metres total width of clearing.
- constructed fences will be stockproof and native fauna friendly (no barb wire is to be used for the top two wire strands);
 - fallen timber and any other obstructions can be removed to maintain access;
 - standing timber that poses an unacceptable safety risk can be felled;
 - all works will be undertaken in a manner that minimises disturbance to soil and hydrological characteristics, and avoids erosion, as per OEH guidelines *Erosion and sediment control on unsealed roads* (OEH 2012);
 - old fences will be removed and unwanted tracks closed within the Offset Area; and
 - site disturbance may be required to facilitate revegetation activities.

4.6.3 Implementation and reporting

The Coal & Allied Ground Disturbance Permit (GDP) checklist will be adopted to ensure compliance with all legal and environmental protection measures prior to any significant disturbance.

A description of the activity is to be provided to Coal & Allied and work cannot commence until checklist is completed and approved.

The GDP checklist considers the impact of the disturbance on:

- cultural heritage – search relevant sources to determine their presence;
- land ownership and tenement – ensure action is located on land owned or managed by Coal & Allied;
- environment – search relevant sources to identify presence of listed ecological communities, flora or fauna;
- regulatory approval – legal authority for the action;
- rehabilitation – requirement for rehabilitation; and
- water – potential water impacts and mitigation.

All infrastructure improvements will be recorded to Coal & Allied via the quarterly audits. All relevant information will be stored and revised geographic information layers will be accessed by the online Biodiversity Offset Portal.

Routine inspections and maintenance of infrastructure (access/fire tracks, fence lines and gates) will be undertaken to ensure they are to standard and fit for purpose.

4.9.3 Performance and completion criteria

The following provides the PC and CC for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
Map access track and fences	Data collected and saved on to Portal	Data layer revised.	Data layer revised.	All data accessible from Biodiversity Offset Portal.
Tracks and fences provide appropriate access and protection.	Complete annual inspection and report all works completed.	Complete annual inspection and report all works completed.	Complete annual inspection and report all works completed.	

4.10 Fire management

Bushfire prevention is required under the *Rural Fires Act 1997*. The absence of fire and the reduction of livestock grazing will lead to a build-up of fire fuel and risk of high intensity bushfire. Coal & Allied, as the owner, is required to take practicable steps to prevent the occurrence of bush fires on the land and minimise the spread of bushfire.

Coal & Allied has prepared a Bushfire Management Plan for the MTW mine site which identifies fire risks, control measures and communication procedures.

The quick identification of a threatening bushfire, notification of the Rural Fire Service and suppression is the primary goal.

4.10.1 Management Objective

To protect lives, biodiversity values and infrastructure assets from the impacts of bushfires.

4.10.2 Methods

Key control measures will focus on:

- documentation of access and water supply points for suppression activities;
- maintain access for fire suppression activities;
- security and controlling access;
- use of slashing to reduce fuel build-up along potential ignition sources, such as public roads, prior to the fire season;
- use of cool burns (with any required approvals and/or permits from Rural Fire Service) to reduce fuel build-up to protect biodiversity and nested conservation values;
- establishment of asset protection zones around priority infrastructure;
- investment in water and other fire suppression assets; and
- communication of Bushfire Management Plan and response procedures with key stakeholders, including Leaseholders, neighbours, consultants, contractors and employees.

Any fuel hazard reduction burns will be planned in accordance with the *Bush Fire Environmental Assessment Code for New South Wales* (NSW Rural Fire Service, February 2006) and the guidelines contained in the Threatened Species Hazard Reduction Lists for the Bush Fire Environmental Assessment Code.

Current recommendations under the Code are:

- in woodland vegetation, fire should not occur within 5 years of a previous fire and consideration should be given to burning within 40 years of any previous fire; and
- in grassland vegetation derived from the woodland vegetation, the recommended fire intervals are the same as woodland vegetation.

4.10.3 Implementation

Annual meetings will be held between Rural Fire Service and Coal & Allied to review the Bushfire Management Plan and prepare the annual actions list to prepare for the proceeding fire season.

4.10.4 Performance and completion criteria

The following provides the PC and CC for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
Bushfire Management Plan for MTW (including BAs)	Actions implemented Annual review	Actions implemented Annual review	Actions implemented Annual review	All actions implemented BFMP reviewed annually

4.11 Waste management

Previous landowners of the BA properties had created small rubbish dumps and/or former agriculture infrastructure or equipment had become dilapidated, broken down or collapsed within the BAs.

4.11.1 Management Objective

Improve / enhance BAs through the management and removal of waste.

4.11.2 Methods

Location of significant areas of waste or disused agricultural infrastructure is to be mapped and when appropriate the waste or structure will be removed. Disused houses will remain unless they cause significant health or safety issues.

Any material that is recyclable (i.e. scrap steel) or would be classed as “General Solid Waste – Non-putrescible” and may be taken to the Singleton or Upper Hunter Council waste depots.

If any rubbish was not to be classified as “General Solid Waste – Non-putrescible”, then Coal & Allied would assess the waste in accordance with the Waste Classification Guidelines (OEH) and dispose of the material appropriately.

4.11.3 Performance and completion criteria

The following provides the PC and CC for this strategy; the monitoring programme described in Chapter 5 will collect the relevant data to measure success.

	Year 1 PC	Year 2 PC	Year 3 PC	CC
Locate significant areas of waste or structures for removal	Mapping completed and uploaded to Portal.	Implement removal and report.	Implement removal and report.	All areas and structures removed.
Remove reported dumped rubbish	Action and remove any dumped rubbish reported	Action and remove any dumped rubbish reported	Action and remove any dumped rubbish reported	No dumped rubbish

4.12 Habitat augmentation

Habitat augmentation involves the establishment and enhancement of habitat sites for specific threatened fauna species within the BAs. This may include opportune relocation of hollow bearing trees, hollow logs and other habitat features such as rocks from disturbance areas, as well as the installation of nest boxes within the BAs. Three habitat ponds were constructed in 2009 to increase habitat complexity within the Green Offsets and these are shown in Figure 5.

Where the ecological monitoring indicates the requirement for habitat augmentation, the installation of additional habitat ponds and/or installation of nesting boxes will be included in the schedule for infrastructure improvements.

4.13 Grazing

Stock allowed free and uncontrolled access to woodland vegetation can limit the regeneration of native plants and alienate middle and understorey vegetation.

Stock grazing currently occurs on land to the south of Putty Road, grazing will be removed from these areas to support the implementation of the re-establishment of these exotic grasslands.

Grazing will be excluded for all other areas of the Southern and Northern BAs. Grazing to control fire risks maybe used and when this is proposed it will be reported prior to commencement of grazing.

4.14 Salinity management

There are no significant areas that are impacted by salinity. Should any areas be observed through the monitoring programme and appropriate mediation works will be installed when required.

4.15 Cultural Heritage

Cultural heritage sites or values identified have been recorded and managed to ensure their protection. Any new sites identified will be managed in accordance with legislation and company policy to guide the protection of and interaction with the sites across the BAs. These include the *Rio Tinto Coal Australia Cultural Heritage Management System* and the NSW OEH *Due Diligence Code of Practice for the Protection of Aboriginal Objects*.

The Wollombi Brook Aboriginal Cultural Heritage Conservation Area is to be secured for protection under a legally binding mechanism, which maybe under the one a biobanking

agreement under the TSC Act for the Offset Areas in Southern BA. Coal & Allied will encourage local Aboriginal groups to be involved in the management of BAs where appropriate. Prior to any works in the BAs associated with the Local OMP, Coal & Allied will consult the *Rio Tinto Coal Australia Cultural Heritage Management System* to ensure all management activities in the BAs are conducted in a manner consistent with the *Rio Tinto Coal Australia Cultural Heritage Management System*.

The location and information relating to cultural heritage sites will be stored and accessed from the online Biodiversity Offsets Portal.

5 Monitoring Programme

5.1 Monitoring Approach and Frequency

The monitoring programme comprises three components to capture environmental change at different scales:

- Landscape monitoring: to assess vegetation changes and habitat connectivity at the landscape scale in the long-term (7-10 years);
- Ecological monitoring: Vegetation and bird assemblage to quantify changes in vegetation structure, key fauna habitat features and bird assemblages in the medium-term (biennially); and
- Restoration monitoring: Rapid Condition Assessments to identify threats and inform management activities consistent with the adaptive management approach in the short term (annually) and survival assessments to assess the performance of planting activities.

The frequency of monitoring activities will vary according to the monitoring schedule provided in **Table 16**. To enhance the understanding and knowledge of all key stakeholders in the management of the BAs, Coal & Allied representatives, where feasible, will accompany the Biodiversity Auditors during the field based components of this monitoring programme.

All monitoring results will be stored and accessible on the Biodiversity Offsets Portal.

Table 16 Monitoring Schedule

	2013	2014	2015	2016	2017	2018	2019	2020
Landscape								
Aerial photo analysis	X							X
Ecological								
Vegetation		Sept-Nov		Sept-Nov		Sept-Nov		Sept-Nov
Bird Assemblage		July-Aug		July-Aug		July-Aug		July-Aug
Restoration								
Rapid Condition Assessment	Sept	Sept	Sept	Sept	Sept	Sept	Sept	Sept
Survival Assessment		3 and 6 month post planting						

5.2 Landscape Monitoring

Aerial photographic imagery will be updated every 7-10 years. This imagery will be analysed and the findings ground-truthed to assess the extent of canopy regeneration within the BAs.

The analysis of tree canopy cover and condition assessments (RCA section 5.4) will be used to map changes in the distribution of woodland habitats and the connectivity of vegetation remnants. An increase in the condition of woodland habitats will be indicative of successful management of the BAs towards the Key Performance Indicators.

5.3 Ecological Monitoring

Vegetation, habitat and bird assemblage monitoring will be undertaken across the Southern and Northern Biodiversity Areas and will be associated with the Warkworth Sands Woodland and Central Hunter Grey Box – Ironbark Woodland (CHGBIW) re-establishment activities.

The objectives of the vegetation, habitat and bird assemblage monitoring are to:

- demonstrate changes in vegetation community composition, structure and habitat features in the Transformation sites towards the Reference sites;
- demonstrate changes in vegetation composition, structure and habitat features towards the BioBanking Vegetation Benchmarks;
- demonstrate recruitment of canopy species through transition up age classes (measured as Diameter at Breast Height (DBH));
- demonstrate ongoing habitat usage by woodland birds and a decrease in the relative abundance of bird species typical of forest margins and grasslands; and
- assess the presence of Swift Parrot and Regent Honeyeater within the BAs and collect information regarding their movements and habitat usage.

5.3.1 Vegetation and habitat monitoring

Twenty four vegetation monitoring plots will be established across the Southern and Northern Biodiversity Areas to monitor the condition of woodland reference sites and grassland transformation sites. **Table 17** lists the plots that have already been established and the addition plots to be established in 2014.

The first complete survey of all 24 plots will be conducted during late spring/early summer 2014 and subsequent surveys will be biennial (every two years).

The monitoring programme will assess changes in key attributes within the BAs through time and relative to the benchmark values presented in the Biometrics Vegetation Types Database (OEH, 2012). These benchmark values relate to species richness and percent cover of native plants in the various vegetation layers as well as counts of tree hollows and the length of fallen timber. Additional habitat features will also be included in this monitoring programme to track canopy regeneration and health.

5.3.1.1 Field Methods

Twenty four vegetation monitoring plots will be established across the Southern and Northern Biodiversity Areas, according to the following breakdown:

Table 17 Vegetation monitoring plots

Biodiversity Area		Plot established	Plot to be established	Total
Southern BA	WSW - reference plots	3	1 (WSW Offset area)	4
	WS Grasslands - 3 transformation plots	3	1	4
	Central Hunter Grey Box Ironbark Woodland - reference plots		3	3
	Central Hunter Grey Box Ironbark Grassland - transformation plots		3	3
Northern Biodiversity Area	WSW - reference plots	2	2	4
	WS Grasslands -transformation plots	2	2	4
	Central Hunter Grey Box Ironbark Woodland - reference plots		1	1
	Central Hunter Grey Box Ironbark Grassland - transformation plots		1	1
Total		10	14	24

The field methods will follow the 'Field methodology for measuring condition variables for Site Value and at Reference Sites' according to the Biometric 3.1 methods (Department of Environment, Climate Change and Water, 2011). In addition, more detailed data will be collected on species composition and cover abundance, canopy regeneration and health, habitat features and soils as outlined below.

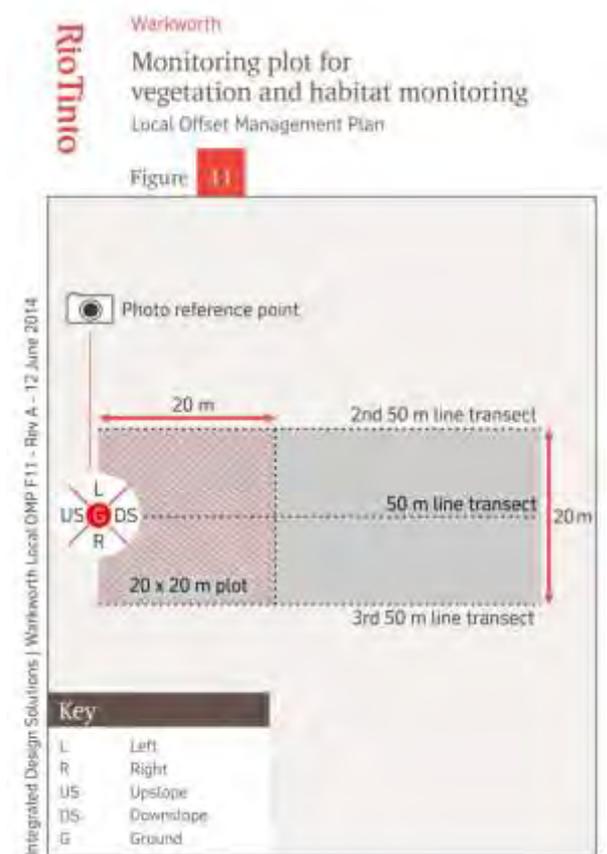
The plot will be 50m x 20m and will be established such that the plot runs downslope. A 20m x 20m quadrat will be positioned within this larger plot and three 50m transects will run its length (0). Where possible, four marker pegs will be used to establish a permanent plot position. GPS coordinates are taken to ensure monitoring plots can be relocated over time.

The 50m x 20m plot will be used to record details of the over-storey (canopy) layer including species composition, species richness, canopy regeneration and canopy health. The % foliage cover directly overhead for canopy species and presence of specific habitat features, such as the abundance of tree hollows, flowers/fruit, mistletoe and fallen logs will also be recorded at this scale

The 20m x 20m quadrat will be used to record details of the mid-storey and ground stratum composition and structure. All plant species will be identified and a cover abundance ranking assigned to each species using a modified Braun-Blanquet cover abundance ranking (Braun Blanquet 1928). The % cover of native/exotic species for various structural layers/plant groups will be estimated and additional habitat features such as rocks, litter and bare ground will also be recorded at this scale.

Three 50m transects will be used to assess the total % foliage cover of the over-storey. These data will be collected at 10 points (i.e. at every 5m) along the length of the transects.

Further details of the field sampling methods, including a table summarising the attributes (measurements) that will be recorded, their unit of measurement and the sampling unit are provided in Appendix C. To ensure consistency and completeness of monitoring data, field data sheet templates have been created and will be stored on the Biodiversity Offsets Portal and all data will be uploaded to the Portal following a monitoring event.



5.3.1.2 Photo Reference Points

A photo reference point also will be established and permanently marked within each habitat monitoring plot. Photo reference points will be established at the top of the middle 50m transect (0). During each monitoring event, a series of photos will be taken from this point to provide a visual record of any changes in vegetation and habitat condition.

Depending of the location of the monitoring plot, this might include:

- changes in vegetation structure (e.g. presence/ absence of canopy species, shrubs, tussock grasses);
- the presence/condition of special habitat features (e.g. rock outcrops, flowering/fruited species); and
- changes in identified threatening processes (e.g. weed infestations, erosion).

At each photo reference point, a minimum of five photos will be taken, in the following directions:

- downslope;
- upslope;
- across the slope – left (when facing downslope);
- across the slope – right (when facing downslope); and
- directly down.

The photo records will be displayed on the Biodiversity Offsets Portal such that monitoring photos can be viewed against earlier years. This will provide an ongoing and gradual visual record of changes in habitats as the management strategies are implemented as well as changes in existing threats and early warning of emerging threats at monitoring sites.

5.3.1.3 Soil analysis

Soil samples will be undertaken using standard soil sampling techniques with a core sampler within the monitoring quadrat. At least 12 cores will be taken at each site and bulked together. Soil analysis will consist of assessing the parameters, pH, EC, Available Ca, Mg, K, ammonia, sulphur, organic matter, exchangeable Na, Ca, Mg, K, H, Al, cation exchange capacity, available and extractable phosphorus, micronutrients (Zn, Mn, Fe, Cu, B), total carbon and nitrogen. Exchangeable Sodium Percentages are to be calculated as a measure of sodicity or dispersion.

Results of key parameters such as pH, electrical conductivity, organic matter, phosphorous, nitrate, Cation Exchange Capacity and Exchangeable Sodium Percentages are used as primary indicators of the suitability of the soil for native vegetation within the monitoring site.

5.3.2 Bird Assemblage Monitoring

Birds are typically abundant and widespread taxa whose populations are easily surveyed. Although they are relatively mobile, many species can show specialisation in their habitat requirements. Patterns in the distribution and abundance of bird assemblages can be indicative of biodiversity as a whole and of environmental change. Accordingly, bird assemblages will be monitored as indicators of general ecosystem condition.

A two ha area will be surveyed for 20 minutes by two observers at 12 of the vegetation monitoring plot locations. Habitat area searches will be conducted in accordance with Birdlife Australia (formerly Birds Australia) Atlas search methodology (Birdlife Australia 2013) and EPBC Act bird survey guidelines (DEWHA 2010). This method involves searching a set area and recording data only from within the pre-defined search zone.

Incidental and opportunistic surveys will also be conducted where suitable habitat areas for the migratory woodland birds are observed when travelling to and between monitoring sites. All opportunistic sightings of these species and their locations will be recorded. General notes and important habitat resources such as tree hollows, flowering trees and nests will be recorded incidentally and photographed, as will any notable bird activities such as specific forage behaviour or signs of breeding activity.

5.3.3 Data Analysis and Interpretation

To assess the success of the management activities in meeting the Key Performance Indicators, data on vegetation, fauna habitats and bird assemblages will be analysed against the predicted changes in these groups associated with implementation of the management strategies.

Univariate and multivariate techniques will be used to analyse and visualise patterns in the data and may include:

- Analysis of Variance (ANOVA): to test for changes in univariate data including species richness, abundance of specific habitat features, % cover vegetation structural layers;
- Distance-based permutational Analysis of Variance (Anderson, 2001; 2004) based on Bray-Curtis dissimilarities: to test for changes in multivariate data including fauna and plant community composition;

- Graphs and charts: to summarise patterns in univariate data and visualise changes in variables relative to the reference condition (medium-high quality woodland); and
- Non-metric Multidimensional scaling and SIMPER analyses: to summarise patterns in multivariate data, visualize changes in the data relative to the reference condition and assist in ecological interpretation of the results.

Analysis of the baseline data will assess difference in fauna assemblages, habitats and vegetation condition between grasslands and woodlands across the BAs. It is expected that in subsequent years, with the progressive improvement in vegetation condition, the ecological data analysis will eventually show a convergence of ecological variables to that of the reference woodland. This is expected to be a medium to long-term upward trend that will reflect the regeneration of grassland areas to woodland and the development and availability of critical fauna habitat features such as hollows, ground debris and forage resources. By demonstrating this convergence through time, it will be inferred that the proposed conservation management strategies have been successful in restoring the lower quality vegetation and fauna habitats towards the reference condition.

5.4 Restoration monitoring

5.4.1 Rapid Condition Assessment

A RCA of mature and regrowth vegetation is to be undertaken on an annual basis according to the following methodology. These assessments will complement the inspections and reporting associated with the conservation management strategies outlined in **Chapter 4** to provide regular feedback on the effectiveness of management strategies and inform ongoing management decisions such as;

- weed control - new or significant changes to noxious weed infestations and control activities;
- pest animal control - damage or presence of feral pest animal and control activities; and
- Fire management - fire fuel hazard assessments and control activities; and
- Habitats - presence or absence of key habitat components.

The RCA requires answering true or false to a series of questions, with a tally of the “True” scores indicating woodland health. Where answers are false, improved management in these areas may be required. Sites scoring 16 - 20 “trues” are generally considered to be areas of healthy vegetation that are sustainable under current management. Sites scoring 10 - 15 “trues” are generally considered to be areas of moderately disturbed bushland that have key elements missing and need improved management. Scores lower than 10 are highly disturbed and have many key elements missing. They are generally unsustainable under the current management and require improved management. These RCA attributes are listed in **Table 18** with an example score for relatively undisturbed woodland.

Table 18 Rapid Condition Assessment attributes

Remnant attribute	Site
Low grazing intensity - never farmed	True
Tree and shrub regeneration present (<2m)	True
Infrequent fire regime (<5year intervals)	True
Healthy mature trees (no dieback)	False
Little to no evidence of rabbits	True
Little to no evidence of foxes/cats	True
Low abundance of weeds (most remnants contain some weeds)	True
No evidence of firewood collection	False
No obvious signs of erosion or salinity	True
Not susceptible to fertiliser application, herbicide or pesticide drift	True
Less than 20% trees with Mistletoe (NB some mistletoe is healthy)	True
Few tracks, trails or fence lines	True
Presence of native shrubs	True

Remnant attribute	Site
Presence of large, old growth trees with hollows	True
Dead timber is left standing	True
Fallen timber and logs are left on the ground	True
Abundance of native ground flora	True
Presence of litter, cryptogams, cracks and rocks	True
Remnant is large (> 5ha is optimum)	True
Connected to or in close proximity to other remnant vegetation	True
Total No. True answers (x/20)	18/20

There are 10 collocated RCA and photo monitoring plots and 9 photo monitoring plots that will be measured annually.

5.4.2 Survival Assessment

To assess the survival of planted tubestock and observe regeneration a 50m line transect will be used and 2m x 2m quadrat every 10m along the transect. One transect will be established to assess every 10ha of re-establishment.

Along the 50m transect number of dead and living tubestock will be recorded. Within the 2m x 2m quadrats at every 10m the following is to be recorded:

- Number of native plants regenerating;
- Number of weed species; and
- Record any erosion.

The starting point and end point of each transect is to be recorded by GPS.

6 Conclusion

The Local OMP is the framework document for effective conservation and restoration of the BAs. It documents:

- Objectives, Performance Criteria and Completion Criteria
- Conservation management strategies; and
- Monitoring programme, for the WSW offset and surrounding Biodiversity Areas.

Table 19 identifies the key risks to the Local OMP, the contingency measures in place and the relevant section that addresses these risks. The table identifies the key responsible person and the components of the monitoring programme aimed to observe the presence or impacts of the risk. This adaptive management approach to risk and contingency management is made effective by the monitoring programme, communication between relevant stakeholders and the implementation of conservation management strategies.

Table 19 Risk and Contingency Assessment Matrix

Risk	Description of risk	Contingency Measure	Reference in OMP	Key responsible person	Monitoring Programme
Weed Incursion	Vehicles spreading weeds	Control of access. Weed hygiene.	Weed Control Method (section 4.7) Table 8 Weed Control Methods	Coal & Allied UHWA All visitors to the MTW and BAs	Monitoring (section 5)
Pest Animals	High populations of pest animals restricting native plant regeneration or growth.	Annual control of pest animals and monitoring impacts.	Pest animal control (section 4.8)	Coal & Allied Contractor	Monitoring (section 5)
Fire	Wildfire entering the WSW Offsets.	Implementation of annual Bushfire Management Plan	Fire management (section 4.10)	Coal & Allied RFS	
	Increases fire intensity due to higher fuel loads	Implementation of annual Bushfire Management Plan	Fire management (section 4.10)	Coal & Allied RFS	Monitoring (section 5)
Herbicide Drift	Chemical spray drift.	Follow government regulations and only spray in variable weather conditions. Use alternative weed control measures where practical (e.g. Biological control)	Weed Control (section 4.7)	Coal & Allied Weed control contractors	Monitoring (section 5)
Vegetation Management	Removal or clearing of native vegetation, including dead timber and live plants.	Clearing of vegetation for essential infrastructure will adhere to relevant legislation.	Access and Infrastructure improvement (section 4.9)	Coal & Allied	Monitoring (section 5)
Drought	Impact on active restoration	Action to be undertaken with appropriate climatic conditions	Method (section 2.2)	Coal & Allied	Monitoring (section 5)

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Appendix A – Species list and photo points from 2013 vegetation monitoring data

Reference Plot 1		Reference Plot 2		Reference Plot 3		Reference Plot 4		Reference Plot 5	
Native	Exotic	Native	Exotic	Native	Exotic	Native	Exotic	Native	Exotic
<i>Eucalyptus crebra</i>	<i>Opuntia humifusum</i>	<i>Angophora floribunda</i>	<i>Opuntia humifusum</i>	<i>Eucalyptus tereticornis</i>	<i>Opuntia humifusum</i>	<i>Eucalyptus crebra</i>	<i>Opuntia humifusum</i>	<i>Angophora floribunda</i>	<i>Opuntia aurantiaca</i>
<i>Allocasuarina luehmannii</i>	<i>Melinis repens</i>	<i>Callitris endlicheri</i>	<i>Melinis repens</i>	<i>Acacia filicifolia</i>		<i>Eucalyptus tereticornis</i>	<i>Opuntia aurantiaca</i>	<i>Allocasuarina luehmannii</i>	<i>Melinis repens</i>
<i>Acacia longissima</i>	<i>Richardia stellaris</i>	<i>Acacia filicifolia</i>	<i>Taraxicum officinale</i>	<i>Banksia integrifolia</i>		<i>Cassinia arcuata</i>	<i>Galenia pubescens</i>	<i>Melichrus urceolatus</i>	<i>Hypochaeris radicata</i>
<i>Breynia oblongifolia</i>	<i>Senecio madagascariensis</i>	<i>Breynia oblongifolia</i>	<i>Senecio madagascariensis</i>	<i>Breynia oblongifolia</i>		<i>Aristida ramosa</i>	<i>Bidens pilosa</i>	<i>Hibbertia linearis</i>	<i>Senecio madagascariensis</i>
<i>Brachyloma daphnoides</i>	<i>Eragrostis curvula</i>	<i>Brachyloma daphnoides</i>	<i>Bidens pilosa</i>	<i>Melaleuca thymifolia</i>		<i>Cymbopogon refractus</i>	<i>Lycium ferocissimum</i>	<i>Pteridium esculentum</i>	<i>Petrorhagia nanteuillii</i>
<i>Hibbertia linearis</i>		<i>Hibbertia linearis</i>	<i>Cynoglossum australe</i>	<i>Hibbertia linearis</i>		<i>Cynodon dactylon</i>	<i>Senecio madagascariensis</i>	<i>Pimelea linifolia</i>	<i>A cetosella vulgaris</i>
<i>Grevillea montana</i>		<i>Grevillea montana</i>	<i>Cyperus aggregatus</i>	<i>Pimelea linifolia</i>		<i>Entolasia marginata</i>	<i>Melinis repens</i>	<i>Chrysocephalum apiculatum</i>	
<i>Acacia amblygona</i>		<i>Notelaea microcarpa</i>	<i>Heliotropium amplexicaule</i>	<i>Allocasuarina luehmannii</i>		<i>Paspalum distichum</i>	<i>Cotula australis</i>	<i>Commelina cyanea</i>	
<i>Cheilanthes sieberi</i>		<i>Banksia integrifolia</i>	<i>Opuntia aurantiaca</i>	<i>Solanum prinophyllum</i>		<i>Solanum prinophyllum</i>		<i>Glycine clandestina</i>	
<i>Pomax umbellata</i>		<i>Pteridium esculentum</i>	<i>Lepidium bonariense</i>	<i>Pteridium esculentum</i>		<i>Microlaena stipoides</i>		<i>Ajuga australis</i>	
<i>Dianella revoluta</i>		<i>Cheilanthes sieberi</i>	<i>Stellaria media</i>	<i>Pomax umbellata</i>		<i>Commelina cyanea</i>		<i>Imperata cylindrica</i>	
<i>Commelina cyanea</i>		<i>Veronica plebeia</i>		<i>Cheilanthes sieberi</i>		<i>Cheilanthes sieberi</i>		<i>Oxalis perennans</i>	
<i>Chrysocephalum apiculatum</i>		<i>Entolasia marginata</i>		<i>Oxalis perennans</i>		<i>Oxalis perennans</i>		<i>Lomandra multiflora</i>	
<i>Einadia trigonos</i>		<i>Einadia trigonos</i>		<i>Commelina cyanea</i>		<i>Einadia trigonos</i>		<i>Glycine tabacine</i>	
<i>Glossocardia bidens</i>		<i>Oxalis perennans</i>		<i>Aristida vagans</i>		<i>Aristida vagans</i>		<i>Themeda australis</i>	
<i>Glycine tabacina</i>		<i>Glycine clandestina</i>		<i>Cynodon dactylon</i>				<i>Cymbopogon</i>	

Reference Plot 1		Reference Plot 2		Reference Plot 3		Reference Plot 4		Reference Plot 5	
Native	Exotic	Native	Exotic	Native	Exotic	Native	Exotic	Native	Exotic
								<i>refractus</i>	
<i>Glycine clandestina</i>		<i>Pimelea linifolia</i>		<i>Notelaea microcarpa</i>				<i>Fimbristylis dichotoma</i>	
<i>Lomandra longifolia</i>		<i>Imperata cylindrica</i>		<i>Einadia trigonos</i>				<i>Laxmannii gracilis</i>	
<i>Lomandra glauca</i>		<i>Aristida ramosa</i>		<i>Hypoxis hygrometrica</i>				<i>Wahlenbergia graniticola</i>	
<i>Laxmannia compacta</i>		<i>Calandrinia balonensis</i>		<i>Angophora floribunda</i>					
<i>Stylidium eglandulosum</i>		<i>Lomandra multiflora</i>		<i>Aristida ramosa</i>					
<i>Oxalis perennans</i>				<i>Imperata cylindrica</i>					
<i>Cymbopogon refractus</i>				<i>Brachychiton populneus</i>					
<i>Echinopogon caespitosus</i>				<i>Paspalum distichum</i>					
<i>Imperata cylindrica</i>									
<i>Aristida ramosa</i>									
<i>Lomandra multiflora</i>									
<i>Eragrostis brownii</i>									
<i>Aristida vagans</i>									
<i>Panicum simile</i>									
<i>Cynodon dactylon</i>									

Transformation Plot 1		Transformation Plot 2		Transformation Plot 3		Transformation Plot 4		Transformation Plot 5	
Native	Exotic	Native	Exotic	Native	Exotic	Native	Exotic	Native	Exotic
<i>Angophora floribunda</i>	<i>Opuntia humifusum</i>	<i>Cynodon dactylon</i>	<i>Senecio madagascariensis</i>	<i>Cynodon dactylon</i>	<i>Heliotropium amplexicaule</i>	<i>Cynodon dactylon</i>	<i>Senecio madagascariensis</i>	<i>Cynodon dactylon</i>	<i>Senecio madagascariensis</i>
<i>Hibbertia linearis</i>	<i>Melinis repens</i>	<i>Cymbopogon refractus</i>	<i>Plantago sp.</i>	<i>Cymbopogon refractus</i>	<i>Galenia pubescens</i>	<i>Perotis rara</i>	<i>Acetosella vulgaris</i>	<i>Banksia integrifolia</i>	<i>Acetosella vulgaris</i>
<i>Melichrus urceolatus</i>	<i>Senecio madagascariensis</i>	<i>Sporobolus creber</i>	<i>Alternanthera pungens</i>	<i>Sporobolus creber</i>	<i>Alternanthera pungens</i>	<i>Eragrostis brownii</i>	<i>Opuntia aurantiaca</i>	<i>Perotis rara</i>	<i>Opuntia aurantiaca</i>
<i>Pteridium esculentum</i>	<i>Acetosella vulgaris</i>	<i>Eragrostis leptostachya</i>	<i>Setaria sp.</i>	<i>Chrysocephalum apiculatum</i>	<i>Hypochaeris radicata</i>	<i>Aristida vagans</i>	<i>Richardia stellaris</i>	<i>Cheilanthes sieberi</i>	<i>Heliotropium amplexicaule</i>
<i>Themeda australis</i>	<i>Hypochaeris radicata</i>	<i>Sida sp.</i>	<i>Opuntia humifusa</i>	<i>Cheilanthes sieberi</i>	<i>Opuntia humifusa</i>	<i>Hibbertia linearis</i>	<i>Conyza sp.</i>	<i>Chrysocephalum apiculatum</i>	<i>Melinis repens</i>
<i>Aristida ramosa</i>	<i>Opuntia aurantiaca</i>	<i>Juncus usitatus</i>	<i>Verbena bonariensis</i>		<i>Setaria sp.</i>	<i>Cheilanthes sieberi</i>	<i>Heliotropium amplexicaule</i>	<i>Dianella caerulea</i>	<i>Opuntia humifusa</i>
<i>Chrysocephalum apiculatum</i>			<i>Sida rhombifolia</i>		<i>Senecio madagascariensis</i>	<i>Oxalis sp.</i>	<i>Melinis repens</i>		<i>Verbascum vergatum</i>
<i>Lomandra leucocephala</i>			<i>Conyza sp.</i>		<i>Conyza sp.</i>	<i>Boerhavia dominii</i>			<i>Heterotheca grandiflora</i>
<i>Wahlenbergia graniticola</i>					<i>Eragrostis curvula</i>				<i>Oenothera stricta</i>
<i>Ajuga australis</i>					<i>Oenothera stricta</i>				<i>Richardia stellaris</i>
<i>Cymbopogon refractus</i>					<i>Eragrostis sp.</i>				<i>Conyza sp.</i>
<i>Lomandra multiflora</i>					<i>Lepidium sp.</i>				<i>Senecio madagascariensis</i>
<i>Aristida vagans</i>									<i>Hypochaeris radicata</i>
<i>Pimelea linifolia</i>									
<i>Fimbristylis dichotoma</i>									
<i>Laxmannii gracilis</i>									

Reference Site 1 photos



Reference Site 1 – Q1



Reference Site 1 – Q4



Reference Site 1 – Q2



Reference Site 1 – T1



Reference Site 1 – Q3



Reference Site 1 – T2

Reference Site 2 photos



Reference Site 2 – Q1

Reference Site 2 – Q4



Reference Site 2 – Q2

Reference Site 2 – T1



Reference Site 2 – Q3

Reference Site 2 – T2

Reference Site 3 photos



Reference Site 3 – Q1



Reference Site 3 – Q4



Reference Site 3 – Q2



Reference Site 3 – T1



Reference Site 3 – Q3



Reference Site 3 – T2

Reference Site 4 photos



Reference Site 4 – Q1



Reference Site 4 – Q4



Reference Site 4 – Q2



Reference Site 4 – T1



Reference Site 4 – Q3



Reference Site 4 – T2

Reference Site 5 photos



Reference Site 5 – Q1



Reference Site 5 – Q4



Reference Site 5 – Q2



Reference Site 5 – T1



Reference Site 5 – Q3



Reference Site 5 – T2

Transformation Site 1 photos



Transformation Site 1 – Q1



Transformation Site 1 – Q4



Transformation Site 1 – Q2



Transformation Site 1 – T1



Transformation Site 1 – Q3



Transformation Site 1 – T2

Transformation Site 2 photos



Transformation Site 2 – Q1



Transformation Site 2– Q4



Transformation Site 2 – Q2



Transformation Site 2 – T1



Transformation Site 2 – Q3



Transformation Site 2 – T2

Transformation Site 3 photos



Transformation Site 3 – Q1



Transformation Site 3 – Q4



Transformation Site 3 – Q2



Transformation Site 3 – T1



Transformation Site 3 – Q3



Transformation Site 3 – T2

Transformation Site 4 photos



Transformation Site 4 – Q1



Transformation Site 4– Q4



Transformation Site 4 – Q2



Transformation Site 4 – T1



Transformation Site 4 – Q3



Transformation Site 4 – T2

Transformation Site 5 photos



Transformation Site 5 – Q1



Transformation Site 5– Q4



Transformation Site 5 – Q2



Transformation Site 5 – T1



Transformation Site 5 – Q3



Transformation Site 5– T2

Appendix B MTW Bird Monitoring Results: July 2011

Sites as in 2008 surveys (Debus 2008, 2009). Survey area = 4 ha around survey point. Numbers are no. of individuals recorded on site during survey (maximum per site out of four replicate counts); O = off-site during counts or on/near site outside count times; F = feeding sign only (chewed *Allocasuarina* cones). Bold = threatened species (NSW *Threatened Species Conservation Act*). *New species for MTW; ** species known for MTW but not previously recorded in winter (June 2009).

Species	Site										Total
	1	2	3	4	5	7	8	9	10		
Australian Wood Duck			3					2			5
Pacific Black Duck								2			2
Common Bronzewing		2					0	1			3
**Crested Pigeon			1								1
Bar-shouldered Dove								1			1
*Wonga Pigeon								1			1
White-faced Heron			1		1	0					2
Wedge-tailed Eagle	2	1		1				1	1		6
Glossy Black-Cockatoo	F							4			4
Sulphur-crested Cockatoo					0						
Little Lorikeet		4									4
Australian King-Parrot					1						1
**Crimson Rosella								2			2
Eastern Rosella	2		3								5
Red-rumped Parrot		0									
Fan-tailed Cuckoo									1	1	2
Laughing Kookaburra	1		2	3	2		2	2			12
White-throated Treecreeper					1	3					4
Brown Treecreeper		1									1
Satin Bowerbird		0									
Superb Fairy-wren	7	2	2	2	4		6	6			29
Variigated Fairy-wren	4				5		2				11
White-browed Scrubwren									1		1
Speckled Warbler	2	5	2	3	5	4	3	6	2		32
Weebill	9	9	5	19	13	6	13	10	8		92
*Brown Gerygone								1			1
Yellow Thornbill	5	2	2	5	5	3	4	8	7		41
Yellow-rumped Thornbill								5	6		11
Buff-rumped Thornbill	2	5		2	8	7	4	4	7		39
Brown Thornbill	1							2	1		4
Spotted Pardalote			2	2	1	1	2	3	2		13
Striated Pardalote	1		1	1				2			5
Eastern Spinebill	3							4	4		11
**Lewin's Honeyeater									1		1
Yellow-faced Honeyeater	10	10		1	2	1	12	3	1		40
White-eared Honeyeater				1	5	3	4	2	1		16
White-plumed Honeyeater	1	4	2								7
Noisy Miner	9	15	20					2	3		49

Species	Site										Total
	1	2	3	4	5	7	8	9	10		
Red Wattlebird							5				5
**Scarlet Honeyeater	1		1			1	1				4
*White-cheeked Honeyeater								2			2
Brown-headed Honeyeater		20	12		8		10	3	5		58
**Noisy Friarbird			2	1							3
Striped Honeyeater	1		2	3			1		1		8
Grey-crowned Babbler		0	8					0			8
**Varied Sittella				8			3	3	6		20
Black-faced Cuckoo-shrike	1			2	1	1			2		7
*Crested Shrike-tit				1							1
Golden Whistler	1	1		2	1	3	1	2	4		15
**Rufous Whistler			1								1
Grey Shrike-thrush	1	2	1	2	1	1	2	3	1		14
Dusky Woodswallow			0								
Grey Butcherbird		1	2	1		1	1	1			7
Pied Butcherbird	2		1	1	1		1				6
Australian Magpie		1	2	2	1	1	4	2	5		18
**Pied Currawong	1			3	1	1	2	1	1		10
Grey Fantail	2	4	1	2	2	2	2	4	3		22
Willie Wagtail		1	1						1		3
Australian Raven	2	5	4	7	2	3	2	2	5		32
Restless Flycatcher		0			0						
Magpie-lark	1		2					1			4
White-winged Chough	15	6		20	15		15		15		86
Jacky Winter		1						2			3
*Scarlet Robin				1	2	1		1	2		7
Red-capped Robin		1			1	2			3		7
Rose Robin	1		1		2	1	1	2	1		9
Hooded Robin		0									
Eastern Yellow Robin	1	2		1			1	3	2		10
Silvereye	2					2	2	8			14
Welcome Swallow			3					1			4
Mistletoebird	1	2	1	2			1	1			8
Double-barred Finch								2			2
Red-browed Finch	4	4			2		2	10			22
Diamond Firetail		1									1
Total species	32	32	31	28	29	23	40	40	25		870

Grand total: 74 species

Appendix C - Vegetation Monitoring – Field Methods

Details of the field methods for Vegetation Monitoring are provided below and a summary of the key variables that will be extracted from this data for analysis is provided in Table 1.

• 50x20m plot

Over-storey composition and species richness: Systematically cover the entire 50x20m plot identifying all over-storey species (tallest woody stratum >1m). Estimate estimate % foliage cover directly overhead (over-storey) using reference images provided in the BioMetric 3.1 Operational Manual (Department of Environment, Climate Change and Water, NSW, 2011).

Over-storey regeneration: When identifying over-storey species, also record stem diameter class (0-10cm, 10-20cm or >20cm) for each tree.

Additional habitat features: When identifying over-storey species, note the presence of tree hollows (minimum entrance width of 5cm), mistletoe or flowers/fruit on each tree and any dead trees. Also record the length of fallen logs (minimum diameter 10cm and minimum length 0.5m) within the plot.

• 20x20m quadrat

Community species richness: Systematically cover the entire 20x20m quadrat identifying and recording all native species in the mid-storey (all vegetation between the over-storey and >1m including tall shrubs, under-storey trees and tree regeneration) and all native species in the ground stratum noting native grasses (plants belonging to the Family Poaceae), native shrubs (woody vegetation <1m), other native species (other native non-woody vegetation in ground stratum e.g. forbs, herbs, lilies, rushes, sedges) and exotic species. Assign a cover abundance ranking to each species, using a modified Braun-Blanquet cover abundance ranking (Braun Blanquet 1928). Rankings will follow: 1 = few individuals (< 1% cover); 2 = many individuals (< 5% cover); 3 = 5 – 25% cover; 4 = 26 – 50% cover; 5 = 51 – 75% cover; 6 = 76 – 100% cover.

Community structure: Divide the 20x20m quadrat into four 10x10m quarters and estimate the % cover of native species in each stratum (mid-storey, ground stratum (grasses), ground-stratum (shrubs), ground stratum (other) and exotics) within each quarter. Average the four estimates to obtain an average % cover for each stratum in the 20x20m quadrat.

Additional habitat features: Within each quarter of the quadrat, also estimate % cover of litter, rock and bare ground. Average the four estimates to obtain an average % cover for each habitat feature in the 20x20m quadrat.

• 50m transect

Community structure: At 10 points along each of the three 50m transects (every 5m) estimate % foliage cover directly overhead (over-storey) using reference images provided in the BioMetric 3.1 Operational Manual (Department of Environment, Climate Change and Water, NSW, 2011). Average the estimates to obtain an average % foliage cover for the plot.

Table 1 Key attributes used to monitor changes in the vegetation/habitat condition

Attributes	Measurement units	Sampling units
SPECIES RICHNESS		
Native over-storey	Species ID and No. species/sampling unit	50x20m plot
Native mid-storey	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (grasses)	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (shrubs)	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (other)	Species ID and No. species/sampling unit	20x20m quadrat
Exotic ground stratum	Species ID and No. species/sampling unit	20x20m quadrat
Total	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
Total Native	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
Total Exotic	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
COMMUNITY STRUCTURE		
Native over-storey	% cover of species and vegetation layer	3x50m transects
Native mid-storey	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (grasses)	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (shrubs)	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (other)	% cover of species and vegetation layer	20x20m quadrat
Exotic	% cover of species and vegetation layer	20x20m quadrat
OVERSTOREY REGENERATION & HEALTH		
Over-storey species regeneration	No. species	50x20m plot
Over-storey species stem diameter class (0-10cm)	No./sampling unit	50x20m plot
Over-storey species stem diameter class (10-20cm)	No./sampling unit	50x20m plot
Over-storey species stem diameter class (>20)	No./sampling unit	50x20m plot
ADDITIONAL HABITAT FEATURES		
Litter	% cover	20x20m quadrat
Rock	% cover	20x20m quadrat
Bare ground	% cover	20x20m quadrat
Log	Length	50x20m plot
Tree hollows	Number	50x20m plot
Dead trees	(% tree population)	50x20m plot
Mistletoe	(% tree population)	50x20m plot
Flower/fruit	(% tree population)	50x20m plot

Appendix C

Summary of submissions



Appendix C — Summary of submissions



Table 4 - Summary of submissions of objection

Summary of matters raised (objections)										
Respondent type (SP - special interest, I - individual)	No.									
	290	291	292	293	294	295	296	297	298	
Matter										
Economics										
Regional economic impact assessment (eg economic benefits overstated)										•
Economic argument misleading, particularly with regard to employment										
Broad methodology and assumptions (eg mining profits directed overseas and tax liabilities minimised) Mining profits are directed overseas and tax liabilities minimised									•	
Broad methodology and assumptions (eg errors regarding employee origin statistics)										
Cost benefit analysis (eg externalities not quantified or assessed)			•							
Broad methodology and assumptions (eg 2012 ruling found the proposal had no economic merit)									•	
Cost benefit analysis (eg economic factors must not outweigh environmental values)										•
Noise and vibration										
L&E Court and the Industrial Noise Policy			•							
Noise modelling results - General noise and blasting impacts on amenity		•	•				•			
Noise modelling results - Cumulative noise impacts		•					•			
Noise modelling results - Low frequency noise limits must be applied and monitored										•
Noise modelling results - Cumulative noise impact especially with Bulga Mine										
Noise modelling results - Vibration exceedences										
Noise modelling results - Noise problems originated when slag heaps were raised above the height of Saddle Ridge										
Background noise levels and criteria			•				•			•
Modelling accuracy & assessment scenarios			•				•			•
Sleep disturbance										
Current and proposed operational noise controls and procedures			•							•
Animal health										
Air quality										
Air quality results - Tank water quality impacts due to dust										
Air quality results - Blasting air quality impacts to amenity							•			
Air quality results - General air quality impacts on amenity					•		•			•
Mine will be unable to control dust impacts as a result of this proposal										•
Cumulative air quality impacts										•
Health impacts of PM2.5 and PM10							•			
General climate change impacts and increased GHG emissions										
Ecology										
Assessment methodology and acceptability of impacts		•					•			•
Biodiversity Certification and offset strategy		•					•			•
Re-establishment of WSW from WSG as an offset		•								
Green Offsets										
Cumulative impacts to EECs in the Hunter Valley										
Final landform and rehabilitation										
The mine does little, if any, rehabilitation										•
Post-mining rehabilitation is not acceptable										
Visual										
General visual and lighting impacts							•			•
Current visual impacts will continue under the proposal										
Removal of Saddleback Ridge will not have a minimal visual impact and any residences higher than the creek bank will be affected.							•			
2003 EIS conceded that Saddleback Ridge was an important visual barrier							•			
Water										
Removal of Saddleback Ridge will alter run-off patterns, reducing inflows to Wollombi Brook							•			
Proposal will leave a saline void lake							•			
General impacts to water; volume and quality		•					•			
Identification of impacts on water is inadequate							•			
Management of surface water procedure with BCC with respect to Loders Creek										
Cumulative groundwater impacts (and management thereof) on and with Bulga (and BOP) in										
Heritage										
Proposal will destroy a number of identified and recognised Aboriginal cultural heritage sites							•			
Proposal will destroy a WWII RAAF base									•	
General impacts to Aboriginal cultural heritage										
Closure of WSR will impact heritage value of Great North Road/Convict Trail										
General impacts to heritage (historic and Aboriginal cultural)							•			
Traffic and transport										
Closure of WSR poses risks to emergency response and access							•			
Closure of WSR will result in increased travel times										
Closure of WSR will result in increased traffic at the Mt Thorley intersection, an already dangerous intersection for those travelling to and from Bulga.										
Social										
Future of Bulga village			•							•
Solastalgia			•							
Proposals place the economic needs of many above the rights of a few										
Health impacts			•							•
Property devaluation			•							
NDA1, including Saddleback Ridge			•				•			
Social impact assessment			•				•			•
Community engagement			•				•			
Executive summary states very few issues of non-compliance, ignoring call logs of complaints										
Reduced quality of life			•							•
Property acquisition			•							
Government assessment process							•	•		•
RTCA actively looking to reduce its workforce through automation of services inc driverless trucks										
Project design and development										
Mine should go underground to reduce impacts										
L&E Court matters										
The proposal is inconsistent with the L&E Court judgment		•	•						•	•
Other matters										
It has always been known that the mine had a 30 year lifespan, RTCA are greedy in trying to gain approval for these proposals										
Proposals disregard finite nature of the resource										
The short space of time between the issuing of the SRs and lodgement of the EIS means that they could not have been adequately addressed							•			
General objection to mining and the industry										
Submission of two related proposals concurrently has confused the issues										
Government subsidising coal industry and ignoring climate change		•								

Appendix D

Supplementary air quality information for EPA



Appendix D — Supplementary air quality information for EPA

D

Appendix D1

Contemporaneous 24-hour PM10 cumulative impact assessment

Table 1: Bulga – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
27/11/2012	56.1	-0.7	55.4	-	-	-	-
7/10/2012	40.9	-4.1	36.8	14/06/2012	ND	5.2	5.2
29/09/2012	39.2	0.0	39.2	4/03/2012	9.8	4.3	14.2
8/11/2012	38.7	0.3	39.0	16/03/2012	ND	3.0	3.0
2/12/2012	37.4	-1.9	35.6	22/04/2012	9.1	2.9	12.1
22/10/2012	34.5	0.0	34.5	15/10/2012	11.4	2.6	14.0
9/01/2012	33.7	1.4	35.0	21/03/2012	8.3	2.0	10.3
6/01/2012	33.4	0.0	33.4	17/05/2012	13.7	1.9	15.5
18/08/2012	32.8	0.0	32.8	14/04/2012	12.1	1.8	13.9
19/12/2012	32.6	-0.9	31.6	2/05/2012	15.3	1.7	17.0
25/10/2012	32.2	-0.6	31.5	25/05/2012	14.0	1.7	15.7

Table 2: Wallaby Scrub Road – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
18/10/2012	46.0	-7.0	39.0	8/06/2012	ND	7.9	7.9
7/09/2012	45.0	0.0	45.0	14/06/2012	ND	7.0	7.0
29/09/2012	44.0	0.0	44.0	1/04/2012	14.0	5.1	19.1
7/10/2012	41.0	0.5	41.5	8/07/2012	8.0	4.2	12.2
2/12/2012	41.0	1.2	42.2	22/04/2012	13.0	3.8	16.8
6/09/2012	37.0	0.0	37.0	3/09/2012	19.0	3.8	22.8
25/08/2012	36.0	0.1	36.1	22/02/2012	8.0	3.8	11.8
18/08/2012	35.0	0.0	35.0	3/04/2012	13.0	3.4	16.4
27/11/2012	34.0	-3.9	30.1	4/05/2012	10.0	3.0	13.0
19/12/2012	34.0	-2.0	32.0	8/04/2012	27.0	2.9	29.9

Table 3: Warkworth – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	2.1	43.3	10/12/2012	31.7	19.0	50.7
7/11/2012	40.0	-0.4	39.6	11/12/2012	ND	11.4	11.4
7/09/2012	38.0	0.0	38.0	28/03/2012	15.9	11.3	27.2
23/10/2012	37.8	3.1	40.9	1/02/2012	12.9	11.3	24.2
27/10/2012	37.6	-0.8	36.8	13/06/2012	6.7	10.7	17.4
29/09/2012	37.3	0.0	37.3	2/06/2012	12.2	10.2	22.4
7/10/2012	36.3	1.2	37.5	5/01/2012	21.2	9.9	31.1
18/10/2012	35.9	-1.5	34.4	2/01/2012	17.8	9.2	27.0
8/11/2012	35.3	0.9	36.2	13/01/2012	ND	9.2	9.2
2/11/2012	34.7	0.5	35.2	3/01/2012	19.5	9.1	28.6

Table 4: Knodlers Lane – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
29/09/2012	56.3	0.0	56.3	-	-	-	-
2/11/2012	54.5	0.0	54.5	-	-	-	-

26/10/2012	49.7	0.1	49.8	2/06/2012	6.7	4.4	11.1
27/10/2012	48.7	0.4	49.0	1/03/2012	ND	3.1	3.1
17/10/2012	47.7	0.0	47.7	18/04/2012	16.0	3.0	19.0
6/10/2012	47.1	0.4	47.4	11/03/2012	14.0	3.0	17.0
18/10/2012	43.6	0.2	43.8	7/01/2012	10.5	3.0	13.5
5/10/2012	42.8	0.0	42.8	11/11/2012	14.9	2.5	17.4
6/09/2012	42.3	0.0	42.3	9/02/2012	ND	2.4	2.4
21/10/2012	41.1	0.4	41.5	14/11/2012	31.0	2.4	33.3
23/10/2012	40.8	-0.5	40.3	24/01/2012	ND	2.3	2.3
12/09/2012	39.6	0.6	40.2	3/01/2012	12.0	2.2	14.2

Table 5: MTIE – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	1.3	78.3	-	-	-	-
14/09/2012	76.0	-2.1	73.9	-	-	-	-
6/10/2012	73.0	-0.1	72.9	-	-	-	-
27/10/2012	72.0	0.9	72.9	-	-	-	-
18/08/2012	68.0	-0.7	67.3	-	-	-	-
31/08/2012	65.0	-3.0	62.0	-	-	-	-
5/10/2012	63.0	0.7	63.7	-	-	-	-
4/09/2012	62.0	1.0	63.0	-	-	-	-
23/08/2012	59.0	-1.6	57.4	-	-	-	-
6/09/2012	59.0	-12.1	46.9	-	-	-	-
17/08/2012	57.0	-1.3	55.7	-	-	-	-
8/09/2012	56.0	-3.8	52.2	-	-	-	-
13/05/2012	55.0	-3.1	51.9	-	-	-	-
25/05/2012	54.0	0.9	54.9	-	-	-	-
28/10/2012	54.0	0.1	54.1	-	-	-	-
7/09/2012	53.0	-10.8	42.2	-	-	-	-
25/09/2012	52.0	0.2	52.2	-	-	-	-
16/09/2012	51.0	1.5	52.5	-	-	-	-
29/09/2012	51.0	-4.4	46.6	-	-	-	-
3/11/2012	51.0	0.5	51.5	-	-	-	-
21/10/2012	49.0	0.6	49.6	15/06/2012	19.0	9.1	28.1
16/08/2012	48.0	-4.7	43.3	17/07/2012	11.0	7.4	18.4
11/05/2012	47.0	1.3	48.3	29/06/2012	17.0	6.4	23.4
14/05/2012	47.0	-1.4	45.6	21/05/2012	35.0	5.6	40.6
24/05/2012	47.0	0.7	47.7	21/08/2012	37.0	5.6	42.6
1/09/2012	47.0	-3.1	43.9	8/05/2012	35.0	5.3	40.3
5/09/2012	47.0	-0.7	46.3	4/05/2012	10.0	5.3	15.3
6/12/2012	47.0	-0.9	46.1	29/07/2012	18.0	5.1	23.1
12/05/2012	46.0	-4.4	41.6	27/09/2012	ND	5.1	5.1
12/01/2012	45.0	0.4	45.4	22/08/2012	23.0	5.0	28.0

Table 6: Bulga – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
27/11/2012	56.1	-1.7	54.4	-	-	-	-
7/10/2012	40.9	-6.0	34.9	14/06/2012	ND	14.8	14.8
29/09/2012	39.2	0.0	39.2	8/06/2012	5.9	12.8	18.7
8/11/2012	38.7	2.8	41.5	22/04/2012	9.1	12.3	21.5
2/12/2012	37.4	-1.9	35.5	4/03/2012	9.8	11.8	21.6
22/10/2012	34.5	0.0	34.5	16/03/2012	ND	10.8	10.8
9/01/2012	33.7	-0.4	33.3	3/04/2012	11.9	9.2	21.1
6/01/2012	33.4	0.3	33.7	17/05/2012	13.7	9.1	22.8

18/08/2012	32.8	0.0	32.8	14/04/2012	12.1	8.9	21.0
19/12/2012	32.6	-3.8	28.8	30/10/2012	16.3	8.2	24.5
25/10/2012	32.2	-1.2	31.0	15/10/2012	11.4	8.0	19.4

Table 7: Wallaby Scrub Road – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
18/10/2012	46.0	-4.8	41.2	8/06/2012	ND	16.9	16.9
7/09/2012	45.0	0.0	45.0	3/09/2012	19.0	16.7	35.7
29/09/2012	44.0	0.0	44.0	8/07/2012	8.0	11.3	19.3
7/10/2012	41.0	3.8	44.8	22/04/2012	13.0	11.1	24.1
2/12/2012	41.0	3.3	44.3	1/04/2012	14.0	10.2	24.2
6/09/2012	37.0	0.0	37.0	4/05/2012	10.0	10.0	20.0
25/08/2012	36.0	0.0	36.0	13/01/2012	18.0	9.7	27.7
18/08/2012	35.0	0.0	35.0	19/02/2012	22.0	8.6	30.6
27/11/2012	34.0	-0.6	33.4	20/04/2012	9.0	8.3	17.3
19/12/2012	34.0	1.1	35.1	6/10/2012	20.0	7.6	27.6

Table 8: Warkworth – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	-11.5	29.7	10/12/2012	31.7	56.3	88.0
7/11/2012	40.0	0.2	40.2	11/12/2012	ND	50.1	50.1
7/09/2012	38.0	0.0	38.0	12/06/2012	6.6	45.7	52.3
23/10/2012	37.8	14.9	52.7	17/04/2012	23.7	44.6	68.3
27/10/2012	37.6	-2.2	35.4	12/08/2012	10.6	41.9	52.5
29/09/2012	37.3	0.0	37.3	11/06/2012	11.5	38.5	50.0
7/10/2012	36.3	-1.7	34.6	10/07/2012	12.0	38.0	50.0
18/10/2012	35.9	-15.5	20.4	21/07/2012	10.5	35.5	46.0
8/11/2012	35.3	-0.6	34.7	6/07/2012	11.0	34.5	45.5
2/11/2012	34.7	0.8	35.5	7/03/2012	17.1	34.0	51.1
21/10/2012	34.1	1.5	35.6	22/07/2012	12.8	30.9	43.7
6/09/2012	32.9	0.0	32.9	18/03/2012	11.0	30.7	41.7
23/11/2012	32.7	1.0	33.7	29/05/2012	16.1	29.3	45.4
18/08/2012	31.7	0.0	31.7	5/01/2012	21.2	29.1	50.3
10/12/2012	31.7	56.3	88.0	10/06/2012	9.6	26.8	36.4
25/11/2012	31.5	2.7	34.2	13/06/2012	6.7	26.1	32.8
2/12/2012	30.8	7.7	38.5	19/11/2012	22.5	25.1	47.6
18/09/2012	30.7	3.6	34.3	21/02/2012	13.7	23.6	37.3
20/10/2012	30.5	-2.1	28.4	29/02/2012	18.8	22.8	41.6
13/09/2012	30.3	0.6	30.9	6/06/2012	6.9	22.2	29.1
26/10/2012	29.8	4.0	33.8	26/06/2012	9.1	21.0	30.1
14/09/2012	29.5	0.8	30.3	23/07/2012	10.0	20.9	30.9
14/11/2012	29.0	6.2	35.2	5/07/2012	9.8	20.8	30.6

Table 9: Knodlers Lane – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
29/09/2012	56.3	0.0	56.3	-	-	-	-
2/11/2012	54.5	0.8	55.3	-	-	-	-
26/10/2012	49.7	0.9	50.6	1/05/2012	17.1	3.2	20.3
27/10/2012	48.7	3.2	51.8	9/06/2012	8.6	3.2	11.8

17/10/2012	47.7	0.0	47.7	27/10/2012	48.7	3.2	51.8
6/10/2012	47.1	0.1	47.2	28/05/2012	12.6	2.9	15.5
18/10/2012	43.6	-0.1	43.5	30/04/2012	18.1	2.7	20.9
5/10/2012	42.8	0.1	42.8	24/09/2012	24.3	2.2	26.4
6/09/2012	42.3	0.0	42.3	26/06/2012	10.0	2.2	12.2
21/10/2012	41.1	0.3	41.4	9/07/2012	15.9	2.2	18.1
23/10/2012	40.8	-0.3	40.5	31/07/2012	6.0	2.1	8.1
12/09/2012	39.6	0.6	40.2	30/03/2012	16.1	2.0	18.1

Table 10: MTIE – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	5.2	82.2	-	-	-	-
14/09/2012	76.0	-2.8	73.2	-	-	-	-
6/10/2012	73.0	0.0	73.0	-	-	-	-
27/10/2012	72.0	2.3	74.3	-	-	-	-
18/08/2012	68.0	-3.5	64.5	-	-	-	-
31/08/2012	65.0	-4.6	60.4	-	-	-	-
5/10/2012	63.0	-9.1	53.9	-	-	-	-
4/09/2012	62.0	2.0	64.0	-	-	-	-
23/08/2012	59.0	-6.0	53.0	-	-	-	-
6/09/2012	59.0	-13.6	45.4	-	-	-	-
17/08/2012	57.0	-4.1	52.9	-	-	-	-
8/09/2012	56.0	-5.3	50.7	-	-	-	-
13/05/2012	55.0	-13.7	41.3	-	-	-	-
25/05/2012	54.0	-3.0	51.0	-	-	-	-
28/10/2012	54.0	-0.1	53.9	-	-	-	-
7/09/2012	53.0	-17.3	35.7	-	-	-	-
25/09/2012	52.0	0.0	52.0	-	-	-	-
16/09/2012	51.0	-2.1	48.9	-	-	-	-
29/09/2012	51.0	-10.1	40.9	-	-	-	-
3/11/2012	51.0	-0.2	50.8	-	-	-	-
21/10/2012	49.0	0.1	49.1	26/07/2012	18.0	10.4	28.4
16/08/2012	48.0	-7.2	40.8	22/09/2012	45.0	10.1	55.1
11/05/2012	47.0	-4.8	42.2	31/07/2012	36.0	9.4	45.4
14/05/2012	47.0	-2.0	45.0	30/07/2012	17.0	9.2	26.2
24/05/2012	47.0	8.6	55.6	10/03/2012	21.0	8.7	29.7
1/09/2012	47.0	4.2	51.2	24/05/2012	47.0	8.6	55.6
5/09/2012	47.0	-1.9	45.1	5/05/2012	18.0	8.3	26.3
6/12/2012	47.0	2.6	49.6	3/07/2012	20.0	7.3	27.3
12/05/2012	46.0	-4.4	41.6	13/09/2012	42.0	7.3	49.3
12/01/2012	45.0	0.9	45.9	11/07/2012	36.0	7.1	43.1
22/09/2012	45.0	10.1	55.1	19/06/2012	ND	6.9	6.9
11/08/2012	44.0	1.1	45.1	13/10/2012	20.0	6.8	26.8
21/01/2012	43.0	-0.1	42.9	12/07/2012	12.0	6.7	18.7

Table 11: Bulga – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
27/11/2012	56.1	-3.0	53.1	-	-	-	-
7/10/2012	40.9	-10.7	30.1	4/03/2012	9.8	18.9	28.7
29/09/2012	39.2	0.0	39.2	14/06/2012	ND	18.9	18.9
8/11/2012	38.7	3.3	42.0	8/06/2012	5.9	17.0	22.9
2/12/2012	37.4	-5.6	31.8	30/10/2012	16.3	16.6	32.8
22/10/2012	34.5	0.0	34.4	20/09/2012	10.8	15.3	26.1

9/01/2012	33.7	-3.2	30.4	17/05/2012	13.7	14.8	28.5
6/01/2012	33.4	0.3	33.7	16/03/2012	ND	14.7	14.7
18/08/2012	32.8	0.0	32.8	22/04/2012	9.1	14.2	23.3
19/12/2012	32.6	-8.3	24.2	3/04/2012	11.9	11.1	23.0
25/10/2012	32.2	-2.0	30.2	20/04/2012	ND	10.9	10.9

Table 12: Wallaby Scrub Road – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
18/10/2012	46.0	-13.4	32.6	8/06/2012	ND	23.3	23.3
7/09/2012	45.0	0.0	45.0	22/04/2012	13.0	18.5	31.5
29/09/2012	44.0	0.0	44.0	3/09/2012	19.0	17.7	36.7
7/10/2012	41.0	4.9	45.9	4/05/2012	10.0	16.1	26.1
2/12/2012	41.0	4.6	45.6	8/07/2012	8.0	15.2	23.2
6/09/2012	37.0	0.0	37.0	20/04/2012	9.0	13.2	22.2
25/08/2012	36.0	0.0	36.0	13/01/2012	18.0	12.5	30.5
18/08/2012	35.0	0.0	35.0	1/04/2012	14.0	12.3	26.3
27/11/2012	34.0	-4.3	29.7	30/10/2012	17.0	11.9	28.9
19/12/2012	34.0	-1.8	32.2	27/04/2012	13.0	10.7	23.7

Table 13: Warkworth – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	-12.4	28.8	6/06/2012	6.9	65.4	72.3
7/11/2012	40.0	-1.1	38.9	10/12/2012	31.7	57.3	89.0
7/09/2012	38.0	0.0	38.0	11/12/2012	ND	45.0	45.0
23/10/2012	37.8	-1.4	36.4	26/06/2012	9.1	37.2	46.3
27/10/2012	37.6	-2.2	35.4	5/07/2012	9.8	37.1	46.9
29/09/2012	37.3	0.0	37.3	21/07/2012	10.5	35.1	45.6
7/10/2012	36.3	-0.8	35.5	11/06/2012	11.5	34.1	45.6
18/10/2012	35.9	-17.1	18.8	21/02/2012	13.7	33.1	46.8
8/11/2012	35.3	-0.9	34.4	12/08/2012	10.6	32.5	43.1
2/11/2012	34.7	2.8	37.5	11/04/2012	12.3	31.9	44.2
21/10/2012	34.1	0.6	34.7	17/04/2012	23.7	31.3	55.0
6/09/2012	32.9	0.0	32.9	29/05/2012	16.1	31.0	47.1
23/11/2012	32.7	-5.8	26.9	11/08/2012	11.7	30.8	42.5
18/08/2012	31.7	0.0	31.7	6/07/2012	11.0	28.6	39.6
10/12/2012	31.7	57.3	89.0	10/07/2012	12.0	28.0	40.0
25/11/2012	31.5	0.7	32.2	7/03/2012	17.1	27.7	44.8
2/12/2012	30.8	2.8	33.6	22/07/2012	12.8	26.9	39.7
18/09/2012	30.7	4.5	35.2	26/12/2012	ND	26.7	26.7
20/10/2012	30.5	-2.0	28.5	7/06/2012	9.3	24.4	33.7
13/09/2012	30.3	0.3	30.6	28/05/2012	7.1	24.4	31.5
26/10/2012	29.8	6.9	36.7	30/03/2012	16.4	23.3	39.7
14/09/2012	29.5	0.5	30.0	24/07/2012	9.5	21.2	30.7
14/11/2012	29.0	-5.8	23.2	5/01/2012	21.2	20.9	42.1

Table 14: Knodlers Lane – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
29/09/2012	56.3	0.0	56.4	-	-	-	-
2/11/2012	54.5	0.3	54.8	-	-	-	-

26/10/2012	49.7	0.3	50.0	27/10/2012	48.7	4.1	52.8
27/10/2012	48.7	4.1	52.8	20/07/2012	12.1	3.5	15.6
17/10/2012	47.7	0.0	47.7	31/07/2012	6.0	1.4	7.4
6/10/2012	47.1	0.2	47.3	7/10/2012	27.3	1.1	28.5
18/10/2012	43.6	-0.1	43.5	1/11/2012	28.9	1.0	29.9
5/10/2012	42.8	0.1	42.9	10/01/2012	ND	0.9	0.9
6/09/2012	42.3	0.0	42.3	28/05/2012	12.6	0.9	13.5
21/10/2012	41.1	-0.1	41.0	20/05/2012	25.0	0.9	25.9
23/10/2012	40.8	-1.8	39.0	15/09/2012	11.6	0.7	12.4
12/09/2012	39.6	-3.4	36.2	6/12/2012	24.7	0.6	25.3

Table 15: MTIE – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	-0.1	76.9	-	-	-	-
14/09/2012	76.0	-9.9	66.1	-	-	-	-
6/10/2012	73.0	-0.4	72.6	-	-	-	-
27/10/2012	72.0	0.3	72.3	-	-	-	-
18/08/2012	68.0	-4.0	64.0	-	-	-	-
31/08/2012	65.0	-12.2	52.8	-	-	-	-
5/10/2012	63.0	-9.7	53.3	-	-	-	-
4/09/2012	62.0	-6.2	55.8	-	-	-	-
23/08/2012	59.0	-7.9	51.1	-	-	-	-
6/09/2012	59.0	-16.1	42.9	-	-	-	-
17/08/2012	57.0	-7.7	49.3	-	-	-	-
8/09/2012	56.0	-8.4	47.6	-	-	-	-
13/05/2012	55.0	-15.8	39.2	-	-	-	-
25/05/2012	54.0	-3.3	50.7	-	-	-	-
28/10/2012	54.0	-0.1	53.9	-	-	-	-
7/09/2012	53.0	-21.5	31.5	-	-	-	-
25/09/2012	52.0	0.4	52.4	-	-	-	-
16/09/2012	51.0	0.9	51.9	-	-	-	-
29/09/2012	51.0	-14.1	36.9	-	-	-	-
3/11/2012	51.0	0.3	51.3	-	-	-	-
21/10/2012	49.0	-3.7	45.3	2/06/2012	19.0	1.6	20.6
16/08/2012	48.0	-17.3	30.7	31/05/2012	13.0	1.4	14.4
11/05/2012	47.0	-6.6	40.4	8/10/2012	34.0	1.2	35.2
14/05/2012	47.0	-3.1	43.9	16/09/2012	51.0	0.9	51.9
24/05/2012	47.0	-7.0	40.0	30/05/2012	12.0	0.8	12.8
1/09/2012	47.0	-9.0	38.0	4/02/2012	5.0	0.8	5.8
5/09/2012	47.0	-6.0	41.0	12/02/2012	16.0	0.8	16.8
6/12/2012	47.0	-1.4	45.6	1/05/2012	24.0	0.7	24.7
12/05/2012	46.0	-15.9	30.1	14/03/2012	17.0	0.7	17.7
12/01/2012	45.0	0.5	45.5	13/03/2012	21.0	0.7	21.7

Appendix D2

Further detail regarding 24-hour PM₁₀ analysis

Table 1: Assessment Location 81 – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
27/11/2012	56.1	-0.1	56.0	-	-	-	-
6/10/2012	40.9	-3.0	37.9	13/06/2012	ND	6.5	6.5
28/09/2012	39.2	0.0	39.2	4/03/2012	9.8	5.9	15.7
8/11/2012	38.7	0.4	39.1	21/04/2012	9.1	4.4	13.5
2/12/2012	37.4	-1.6	35.9	2/04/2012	11.9	3.6	15.5
22/10/2012	34.5	0.0	34.4	30/10/2012	16.3	3.1	19.4
9/01/2012	33.7	-1.3	32.4	13/04/2012	12.1	2.9	15.0
6/01/2012	33.4	-0.6	32.8	1/04/2012	10.3	2.7	13.0
17/08/2012	32.8	0.0	32.8	16/03/2012	ND	2.7	2.7
19/12/2012	32.6	-1.3	31.2	13/01/2012	16.9	2.6	19.5
25/10/2012	32.2	-0.8	31.4	16/05/2012	13.7	2.5	16.2

Table 2: Assessment Location 118 – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
28/09/2012	56.3	0.0	56.3	-	-	-	-
2/11/2012	54.5	0.2	54.7	-	-	-	-
26/10/2012	49.7	0.3	50.0	19/07/2012	12.1	2.6	14.7
27/10/2012	48.7	1.4	50.1	26/04/2012	16.8	2.0	18.7
17/10/2012	47.7	0.0	47.7	10/01/2012	ND	1.9	1.9
5/10/2012	47.1	0.2	47.3	31/08/2012	17.4	1.6	19.0
18/10/2012	43.6	0.0	43.6	7/06/2012	7.4	1.5	8.9
4/10/2012	42.8	0.0	42.8	27/10/2012	48.7	1.4	50.1
5/09/2012	42.3	0.0	42.3	20/04/2012	ND	1.4	1.4
21/10/2012	41.1	0.1	41.2	8/06/2012	8.6	1.4	10.1
23/10/2012	40.8	-0.4	40.5	15/05/2012	20.7	1.2	21.9
11/09/2012	39.6	-0.7	38.9	11/03/2012	14.0	1.2	15.2

Table 3: Assessment Location 259 – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
28/09/2012	56.3	0.0	56.3	-	-	-	-
2/11/2012	54.5	0.3	54.8	-	-	-	-
26/10/2012	49.7	0.4	50.1	19/07/2012	12.1	2.8	14.9
27/10/2012	48.7	1.9	50.5	10/01/2012	ND	2.1	2.1
17/10/2012	47.7	0.0	47.7	26/04/2012	16.8	2.0	18.8
5/10/2012	47.1	0.2	47.3	27/10/2012	48.7	1.9	50.5
18/10/2012	43.6	0.0	43.6	31/08/2012	17.4	1.5	19.0
4/10/2012	42.8	0.0	42.8	7/06/2012	7.4	1.5	8.9
5/09/2012	42.3	0.0	42.3	8/06/2012	8.6	1.4	10.1
21/10/2012	41.1	0.1	41.2	20/04/2012	ND	1.4	1.4
23/10/2012	40.8	-0.3	40.5	11/03/2012	14.0	1.2	15.2
11/09/2012	39.6	-0.9	38.7	15/05/2012	20.7	1.2	21.9

Table 4: Assessment Location 126 – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	1.0	78.0	-	-	-	-
13/09/2012	76.0	4.6	80.6	-	-	-	-
5/10/2012	73.0	0.2	73.2	-	-	-	-
27/10/2012	72.0	3.9	75.9	-	-	-	-
17/08/2012	68.0	0.0	68.0	-	-	-	-
30/08/2012	65.0	-0.5	64.5	-	-	-	-
4/10/2012	63.0	-0.2	62.8	-	-	-	-
3/09/2012	62.0	2.1	64.1	-	-	-	-
22/08/2012	59.0	-0.8	58.2	-	-	-	-
5/09/2012	59.0	0.0	59.0	-	-	-	-
16/08/2012	57.0	-0.3	56.7	-	-	-	-
7/09/2012	56.0	-0.5	55.5	-	-	-	-
12/05/2012	55.0	-0.6	54.4	-	-	-	-
24/05/2012	54.0	0.0	54.0	-	-	-	-
28/10/2012	54.0	1.3	55.3	-	-	-	-
6/09/2012	53.0	-0.7	52.3	-	-	-	-
24/09/2012	52.0	2.9	54.9	-	-	-	-
15/09/2012	51.0	4.4	55.4	-	-	-	-
28/09/2012	51.0	4.3	55.3	-	-	-	-
3/11/2012	51.0	2.9	53.9	-	-	-	-
21/10/2012	49.0	0.7	49.7	29/07/2012	17.0	6.7	23.7
15/08/2012	48.0	-0.9	47.1	28/05/2012	ND	6.4	6.4
10/05/2012	47.0	0.1	47.1	25/06/2012	22.0	6.3	28.3
13/05/2012	47.0	1.8	48.8	9/07/2012	20.0	6.0	26.0
23/05/2012	47.0	1.9	48.9	19/09/2012	ND	5.5	5.5
31/08/2012	47.0	0.7	47.7	18/02/2012	22.0	5.2	27.2
4/09/2012	47.0	0.1	47.1	1/06/2012	19.0	5.2	24.2
6/12/2012	47.0	1.2	48.2	11/01/2012	25.0	5.1	30.1
11/05/2012	46.0	0.0	46.0	8/06/2012	11.0	5.0	16.0
12/01/2012	45.0	-1.0	44.0	12/09/2012	42.0	5.0	47.0

Table 5: Assessment Location 262 – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	1.2	78.2	-	-	-	-
13/09/2012	76.0	4.1	80.1	-	-	-	-
5/10/2012	73.0	0.2	73.2	-	-	-	-
27/10/2012	72.0	4.2	76.2	-	-	-	-
17/08/2012	68.0	0.0	68.0	-	-	-	-
30/08/2012	65.0	-0.6	64.4	-	-	-	-
4/10/2012	63.0	-0.1	62.9	-	-	-	-
3/09/2012	62.0	1.8	63.8	-	-	-	-
22/08/2012	59.0	-0.8	58.2	-	-	-	-
5/09/2012	59.0	0.0	59.0	-	-	-	-
16/08/2012	57.0	-0.2	56.8	-	-	-	-
7/09/2012	56.0	-0.6	55.4	-	-	-	-
12/05/2012	55.0	-0.9	54.1	-	-	-	-
24/05/2012	54.0	0.0	54.0	-	-	-	-
28/10/2012	54.0	1.0	55.0	-	-	-	-

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
6/09/2012	53.0	-0.5	52.5	-	-	-	-
24/09/2012	52.0	2.8	54.8	-	-	-	-
15/09/2012	51.0	4.2	55.2	-	-	-	-
28/09/2012	51.0	3.8	54.8	-	-	-	-
3/11/2012	51.0	2.3	53.3	-	-	-	-
21/10/2012	49.0	0.6	49.6	29/07/2012	17.0	6.7	23.7
15/08/2012	48.0	-0.8	47.2	28/05/2012	ND	6.2	6.2
10/05/2012	47.0	0.1	47.1	25/06/2012	22.0	6.0	28.0
13/05/2012	47.0	1.8	48.8	9/07/2012	20.0	5.6	25.6
23/05/2012	47.0	1.6	48.6	19/09/2012	ND	5.1	5.1
31/08/2012	47.0	0.6	47.6	8/06/2012	11.0	5.0	16.0
4/09/2012	47.0	0.1	47.1	29/05/2012	12.0	4.9	16.9
6/12/2012	47.0	1.1	48.1	31/05/2012	14.0	4.9	18.9
11/05/2012	46.0	0.1	46.1	12/09/2012	42.0	4.8	46.8
12/01/2012	45.0	-1.0	44.0	11/01/2012	25.0	4.8	29.8

Table 6: Assessment Location 102 – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	2.9	44.1	10/12/2012	31.7	33.4	65.1
7/11/2012	40.0	-1.1	38.9	11/12/2012	ND	22.2	22.2
6/09/2012	38.0	0.0	38.0	12/06/2012	6.7	20.1	26.8
23/10/2012	37.8	6.1	43.9	1/06/2012	12.2	19.3	31.5
27/10/2012	37.6	-0.4	37.2	5/01/2012	21.2	18.6	39.8
28/09/2012	37.3	0.0	37.3	28/05/2012	16.1	18.4	34.5
6/10/2012	36.3	2.5	38.8	1/02/2012	12.9	17.0	29.9
18/10/2012	35.9	0.4	36.3	13/01/2012	ND	16.6	16.6
8/11/2012	35.3	2.4	37.7	9/07/2012	12.0	16.5	28.5
2/11/2012	34.7	0.6	35.3	18/03/2012	11.0	16.4	27.4
21/10/2012	34.1	3.7	37.8	18/04/2012	10.8	16.3	27.1
5/09/2012	32.9	0.0	32.9	25/06/2012	9.1	15.2	24.3

Table 7: Assessment Location 264 – Year 3

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	3.1	44.3	10/12/2012	31.7	36.1	67.8
7/11/2012	40.0	-1.0	39.0	11/12/2012	ND	24.0	24.0
6/09/2012	38.0	0.0	38.0	12/06/2012	6.7	22.2	28.9
23/10/2012	37.8	6.9	44.7	1/06/2012	12.2	21.8	34.0
27/10/2012	37.6	-0.2	37.4	28/05/2012	16.1	20.7	36.8
28/09/2012	37.3	0.0	37.3	5/01/2012	21.2	20.0	41.2
6/10/2012	36.3	3.1	39.4	18/04/2012	10.8	18.6	29.4
18/10/2012	35.9	1.6	37.5	13/01/2012	ND	18.2	18.2
8/11/2012	35.3	2.7	38.0	1/02/2012	12.9	18.0	30.9
2/11/2012	34.7	0.8	35.5	18/03/2012	11.0	18.0	29.0
21/10/2012	34.1	4.1	38.2	9/07/2012	12.0	17.8	29.8
5/09/2012	32.9	0.0	32.9	31/05/2012	16.1	17.1	33.2

Table 8: Assessment Location 81 – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
27/11/2012	56.1	-1.3	54.8	-	-	-	-
6/10/2012	40.9	-5.8	35.1	7/06/2012	5.9	16.6	22.5
28/09/2012	39.2	0.0	39.2	13/06/2012	ND	14.9	14.9
8/11/2012	38.7	1.5	40.2	21/04/2012	9.1	11.6	20.7
2/12/2012	37.4	-1.4	36.1	4/03/2012	9.8	11.3	21.2
22/10/2012	34.5	-0.1	34.4	13/04/2012	12.1	11.1	23.2
9/01/2012	33.7	1.1	34.8	2/09/2012	12.1	11.1	23.2
6/01/2012	33.4	-0.6	32.8	2/04/2012	11.9	9.9	21.8
17/08/2012	32.8	0.0	32.8	22/02/2012	7.8	9.7	17.5
19/12/2012	32.6	-3.3	29.3	26/04/2012	12.3	9.2	21.5
25/10/2012	32.2	-2.1	30.1	1/04/2012	10.3	8.8	19.1

Table 9: Assessment Location 118 – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
28/09/2012	56.3	0.0	56.3	-	-	-	-
2/11/2012	54.5	1.1	55.6	-	-	-	-
26/10/2012	49.7	1.0	50.8	27/10/2012	48.7	4.8	53.4
27/10/2012	48.7	4.8	53.4	30/04/2012	17.1	4.1	21.2
17/10/2012	47.7	0.0	47.7	8/06/2012	8.6	3.9	12.5
5/10/2012	47.1	0.1	47.2	25/06/2012	10.0	3.4	13.5
18/10/2012	43.6	-0.1	43.5	27/05/2012	12.6	3.4	16.0
4/10/2012	42.8	0.1	42.8	19/07/2012	12.1	3.1	15.2
5/09/2012	42.3	0.0	42.3	4/05/2012	14.6	2.8	17.5
21/10/2012	41.1	0.3	41.4	30/07/2012	6.0	2.8	8.7
23/10/2012	40.8	-0.3	40.5	8/07/2012	15.9	2.5	18.4
11/09/2012	39.6	0.6	40.2	29/04/2012	18.1	2.4	20.6

Table 10: Assessment Location 259 – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
28/09/2012	56.3	0.0	56.3	-	-	-	-
2/11/2012	54.5	1.2	55.7	-	-	-	-
26/10/2012	49.7	1.1	50.8	27/10/2012	48.7	5.0	53.6
27/10/2012	48.7	5.0	53.6	30/04/2012	17.1	4.1	21.2
17/10/2012	47.7	0.0	47.7	8/06/2012	8.6	4.0	12.6
5/10/2012	47.1	0.1	47.2	25/06/2012	10.0	3.4	13.5
18/10/2012	43.6	-0.1	43.5	19/07/2012	12.1	3.2	15.3
4/10/2012	42.8	0.1	42.8	4/05/2012	14.6	3.1	17.8
5/09/2012	42.3	0.0	42.3	27/05/2012	12.6	3.0	15.5
21/10/2012	41.1	0.3	41.4	30/07/2012	6.0	2.9	8.9
23/10/2012	40.8	-0.3	40.6	8/07/2012	15.9	2.4	18.3
11/09/2012	39.6	0.3	39.9	20/05/2012	28.2	2.3	30.5

Table 11: Assessment Location 126 – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	-2.0	75.0	-	-	-	-
13/09/2012	76.0	7.6	83.6	-	-	-	-
5/10/2012	73.0	0.4	73.4	-	-	-	-
27/10/2012	72.0	0.1	72.1	-	-	-	-
17/08/2012	68.0	0.0	68.0	-	-	-	-
30/08/2012	65.0	-0.4	64.6	-	-	-	-
4/10/2012	63.0	0.0	63.0	-	-	-	-
3/09/2012	62.0	0.0	62.0	-	-	-	-
22/08/2012	59.0	-0.3	58.7	-	-	-	-
5/09/2012	59.0	0.0	59.0	-	-	-	-
16/08/2012	57.0	-0.2	56.8	-	-	-	-
7/09/2012	56.0	1.8	57.8	-	-	-	-
12/05/2012	55.0	0.3	55.3	-	-	-	-
24/05/2012	54.0	0.0	54.0	-	-	-	-
28/10/2012	54.0	0.9	54.9	-	-	-	-
6/09/2012	53.0	0.1	53.1	-	-	-	-
24/09/2012	52.0	-0.1	51.9	-	-	-	-
15/09/2012	51.0	-1.3	49.7	-	-	-	-
28/09/2012	51.0	9.2	60.2	-	-	-	-
3/11/2012	51.0	1.8	52.8	-	-	-	-
21/10/2012	49.0	1.2	50.2	5/12/2012	27.0	12.8	39.8
15/08/2012	48.0	0.4	48.4	8/08/2012	33.0	10.3	43.3
10/05/2012	47.0	0.1	47.1	1/06/2012	19.0	9.5	28.5
13/05/2012	47.0	1.0	48.0	28/09/2012	51.0	9.2	60.2
23/05/2012	47.0	-1.0	46.0	13/09/2012	76.0	7.6	83.6
31/08/2012	47.0	1.0	48.0	18/06/2012	ND	7.0	7.0
4/09/2012	47.0	-0.3	46.7	27/06/2012	10.0	6.8	16.8
6/12/2012	47.0	1.0	48.0	29/07/2012	17.0	6.3	23.3
11/05/2012	46.0	1.5	47.5	30/05/2012	13.0	6.3	19.3
12/01/2012	45.0	-5.2	39.8	31/05/2012	14.0	6.0	20.0
21/09/2012	45.0	5.0	50.0	7/04/2012	33.0	5.4	38.4
10/08/2012	44.0	-3.8	40.2	21/09/2012	45.0	5.0	50.0

Table 12: Assessment Location 262 – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	-1.8	75.2	-	-	-	-
13/09/2012	76.0	7.5	83.5	-	-	-	-
5/10/2012	73.0	0.4	73.4	-	-	-	-
27/10/2012	72.0	0.6	72.6	-	-	-	-
17/08/2012	68.0	0.0	68.0	-	-	-	-
30/08/2012	65.0	-0.4	64.6	-	-	-	-
4/10/2012	63.0	0.0	63.0	-	-	-	-
3/09/2012	62.0	-0.1	61.9	-	-	-	-
22/08/2012	59.0	-0.4	58.6	-	-	-	-
5/09/2012	59.0	0.0	59.0	-	-	-	-
16/08/2012	57.0	-0.2	56.8	-	-	-	-
7/09/2012	56.0	1.5	57.5	-	-	-	-
12/05/2012	55.0	0.0	55.0	-	-	-	-

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
24/05/2012	54.0	0.0	54.0	-	-	-	-
28/10/2012	54.0	0.7	54.7	-	-	-	-
6/09/2012	53.0	0.1	53.1	-	-	-	-
24/09/2012	52.0	-0.2	51.8	-	-	-	-
15/09/2012	51.0	-1.4	49.6	-	-	-	-
28/09/2012	51.0	9.2	60.2	-	-	-	-
3/11/2012	51.0	1.3	52.3	-	-	-	-
21/10/2012	49.0	1.1	50.1	5/12/2012	27.0	12.6	39.6
15/08/2012	48.0	0.3	48.3	8/08/2012	33.0	9.8	42.8
10/05/2012	47.0	0.1	47.1	28/09/2012	51.0	9.2	60.2
13/05/2012	47.0	1.2	48.2	1/06/2012	19.0	8.5	27.5
23/05/2012	47.0	-0.9	46.1	13/09/2012	76.0	7.5	83.5
31/08/2012	47.0	0.8	47.8	29/07/2012	17.0	6.7	23.7
4/09/2012	47.0	-0.3	46.7	18/06/2012	ND	6.7	6.7
6/12/2012	47.0	1.1	48.1	27/06/2012	10.0	6.1	16.1
11/05/2012	46.0	1.4	47.4	31/05/2012	14.0	6.0	20.0
12/01/2012	45.0	-5.1	39.9	30/05/2012	13.0	6.0	19.0
21/09/2012	45.0	4.8	49.8	7/04/2012	33.0	5.6	38.6
10/08/2012	44.0	-4.0	40.0	21/09/2012	45.0	4.8	49.8

Table 13: Assessment Location 102 – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	-13.7	27.5	10/12/2012	31.7	73.3	105.0
7/11/2012	40.0	-0.9	39.1	11/12/2012	ND	64.3	64.3
6/09/2012	38.0	0.0	38.0	11/08/2012	10.6	59.5	70.1
23/10/2012	37.8	12.1	49.9	16/04/2012	23.7	59.1	82.8
27/10/2012	37.6	-1.1	36.5	10/06/2012	11.5	58.9	70.4
28/09/2012	37.3	0.0	37.3	11/06/2012	6.6	58.0	64.6
6/10/2012	36.3	-1.7	34.6	5/07/2012	11.0	49.3	60.3
18/10/2012	35.9	-17.9	18.0	7/03/2012	17.1	48.3	65.4
8/11/2012	35.3	-1.1	34.2	20/07/2012	10.5	47.7	58.2
2/11/2012	34.7	0.9	35.6	9/07/2012	12.0	42.0	54.0
21/10/2012	34.1	2.1	36.2	28/05/2012	16.1	42.0	58.1
5/09/2012	32.9	0.0	32.9	21/07/2012	12.8	37.8	50.6
23/11/2012	32.7	-0.8	31.9	9/06/2012	9.6	37.2	46.8
17/08/2012	31.7	0.0	31.7	12/06/2012	6.7	36.1	42.8
10/12/2012	31.7	73.3	105.0	5/06/2012	6.9	35.3	42.2
25/11/2012	31.5	3.1	34.6	21/02/2012	13.7	34.1	47.8
2/12/2012	30.8	10.4	41.2	5/01/2012	21.2	33.3	54.5
17/09/2012	30.7	6.6	37.3	19/11/2012	22.5	31.9	54.4
20/10/2012	30.5	-1.3	29.2	6/06/2012	9.3	31.7	41.0
12/09/2012	30.3	2.0	32.3	10/08/2012	11.7	31.6	43.3
26/10/2012	29.8	6.0	35.8	25/06/2012	9.1	31.6	40.7
13/09/2012	29.5	2.6	32.1	18/03/2012	11.0	31.0	42.0
14/11/2012	29.0	5.7	34.7	29/02/2012	18.8	28.4	47.2
7/12/2012	28.8	4.6	33.4	11/09/2012	ND	28.1	28.1
5/10/2012	28.6	-11.2	17.4	22/07/2012	10.0	26.5	36.5
9/12/2012	28.5	7.9	36.4	13/02/2012	11.2	26.4	37.6
16/11/2012	28.4	10.8	39.2	7/02/2012	21.7	25.8	47.5
18/12/2012	28.3	-9.8	18.5	29/05/2012	9.8	25.0	34.8
15/11/2012	27.8	-6.2	21.6	9/04/2012	12.7	24.7	37.4
17/10/2012	27.4	-4.5	22.9	4/07/2012	9.8	24.6	34.4
15/12/2012	27.3	-2.5	24.8	27/06/2012	8.9	23.8	32.7
17/12/2012	27.3	22.7	50.0	14/10/2012	11.5	22.9	34.4
27/09/2012	27.1	0.0	27.1	17/12/2012	27.3	22.7	50.0

Table 14: Assessment Location 264 – Year 9

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	-14.5	26.7	10/12/2012	31.7	77.3	109.0
7/11/2012	40.0	-1.2	38.8	11/12/2012	ND	66.9	66.9
6/09/2012	38.0	0.0	38.0	10/06/2012	11.5	62.7	74.2
23/10/2012	37.8	11.7	49.5	11/08/2012	10.6	62.3	72.9
27/10/2012	37.6	-1.1	36.5	16/04/2012	23.7	61.8	85.5
28/09/2012	37.3	0.0	37.3	11/06/2012	6.6	59.5	66.1
6/10/2012	36.3	-1.6	34.7	5/07/2012	11.0	52.3	63.3
18/10/2012	35.9	-18.5	17.4	7/03/2012	17.1	50.8	67.9
8/11/2012	35.3	-1.2	34.1	20/07/2012	10.5	49.7	60.2
2/11/2012	34.7	1.0	35.7	28/05/2012	16.1	45.4	61.5
21/10/2012	34.1	2.4	36.5	9/07/2012	12.0	43.7	55.7
5/09/2012	32.9	0.0	32.9	21/07/2012	12.8	39.5	52.3
23/11/2012	32.7	-1.2	31.5	9/06/2012	9.6	38.8	48.4
17/08/2012	31.7	0.0	31.7	12/06/2012	6.7	38.7	45.4
10/12/2012	31.7	77.3	109.0	5/06/2012	6.9	38.5	45.4
25/11/2012	31.5	3.4	34.9	21/02/2012	13.7	35.8	49.5
2/12/2012	30.8	10.8	41.6	25/06/2012	9.1	35.0	44.1
17/09/2012	30.7	7.4	38.1	10/08/2012	11.7	34.8	46.5
20/10/2012	30.5	-1.0	29.5	5/01/2012	21.2	34.4	55.6
12/09/2012	30.3	2.3	32.6	6/06/2012	9.3	34.1	43.4
26/10/2012	29.8	6.6	36.4	19/11/2012	22.5	33.4	55.9
13/09/2012	29.5	2.9	32.4	18/03/2012	11.0	31.4	42.4
14/11/2012	29.0	5.7	34.7	11/09/2012	ND	29.8	29.8
7/12/2012	28.8	4.5	33.3	29/02/2012	18.8	29.5	48.3
5/10/2012	28.6	-12.2	16.4	13/02/2012	11.2	28.1	39.3
9/12/2012	28.5	8.3	36.8	22/07/2012	10.0	27.5	37.5
16/11/2012	28.4	11.4	39.8	29/05/2012	9.8	27.1	36.9
18/12/2012	28.3	-10.2	18.1	7/02/2012	21.7	26.7	48.4
15/11/2012	27.8	-6.4	21.4	4/07/2012	9.8	26.3	36.1
17/10/2012	27.4	-4.6	22.8	9/04/2012	12.7	25.8	38.5
15/12/2012	27.3	-2.5	24.8	27/06/2012	8.9	25.3	34.2
17/12/2012	27.3	23.1	50.4	14/10/2012	11.5	24.5	36.0
27/09/2012	27.1	0.0	27.1	17/12/2012	27.3	23.1	50.4
8/12/2012	27.1	5.0	32.1	27/05/2012	7.1	22.6	29.7

Table 15: Assessment Location 81 – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
27/11/2012	56.1	-3.5	52.6	-	-	-	-
6/10/2012	40.9	-11.3	29.6	7/06/2012	5.9	20.8	26.7
28/09/2012	39.2	0.0	39.2	13/06/2012	ND	17.6	17.6
8/11/2012	38.7	2.1	40.8	30/10/2012	16.3	17.2	33.5
2/12/2012	37.4	-5.5	31.9	4/03/2012	9.8	17.0	26.8
22/10/2012	34.5	-0.2	34.3	21/04/2012	9.1	14.6	23.8
9/01/2012	33.7	-1.3	32.3	19/04/2012	ND	13.2	13.2
6/01/2012	33.4	-0.9	32.5	2/09/2012	12.1	12.7	24.8
17/08/2012	32.8	0.0	32.8	2/04/2012	11.9	12.4	24.3
19/12/2012	32.6	-9.3	23.2	13/04/2012	12.1	12.2	24.3
25/10/2012	32.2	-2.8	29.3	30/04/2012	14.4	11.8	26.2

Table 16: Assessment Location 118 – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
28/09/2012	56.3	0.2	56.5	-	-	-	-
2/11/2012	54.5	0.2	54.7	-	-	-	-
26/10/2012	49.7	0.3	50.0	19/07/2012	12.1	4.2	16.3
27/10/2012	48.7	3.4	52.0	27/10/2012	48.7	3.4	52.0
17/10/2012	47.7	0.0	47.7	15/07/2012	6.7	1.3	7.9
5/10/2012	47.1	0.1	47.2	30/08/2012	25.4	1.3	26.7
18/10/2012	43.6	-0.1	43.5	30/07/2012	6.0	1.3	7.3
4/10/2012	42.8	0.1	42.8	10/01/2012	ND	1.0	1.0
5/09/2012	42.3	0.0	42.3	19/05/2012	25.0	0.9	25.9
21/10/2012	41.1	-0.1	41.0	12/09/2012	35.4	0.9	36.3
23/10/2012	40.8	-1.8	39.0	11/01/2012	ND	0.9	0.9
11/09/2012	39.6	-3.8	35.8	30/04/2012	17.1	0.7	17.8

Table 17: Assessment Location 259 – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
28/09/2012	56.3	0.2	56.6	-	-	-	-
2/11/2012	54.5	0.1	54.6	-	-	-	-
26/10/2012	49.7	0.3	50.0	19/07/2012	12.1	3.9	16.0
27/10/2012	48.7	2.8	51.5	27/10/2012	48.7	2.8	51.5
17/10/2012	47.7	0.0	47.7	30/08/2012	25.4	1.6	27.0
5/10/2012	47.1	0.1	47.1	15/07/2012	6.7	1.6	8.2
18/10/2012	43.6	-0.1	43.5	11/01/2012	ND	1.3	1.3
4/10/2012	42.8	0.1	42.8	10/01/2012	ND	1.0	1.0
5/09/2012	42.3	0.0	42.3	19/05/2012	25.0	0.9	25.9
21/10/2012	41.1	-0.1	41.0	30/07/2012	6.0	0.9	6.9
23/10/2012	40.8	-1.8	39.1	12/09/2012	35.4	0.9	36.3
11/09/2012	39.6	-3.9	35.7	30/04/2012	17.1	0.6	17.7

Table 18: Assessment Location 126 – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	-3.1	73.9	-	-	-	-
13/09/2012	76.0	6.0	82.0	-	-	-	-
5/10/2012	73.0	0.2	73.2	-	-	-	-
27/10/2012	72.0	-1.9	70.1	-	-	-	-
17/08/2012	68.0	0.0	68.0	-	-	-	-
30/08/2012	65.0	-3.3	61.7	-	-	-	-
4/10/2012	63.0	-0.1	62.9	-	-	-	-
3/09/2012	62.0	-3.1	58.9	-	-	-	-
22/08/2012	59.0	-0.8	58.2	-	-	-	-
5/09/2012	59.0	0.0	59.0	-	-	-	-
16/08/2012	57.0	-0.3	56.7	-	-	-	-
7/09/2012	56.0	0.5	56.5	-	-	-	-
12/05/2012	55.0	-0.7	54.3	-	-	-	-
24/05/2012	54.0	0.0	54.0	-	-	-	-
28/10/2012	54.0	1.0	55.0	-	-	-	-
6/09/2012	53.0	-0.3	52.7	-	-	-	-
24/09/2012	52.0	-7.8	44.2	-	-	-	-
15/09/2012	51.0	-7.9	43.1	-	-	-	-
28/09/2012	51.0	8.3	59.3	-	-	-	-
3/11/2012	51.0	1.4	52.4	-	-	-	-
21/10/2012	49.0	-0.1	48.9	5/12/2012	27.0	10.0	37.0
15/08/2012	48.0	-1.0	47.0	8/08/2012	33.0	9.0	42.0
10/05/2012	47.0	-0.1	46.9	28/09/2012	51.0	8.3	59.3
13/05/2012	47.0	-3.0	44.0	1/06/2012	19.0	7.2	26.2
23/05/2012	47.0	-5.5	41.5	13/09/2012	76.0	6.0	82.0
31/08/2012	47.0	-1.5	45.5	11/01/2012	25.0	5.2	30.2
4/09/2012	47.0	-0.6	46.4	27/07/2012	25.0	4.1	29.1
6/12/2012	47.0	-2.5	44.5	29/07/2012	17.0	3.7	20.7
11/05/2012	46.0	-1.8	44.2	26/06/2012	18.0	3.3	21.3
12/01/2012	45.0	-8.6	36.4	27/06/2012	10.0	3.2	13.2

Table 19: Assessment Location 262 – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
2/11/2012	77.0	-2.8	74.2	-	-	-	-
13/09/2012	76.0	6.0	82.0	-	-	-	-
5/10/2012	73.0	0.2	73.2	-	-	-	-
27/10/2012	72.0	-1.5	70.5	-	-	-	-
17/08/2012	68.0	0.0	68.0	-	-	-	-
30/08/2012	65.0	-3.2	61.8	-	-	-	-
4/10/2012	63.0	-0.1	62.9	-	-	-	-
3/09/2012	62.0	-3.1	58.9	-	-	-	-
22/08/2012	59.0	-0.7	58.3	-	-	-	-
5/09/2012	59.0	0.0	59.0	-	-	-	-
16/08/2012	57.0	-0.2	56.8	-	-	-	-
7/09/2012	56.0	0.1	56.1	-	-	-	-
12/05/2012	55.0	-1.0	54.0	-	-	-	-
24/05/2012	54.0	0.0	54.0	-	-	-	-
28/10/2012	54.0	0.8	54.8	-	-	-	-

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
6/09/2012	53.0	-0.2	52.8	-	-	-	-
24/09/2012	52.0	-7.6	44.4	-	-	-	-
15/09/2012	51.0	-7.8	43.2	-	-	-	-
28/09/2012	51.0	8.2	59.2	-	-	-	-
3/11/2012	51.0	1.1	52.1	-	-	-	-
21/10/2012	49.0	-0.1	48.9	5/12/2012	27.0	9.7	36.7
15/08/2012	48.0	-0.9	47.1	28/09/2012	51.0	8.2	59.2
10/05/2012	47.0	-0.1	46.9	8/08/2012	33.0	8.1	41.1
13/05/2012	47.0	-2.9	44.1	1/06/2012	19.0	6.5	25.5
23/05/2012	47.0	-5.3	41.7	13/09/2012	76.0	6.0	82.0
31/08/2012	47.0	-1.6	45.4	11/01/2012	25.0	5.1	30.1
4/09/2012	47.0	-0.5	46.5	29/07/2012	17.0	4.1	21.1
6/12/2012	47.0	-2.5	44.5	27/07/2012	25.0	4.1	29.1
11/05/2012	46.0	-1.6	44.4	31/05/2012	14.0	3.4	17.4
12/01/2012	45.0	-8.5	36.5	27/06/2012	10.0	2.9	12.9

Table 20: Assessment Location 102 – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	-14.9	26.3	5/06/2012	6.9	92.1	99.0
7/11/2012	40.0	-5.6	34.4	10/12/2012	31.7	56.4	88.1
6/09/2012	38.0	0.0	38.0	4/07/2012	9.8	45.8	55.6
23/10/2012	37.8	-4.6	33.2	20/07/2012	10.5	43.0	53.5
27/10/2012	37.6	1.0	38.6	10/04/2012	12.3	39.1	51.4
28/09/2012	37.3	0.2	37.5	11/12/2012	ND	37.3	37.3
6/10/2012	36.3	4.3	40.6	10/08/2012	11.7	34.9	46.6
18/10/2012	35.9	-18.8	17.1	21/02/2012	13.7	34.6	48.3
8/11/2012	35.3	-1.4	33.9	25/06/2012	9.1	32.7	41.8
2/11/2012	34.7	6.9	41.6	28/05/2012	16.1	31.1	47.2
21/10/2012	34.1	1.2	35.3	26/12/2012	ND	29.7	29.7
5/09/2012	32.9	0.0	32.9	9/04/2012	12.7	28.8	41.5
23/11/2012	32.7	-8.2	24.5	6/06/2012	9.3	28.8	38.1
17/08/2012	31.7	0.0	31.7	27/05/2012	7.1	27.8	34.9
10/12/2012	31.7	56.4	88.1	11/08/2012	10.6	25.6	36.2
25/11/2012	31.5	1.4	32.9	29/07/2012	8.3	24.9	33.2
2/12/2012	30.8	1.4	32.2	7/03/2012	17.1	23.8	40.9
17/09/2012	30.7	7.0	37.7	24/09/2012	17.9	23.8	41.7
20/10/2012	30.5	-1.3	29.2	23/09/2012	13.2	23.2	36.4
12/09/2012	30.3	4.6	34.9	5/07/2012	11.0	22.7	33.7
26/10/2012	29.8	11.4	41.2	16/04/2012	23.7	22.1	45.8
13/09/2012	29.5	3.9	33.4	10/06/2012	11.5	21.8	33.3
14/11/2012	29.0	-9.7	19.3	9/08/2012	13.2	21.3	34.5
7/12/2012	28.8	-8.9	19.9	30/03/2012	16.4	21.0	37.4

Table 21: Assessment Location 264 – Year 14

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
19/12/2012	41.2	-15.7	25.5	5/06/2012	6.9	94.3	101.2
7/11/2012	40.0	-6.4	33.6	10/12/2012	31.7	57.5	89.2
6/09/2012	38.0	0.0	38.0	4/07/2012	9.8	46.1	55.9
23/10/2012	37.8	-5.0	32.8	20/07/2012	10.5	43.7	54.2
27/10/2012	37.6	1.1	38.7	10/04/2012	12.3	38.6	50.9
28/09/2012	37.3	0.6	37.9	11/12/2012	ND	37.0	37.0

Date	Background	Predicted increment	Total	Date	Background	Highest predicted increment	Total
6/10/2012	36.3	5.5	41.8	21/02/2012	13.7	35.3	49.0
18/10/2012	35.9	-19.1	16.8	10/08/2012	11.7	35.0	46.7
8/11/2012	35.3	-1.4	33.9	25/06/2012	9.1	31.1	40.2
2/11/2012	34.7	7.5	42.2	28/05/2012	16.1	30.5	46.6
21/10/2012	34.1	1.4	35.5	26/12/2012	ND	30.0	30.0
5/09/2012	32.9	0.0	32.9	6/06/2012	9.3	29.6	38.9
23/11/2012	32.7	-8.9	23.8	9/04/2012	12.7	29.3	42.0
17/08/2012	31.7	0.0	31.7	27/05/2012	7.1	28.0	35.1
10/12/2012	31.7	57.5	89.2	11/08/2012	10.6	25.4	36.0
25/11/2012	31.5	1.6	33.1	23/09/2012	13.2	25.1	38.3
2/12/2012	30.8	1.5	32.3	29/07/2012	8.3	25.0	33.3
17/09/2012	30.7	7.3	38.0	9/08/2012	13.2	23.3	36.5
20/10/2012	30.5	-1.0	29.5	7/03/2012	17.1	23.2	40.3
12/09/2012	30.3	6.6	36.9	24/09/2012	17.9	23.0	40.9
26/10/2012	29.8	12.6	42.4	5/07/2012	11.0	22.4	33.4
13/09/2012	29.5	4.6	34.1	4/05/2012	13.7	22.0	35.7
14/11/2012	29.0	-10.3	18.7	16/04/2012	23.7	21.6	45.3
7/12/2012	28.8	-9.3	19.5	30/07/2012	11.2	21.5	32.7
5/10/2012	28.6	-18.0	10.6	10/06/2012	11.5	20.8	32.3

Appendix D3

Isopleths diagrams – Blast emissions

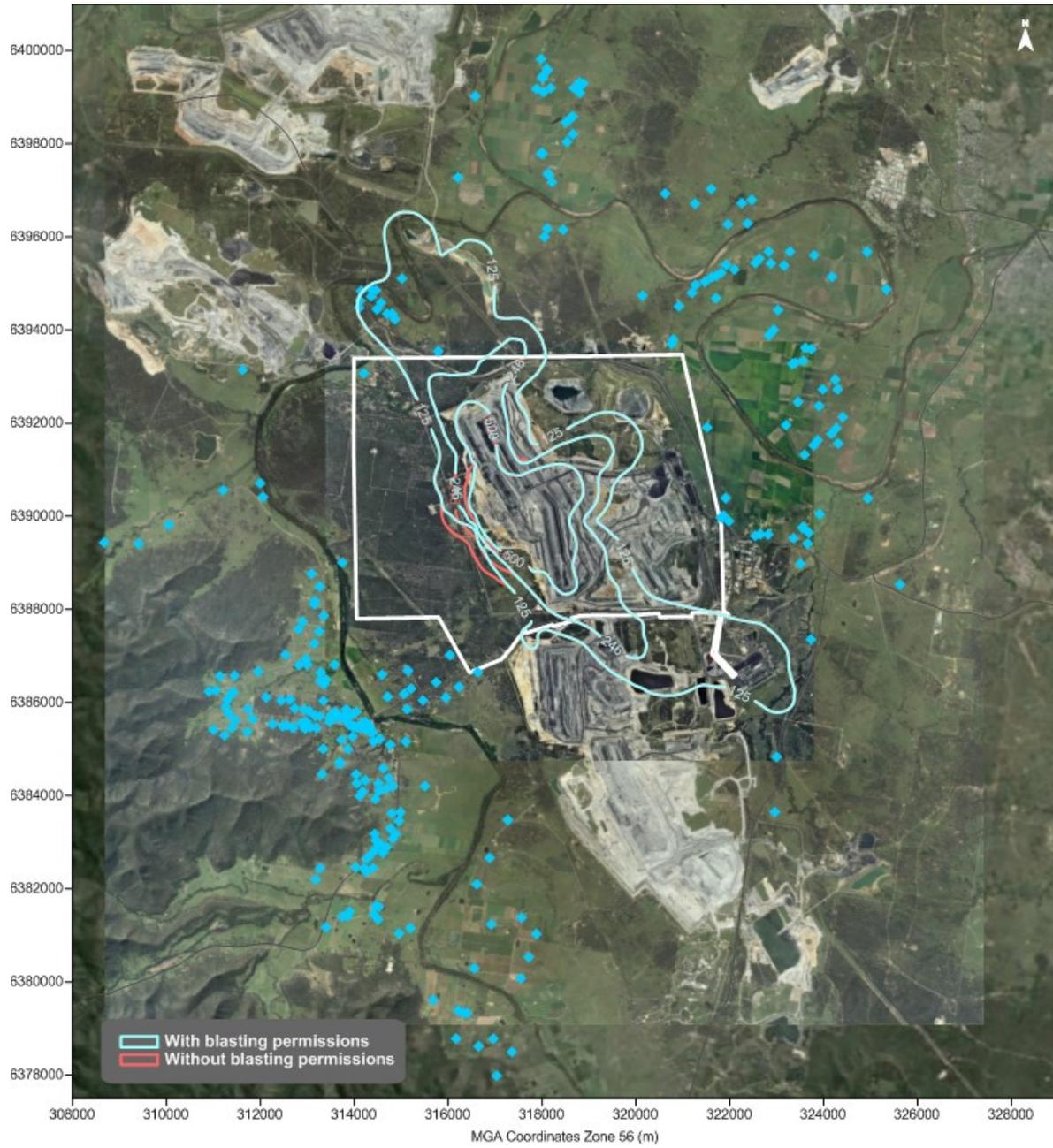


Figure 1: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 07:00 (NO₂ concentrations µg/m³)

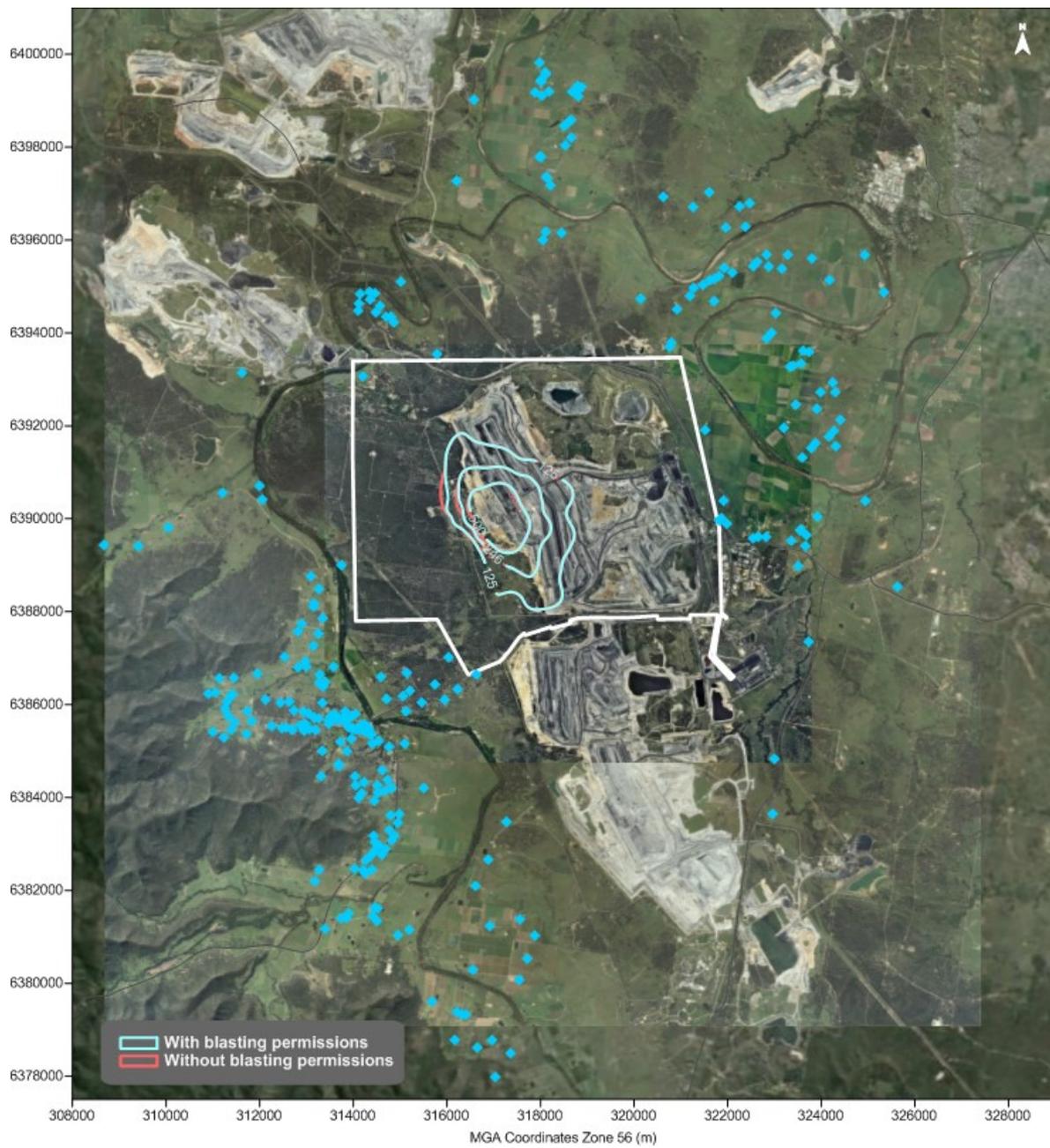


Figure 2: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 08:00 (NO₂ concentrations µg/m³)

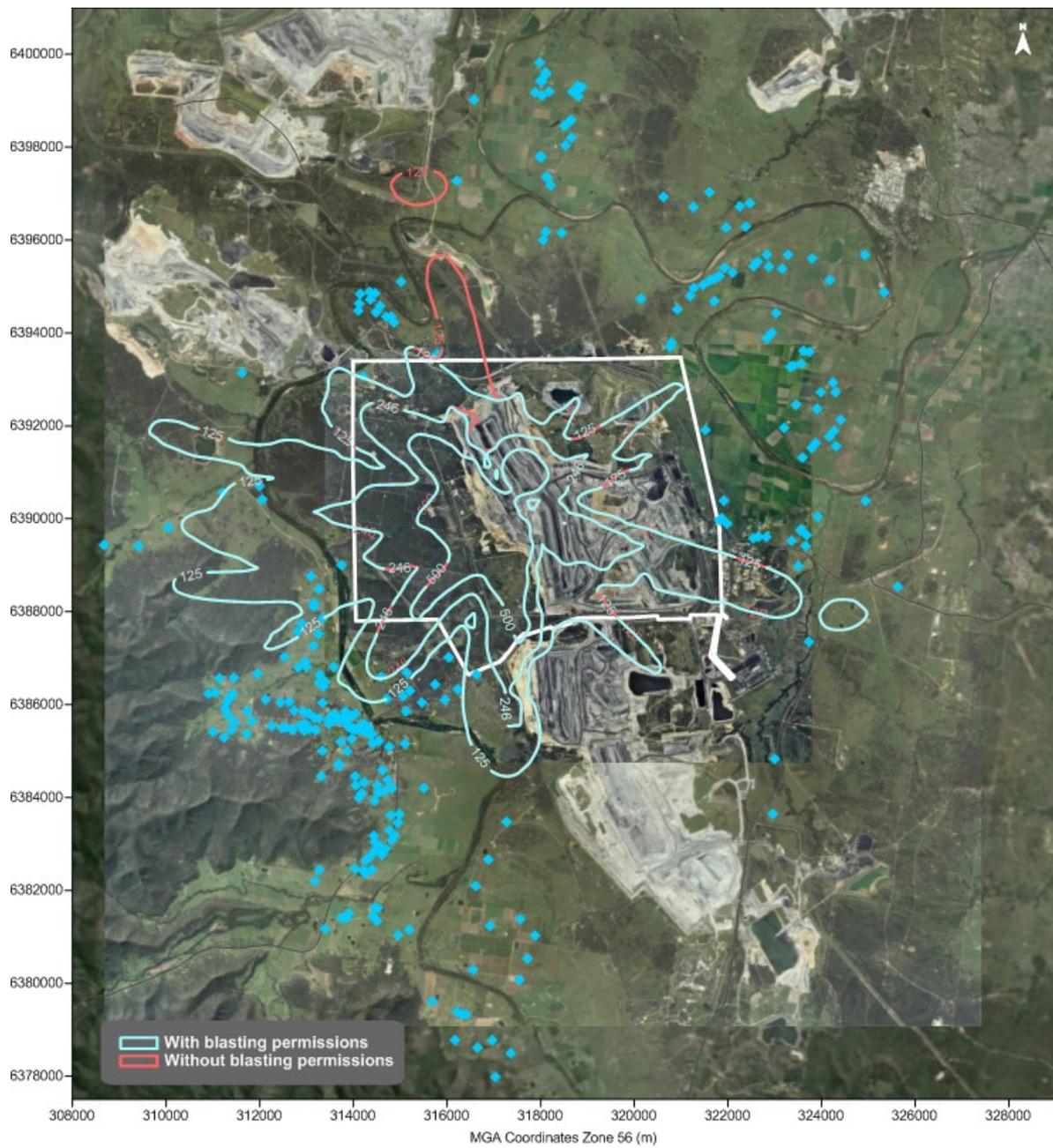


Figure 3: Predicted maximum 1-hour average blast emissions from the proposal in Year 3 – 18:00 (NO₂ concentrations µg/m³)

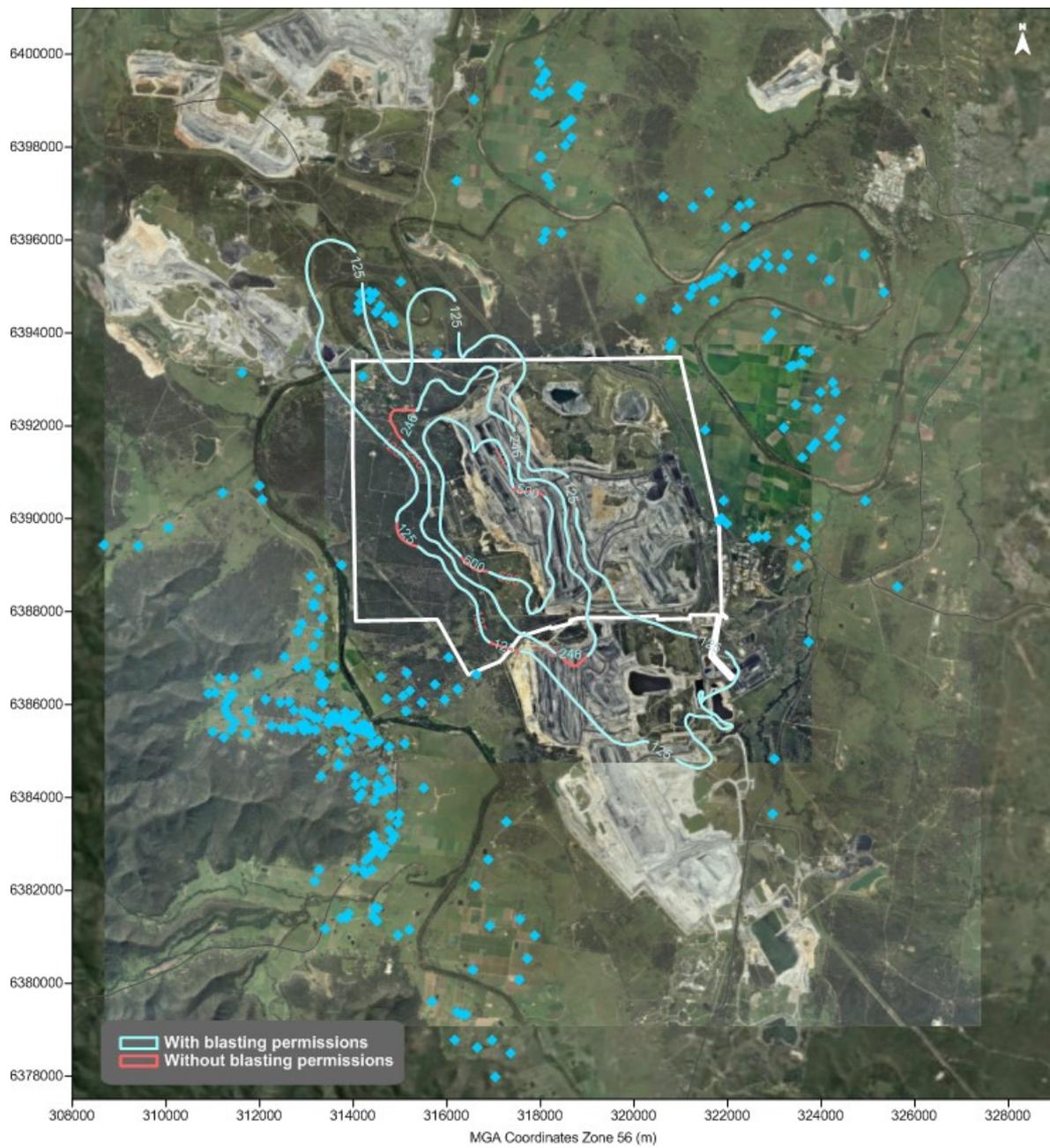


Figure 4: Predicted maximum 1-hour average blast emissions from the proposal in Year 9 – 07:00 (NO₂ concentrations µg/m³)

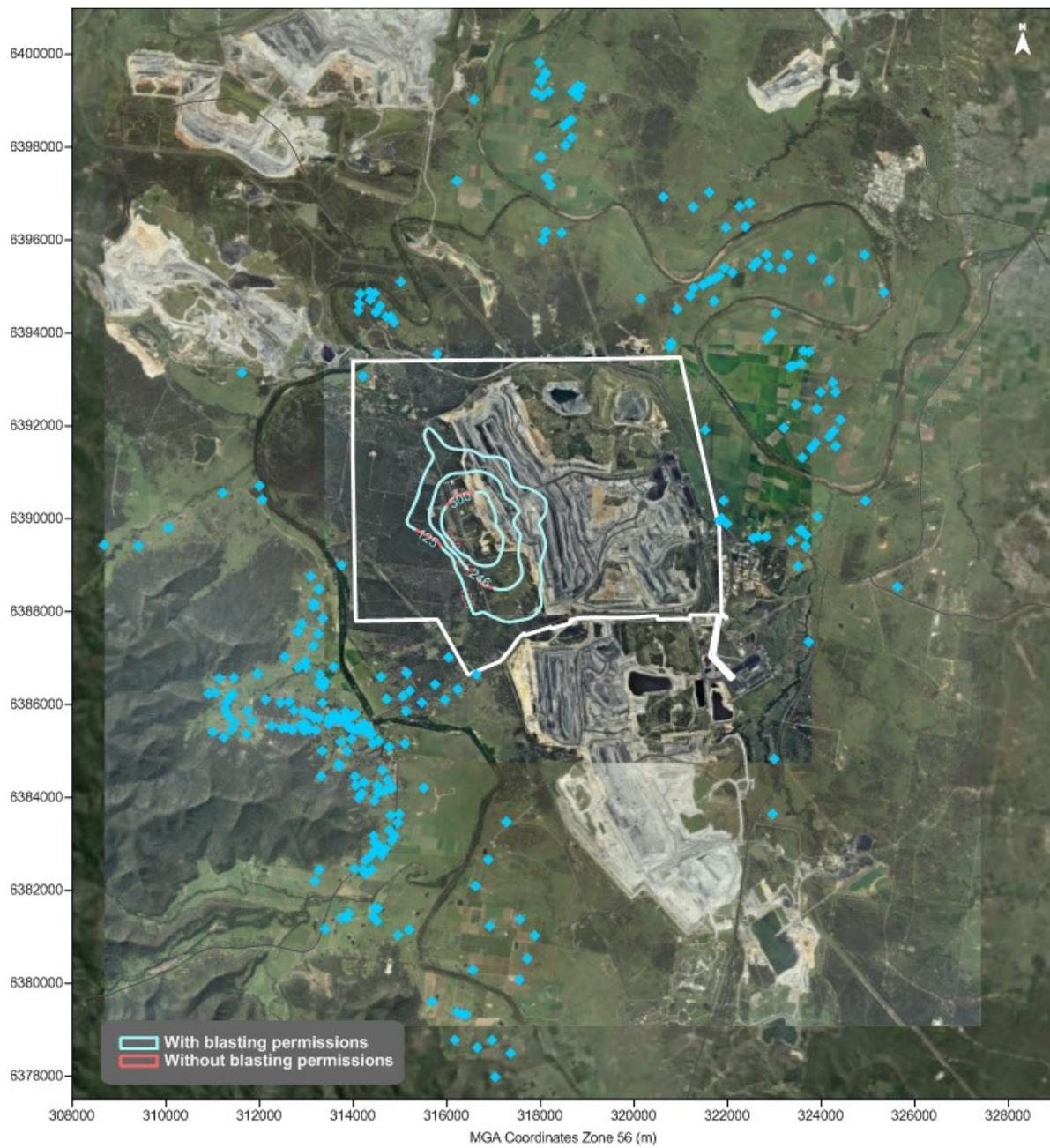


Figure 5: Predicted maximum 1-hour average blast emissions from the proposal in Year 9 – 08:00 (NO₂ concentrations µg/m³)

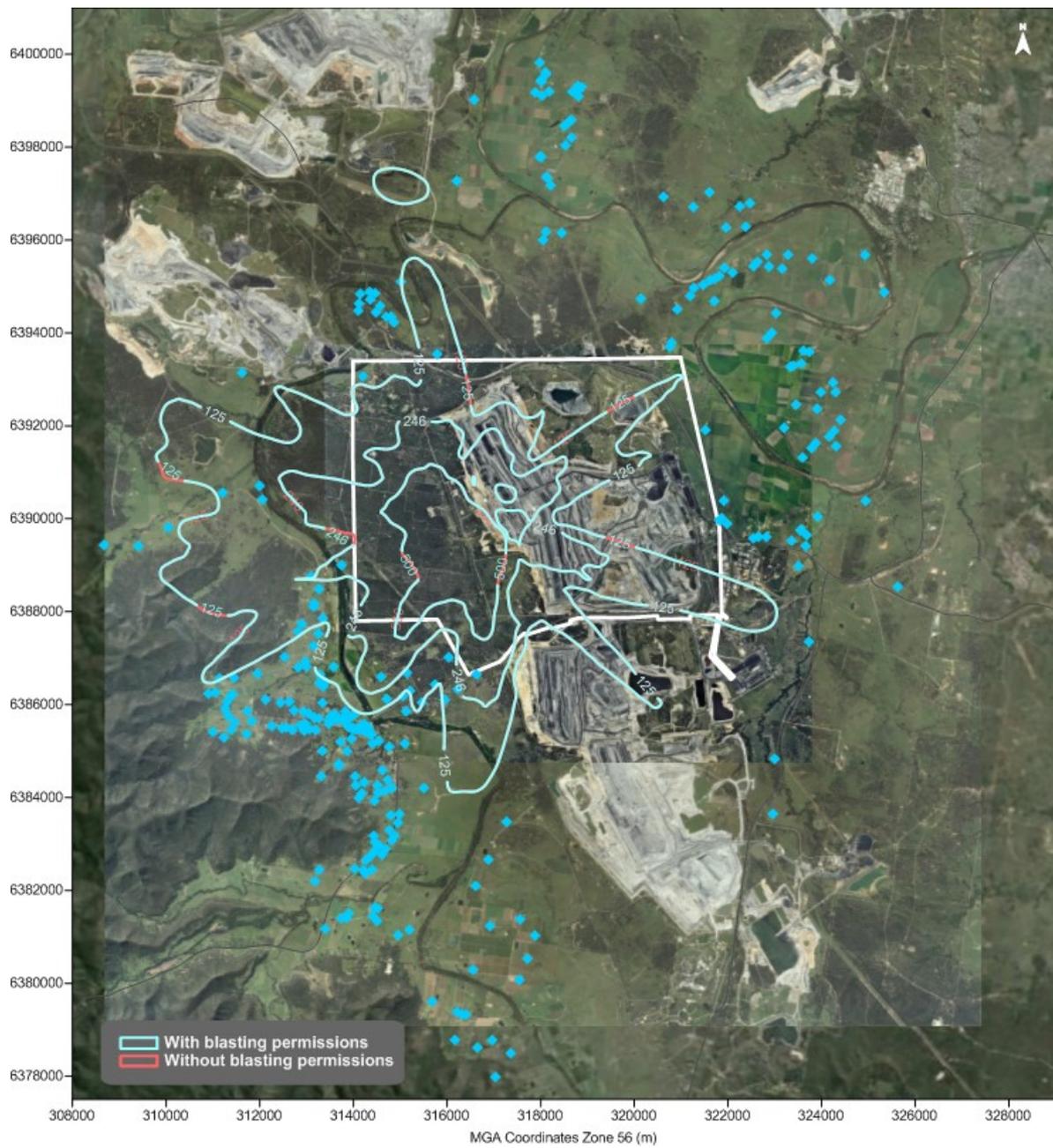


Figure 6: Predicted maximum 1-hour average blast emissions from the proposal in Year 9 – 18:00 (NO₂ concentrations $\mu\text{g}/\text{m}^3$)

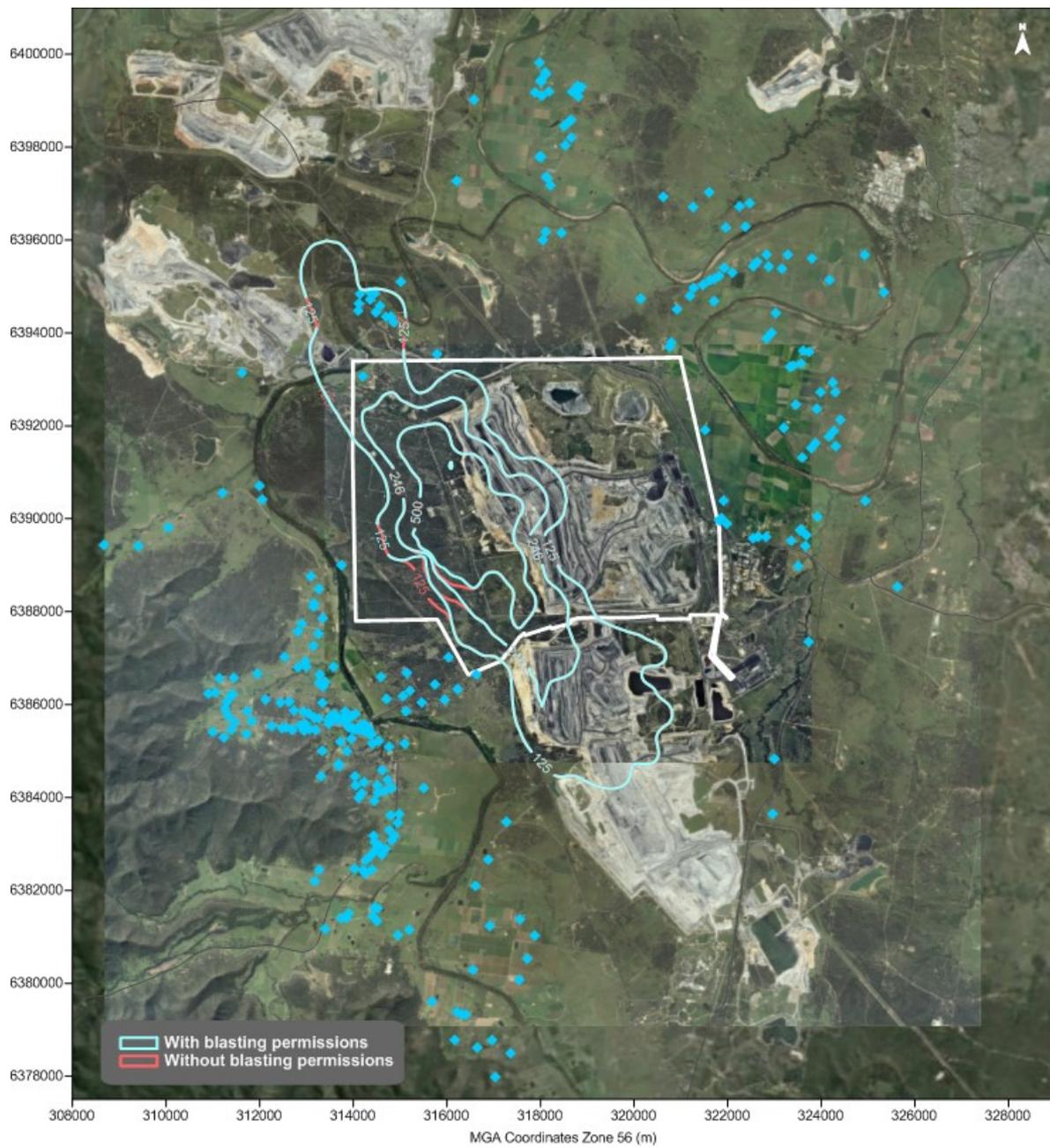


Figure 7: Predicted maximum 1-hour average blast emissions from the proposal in Year 14 – 07:00 (NO₂ concentrations µg/m³)

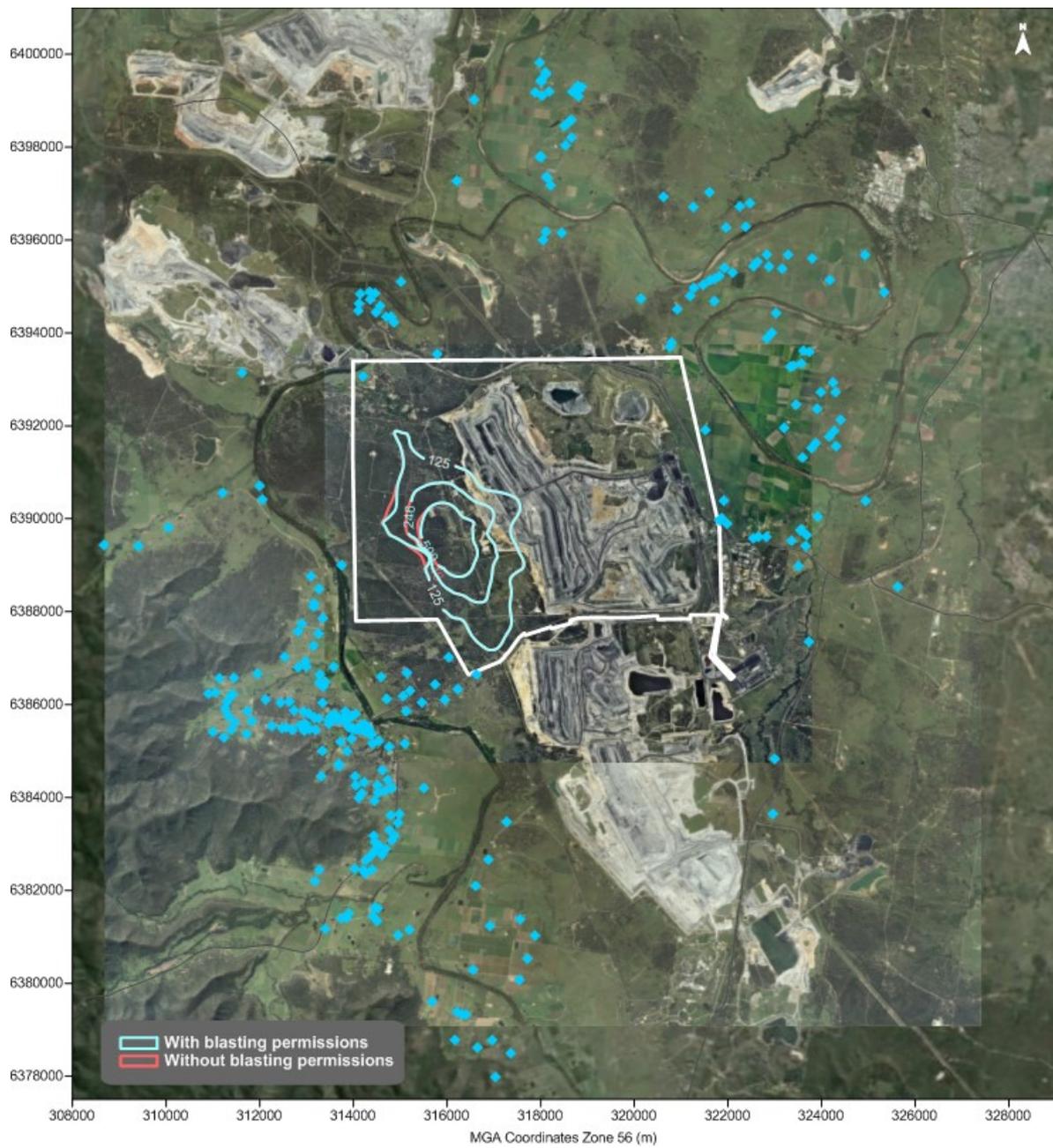


Figure 8: Predicted maximum 1-hour average blast emissions from the proposal in Year 14 – 08:00 (NO₂ concentrations µg/m³)

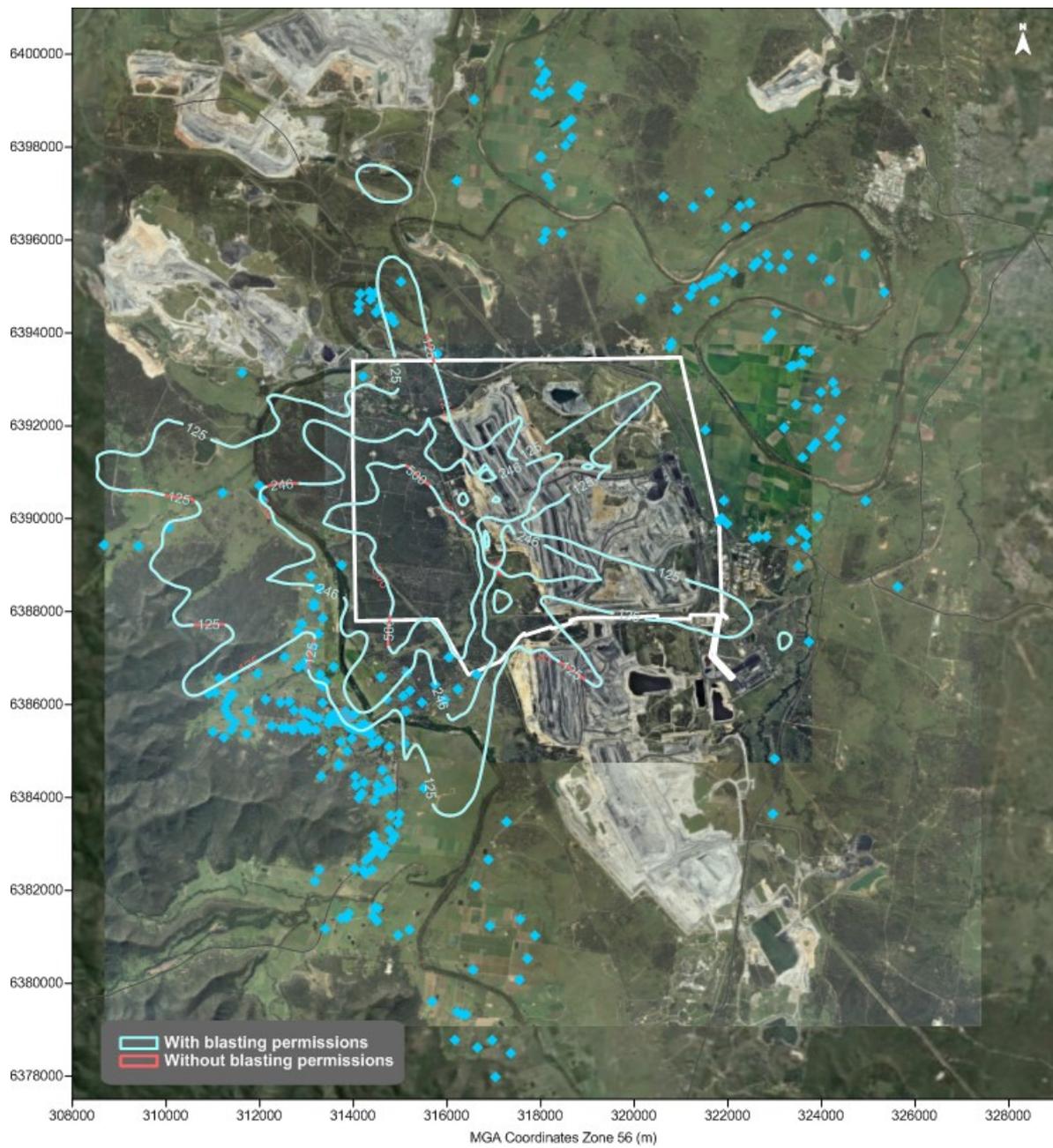


Figure 9: Predicted maximum 1-hour average blast emissions from the proposal in Year 14 – 18:00 (NO₂ concentrations µg/m³)

Appendix E

Social impacts and opportunities from the proposal - perceived and technical studies



Appendix E — Social impacts and opportunities from the proposal - perceived and technical studies

E

Appendix E

Social impacts and opportunities from the proposal - perceived and technical studies

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
Amenity	
<p>Noise</p> <p>Noise levels and impacts on amenity, health and well-being</p> <p>Noise was the most frequently identified perceived impact. Near neighbours (that is, residents living in proximity to the mine with potential noise exposure) perceive that the proposal is very likely to contribute to noise (including low frequency noise), impacting on the amenity, health and well-being of residents in Bulga, Long Point and Gouldsville.</p>	<p>Noise management</p> <p>The applicant has committed to implementing best practice sound suppression on all major plant. Further, the applicant is in the final stages of developing a pre-emptive real time noise modelling interface (a first in the NSW mining industry) and is using best practice real time noise monitoring and management techniques. This constitutes all reasonable and feasible mitigation that has and would be adopted under the proposal.</p> <p>Assessment criteria</p> <p>The Mining SEPP’s non-discretionary standard for cumulative amenity noise levels at privately-owned residential dwellings is met for Bulga village, and noise impacts are predicted to be below the acceptable noise levels and amenity of the village as a rural area would be maintained. Further, the Mining SEPP’s non-discretionary standard for cumulative amenity noise levels is also met at other surrounding localities such as Gouldsville and Long Point.</p> <p>The L&E Court judgement (par. 64), notes that experience of noise levels from current mine operations is more than an expression of subjective fear or concern. However, while noise levels may be perceived differently by different stakeholders, the noise assessment used objective INP noise criteria designed to protect at least 90 per cent of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90 per cent of the time.</p> <p>Project specific noise levels</p> <p>The determining factor for the project specific noise levels (PSNLs) for all residences is the intrusiveness criteria. Background levels have been set at appropriate levels to determine these.</p> <p>Significant exceedances (>5dB(A)) of the PSNLs are predicted to occur at four assessment locations, three at Warkworth village (77, 102 and 264) and one to the north of Bulga village (34). Assessment location 77 is currently afforded acquisition rights from an adjacent mining operation. Assessment location 264 is inferred to have acquisition rights from an adjacent mine but is not currently included in its approval. Assessment location 102 is Warkworth Hall, which is a non-residence. Significant exceedances (>5dB(A)) of the PSNLs are not predicted at any other surrounding localities including Long Point and Gouldsville.</p> <p>Noise levels would be within 1 or 2dB(A) of the PSNLs for the majority of the residences at Bulga. As noted in Section 10.2.2 of the EIS, changes of 1 to 2dB are imperceptible.</p> <p>Low frequency noise</p> <p>Noise levels are predicted to meet relevant Broner criteria for low frequency noise and INP criteria for sleep disturbance at representative assessment locations.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
	<p>Cumulative noise</p> <p>Cumulative noise levels would satisfy the INP (and Mining SEPP) night time criterion at all but one representative assessment location in Warkworth village (77). As this is a representative location, the criterion is also likely to be exceeded at two neighbouring locations in Warkworth village (102 and 264). It should be noted that these assessment locations are currently afforded acquisition rights from an adjacent mining operation. The status of assessment location 264 is referenced above.</p> <p>Traffic noise</p> <p>The closure of Wallaby Scrub Road and resulting increased traffic on detoured roads would not result in an exceedance of relevant noise criteria.</p> <p>Summary</p> <p>All reasonable and feasible measures have been applied to control noise from Warkworth Mine.</p> <p>Overall, one additional privately-owned residence that is not within either Warkworth Mine’s or a neighbouring mine’s existing acquisition zone (as per existing development consents), would be afforded acquisition rights under the proposal. Furthermore, given that the cumulative noise levels have been met at the majority of assessment locations, and it is unlikely there would be additional noise sources nearby in the future, the residences at Bulga generally have a rural level of amenity as defined in the INP.</p> <p>Coal & Allied would implement operational, noise and blasting management strategies and monitoring as detailed in Chapter 10 of the EIS. Specifically for Bulga, this includes measures such as a trigger action response process (TARP), whereby noise level triggers from the MTW real time noise monitoring network initiate a series of management measures to reduce offsite noise levels.</p>
<i>Assessment of impact</i>	<p>Noise criteria are established by government to protect at least 90 per cent of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90 per cent of the time.</p> <p>Stakeholders perceived that the proposal would contribute to noise, especially low frequency noise and that this may impact on the amenity, health and well being of near neighbours.</p> <p>As noted above, the highest predicted operational noise levels at one additional privately-owned residence that is not within either Warkworth Mine’s or a neighbouring mine’s existing acquisition zone (as per existing development consents), would, under worst case meteorological conditions, significantly exceed (>5dB(A)) criteria. This residence would be afforded acquisition rights under the proposal. Noise at several residences is predicted to moderately exceed (3-5dB(A)) criteria. Noise levels are predicted to meet relevant Broner criteria for low frequency noise and INP criteria for sleep disturbance at representative assessment locations.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
	<p>Further, all residences in Bulga are predicted to satisfy the Mining SEPP's cumulative noise limit from all industrial noise sources. Compliance with the Mining SEPP's cumulative noise limit is accepted as providing significant protection against noise impacts. This means that the total impact from all mines in the locality would achieve amenity level recommendations of the INP. The closure of Wallaby Scrub Road and resulting increased traffic on detoured roads would not result in an exceedance of relevant noise criteria.</p> <p>Overall, one additional privately-owned residence that is not within either Warkworth Mine's or a neighbouring mine's existing acquisition zone (as per existing development consents), would be afforded acquisition rights under the proposal. Furthermore, given that the cumulative noise levels have been met at the majority of assessment locations, and it is unlikely there would be additional noise sources nearby in the future, the residences at Bulga generally have a rural level of amenity as defined in the INP.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, it is concluded that social impacts from noise on amenity, health and well-being are acceptable and meet Government guidelines.</p>
Air quality	<p>Air quality impacts</p> <p>Near neighbours expressed concern that the proposal is likely to contribute to air quality impacts from dust, diesel emissions and blast fumes.</p> <p>It is perceived that air quality would deteriorate due to increasing proximity of the mine to Bulga, the proposed disturbance of approximately 698ha of land, and air quality impacts experienced from current operations.</p> <p>Impacts of air quality on health and well-being</p> <p>Some stakeholders perceive that air quality impacts on amenity, health and well-being of affected residents are likely. Some stakeholders feel that they have little capacity of these affected residents to cope with air quality impacts.</p> <p>Air quality management</p> <p>Air quality goals are benchmarks set to protect the general health and amenity of the community in relation to air quality.</p> <p>Air quality impacts are currently managed at Warkworth Mine through an existing integrated management system which involves the implementation of a monitoring network, best practice mitigation measures, and operational control strategies and measures with the objective of continuous improvement (see Section 11.5 of the EIS). Recent air quality monitoring results for 2012 and 2013 have shown that the Warkworth Mine is complying with the relevant air quality criteria.</p> <p>Assessment criteria</p> <p>The Mining SEPP's non-discretionary standard for cumulative air quality is met at all but two privately-owned residential dwellings (assessment locations 77 and 264) which are in Warkworth village. These assessment locations, and one non-residence (102 – Warkworth Hall), may experience concentrations above the relevant air quality goals for 24-hour average and annual average PM₁₀ (particulate matter with a diameter of 10µm or less). Assessment location 77 is currently afforded acquisition rights from a neighbouring mine. Assessment location 264 is inferred to have acquisition rights from neighbouring mines but is not currently included in its approval.</p> <p>The Mining SEPP's non-discretionary standard for cumulative air quality at privately-owned residential dwellings is met for Bulga village and air quality impacts are predicted to be below the acceptable air quality concentrations and amenity of the village would be maintained.</p> <p>Particulate matter</p> <p>Twenty four mine-owned assessment locations are predicted to experience concentrations above the relevant air quality goals for 24-hour average and annual average PM₁₀. A subset of these assessment locations may also experience concentrations above the relevant air quality goals for annual average total suspended particulate matter (TSP) and incremental and total annual average dust deposition.</p> <p>Dust from mining is generally coarse in fraction (> PM_{2.5}) whereas the fine fraction dust (< PM_{2.5}) of concern to human health typically originates from combustion sources.</p> <p>Cumulative PM_{2.5} (particulate matter with a diameter of 2.5µm or less) concentrations would be below the National</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
		<p>Environment Protection Measure (NEPC 2003) advisory reporting standards at all of the assessment locations where the concentrations of other pollutants are below the relevant air quality goals.</p> <p>Diesel emissions and blast fume emissions</p> <p>No air quality impacts are predicted to result from diesel emissions (NO₂ and CO) and blast fume emissions.</p>
<i>Assessment of impact</i>	<p>Air quality goals are benchmarks set to protect the general health and amenity of the community in relation to air quality. Recent air quality monitoring results for 2012 and 2013 have shown that the Warkworth Mine is complying with the relevant air quality criteria.</p> <p>Near neighbours expressed concern that the proposal would contribute to air quality impacts from dust, diesel emissions and blast fumes with a resulting impact on amenity, health and well-being.</p> <p>As noted above, the Mining SEPP’s non-discretionary standard for cumulative air quality is met at all but two privately-owned residential dwellings in Warkworth village and one non-residential building. One of these locations is currently afforded acquisition rights from a neighbouring mine, while the other is inferred to have acquisition rights from neighbouring mines. The Mining SEPP’s non-discretionary standard for cumulative air quality at privately-owned residential dwellings is met for Bulga village. This means that amenity of the village would be maintained. Cumulative PM_{2.5} concentrations would be below the NEPC (2003) advisory reporting standards at all of the assessment locations where the concentrations of other pollutants are below the relevant air quality goals. This means that the current standards of air quality would be maintained. No air quality impacts are predicted to result from diesel emissions (NO₂ and CO) and blast fume emissions.</p> <p>On this basis and subject to the implementation of all reasonable and feasible mitigation, it is concluded that air quality impacts are a low risk to social amenity and are acceptable given Government criteria guidelines are met for privately-owned residences.</p>	
Blasting and vibrations	<p>Blasting and vibration impacts</p> <p>Near neighbours perceive that the proposal is likely to contribute to vibration impacts from blasting on the amenity and properties of residents in Bulga, Milbrodale, areas of Broke, Long Point and Gouldsville.</p> <p>Stakeholders perceive that vibration impacts from the proposal on the amenity and properties of affected residents are likely as mining operations and blasting activities come closer to Bulga.</p>	<p>Blasting and vibration impacts</p> <p>Blast noise overpressure and ground vibration limits would be met with the implementation of appropriate blast management (see more detail in Chapter 10 of the EIS). The blasting impact assessment focused on Bulga Bridge and St Phillip’s Church in Warkworth Village as the most sensitive local structures. As the minimum separation distance between these structures and blast areas would be at least 2.5km, it is highly unlikely that these structures would be impacted.</p> <p>Subject to the implementation of the protocols outlined in the MTW blast management plan no impacts are predicted to result from blast fume emissions.</p> <p>As described in Chapter 11 of the EIS, MTW is currently implementing a predictive management system to aid with management of blasting operations. Such a system uses actual conditions for each blast to predict the potential impact which may occur. The prediction is made on the basis of forecast weather data, allowing operators to schedule a blast to the time of least impact over the course of the upcoming day. In effect the system updates the blasting restrictions for each individual blast on the basis of predicted impact. The system thus deals with the spatially and time varying weather and terrain influences and is generally more reliable than relying on a fixed set of wind speed and wind direction restrictions.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Near neighbours perceived that blasting from the proposal may contribute to vibration and amenity impacts on properties as mining activities move closer to Bulga.</p> <p>An assessment of blasting impacts on sensitive structures in the vicinity (Bulga Bridge and St Phillips Church in Warkworth) indicated that it is highly unlikely that these structures would be impacted by blasting. As noted above, a predictive modelling system is being implemented at MTW. It will continue to use spatially and time varying weather and terrain data to predict the most appropriate time of day to complete blasting activities. Subject to the implementation of the protocols outlined in the MTW blast management plan no impacts are predicted to result from blast fume emissions.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts on property and amenity from blasting or vibration are considered acceptable and meet Government guidelines.</p>	
Visual amenity	<p>Visual amenity impacts</p> <p>Near neighbours expressed concern that the proposal is very likely to contribute to visual amenity impacts on residents of Bulga, Milbrodale, areas of Broke, Long Point and Gouldsville.</p> <p>It is perceived that visual amenity would deteriorate due to the increasing proximity of the mine to Bulga and given the surrounding landforms. Some stakeholders expressed concern that that this would particularly be experienced at properties in Bulga on the western side of Inlet Road and nearby roads/streets, the western side of Putty Road and nearby roads/streets, and the elevated sections of the western side of Wambo Road.</p>	<p>Visual amenity impacts</p> <p>As described in Section 15.1 of the EIS, open cut coal mines, including Warkworth Mine, and supporting infrastructure are a prominent landscape feature the landscape. The proposal would extend exposure to views from the west of the Site, and decrease the distance between sensitive viewers and mine and rehabilitated landform, in the long-term. The active mining face would advance away from sensitive viewers in the east under the proposal. Overburden emplacement at the Site would continue to be visible to some viewers in Bulga. Some residences west of the Site, such as elevated residences around Bulga village, may experience high visual impacts. However in the broader area, overall visual impacts of the proposal would generally be moderate to low, as the impact on visual amenity would be limited, localised and consistent with existing views. The existing topography and vegetation would continue to provide screening to the mine to varying extents depending on view location and elevation.</p> <p>Visual impact mitigation measures</p> <p>Visual impact mitigation measures would be put in place to mitigate the potential impacts on the overall surrounding landscape. This would include vegetation and bund screening to the boundaries of the Site. In addition, site-specific visual assessments (SSVAs) would be available to individual landowners of potentially impacted properties. These SSVAs would prescribe specific mitigation measures, if the proposal is determined to have high or high/moderate visual impact at the property.</p> <p>The L&E Court judgement (par. 434) found that being able to see overburden emplacements are a constant reminder of the mine and that lights from the mine are intrusive and annoying. Implementation of the mitigation measures prescribed in SSVAs at impacted properties would be important to substantially reduce these amenity impacts.</p> <p>Progressive rehabilitation of the Site would further reduce the level of contrast in the viewing landscape and, ultimately, result in a higher level of visual integration.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<i>Assessment of impact</i>	<p>Open cut mines and associated infrastructure has long been a dominant feature of the local area’s visual character, as would follow with mining being the highest employer in the region. This includes the Warkworth Mine which was established over 30 years ago.</p> <p>Near neighbours expressed concerns that the proposal will contribute to visual amenity impacts on residents, particularly on the western side of Inlet and Putty roads.</p> <p>The proposal will result in some negative visual impacts for residences to the west, including those in more elevated parts of Bulga village: the mine and rehabilitated landform will move closer and active mining will occur over an extended period of time. The proposal will also result in some positive visual impacts: the final landform at Warkworth Mine will be more undulating supporting a more natural looking landscape and improved at MTO by the removal of a final void when compared to the final landforms approved under the respective mines’ approvals.</p> <p>Given the proposed extension area is on the western side of the mine, visual impacts from the north, east and south are negligible. Potential visual impacts will generally limited to areas to the west of the mine, specifically, Bulga village. Visual impacts experienced will range from moderate to low, as the impact where existing topography and vegetation would continue to provide screening to the mine, to high, such as at the more elevated residences around Bulga village.</p> <p>Where high or high/moderate visual impacts occur, site-specific mitigation measures (eg SSVAs) would be available to individual landowners. In addition, visual impact mitigation measures would be put in place to mitigate the potential impacts on the overall surrounding landscape including vegetation and bund screening to the boundaries of the Site.</p> <p>As a brownfield extension and subject to the implementation of management measures committed to under the proposal, it is concluded that social impacts from changes to visual amenity under the proposal are acceptable as the viewshed is already dominated by mining developments. The increased impact from the proposal is not considered to significantly alter the viewshed from what it is at present. In addition, mining impacts are short term and the long term rehabilitated landscape will have a low visual impact.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
Environmental		
Groundwater and surface water	<p>Groundwater impacts</p> <p>Stakeholders raised concern about impacts on groundwater from the proposal, including:</p> <ul style="list-style-type: none"> well and bore water decline at privately-owned properties; impacts on the general hydrogeological system of the Bulga, Milbrodale and Broke areas; and subsidence caused by aquifer changes. <p>These were acknowledged as a broader cumulative matter by some near neighbours.</p> <p>These impacts were considered to be contributing factors in reducing water supply to properties, damaging properties and impacting way of life through reducing environmental quality in the area.</p> <p>Surface water impacts</p> <p>Stakeholders perceived that there would be impacts on surface water from the proposal, particularly the potential continued deterioration of the Wollombi Brook which is considered to be an important environmental, social and community attribute, with several stakeholders citing its long-standing importance to Bulga for agricultural production and recreational activities.</p>	<p>Groundwater</p> <p>Groundwater modelling predicts there would be no groundwater drawdown at any privately-owned bore greater than 2m. Government policy stipulates that for any bores where the maximum cumulative decline in groundwater levels is predicted to exceed 2m due to mining a make good agreement between the landholder and the applicant should be in place. A reduction of less than 2m is unlikely to noticeably reduce the pumping yield from any bore.</p> <p>Groundwater modelling indicates that risks to groundwater systems are negligible and manageable subject to the obtainment of the necessary water entitlements. The applicant is committed to ensuring the necessary licences are held with sufficient share component and water allocation to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased.</p> <p>Potential groundwater impacts from the proposal would not result in subsidence and, as such, would not impact on property. Coal & Allied would implement groundwater management strategies and monitoring as detailed in Chapter 16 of the EIS.</p> <p>Surface water</p> <p>Impacts of the proposal are unlikely to be significantly different to those from the existing approved operations.</p> <p>Groundwater modelling predicts a reduction in saline Permian groundwater discharge to the Wollombi Brook as mining progresses, reduce the salinity of the alluvium (and subsequently in the brook) during the life of the proposal.</p> <p>Surface water modelling predicts that no uncontrolled release of saline water would occur over the life of the proposal. Excess saline water would continue to be released in accordance with the existing rules of the Hunter River salinity trading scheme.</p> <p>The MTW water management system would continue to operate and prevent sedimentation.</p> <p>As all offsite water supply requirements (if required) and water take under would be obtained from licensed sources, there would be no adverse impact on other licensed users (subject to climatic conditions and the operation of the water supply scheme). Therefore, agricultural production and recreational activities would not be impacted.</p> <p>Coal & Allied would implement surface water management strategies and monitoring as detailed in Chapter 17 of the EIS.</p>
<i>Assessment of impacts</i>	<p>Water related legislation provides for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The <i>NSW Aquifer Interference Policy</i> (AIP) defines the regime for protecting and managing the impacts of aquifer interference activities on NSW's water resources and strikes a balance between the water needs of towns, farmers, industry and the environment.</p> <p>It is concluded that the social impact from proposal's interaction with surface and groundwater is acceptable given Government policy (eg AIP) and legislative licensing requirements will be met.</p>	

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<p>Warkworth Sands Woodland</p> <p>Loss of Warkworth Sands Woodland (WSW)</p> <p>Near neighbours expressed concern about a loss of the ‘unique ecology’ of WSW. It was perceived that this would impact fauna (particularly birdlife) and groundwater systems, removing opportunities for educational and recreational activities such as school visits, bird watching and nature walks.</p> <p>Biodiversity offsets</p> <p>Stakeholders were generally sceptical about the effectiveness of biodiversity offsets in areas far-removed from WSW and questioned the achievements of other offsetting projects undertaken in the Hunter Valley.</p>	<p>Impacts on vegetation including WSW</p> <p>WSW would be disturbed under the proposal. This would be managed through provision of biodiversity offsets and supplementary measures, such as the reestablishment of Warkworth Sands Grassland (WSG) to WSW and provision of funds for the development of an integrated management plan for WSW.</p> <p>A thin perched groundwater system of limited extent, recharged by rainfall, is present in the Aeolian Warkworth sands that support the WSW ecological community. This system is not in direct hydraulic connection with the underlying Permian fractured rock (AGE 2014). Therefore, the proposal is not expected to impact on the groundwater system or the associated vegetation community.</p> <p>Open cut mining projects cannot readily avoid impacts where mineral resources are beneath flora and fauna habitats. Listed species and communities, including WSW, were avoided to the greatest possible extent during mine and infrastructure design.</p> <p>The proposal’s remaining impacts on WSW and other vegetation were assessed in accordance with contemporary government policy.</p> <p>Coal & Allied would implement the measures to avoid, minimise, mitigate and compensate for the loss of WSW and other native vegetation as described in Chapter 12 of the EIS.</p> <p>Biodiversity offsets</p> <p>Offsets for WSW are proposed within the SBA and NBA including existing vegetation and reestablishment. The reestablishment of WSW in areas mapped as WSG would establish large, fully functioning examples of the EEC through enhancement of areas. In the long-term, this would result in a larger area of WSW than currently exists and would be managed and protected, which is not the case currently. The offsets would also provide habitat into the future for threatened fauna species associated with this vegetation community.</p> <p>In addition, supplementary measures are proposed, including:</p> <ul style="list-style-type: none"> • development of rehabilitation completion criteria based on the University of New England research over the last five years; and • provision of funds for the development of an integrated management plan. <p>The assessment of groundwater dependent ecosystems concluded that no direct impacts to this groundwater system resulting from the proposal would occur.</p> <p>In combination, these measures would result in a larger area of WSW than currently exists that would be managed and protected, which is not the case currently.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Environmental legislation and policy provides for the assessment and management of ecology in NSW for the benefit of both present and future generations.</p> <p>Near neighbours expressed concerns in regards to the loss of a portion of WSW and the resulting impacts of removal on birdlife, recreation and groundwater systems. Concerns were also raised in regards to the effectiveness of biodiversity offsets in areas far-removed from current WSW.</p> <p>Open cut mining projects cannot readily avoid impacts where mineral resources are beneath flora and fauna habitats. Listed species and communities, including WSW, were avoided to the greatest possible extent during mine and infrastructure design. The assessment of disturbance to the WSW has been undertaken in accordance with government policy and its certified quantification tools (ie BCAM). The BOS will comprise provision of biodiversity offsets and supplementary measures, such as the reestablishment of WSG to WSW and provision of funds for the development of an integrated management plan for WSW. Offsets for WSW are proposed within the SBA and NBA which would establish large, fully functioning examples of the EEC and in the long term result in protection of a larger area of WSW. The WSW contains groundwater resources recharged by rainfall. This system is not in direct hydraulic connection with the underlying Permian fractured rock (AGE 2014). Therefore, the proposal is not expected to impact on the groundwater system supporting WSW or the associated vegetation community.</p> <p>The proposal’s remaining impacts on WSW and other vegetation were considered to be in accordance with contemporary Government policy and will be certified by OEH under the rules of the Upper Hunter Strategic Assessment. On this basis, and subject to the implementation of all reasonable and feasible mitigation, it is concluded that the social impact from the proposal impacts on WSW is acceptable and meets Government policy.</p>	
Rehabilitation and future land use planning	<p>Ineffective rehabilitation</p> <p>Near neighbours and interested stakeholders perceived that past and present rehabilitation practices at MTW and at other mining sites throughout the Hunter Valley have been ineffective/unsuccessful and that little change in these practices is included as part of the proposal.</p> <p>Several stakeholders suggested that evidence is yet to emerge of open cut coal mine rehabilitation leading to positive environmental and land use outcomes.</p>	<p>Rehabilitation achieved and proposed</p> <p>Rehabilitation at MTW is undertaken in a series of stages as mining progresses. Much of the rehabilitation to date has been in the north of the site predominately away from the public views and is consistent with the progression of mining.</p> <p>The 2013 Annual Environmental Review for MTW illustrates that the rehabilitation completed in 2013 exceeded the commitment outlined in the Mining Operations Plan (MOP). The cumulative rehabilitation undertaken during the MOP period of 126.2ha has also exceeded that committed to in the MOP (121.9ha) at this point in the mine life.</p> <p>The proposal includes commitments (see Chapter 13 of the EIS) to leading practice rehabilitation and future innovations in rehabilitation to achieve improved outcomes. Given this is the case, it is unlikely that ineffective rehabilitation would lead to social impacts.</p>
<i>Assessment of impacts</i>	<p>Rehabilitation at MTW is undertaken in a series of stages as mining progresses.</p> <p>Near neighbours perceived that rehabilitation practices throughout the Hunter Valley are ineffective.</p> <p>The 2013 Annual Environmental Review for MTW illustrates that the rehabilitation completed in 2013 exceeded the commitment outlined in the MOP. The cumulative rehabilitation undertaken during the MOP period of 126.2ha has also exceeded that committed to in the MOP (121.9ha) at this point in the mine life.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible rehabilitation measures, it is concluded that rehabilitation will not result in a negative social impact given that it meets Government requirements through the MOP. In addition, mining impacts are short term and the long term rehabilitated landscape will have an acceptable visual impact.</p>	

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
Community	
<p>Community and family cohesion</p> <p>Loss of population, community members and leaders</p> <p>The residents of Bulga, Long Point and Gouldsville perceive there may be loss of population, community members and leaders as a result of acquisition and relocation, leading to the gradual decline of community (both facilities/services and existing community connections and village life) and loss of connections between and within communities and families.</p>	<p>Population</p> <p>The proposal is required to enable continuation of operations at Warkworth Mine in 2015 and beyond, and so maintaining the current and the regional population in the medium-term.</p> <p>The decline of smaller rural communities is a broad concern across Australia, including in parts of the middle and upper Hunter region that are experiencing decline. A wide range of factors are contributing to this such as improved communications which is encouraging migration to cities and centralisation of services, restructuring of rural industries and reduced employment opportunities, and population aging and non-replacement leading to towns falling below the critical threshold needed to maintain essential services (Productivity Commission 2009). In contrast, Bulga has a number of significant attributes including retail and community facilities (service station, general store, tavern, community hall, sports ground and fire brigade) and it is well located to service the tourist trade being proximal to attractions like wineries and is on the Putty Road tourist route. Consequently, Bulga has experienced both a growth in population and housing prices, has a relatively robust age structure and relatively low rates of population turnover.</p> <p>Predicted impacts from the proposal would not necessitate property acquisitions in Bulga village. It is also important to note that in contrast to perceptions any property acquisition rights included in an approval are upon the request of the landowner and are not compulsory. If a landowner does not wish to take up their acquisition rights they do not have to. Any landowner with acquisition rights under an approval can also choose when they might like to have their property acquired, if at all, during the life of the development. For example, if the landowner is happy at the start of the project to stay but 10 years later choose to take up their acquisition rights, the rights would still exist and can be validly processed under the approval.</p> <p>The Bulga population has increased 11.5 per cent or 37 persons between the 2006 and 2011 census. However, it is acknowledged that local stakeholders reflect on gradual population decline in nearby villages such as Warkworth, Camberwell and Ravensworth. Even with the replacement of population that may occur with leasing any acquired properties, or with the new owners living or leasing properties sold by owners voluntarily relocating, concern remains regarding the loss of existing community connections, activity and village life.</p> <p>ABS data shows that Bulga SSC's population increased by 11.5 per cent from 321 to 358 persons between 2006 and 2011, which is double the NSW rate of 5.6 per cent for the same period. In this period, Singleton's population declined by 4.7 per cent.</p> <p>While the proposal would contribute to maintaining the current and the regional population, individual community members would continue to make decisions based on individual circumstances about whether to stay in the area. ABS data has shown that Bulga has a lower population turnover rate than the NSW average: in 2011, 71 per cent of people in the Bulga SSC were recorded at the same address they were five years earlier (compared to 57 per cent for both Singleton and NSW). This suggests that community connections would be relatively strong. It also suggests that the majority of residents consider Bulga to be an attractive place to live and, assuming an acceptable level of amenity can be maintained by the proposal, would continue to be so.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<i>Assessment of impact</i>	<p>Residents of Bulga, Long Point and Gouldsville villages perceive population decline may result from acquisition and relocation which in turn may lead to the decline of community and loss of connections between and within communities and families. Conversely, other community members perceive that job losses from disapproval would lead to breakdown of family and support networks, family separation and community depopulation.</p> <p>Predicted impacts from the proposal would not necessitate property acquisitions in Bulga village. The proposal would contribute to maintaining the current and regional population by continuing to provide employment opportunities. Data from the ABS in regards to population trends has shown an increase in the population of Bulga SSC by 11.5 per cent between 2006 and 2011, which is double the NSW rate of 5.6 per cent. Population data also showed Bulga as having a lower population turnover when compared to the NSW average, suggesting that Bulga is considered an attractive place to live and, assuming an acceptable level of amenity can be maintained by the proposal, would continue to be so. As noted above, however, individual community members would continue to make decisions based on individual circumstances about whether to stay in the area.</p> <p>Subject to the implementation of management commitments made under the proposal, it is considered that the potential for loss of population, community members and leaders will remain relatively unchanged and, on balance, there will be limited social impact.</p>
Places of community value and sense of place	<p>Loss of sense of place</p> <p>Near neighbours are worried by the loss of the places of community value and uncertainty regarding the future of the Bulga community.</p> <p>Loss of sense of place has been associated with ‘solastalgia’, which is defined as the distress that is produced by environmental change impacting on people while they are directly connected to their home environment. Some stakeholders had a sense of distress, loss, depression and abandonment when discussing their connections to home, community, family and the rural environment, and that these connections may be lost as a result of the proposal.</p> <p>Loss of sense of place</p> <p>A ‘loss of sense of place’ is a concern of some Bulga residents. Bulga experiences low population turnover and residents have relatively positive health, employment, crime rate and property ownership characteristics that are illustrative of a stable and cohesive community. The reference case (if the proposals were not to proceed) would have a subsequent ‘loss of sense of place’ for a different set of stakeholders if viable mining could not be maintained and they could not obtain jobs in the area and had to move. These would include employees, particularly those that reside in the Singleton LGA (35 per cent of the workforce) and others where the present level of social services could not be maintained (for example student numbers and school closure).</p>
<i>Assessment of impact</i>	<p>Near neighbours raised concerns in regards to loss of places of community value and a sense of place as a result of the proposal.</p> <p>The predicted impacts are below the amenity criteria for a rural area and suggest that the mine and village can co-exist. Additionally, if the proposal did not proceed, stakeholders including employees, particularly those residing in the Singleton LGA, and others where the present level of social services could not be maintained (for example student numbers and school closure) may experience a loss of sense of place. ABS data shows that unemployment has increased dramatically in the Hunter Valley from 5.8 per cent in May last year to 9.2 per cent currently. This includes approximately 1,500 direct mining jobs lost in the Hunter Valley over the past 18 months (NSW Mining 2014). As noted above, predicted impacts from the proposal would not necessitate property acquisitions in Bulga village and individual community members would continue to make decisions based on individual circumstances about whether to stay in the area.</p> <p>On this basis, the potential for loss of sense of place under the proposal is considered to remain acceptable.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
Heritage	<p>Loss of historic and Aboriginal cultural heritage</p> <p>Stakeholders also expressed concern that the proposal would impact on places of community value due to impacts on the Former RAAF Base Bulga Complex, sections of the Great North Road, places of Aboriginal cultural heritage significance and Saddleback Ridge. They also associated indirect impacts of the proposal on places of heritage and community value in Bulga through potential impacts of population decline on the management and maintenance of those places.</p>	<p>Loss of historic heritage</p> <p>Small portions of the former RAAF Base Bulga Complex and Great North Road would be impacted by the proposal, and heritage impacts are considered minor. The former RAAF Base Bulga Complex and the Great North Road have been subject to comprehensive assessment, and conservation management plans have been prepared for both. The former RAAF Base Bulga Complex has also been subject to archival recording in accordance with NSW Heritage Office guidelines.</p> <p>No direct or indirect impacts are predicted on heritage items located in and surrounding Bulga village.</p> <p>The study found that with the implementation of the mitigation measures (see Chapter 19 of the EIS), potential heritage impacts within the study area are likely to be low.</p> <p>Coal & Allied would implement the following additional management measures:</p> <ul style="list-style-type: none"> • establish the MTW Historic Heritage Conservation Fund – the purpose of the fund is to provide resources for local historical research and heritage conservation projects proposed by the local community; and • establish the Great North Road Conservation Fund – the purpose of the fund is to provide resources for heritage conservation works on significant surviving elements of the convict built Great North Road within Singleton LGA (and potentially other areas including the Great North Road World Heritage Area). <p>Loss of Aboriginal cultural heritage</p> <p>Places of material Aboriginal cultural heritage have been identified within the proposed 2014 disturbance area. There are 110 places of material cultural heritage within the proposed 2014 disturbance area that would be disturbed or destroyed as a result of the proposal. However, there are no Aboriginal cultural heritage places with scientific values that constitute a constraint on the proposal.</p> <p>Aboriginal cultural heritage at MTW would continue to be managed under the auspices of the CHWG and the ACHMP. In particular, the WBACHCA would be established for the long-term conservation and management of Aboriginal cultural heritage places and values (see Chapter 19 of the EIS).</p>
<i>Assessment of impact</i>	<p>Stakeholders expressed concerns in regards to the impacts on places of community value and areas with historic and Aboriginal heritage significance.</p> <p>The historic heritage study concluded that potential impacts on heritage were minor. No direct or indirect impacts are predicted on heritage items in and surrounding Bulga village. Commitments such as the implementation of a MTW Historic Heritage Conservation Fund and Great North Road Conservation Fund will be implemented and potentially enhance heritage in the area.</p> <p>No areas of high sensitivity will be disturbed under the proposal. The Aboriginal community are an integral part of the management of Aboriginal cultural heritage at MTW. Commitments made under the proposal were made in full consultation with the Aboriginal community and include the substantial WBACHCA and the nearby Loders Creek Aboriginal Cultural Heritage Conservation Area (LCACHA).</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts from the proposal’s interaction with historic and Aboriginal cultural heritage are considered acceptable and meet Government guidelines.</p>	

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
MTW workforce and their families	<p>Retention of MTW workforce and their families</p> <p>A range of stakeholders identified positive opportunities for the community from the proposal. These opportunities were largely identified for the broader Singleton LGA as a result of the retention of the MTW workforce and their families as a result of the proposal. It was described that the workforce and their families contribute to the community, not only economically (through local spending and support for local business), but also through community participation (attendance at local schools, participation in sporting and other community events and community volunteering).</p>	<p>Indirect contributions of the proposal on the community</p> <p>The local community is experiencing impacts from the recent downturn in the coal industry including a decline in population and the loss of mine workers and their families.</p> <p>Approximately 35 per cent of the MTW workforce lives in Singleton LGA, 56 per cent of the workforce have children who attend educational facilities in their local LGA and approximately 33 per cent participate in volunteering in their local LGA. The MTW workforce and their families contribute to the local and regional economy and community through high levels of local spend and through the continuing use of community facilities and participation in the community, such as through volunteering.</p> <p>The employee and supplier survey results indicate that there would be benefits to small to medium sized enterprises (SMEs) from the retention of the workforce.</p> <p>The proposal would ameliorate some of uncertainty in the community resulting from the recent downturn in the coal industry.</p>
<i>Assessment of impacts</i>	<p>Stakeholders identified positive opportunities for the community from the proposal including the retention of the MTW workforce and their families and thus the retention of their positive contributions to the community through support for local businesses, community groups and community participation.</p> <p>The MTW workforce and their families contribute to the local and regional economy and community through high levels of local spend and through the continuing use of community facilities and participation in the community, such as through volunteering. The proposal would ameliorate some uncertainty in the community resulting from the recent downturn in the coal industry.</p> <p>On this basis, the proposal will have a positive social impact on resulting from the retention of the MTW workforce and their families and retaining their contribution to the local community.</p>	
Intergenerational and intra-generational equity	<p>Rural sustainability and intergenerational equity</p> <p>Some stakeholders perceived that there would be impacts on rural sustainability and intergenerational equity as a result of loss of family and community heritage and the loss of rural villages, environment, community and other associated livelihoods (for example, local business and agriculture).</p> <p>These impacts were perceived as potentially permanent and significant due to the perceived inability to replace the heritage, community and land values of the area post-mining.</p>	<p>Final landform and land uses</p> <p>Following the completion of mining and rehabilitation, a final landform would remain that is safe, stable, free draining, and non-polluting. This would be integrated with the surrounding landscape.</p> <p>The final landform would support final land uses including for the conservation of native vegetation and for agriculture for existing and future generations.</p> <p>The impacts the proposal on heritage and land-values are described above and below, respectively.</p> <p>Direct and indirect employment</p> <p>The proposal contributes to social equity by providing direct and indirect employment. It would result in the transformation of a geological resource into physical and human capital through investment in infrastructure and workforce training, and, indirectly, through contributions to governments which would enable greater investments in public infrastructure and services.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Stakeholders perceived potential impacts on rural sustainability and intergenerational equity from the proposal.</p> <p>The final landform for the proposal will be safe, stable, free draining, and non-polluting which is consistent with leading practice. This would be integrated with the surrounding landscape. It will support land uses including the conservation of native vegetation and agriculture for existing and future generations.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts on rural sustainability and intergenerational equity are considered to be acceptable.</p>
Health and well-being	
Health and well-being – community uncertainty	<p>Health impacts</p> <p>Stakeholders, particularly near neighbours, raised concerns regarding health impacts from the proposal. Perceived health impacts related to stress as a result of uncertainty for the future; and concerns about the health impacts of poor air/water quality.</p> <p>Stress and uncertainty</p> <p>Some stakeholders were concerned about health impacts from stress and uncertainty – for themselves, their family and the community. This uncertainty was most often related to: the acquisition process; the future of Bulga and its community; potential decline of community and fracturing of families; a mistrust of the proposal assessment process; uncertainty regarding ability to sell properties, property values, and related impacts on investments/assets and their future.</p> <p>Stress-related health impacts</p> <p>Health and well-being impacts need to be considered at a community level. In a study of the health of Hunter Valley communities in proximity to coal mining and power generation, Merrit <i>et al.</i> (2013) found that:</p> <p style="padding-left: 40px;">There were no significant differences in management rates of mental health conditions in the Hunter Valley region compared with the rest of rural NSW. Management rates of depression and anxiety were not higher, nor were prescription rates of antidepressants.</p> <p>This indicates that similar levels of anxiety are experienced in Hunter Valley region compared to rural NSW as a whole although the causes of anxiety may vary between regions.</p> <p>Health impacts of dust</p> <p>The air quality and greenhouse gas study was completed in accordance with the applicable NSW and Commonwealth guidelines, standards and impact assessment criteria which take into account the known health effects of particulates on sufferers of asthma, lung conditions and heart disease.</p> <p>Air quality assessment criteria are designed to protect urban communities. Compared to the urban environment, there are less fine particulates in dust from mining and these particulates do not contain combustion products. Therefore, the assessment criteria provide a high level of conservatism when used to determine the acceptable levels of dust from mining projects in rural settings. The assessment results based on these criteria are described in above in ‘Impacts on air quality’.</p> <p>Health impacts of blast fumes</p> <p>The impacts of blast fumes have been assessed based on guidelines, standards and impact assessment criteria. With the implementation of blast restrictions when required, blasts would not result in assessment criteria being exceeded. The assessment results based on these criteria are described in above in ‘Impacts from blasting/vibration’.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	Technical assessment
Perceived	<p>Impacts on rainwater tanks</p> <p>Lucas <i>et al.</i> (2009) investigated the potential for health impacts from coal dust deposited on rooftops and washed into water tanks. With the exception of two mine-owned residences, the incremental dust deposition predicted for the proposal at private and mine-owned residences is less than the 2g/m²/month incremental criterion in all modelling years. Taking the predicted dust deposition levels, the spatial separation of residences from the mine and the findings of Lucas <i>et al.</i> (2009) into account, the potential for adverse impacts to rainwater tanks from the deposition of coal dust is low, even at the closest residences.</p> <p>Impacts of mining on health</p> <p>Merrit <i>et al.</i> (2013) conducted an analysis of general practice data for rural communities in close proximity to coal mining and coal-fired power generation in the Hunter Valley to identify unusual patterns of illness. The study in the NSW Public Health Bulletin concluded that:</p> <p>There was no evidence of a significant difference in problems managed or medications prescribed by [general practitioners] GPs for residents of communities potentially affected by heavy industrial activity (coal mining and power generation) in the Hunter Valley region of NSW compared with residents in the remainder of rural NSW during the period 1998–2010. The diverging trend for respiratory problem management over time is worthy of further exploration.</p> <p>The ‘diverging trend’ refers to a comparison of the management rates of respiratory problems (as a group) during the period 2005–2010 with those for 1998–2004. This indicated that there was no significant change in the Hunter Valley region despite a significant decrease for the remainder of rural NSW over this period. However, the statistical significance of this difference could not be determined due to the sample size.</p> <p>Other</p> <p>Particular areas of concern to stakeholders regarding community uncertainty are addressed elsewhere in this chapter in the following sections:</p> <ul style="list-style-type: none"> <li>• uncertainty surrounding the acquisition process; <li>• the future of Bulga and its community; <li>• potential decline of community and fracturing of families; <li>• a mistrust of the proposal assessment process; and <li>• uncertainty regarding the ability to sell properties, property values, and related impacts on investments/assets and their future.

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Government policies and guidelines are in place to protect the health of communities. Applicable NSW and Commonwealth guidelines, standards and impact assessment criteria are designed to take into account the known health effects of particulates on sufferers of asthma, lung conditions and heart disease.</p> <p>Stakeholders raised concerns in regards to the impacts of the proposal on health and wellbeing, particularly in the areas of stress, uncertainty and poor air or water quality. I Submissions from employees of the mine and supporting businesses commonly referenced health impacts, such as stress related illnesses, due to the uncertainty regarding the mine’s future and job security. The primary or only earner supporting a family working at the mine and employment vulnerability should the proposal not proceed was commonly raised. Fear and uncertainty associated with potential job loss were expressed in these submissions. This was often linked to the inability to find alternative employment in the region, necessitating the relocation of families and leaving social support networks.</p> <p>Air quality, water and blasting studies completed for this proposal were completed using the applicable NSW and Commonwealth guidelines. The assessment results based on these criteria are described above in relevant sections. Merrit et al. (2013) found that similar levels of anxiety are experienced in Hunter Valley region compared to rural NSW as a whole although the causes of anxiety may vary between regions. Particular areas of concern to stakeholders regarding community uncertainty are addressed elsewhere in this table in the following sections:</p> <ul style="list-style-type: none"> • uncertainty surrounding the acquisition process; • the future of Bulga and its community; • potential decline of community and fracturing of families; • a mistrust of the proposal assessment process; and • uncertainty regarding the ability to sell properties, property values, and related impacts on investments/assets and their future. <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts on health and wellbeing are considered to be acceptable and meet Government policies and guidelines.</p>	
Vulnerable groups	<p>Impacts to vulnerable groups</p> <p>Some stakeholders expressed concern that some vulnerable groups would be exposed to impacts on: their health from the amenity impacts; their economic and asset base due to a perceived inability to sell properties/assets; and indirectly through the potential loss of community services and facilities in light of a perceived decline in community.</p>	<p>Vulnerable groups</p> <p>Particular areas of concern to stakeholders regarding vulnerable groups are addressed elsewhere in this table:</p> <ul style="list-style-type: none"> • potential amenity impacts of the proposal (from noise, dust and vibration); • health matters related to mining; • potential impacts on property values and ability to sell; and • the potential for fracturing of the community. <p>Mitigation measures</p> <p>Notwithstanding this, it is recognised that vulnerable groups, including older members of the community, may not adapt to change and can be more susceptible to impacts, perceived or otherwise. In recognition of this concern, Coal & Allied propose to contribute to a Bulga and Near Neighbour Amenity Resource which would provide services such as property maintenance to residents surrounding the operation. Vulnerable near neighbour residents would have access to this resource.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Stakeholders expressed concerns that vulnerable groups may be exposed to health and economic impacts and a loss of community services.</p> <p>It is recognised that that vulnerable groups, including older members of the community, may not adapt to change and can be more susceptible to impacts, perceived or otherwise. Coal & Allied propose to contribute to a Bulga and Near Neighbour Amenity Resource which would provide services such as property maintenance to residents surrounding the operation. Vulnerable near neighbour residents would have access to this resource. Other areas of concern to stakeholders regarding vulnerable groups are addressed elsewhere in this chapter.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts on vulnerable groups are considered to be acceptable.</p>	
Economic		
Properties value, saleability and investor confidence	<p>Negative impacts on property values and saleability</p> <p>Near neighbours raised concern that the proposal would have a negative impact on property values and ability to sell in line with current and historical trends.</p> <p>Positive impacts on property values and saleability</p> <p>Stakeholders living in Singleton perceived favourable property market opportunities as maintenance of the current workforce would help to stabilise the property market after recent decreases in sales results and rental returns.</p> <p>Some stakeholders (including Singleton residents, businesses and real estate agents) suggested that the recent contraction of the coal industry had contributed to the weakening of the property market through decreased demand. Local business stakeholders (Singleton-based real estate agents) suggested that the market was ‘over-heated’ during the coal mining boom, and that current soft property market figures may reflect a recalibration of the market towards a more realistic and stable trend.</p>	<p>Recent property market trends</p> <p>Recent property market data for the Singleton LGA show a decline in sales results and a dramatic fall in rental returns for Singleton LGA. Median sales prices fell consistently in 2013 (almost 9 per cent annual decline for all properties) and rental returns fell by approximately 25 per cent on average in the 12 months to December 2013.</p> <p>The issue of devaluation of properties was considered by Stubbs (2012) who examined the purchase price of properties within Bulga during the lodgement and determination of the application for the Warkworth Extension Project in 2010 and 2011 and early 2012. The application was lodged on 1 March 2010 and the EA was placed on exhibition from 30 April to 15 June 2010. The matter was considered by the PAC and an approval granted on 3 February 2012. The approval was subsequently appealed in the L&E Court. Stubbs (2012) examined the sale price of all properties sold in Bulga between 1 April 2008 and 23 May 2012. She noted that the purchase price of properties did not appear to have been affected by the lodgement and assessment of the application, with median property values in Bulga and surrounds increasingly considerably since that time (\$282,500 median sale price in the two years prior to lodgement, and \$450,000 median sale price since the lodgement) (Stubbs 2012).</p> <p>Property market stabilisation</p> <p>The proposal would aim to maintain current workforce levels across MTW operations, which should contribute to population levels in the Singleton LGA (with over 35 per cent of MTW employees residing in Singleton LGA) and, subsequently, partly assist in stabilising the property market.</p> <p>Coal & Allied would continue to manage residential properties via the open market. Coal & Allied utilises the services of local real estate agents to manage its properties to a high standard of maintenance and management.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Stakeholders identified both positive and negative impacts from the proposal on property value and investor confidence. Some stakeholders were concerned that the proposal would have a negative impact on property values and their ability to sell properties. Other stakeholders perceived favourable property market opportunities through the maintenance of the current workforce.</p> <p>Property market data from Stubbs (2012) in regards to devaluation of property values noted that the purchase price of properties did not appear to have been affected by the lodgement and assessment of the Warkworth Extension 2010 application with median property values in Bulga and surrounds increasingly considerably since that time (\$282,500 median sale price in the two years prior to lodgement, and \$450,000 median sale price since the lodgement). The maintenance of the current workforce should contribute to population levels in the Singleton LGA (with over 35 per cent of MTW employees residing in Singleton LGA) and, subsequently, partly assist in stabilising the property market.</p> <p>On this basis, the potential social impacts on property values are considered to be acceptable.</p>
Property maintenance and impact management costs	<p>Property maintenance and impact management costs</p> <p>Near neighbours perceived that the impacts of current operations, particularly dust and vibration impacts, have a direct and ongoing economic cost and that the proposals would intensify those impacts.</p> <p>Near neighbour communities are not generally connected to mains water supply, so properties are reliant on tank water.</p> <p>Assessment of impacts</p> <p>Air quality and noise and vibration studies indicate that dust and vibration levels would be within the relevant guidelines.</p> <p>Water tanks</p> <p>Regardless of proximity to mining water tanks generally require routine maintenance to ensure that water quality is maintained. The impacts of the proposal on rainwater tanks are summarised in ‘Health and wellbeing impacts’.</p> <p>While there would be no significant impacts to private residences directly attributable to the proposal, Coal & Allied propose contribution to a Bulga and Near Neighbour Amenity Resource to provide services to residents surrounding the operation.</p>
<i>Assessment of impacts</i>	<p>Near neighbours raised concerns that the proposal would have a negative impact on property maintenance and management.</p> <p>Air quality and noise and vibration studies indicate that dust and vibration levels would be within the relevant Government prescribed criteria and guidelines. Regardless of proximity to mining, water tanks generally require routine maintenance to ensure that water quality is maintained. The impacts of the proposal on rainwater tanks are summarised in ‘Health and wellbeing impacts’.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts of the proposal on property maintenance and management is considered to be acceptable and meets Government criteria and guidelines.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities		
	Perceived	Technical assessment
Employment and training	<p>Employment and training opportunities</p> <p>Stakeholders identified employment, expenditure on suppliers' services and associated opportunities for skills development and scholarships as primary benefit of the proposal.</p> <p>Contribution to economic growth</p> <p>Experience with the growth of the coal industry since the late 1990s gave some stakeholders confidence that the proposal would significantly contribute to employment and economic growth in the Singleton LGA. Local business stakeholders were confident that the proposal would deliver employment and skills development opportunities across the Singleton LGA. Many stated that small downturns in coal industry activity were immediately felt by local suppliers and that the proposal would stabilise supplier workforce numbers and supporting revenues.</p>	<p>Ongoing workforce and suppliers</p> <p>MTW currently employees a workforce of approximately 1,300 persons on average. Although Warkworth Mine and MTO are integrated operations and workforce numbers are difficult to assign to the respective development consents, an estimate of 63 per cent (819 persons on average) could be attributed to activities on the Warkworth Mine development application and 37 per cent (481 persons on average) to the MTO development application.</p> <p>The proposal aims to maintain current workforce levels across MTW operations, bringing with them employment and training opportunities and are expected to contribute employment and supplier revenue benefits into the medium-term, with economic opportunities for the region extending over the proposal life-cycle.</p>
Assessment of impacts	<p>Stakeholders identified the positive contribution that the proposal may make to expenditure in the region, employment and training opportunities, and economic growth in the local area.</p> <p>The proposal aims to maintain current workforce levels across MTW operations, bringing with them employment and training opportunities and are expected to contribute employment and supplier revenue benefits into the medium-term, with economic opportunities for the region extending over the proposal life-cycle.</p> <p>On this basis, it is considered that the proposal will have a positive impact on the employment and training opportunities.</p>	

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<p>Representation of local residents, near neighbours, women, and Aboriginal and Torres Strait Islanders in the MTW workforce</p>	<p>Representation of local residents, near neighbours, women, and Aboriginal and Torres Strait Islanders in the MTW workforce</p> <p>Many near neighbour residents from Bulga, Milbrodale, Long Point/Gouldsvile contended that few near neighbours were employed at MTW and that no new targets for lifting employment rates for near neighbour communities or local employment are included in the proposal.</p>
	<p>Locals in the workforce</p> <p>Almost three quarters of MTW employees and long-term contractors live in the Mid and Upper Hunter region: Singleton LGA (35 per cent), Cessnock (19 per cent) and Maitland LGA (17 per cent). In January 2014, MTW employed 24 people from direct near neighbour communities (for example, Bulga, Milbrodale, Warkworth and Maison Dieu) which equates to approximately 7 per cent of the labour force from those communities.</p> <p>Coal & Allied maintains a continued preference for employees and contractors to reside locally.</p> <p>Women and Aboriginal people in the MTW workforce</p> <p>About 12 per cent of the current workforce (both employees and contractors) are women. Rio Tinto Coal Australia’s goal is to achieve 15 per cent female employment across it operations (RTCA 2014) which is the average proportion of female employees in the mining Australian industry (WGEA 2013).</p> <p>The Indigenous workforce (both employees and contractors) represent about 2 per cent of the total MTW workforce. Rio Tinto Coal Australia’s goal is to achieve five per cent Indigenous employment across its operations (RTCA 2014). The proportion of Indigenous people in the Australian mining industry is four per cent.</p> <p>The MTW Diversity Action Plan has a focus on increasing Indigenous and female employment.</p> <p>Coal & Allied would continue to implement the MTW Apprenticeship and Graduate programme, drawing on local candidates, and consisting of:</p> <ul style="list-style-type: none"> • five new apprenticeship positions each year; • Aboriginal scholarship programme in partnership with University of Newcastle, supporting two Aboriginal students per annum with a scholarship programme and vacation employment to complete their degrees; • two graduate positions per annum on a two year programme; and • two vacation student positions each year.
<p><i>Assessment of impacts</i></p>	<p>Near neighbours raised concerns that the proposal did not provide enough opportunities for near neighbours, women or Aboriginal and Torres Strait Islanders.</p> <p>Data from employee surveys show that almost three quarters of MTW employees and long-term contractors live in the Mid and Upper Hunter region and approximately 7 per cent of the labour force from near neighbour communities. About 12 per cent of the current workforce (both employees and contractors) are women. Rio Tinto Coal Australia’s goal is to achieve 15 per cent female employment across it operations which is the average proportion of female employees in the mining Australian industry (WGEA 2013). The Indigenous workforce (both employees and contractors) represent about two per cent of the total MTW workforce. Rio Tinto Coal Australia’s goal is to achieve 5 per cent Indigenous employment across its operations (RTCA 2014).</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts from the proposal on local representation are acceptable.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
Local and regional businesses and industry	<p>Opportunities for local businesses</p> <p>Local businesses generally speculated that the economic contribution of the proposal would be the most significant opportunity, with continuity of work and the implications that continuity has for workforce planning and maintenance being cited as the most critical benefits for suppliers.</p>	<p>Hunter Valley labour market outlook</p> <p>The HVRF’s measure of employment intentions suggest that further weakness in the Hunter Valley labour market can be anticipated. Employment intentions have declined since December 2011 with HVRF’s most recent measures lower than those during the Global Financial Crisis of 2008. Similar trends are also evident in the HVRF’s (2013b) Household Survey, which suggests that consumer confidence and purchasing intentions in the Hunter Valley remain negative. Overall, HVRF (2013b) conclude that the economic outlook for the Hunter Valley reflects the end of the previous expansion phase combined with a drive to achieve efficiencies, the effects of which are now being felt by local suppliers, contractors and operational employees. Continued MTW operations would assist in maintaining a proportion of supplier revenues.</p> <p>Coal & Allied would continue:</p> <ul style="list-style-type: none"> • to engage with Singleton Council on key areas of common interest including attraction and retention of residents and long-term planning; • the preference for employees and contractors to reside locally; and • the development of the Coal & Allied Local Procurement Strategy incorporating the MTW operation.
<i>Assessment of impacts</i>	<p>Local businesses identified the proposal’s positive economic impact from continuity of work to workforce planning and maintenance. The HVRF’s measure of employment intentions suggest that further weakness in the Hunter Valley labour market can be anticipated. ABS data shows that unemployment has increased in the Hunter Valley from 5.8 per cent in May last year to 9.2 per cent currently. Continued MTW operations would assist in maintaining a proportion of supplier revenues. On this basis, it is considered that the proposal would have a positive social impact on continuity of work and workforce planning and maintenance.</p>	
Corporate community investment and sponsorship	<p>Continued contribution to, and investment in, local communities</p> <p>Stakeholders reflected on the potential for continued contribution to, and investment in, local communities through the proposals, including: Aboriginal and Torres Strait Islander employment, education and training opportunities; direct contributions to community service providers; and, contributions made to training and life-skills programmes at Singleton High School.</p>	<p>Continued contribution to, and investment in, local communities</p> <p>Existing direct community contributions and investment from MTW operations would continue under the proposal. Employees and suppliers make financial and non-financial contributions to the regional community and participated significantly in community activities, which in turn, contribute to community way of life. The proposal would continue to provide employment and economic benefits to suppliers, allowing employees and suppliers to continue to contribute to the community. A proportion of the MTW Site Donation Committee annual funding would be dedicated for projects which contribute to near neighbour communities, including the Bulga community, and which are in accordance with the funding guidelines of the Committee.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Stakeholders identified the positive contribution the proposal could make to investment in, local communities including school groups, Aboriginal and Torres Strait Islander employment and contributions to community service providers.</p> <p>MTW employees and suppliers make financial and non-financial contributions to the regional community and participated significantly in community activities, which in turn, contribute to community way of life. The proposal would continue to provide employment and economic benefits to suppliers, allowing employees and suppliers to continue to contribute to the community.</p> <p>On this basis, it is considered that the proposal would have a positive social impact on corporate and community investment and sponsorship.</p>	
Other industries and diversification	<p>Retention of skilled employees</p> <p>Local business stakeholders perceived that it was difficult to retain skilled employees given their migration to mining jobs for higher salaries.</p> <p>Two-speed economy</p> <p>Several stakeholders commented on the mining industry’s contribution to the creation of a ‘two-speed economy’, where those employed by or who contract to the industry enjoy substantial financial benefits whilst others deal with the inflationary effects on cost of living generated by spending of these benefits.</p> <p>Diversification</p> <p>Local government stakeholders perceived that there is insufficient planning regarding structural diversification of the Singleton LGA economy.</p>	<p>Requirement for skilled employees</p> <p>The proposal would continue current requirements for skilled workers and would continue to be a focus of planning in the Singleton LGA, generating potential for continued skills migration from other industries in the region and potential for maintenance of the status quo when it comes to structural diversification planning.</p> <p>Structural diversification required</p> <p>The imperative for structural diversification has become even more apparent since the end of the mining boom, with the HVRF (2014) noting that the medium-term outlook for increased non-mining productivity in the region would depend on business capacity to invest in innovation and skills to adapt to, and develop, new products, services and markets as the resources boom fades.</p> <p>Wider economic effects</p> <p>Research published by the Reserve Bank of Australia (RBA 2011) indicates that, at least at an economy-wide level, the distribution of mining income – for instance through dividends and tax receipts – is relatively evenly dispersed across the country. The direct effects of the expansion of the mining sector include employment growth, the use of intermediate inputs (such as materials and services, around two thirds of which are sourced locally), royalties and company income taxes, profits paid to shareholders such as superannuation funds, and investment (at least half of which is also contracted locally). Overall, the RBA estimated that the increase in mining revenues in the 2000s made a significant direct contribution to economic activity, and it is estimated that Australian residents received around half of the total receipts earned from mining operations.</p>
<i>Assessment of impacts</i>	<p>Stakeholders identified their inability to retain skilled employees due to the higher salaries in the mining industry.</p> <p>The proposal would continue current requirements for skilled workers and would continue to be a focus of planning in the Singleton LGA, generating potential for continued skills migration from other industries in the region.</p> <p>On this basis, it is considered that the impact of the proposal on the retention of skilled employees will be acceptable.</p>	

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities		
	Perceived	Technical assessment
Infrastructure and services		
<i>Infrastructure, services and local community facilities</i>	<p>Pressure on local infrastructure and services</p> <p>Local government stakeholders perceived that maintenance of MTW workforce numbers would continue to place pressure on local infrastructure, particularly through the frequency of heavy vehicle movements on local roads. However, local government representatives also noted the positive benefits of retention of MTW workforce on community infrastructure and services.</p> <p>Near neighbours perceived that the medium to long-term viability of community facilities and services in Bulga, including the Bulga Hall, tavern and store, would be impacted by proposal-related acquisitions and associated relocation of Bulga residents.</p> <p>Near neighbour stakeholders perceived a failure to adequately plan for lease holdings at the tavern and store following acquisition. It was perceived that changes to these facilities would impact the way of life in the village and access to services, particularly for the elderly, ill and disabled.</p> <p>Local government stakeholder’s identified the potential opportunity to stabilise population levels across the Singleton LGA. Subsequently, the contribution of MTW employees to council land rates would be maintained, helping to support the viability of current council services.</p>	<p>Demand for local infrastructure and services</p> <p>There would be no increase in the use of local infrastructure and demand for health and allied services, emergency services and emergency departments under the proposal, as the intention is to retain the current level of employment.</p> <p>Traffic would remain similar to current levels and safety levels would be unaffected.</p> <p>The proposal would aim to maintain current average workforce levels across MTW operations, helping to stabilise population levels across the Singleton LGA. Subsequently, the contribution of MTW employees to council land rates would be maintained, helping to support the viability of current council services.</p> <p>The continued MTW workforce and their families would also help maintain the use of local businesses and services, particularly shops, services, schools and childcare facilities.</p> <p>A Voluntary Planning Agreement (VPA) would be negotiated with Singleton Council. The VPA presents an opportunity to ensure a proportion of the funds are dedicated to maintaining and/or improving facilities and services in Bulga, other local neighbouring communities, and the Singleton LGA as a whole.</p> <p>As described in the noise section of this table, no residences in Bulga village would be afforded acquisition rights under the proposal due the predicted noise levels being in exceedance of relevant regulatory criteria. It is noted that one resident, assessment location 34, which is north of the village would be afforded acquisition rights. Therefore, proposal related acquisitions would not impact the medium to long-term viability of community facilities and services in Bulga, including the Bulga Hall, tavern and store. The maintenance of the current workforce under the proposal, however, may contribute to the viability of the community facilities and services.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<i>Assessment of impacts</i>	<p>Stakeholders identified positive and negative impacts on infrastructure, services and local facilities. Stakeholders were concerned with the potential pressure from the MTW workforce on local infrastructure and that acquisition of properties would result in the loss of community facilities. Stakeholders also identified the opportunities presented by a stable MTW workforce including helping to support local services, contribution to council land rates and assistance in retaining local community services.</p> <p>As described in the noise section of this table, no residences in Bulga village would be afforded acquisition rights under the proposal due the predicted noise levels not being in exceedance of relevant regulatory criteria. Therefore, proposal related acquisitions would not impact the medium to long-term viability of community facilities and services in Bulga. The maintenance of the current workforce under the proposal, however, may contribute to the viability of the community facilities and services.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts from the proposal on infrastructure and local community facilities is considered to be acceptable.</p>
<p>Closure of Wallaby Scrub Road – traffic, safety, emergency services</p>	<p>Wallaby Scrub Road closure impacts</p> <p>Many stakeholders, including emergency services and local council representatives, perceived that the closure of Wallaby Scrub Road is a key impact of the proposal. It is perceived that it would impact vehicle accident rates, emergency services, shift workers and local resident’s access to towns.</p> <p>Many local stakeholders perceived that there are a high number of accidents at the intersection of Putty Road and the Golden Highway.</p> <p>It was perceived that the proposal would increase the frequency of vehicle movements through this intersection given the closure of Wallaby Scrub Road. It was also perceived that traffic would increase on the Golden Highway between Putty Road and the existing intersection with Wallaby Scrub Road and that, in turn, this would increase vehicle movements through the intersection of Long Point Road and the Golden Highway. Near neighbours perceived increases in accidents at this location given that there are no turning bays at this intersection.</p> <p>Voluntary emergency service stakeholders (Bulga, Warkworth and Jerrys Plains RFS stations) estimated that travel to areas along the Golden</p>
	<p>Wallaby Scrub Road closure impacts</p> <p>The traffic and transport study (see Chapter 20 of the EIS) found that the primary traffic impacts as a result of the closure of Wallaby Scrub Road would be as follows:</p> <ul style="list-style-type: none"> • Level of service would remain unchanged at all intersections. • There would generally be minimal traffic impacts on the detour roads for the Wallaby Scrub Road closure as these roads (and the relevant intersections) have sufficient spare capacity to accommodate the resulting additional traffic with minimal intersection capacity impacts or delays. • The Putty Road and Charlton Road originating vehicle movements would be subject to increased travel distances of approximately 8.8km and 6.2km and additional travel times of 6 and 4 minutes per trip, respectively. • Travel safety and travelling conditions for the detoured traffic is expected to be improved due to improved road construction standards on the Golden Highway. • There would also be some savings in road maintenance costs for the Singleton Council as a result of the road closure. <p>In its letter dated 19 May 2014 (see Appendix O of the EIS), the RFS advises that ‘whilst its preferred option would be the relocation of Wallaby Scrub Road to maintain access for emergency services, an acceptable second option is the construction of a suitable fire trail on the perimeter of the proposed extension area..’. The applicant has committed to the construction of an emergency access road/fire trail between Putty Road and the Golden Highway in accordance with RFS standards under the proposal.</p> <p>Impacts on other local roads generated by Warkworth Mine and MTO employees on external public roads would not change as there would be no change to the combined average project workforce. Truck traffic generated would remain at similar levels.</p>

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

Impact/opportunities	
Perceived	Technical assessment
<p>Highway west of the Wallaby Scrub Road intersection and east to Long Point Road would require additional travel time for trips to Bulga, Milbrodale and Broke from RFS stations at Warkworth and Jerrys Plains.</p> <p>Near neighbours perceive that the closure of Wallaby Scrub Road would inconvenience all Bulga and Milbrodale and some Broke residents in accessing areas west of the current intersection of Wallaby Scrub Road and Golden Highway.</p>	<p>Stakeholders perceived that the closure of Wallaby Scrub Road would negatively impact vehicle accident rates, emergency services, shift workers and local resident’s access to towns. Near neighbours were also concerned that the closure of Wallaby Scrub Road would increase vehicle movements and accidents at the intersection of Putty Road and the Golden Highway.</p> <p>The traffic impact assessment identified that the closure of Wallaby Scrub Road would result in no changes to the level of service at all intersections and minimal impacts on the detour roads as these roads have sufficient capacity to accommodate the increase in traffic. The Putty Road and Charlton Road originating vehicle movements would be subject to increased travel distances of approximately 8.8km and 6.2km and additional travel times of 6 and 4 minutes per trip, respectively. This may also result in improved safety conditions for detoured traffic due to improved road construction standards on the Golden Highway. Impacts on other local roads generated by Warkworth Mine and MTO employees on external public roads would not change as there would be no change to the combined average project workforce.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the potential social impacts from the proposal on traffic movements are considered to be acceptable and meet Government guidelines.</p>
<i>Assessment of impacts</i>	

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
Community engagement/relationships and governance		
Company and community relationships	<p>Opportunities to improve historic community relations</p> <p>Some stakeholders perceived that there were opportunities to improve historic community relations and management of the mine’s current impacts. This perception has impacted community trust.</p> <p>Positive community relations</p> <p>Some stakeholders from local business and local government described positive interactions with individual staff at MTW but perceived a general history of relations with scope for improvement with the mine and a lack of ability to openly discuss, negotiate and engage as part of the local business and resident community.</p>	<p>Opportunities to improve community relations</p> <p>Since the Warkworth Extension 2010 proposal, based on feedback received from a range of stakeholders, a suite of ongoing and proposal specific strategies have been developed by Coal & Allied for communications generally and to manage/ mitigate or enhance these proposal-related impacts and opportunities. These are provided in Sections 21.5.1 and 21.5.2.</p>
<i>Assessment of impacts</i>	<p>Stakeholders have identified positive and negative aspects of the relationship between Rio Tinto Coal Australia and the community. Some stakeholders have identified impacts to community trust and a lack of ability to openly engage with the local community. Other local stakeholders have described positive relationships. A suite of ongoing and proposal specific strategies have been developed by Coal & Allied for communications generally and to manage/ mitigate or enhance these proposal-related impacts and opportunities. These are described in detail in the EIS. It is acknowledged, however, that for some parts of the community further work will be required to restore trust and this will be a function WML delivering on its commitments.</p> <p>On this basis, the potential social impacts from the proposal on company and community relations are considered to be acceptable.</p>	
Understanding of community and social impacts	<p>Opportunity to improve understanding of relationships</p> <p>Some stakeholders perceived the opportunity to improve understanding of relationships with the community through the assessment process.</p>	<p>Opportunity to improve understanding of relationships</p> <p>The assessment provides an opportunity to build understanding of community and social impacts and to improve company-community relations. Stakeholder feedback also suggested some satisfaction with the consultation process itself, and the ability to ‘be heard’.</p>
<i>Assessment of impacts</i>	<p>Stakeholders have identified that the assessment process may provide an opportunity to improve understanding of the relationship through the assessment process. The process of consultation through the assessment has provided an opportunity to build understanding of community and social impacts and to improve company-community relations. Stakeholder feedback also suggested some satisfaction with the consultation process itself, and the ability to ‘be heard’.</p> <p>On this basis, the potential social impacts from the proposal on company and community relations are considered to be acceptable.</p>	

Table E.1 Social impacts and opportunities from the proposal – perceived and technical studies

	Impact/opportunities	
	Perceived	Technical assessment
Government major project assessment process, regulation, monitoring and public representation	<p>Confidence in government assessment processes</p> <p>Stakeholders, including near neighbours, local businesses and council, and other interested stakeholders, perceived that the changes encompassed in the Mining SEPP have resulted in a loss of confidence in the NSW Government to adequately assess major mining projects, including this proposal, and to provide protection to, and representation of, the public. Stakeholders pointed to current allegations before the Independent Commission Against Corruption (ICAC) (during early-mid 2014) and the demonstrated connections between some mining companies and the NSW government (for example, improper donations). Stakeholders also discussed the impact on the ability to undertake a merits-based appeal on a project as an impairment of democratic rights. This proposal is seen by stakeholders to be relevant to the Mining SEPP amendments due to the timing and history of the proposal.</p>	<p>Government assessment processes</p> <p>Coal & Allied conduct its operations in accordance with NSW and Commonwealth legislation and internal high standards of conduct, including The Way We Work, its statement of business practice.</p> <p>As described in Chapter 7 of the EIS, the proposal will be considered by the NSW Government under the EP&A Act and a range of other legislation, regulations, policies and guidelines. These documents are frequently updated to ensure their ongoing relevancy.</p> <p>The EIS was prepared in accordance with current legislation and government policy and used the most recent and accurate scientific data relevant to the proposal. Feedback received from community and government stakeholder engagement together with the Secretary’s requirements and the L&E Court judgement, provided guidance to the assessment approach, ensuring that all potential matters of relevance associated with the proposal were assessed.</p>
<i>Assessment of impacts</i>	<p>Coal & Allied conduct its operations in accordance with NSW and Commonwealth legislation and internal high standards of conduct, including The Way We Work, its statement of business practice.</p> <p>Stakeholders have communicated that the changes in the Mining SEPP and allegations of government corruption have resulted in a lack of confidence in the NSW Government to provide protection for and representation to the public.</p> <p>The proposal will be considered by the NSW Government under the EP&A Act and a range of other legislation, regulations, policies and guidelines. These documents are frequently updated to ensure their ongoing relevancy. This EIS was prepared in accordance with current legislation and government policy and used the most recent and accurate scientific data relevant to the proposal.</p> <p>On this basis, and subject to the implementation of all reasonable and feasible mitigation, the social impact of the proposal on the government major project assessment process is considered to be limited and meets Government laws and guidelines.</p>	

Cite is: Connolly, E. and Orsmond D. (2011), ‘The mining industry: from bust to boom’, Paper prepared for the Reserve Bank of Australia Conference on ‘Australia in the 2000s’, H.C. Coombs Centre for Financial Studies, Kirribilli 15–16 August. [not cited in the BAEconomics report].

Appendix F

Extract from Stubbs Affidavit



Appendix F — Extract from Stubbs Affidavit

F

This and the following 1 pages comprise the Annexure
marked " R " referred to in the Affidavit of Judith Paris Stubby

affirmed before me on the 1st day of August 2012

Appendix K: Property sales for Bulga May
2008 to May 2012

Address	Suburb	Postcode	Sale Date	Price	Median	Bedrooms	Bathrooms	Area (ha)
58 The Inlet Rd	BULGA	2330	23/05/2012	475000				2.05
11 Turnbull Rd	BULGA	2330	15/03/2012	450000				1.56
30 The Inlet	BULGA	2330	17/02/2012	320000				0.4
2401 Putty Rd	BULGA	2330	20/10/2011	4500000				56.8
60 The Inlet Rd	BULGA	2330	20/06/2011	455000				1.98
2307 Putty Rd	BULGA	2330	10/05/2011	245000				0.7
179 Wambo Rd	BULGA	2330	3/05/2011	1225000		5	2	110
Putty Rd	BULGA	2330	24/03/2011	595000				0.67
2038 Putty Rd	BULGA	2330	24/03/2011	595000				0.34
343 The Inlet	BULGA	2330	24/03/2011	377500				1.701
147 The Inlet	BULGA	2330	17/09/2010	185000				1.32
18 The Inlet	BULGA	2330	24/08/2010	280000				0.2
19 Turnbull Rd	BULGA	2330	21/06/2010	346000	450000			8065
345 The Inlet	BULGA	2330	27/01/2010	235000				0.065
1010 Noses Peak Rd	BULGA	2330	30/11/2009	499000		4	2	4.212
Noses Peak Rd	BULGA	2330	14/10/2009	212500				4.283
15 Wambo Rd	BULGA	2330	16/09/2009	380000		3	2	1.9
12 Turnbull Rd	BULGA	2330	7/08/2009	260000		0	0	1.56
192 Thompsons Rd	BULGA	2330	20/07/2009	345000				11.08
Thompsons Rd	BULGA	2330	22/06/2009	280000				13.41
5B Noses Peak Rd	BULGA	2330	11/06/2009	205000				2.782
1946 Putty Rd	BULGA	2330	22/05/2009	1575000				61.38
2338 Putty Rd	BULGA	2330	26/08/2008	285000				0.89
The Inlet	BULGA	2330	31/05/2008	32000				0.094
2046 Putty Rd	BULGA	2330	21/05/2008	350000	282500	4	2	0.8

Source: EAC Redsquare Data Base:

Search of all properties sold since 1 April 2008 in the Suburb of Bulga

Appendix G

Response to Albrecht review (Appendix 4 of BMPA submission)



15 September 2014

Re: Response to submission on social impact assessment prepared by Glenn A. Albrecht

1 Introduction

Professor Albrecht's submission on behalf of the Bulga Milbrodale Progress Association Inc (the **BMPA**) provides an overview of his concept of solastalgia and advocates for how it may apply to the residents of Bulga.

Before turning to a detailed review of Professor Albrecht's submission it is important to place his submission in the appropriate context:

1. Professor Albrecht's submission does not provide any additional social impact analysis beyond the application of his concept of solastalgia or "loss of sense of place" to residents of Bulga.
2. While the concept of solastalgia or "loss of sense of place" is of utility in a SIA, despite Professor Albrecht's assertions to the contrary, it is not the only or pre-eminent consideration. Preston CJ made this clear in his judgment in the Warkworth Extension 2010 L&E Court. Paragraph 408, states that "...consideration of both the objective data for the broader community, and the experiential evidence from residents of the impacts at the local level, is required to have a complete picture of the likely social impacts of the Project."
3. It is clear from his submission that Professor Albrecht has not undertaken any new research with the residents of Bulga and how the concept of solastalgia may apply to them or more generally. This is consistent with the criticism Preston CJ provided on the 'research' Professor Albrecht used to support his affidavit in the Warkworth Extension 2010 L&E Court. This is further discussed in Section 2.10 below.
4. Despite this criticism, Professor Albrecht places great weight on the judgment of Preston CJ, but it is fundamentally misaligned with how Preston CJ recommends a social impact assessment be undertaken.
5. Professor Albrecht does not believe that his concept of "a loss of sense of place" can extend to the 'loss' or 'impacts' that MTW employees and potentially others in the Singleton LGA may feel if the proposal does not proceed. Not considering the potential impacts on people outside of Bulga leads to the very imbalance in the Professor's submission that he claims the applicant's social impact assessment suffers from.

6. Also, while Professor Albrecht is correct in stating concepts like ‘loss of sense of place’ are non-empirical and therefore cannot be measured, there is still however a threshold test required at law for these impacts to be given weight in an SIA. That test is given in *New Century Developments Pty Ltd v Baulkham Hills Shire Council* [2003] L&E Court 154 at 62:

“A fear or concern without rational or justified foundation is not a matter, by itself, that can be considered as an amenity or social impact”.

This is why in the SIA these non-empirical impacts are assessed by some objective measure, in an attempt to determine if they are ‘rational and justifiable’.

7. Lastly, Professor Albrecht’s submission suffers from his use of emotive rhetoric (eg. the ‘mega-mine’, ‘under direct contemporary threat’, ‘chronic desolation’, ‘Orwellian definition of balance’). While these words and phrases may assist Professor Albrecht to paint the picture he wishes the reader to adopt, this rhetoric does nothing to further a rational debate as to whether the impacts of the proposal at large are so great that the proposal should not proceed.

A response to the key aspects of Professor Albrecht’s submission is provided below.

2 Detailed Analysis

2.1 Paragraph 2.2

The contrast between ‘subjective concerns’ and ‘objective evidence’ is not one that is logically sound.

Response

While Professor Albrecht may believe that the contrast between ‘subjective concerns’ and ‘objective evidence’ is not logically sound, this is exactly the analysis that Preston CJ advocated for in the Warkworth Extension 2010 L&E Court. Specifically, in paragraph 408 of his judgment Preston CJ stated:

“In my view, neither Dr Stubbs nor Professor Albrecht provide a comprehensive assessment of the full range of likely social impacts, and consideration of both the objective data for the broader community and the experiential evidence from residents of the impacts at the local level is required to have the complete picture of the likely social impacts of the Project.” (emphasis added)

In this light, Professor Albrecht’s further claims in paragraph 2.2, that the applicant’s social impact assessment has an empirical bias is not consistent with what Preston CJ is seeking from applicants’ in a social impact assessment.

It is also clear from the above paragraph that Preston CJ, like the applicant, does not believe that Professor Albrecht’s social analysis provides a fulsome picture of the social impacts of the proposal and is useful only in understanding the concept of “loss of sense of place” as it may be applicable to certain residents of Bulga.

2.2 Paragraph 2.3

The enduring 'social' value of the Warkworth Extension 2010 L&E Court decision with respect to the Warkworth Extension 2010 was that it gave legal credence to loss of sense of place and other subjective indicators of community well-being.

Response

The applicant, does not dispute that the Professor Albrecht's concept of "loss of sense of place" was a concept that Preston CJ placed some credence on in his judgement. However, from Professor Albrecht's submission, he appears to be claiming that the concept of "loss of sense of place" should be given pre-eminence in the social impact assessment of large-scale mining proposals going forward. As noted in the response to paragraph 2.2, it is clear that Preston CJ believed both experts were limited in the utility of their evidence and that greater analysis of the "objective data for the broader community and the experiential evidence from residents" is required to form a view as to the social impacts of a development and this is what the applicant has sought to achieve in its SIA.

2.3 Paragraph 2.4

The 2010 Planning Assessment Commission (PAC) in their statement on the Warkworth Extension application indicated just how important this point about social impacts was for guiding future mining applications. They argued that the extension would bring open cut coal mining and the threat of extinction closer to the village of Bulga.

Response

It is important to remember that the 2010 PAC approved the Warkworth Extension 2010 project, having clearly given due consideration to its potential social impacts as evidenced by the remainder of paragraph 2.4 of Professor Albrecht's submission.

2.4 Paragraph 2.6

The NSW Government has now mandated, via the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment (Resource Significance) 2013, that the assessment authorities must place a higher value on the instrumental values of a development (e.g., its wealth or job generating capacity) than any other consideration.....Indeed, what could only be an Orwellian definition of balance, the Mining SEPP eliminates the concept of any reasonable meaning of the word and replaces it with a pro-development fiat based solely on instrumental value.

Response

Professor Albrecht's assertion that the 'wealth or job creating capacity' or 'instrumental value' of a project is now the pre-eminent consideration for the consent authority as a result of the Mining SEPP is incorrect. As stated in Section 7.2.3 of the EIS the consent authority is still required to consider all of the heads of consideration within section 79C of the EP&A Act. It is under section 79C(1)(A)(i), where the consent authority is to have consideration for the provisions of any environmental planning instrument (i.e. the Mining SEPP), that the economic benefits of the proposal are to be considered.

2.5 Paragraph 3.2

The overt bias in the EMM Report is clear from the outset as they have eliminated the very possibility of greater negative impacts to the existing community, as Justice Preston argued, namely, to its sense of place and sense of community and instead, focused impacts to the ‘socio-economic environment’ and ‘community services’.

Response

Professor Albrecht’s claims in paragraph 3.2 are not clear. He begins with a charge of ‘overt bias’ as against EMM, despite the fact that EMM have undertaken the SIA in accordance with the requirements outlined by Preston CJ in paragraph 408 of the Warkworth Extension 2010 L&E Court – namely that:

“consideration of both the objective data for the broader community (i.e. the socio-economic environment’ and ‘community services’) and the experiential evidence from residents of the impacts at the local level is required to have the complete picture of the likely social impacts of the Project” (emphasis and words in parentheses added).

Professor Albrecht then goes on to acknowledge that the elements included in EMM’s assessment form part of a ‘genuine social impact assessment’, but then says that ‘they by no means exhaust the list of those things important to consider as social impacts’. The applicant does not claim that these additional elements are the exhaustive list of things to consider in an SIA or are more important than other matters in an SIA, rather, including those elements helps to provide a more fulsome view of the social impacts of a proposal.

It appears from Professor Albrecht’s submission that unless the concept of solastalgia is given the greatest regard in the social impact assessment, he believes there is a fundamental imbalance with the assessment. Instead, the applicant argues that to get a fulsome view of the social impacts, as required by Preston CJ, both those social impacts applicable to the residents of Bulga and those applicable to the wider community need to be assessed, which is what the SIA has provided for.

2.6 Paragraph 3.3

The bulk of the EMM report focuses on the key empirically verifiable social indicators with the Upper Hunter and Singleton Local Government areas and presents the case that the economic contribution of mining has been a major positive for the region.....Bulga is not Singleton and it is erroneous in the extreme to make generalisations from the Upper Hunter-Muswellbrook-Singleton LGA data to characterise the Bulga village and its people. In other words, there is a large amount of largely irrelevant to Bulga ‘stuffing’ in the EMM report.

Response

In addition to assessing the social impacts applicable to Bulga, the EMM report sets out the potential impacts for the wider community if the reference case (i.e. the proposal not being approved) were to occur. While Professor Albrecht may consider that reporting on social impacts applicable to the wider community, to be ‘stuffing’ and irrelevant to Bulga, this is entirely consistent with the approach advocated for by Preston CJ, namely consideration of the objective data of the broader community, as against the experiential evidence of residents of Bulga.

As noted through-out the EIS document, the applicant readily acknowledges that certain impacts will be more directly felt by those closer to the mine. If one is following the clear guidance set down by Preston CJ, then these impacts are to be weighed against the broader community impacts in coming to a decision on the social impacts of a proposal.

2.7 Paragraph 3.4

....within one or two generations, the economic gains produced by the coal industry will have dried up and what remains will be highly degraded land (with enormous highly saline and toxic voids) that cannot sustain rural livelihoods or local villages and towns ever again.

Response

It is not entirely clear what Professor Albrecht's charge in this paragraph is against the proposal specifically, but it appears to be that Professor Albrecht has a belief that no mines should be approved in the future as this will inevitably lead to "highly degraded land (with enormous highly saline and toxic voids) that cannot sustain rural livelihoods or local villages and towns ever again".

The highly emotive words are not considered constructive for further a rational debate as to the social impacts of the proposal.

From Professor Albrecht's CV it is clear that he holds a PhD in Philosophy and an undergraduate degree in social science, but nowhere in his CV is there any reference to experience as an environmental engineer, hydrogeologist, soil scientist or a rehabilitation specialist. Therefore, any claims adduced by Professor Albrecht as to the rehabilitated nature of a mining site must be treated cautiously. Further, Professor Albrecht does not cite any examples of such a site, nor does he cite any reference articles to support his personal opinion.

Similar assertions made by Professor Albrecht in paragraph 3.4 regarding the economic viability of coal mining in the Upper Hunter generally, are again without any apparent evidential basis or personal expertise in economics and therefore these assertions should be given no weight.

2.8 Paragraph 3.5

What the EMM report does not do is focus on Bulga and the non-empirical (hence non-measurable) impacts of the mine extension will have on this particular village.....The elephant in the room, an existing megamining, the mine expansion proposal, and the two court cases have had a significant impact on issues like community cohesion and sense of place and belonging. The EMM SIA has failed to acknowledge the importance of these critically issues (sic).

Response

From the above, it appears Professor Albrecht's claim is that there is not a sufficient focus in the SIA on Bulga and the non-empirical impacts of the proposal.

As outlined in several of the preceding responses, following the clear direction set out by Preston CJ with regards to what an SIA should include, the non-empirical impacts (or using Preston CJ's wording, experiential evidence) are assessed as against the objective data of the broader community. That this analysis does not give these non-empirical issues the pre-eminence that Professor Albrecht believes they are due, again turns on the balance that the SIA is trying to achieve as set out by Preston CJ.

Further, for Professor Albrecht to claim that these non-empirical impacts are not reported is would be interpreted misleading – Figure 21.6 of the EIS (as well as in numerous other places in the EIS) clearly set out the non-empirical impacts that stakeholders identified, namely "decline/fracturing of community and families", "reduced sense of place", "impacts on rural sustainability/intergenerational equality", "uncertainty about the future", "impacts on company-community relationship/engagement", "mistrust of mining industry and project assessment process".

It is important to note that near neighbours made up 44% of the stakeholders reporting these non-empirical impacts. The Bulga community was strongly represented with 20 per cent of Bulga residents participating. That residents of Bulga have not reported these non-empirical issues in perhaps the numbers that Professor Albrecht was expecting, should not be held against the applicant and perhaps reflects the importance those residents place on those issues.

2.9 Paragraph 3.7

I note that these impacts are not seen as 'negative' and to be avoided, they are conceptualised as "opportunities" and to be part of "designing appropriate social management, mitigation or enhancement strategies".

Response

This is another example of Professor Albrecht's misunderstanding of an SIA. At a simple level, not all impacts from a development are 'negative' and so as to distinguish these matters from the actual impacts of a proposal such as visual or noise etc, they are termed 'opportunities'.

2.10 Paragraph 3.8

However, to disaggregate all these responses and treat them separately is again an indication that EMM consultants do not understand the cumulative nature of all these impacts.....To me this suggest an avoidance of intensely local issues that locals are known to be sensitive about. Such cherry picking of 'the issues' is neither 'balanced' nor good research.

Response

What Professor Albrecht's misses in making the above claim, is that in order for his 'holistic view' to be adopted those individual impacts must first pass a threshold as to whether they can be considered "rational or justified". This can only be done with some measure of objectiveness of that impact. This is not a threshold that the applicant or the Department has set, but rather it is set by the Land and Environment Court in the matter of *New Century Developments Pty Ltd v Baulkham Hills Shire Council* [2003] L&E Court 154. This well-cited and accepted decision makes it clear that:

"in forming an opinion on the probable impact of a proposed development on the amenity of an area, tangible or otherwise, a court would prefer views from residents which are based upon specific, concrete, likely effects of the proposed development" (emphasis added).

There is no other way of determining whether a probable impact such as solastalgia is rational or justified and therefore applicable for consideration, without some objective analysis. This is all the SIA attempts to do.

There is no assertion in the SIA that these impacts should only be viewed in isolation – it is obvious that a person who is suffering from a loss of sense of place is likely to do so as a result of other potential impacts they may be experiencing.

As to Professor Albrecht's assertion that EMM have 'cherry picked' issues which in turn he considers poor research, this is a completely baseless assertion, as the responses are taken directly from the stakeholder engagements. In fact, as is set out below (see response 4.0-4.3), it is the methodology adopted by Professor Albrecht's in his 'research' of solastalgia that underpinned his affidavit in the Warkworth 2010 Extension appeal which really raises concerns as to what constitutes acceptable or academic research.

2.11 Paragraphs 3.11 – 3.14

....However, I argue that the reference case (mining would not proceed) will not significantly affect the sense of place of the majority of workforce ‘stakeholders’ because very few, if any, actually live in Bulga and those that do are likely to be single men who have no particular attachment to place (they go wherever work takes them).

Response

That Professor Albrecht is so dismissive of his concept of “a loss of sense of place” being applied to the MTW residents of the Singleton LGA and other Upper Hunter LGA’s who would be impacted should the proposal not proceed, seriously brings into question either the utility of the concept itself to social impact assessments or Professor Albrecht’s ‘balance’ in applying the concept to those he hasn’t been engaged to advocate on behalf of.

It should be very clear from the SIA, that the applicant is not dismissing that certain residents of Bulga are or may experience a loss of sense of place. However, in considering the reference case, it became clear that there were likely to be many MTW employees that suffered a similar “loss of sense of place” should the proposal not proceed as they are required to relocate from their community to obtain future work. Just because not all of MTW’s employees reside in Bulga, should not preclude them from suffering a similar “loss of sense of place” with regards to their own community.

In another example of Professor Albrecht’s use of emotive words, by making the comment that single men are unlikely to have any particular attachment to place, Professor Albrecht minimises the engagement and involvement that MTW employees have with their community. In considering Professor Albrecht’s comments, it important to realise that almost one quarter of employees have worked at MTW for longer than 10 years. Further, 77.4% of respondents in the employee survey developed as part of the SIA stated they have mortgages or own their property and are therefore clearly intending to remain in the community long term. However, according to Professor Albrecht these people do not have the same intrinsic values of place or place attachment to their community (be it the Singleton LGA or elsewhere in the Hunter Valley) that the residents of Bulga do. To so blatantly dismiss the potential impacts or “loss of sense of place” these people may suffer should the proposal not proceed is disappointing from an academic who widely promotes the utility of his concept of “loss of sense of place” to wider demographics than villages, such as Bulga.

2.12 Paragraphs 4.1 – 4.3

4.1. I stated in the context of research conducted by me and the EDO on the then project.....

4.3. However, with the promulgation of the Mining SEPP matters have got even worse for the people of Bulga.....Moreover, as solastalgia is not even ‘in principle’ a reportable biomedical condition, useless data on the physical and psychological ‘health’ of the people of Bulga and the Singleton LGA des (sic) not help the cause of the proponent....such data is ‘report stuffing’.... The EMM SIA has not even acknowledged this further burden on the people of Bulga.

Response

In paragraphs 4.1 and 4.2 of his submission, Professor Albrecht makes much of the study that he and the EDO conducted with certain members of the Bulga community. However, what is overlooked by Professor Albrecht is the significant criticism that this ‘research’ received in the Warkworth Extension 2010 case. While it is true that Preston CJ did accept that the concept of “loss of sense of place” was a worthy consideration in the social impacts associated with a proposal, he was far less accepting of Professor Albrecht’s research methodology.

In short, Professor Albrecht's 'research' into the effects of solastalgia on Bulga residents involved the following:

- a questionnaire which included prompted answers for respondents to use language suggested by Professor Albrecht;
- was responded to by only 17 people (largely members of the BMPA); and
- was sent out to respondents by the secretary of the BMPA with a cover email suggesting that responding would assist their position in the court case.

For Professor Albrecht to now try and cast this in the light of academic research is both dangerous and disingenuous, especially given the claims Professor Albrecht has made as to the balance and quality of EMM's research.

As noted in earlier responses, Professor Albrecht's comments in paragraph 4.3 around the importance of the Mining SEPP again shows a lack of understanding with regards to the importance of matters to be considered by the consent authority.

The final point to note here concerns Professor Albrecht's comments in paragraph 4.3 that the SIA does not consider the burden the MTW continuation process is having on the residents of Bulga and their sense of place. Again, Professor Albrecht's comments appear to reflect a misunderstanding of the SIA process and how stakeholder responses are addressed. It is clear from figure 21.6 and in particular the stakeholder response "uncertainty for the future" which by any reasonable measure must include the Bulga resident's angst associated with the proposal. It appears from Professor Albrecht's comment that despite arguing elsewhere in his submission that impacts must be considered on an interrelated basis, he dismisses the possibility that the Bulga residents have factored the impact of the proposal into the responses that they provided in the stakeholder engagement.

Appendix H

Response to The Australian Institute submission (Appendix 5 of BMPA submission)



MTW economic analysis – a rejoinder to comments by the Australia Institute

BAEconomics was commissioned by Rio Tinto Coal Australia (Rio Tinto) to identify the direct and flow-on economic benefits from the continued operations at Mount Thorley Warkworth (MTW) to satisfy the Secretary's Environmental Assessment Requirements for environmental impact statements to support development applications for Warkworth Continuation 2014 and Mount Thorley Operations 2014 proposals (the MTW proposals).

This rejoinder responds to the submission prepared by The Australia Institute (TAI) on behalf of the Bulga Milbrodale Progress Association Inc. of BAEconomics' 'Economic Impact Assessment for Warkworth Continuation 2014 and Mount Thorley Operations 2014' (June 2014, 'the BAEconomics report').

1 Executive Summary

TAI's assessment of BAEconomics' analysis is characterised by inconsistencies and misconceptions. The most notable of these is the claim, on the one hand, that MTW and 'many other' NSW coal mines are operating at a loss. TAI accordingly suggests that NSW policy makers should ignore the fact that MTW will employ around, on average, about 1,300 workers and pay substantial royalties; according to TAI, these jobs and royalties will not materialise. On the other hand, TAI suggests that NSW policy makers should not be concerned about MTW's existing workforce of around 1,300 workers who are expected to be made redundant if the proposals are not approved; according to TAI, these workers would easily find equally well paid jobs in mining and elsewhere. These claims cannot both be true: either NSW coal mining is in a slump and well-paid coal mining jobs are hard to come by, or NSW coal mining is prospering and there are many mining jobs.

TAI's claim that MTW is not viable underpins its central claim that the employment and royalty benefits of the proposals are questionable. However, TAI fails to consider that MTW is an established mining operation that has a long track record of providing highly paid jobs to the NSW community. Presumably Rio Tinto would not go to the trouble of applying for development consents and engaging in the associated stakeholder consultation processes if it did not believe that the proposals would generate a positive return.

Furthermore, TAI's claim that MTW is not viable is an artefact of two (incorrect) assumptions made by TAI:

- that it is appropriate to use *today's* coal prices and exchange rates to evaluate the economics of a 21-year coal project; and
- TAI's decision to substitute the operating costs of a *different* mine for those of MTW.

TAI also suggests that there are major uncertainties around the costs and benefits of the proposals, while the negative environmental and social impacts of the proposals are up-front and certain. This contention is disputed. The EISs show that there will be both benefits and impacts of the proposals, with the CBA concluding that, on balance, the benefits far outweigh the costs. Any costs are ongoing over the life of the proposals, as are the benefits.

TAI asserts that redundancies caused by the closure of MTW should be discounted since these workers would easily find similarly well-paid employment in mining or other industries. This claim is at odds with the views of well-respected commentators, as well as the reality being experienced in the mining industry:

- Professor Garnaut is one of a number of commentators who have argued forcefully that Australia's resources boom ended in 2011 and as a consequence, incomes, spending and living standards will fall. TAI itself cites a 2013 report to the effect that nationally about 9,000 jobs have been cut in the Australian coal sector since 2012.
- In addition to the evidence cited in the BAEconomics report, there are more recent indications of ongoing job losses in the Hunter Valley. They include a rising unemployment rate in the Hunter Valley, and announcements of significant job losses in coal mining, including 250 at Muswellbrook (July 2014) and 500 at Singleton (May 2014).

TAI raises a number of questions about the assumptions underpinning BAEconomics' estimates of the employment benefits of the proposals. In part, TAI appears to misinterpret the scope of these assumptions. For instance, the assumption that 30 per cent of workers made redundant if the proposals are not approved would leave the *NSW labour force* is not the same as saying that these 30 per cent would leave the *Australian labour force*. Hence, the claim that BAEconomics' labour market participation assumptions are overly pessimistic appears misdirected.

Furthermore, an additional sensitivity analysis undertaken by BAEconomics to test TAI's higher 'alternative wage' assumption shows that the net benefits of the proposals would still be substantial, and range from almost \$900 million to more than \$1.8 billion, depending on what is assumed about the share of MTW workers that would be re-employed in NSW at a higher alternative wage after having been made redundant.

TAI identifies various alleged shortcomings of BAEconomics' valuation of external effects, such as noise, air and ecological impacts on the basis of market-based valuations. In particular, TAI criticises BAEconomics' reliance on NSW Government guidelines, as they relate to acceptable environmental impacts and the suitability of ecological offsets, as a basis for valuing external effects. However, such guidelines constitute a common, agreed standard as to what is acceptable to 'make good' environmental and other damages. Specifically where ecological impacts are concerned, the offsets offered by Rio Tinto for identified ecological impacts would be deemed as being as 'as good or better' than the status quo by the relevant NSW authorities and under current legislation. That legislation, and the associated regulations, has been adopted by a democratically elected government acting on behalf of NSW's society.

Finally, TAI criticises BAEconomics' use of input-output multipliers to undertake the regional impact analysis (REIA). TAI suggests that this analysis should have been done using a Computable General Equilibrium (CGE) model. However, CGE models are complex and require detailed regional/state information that is not available in Australia in sufficient quality to provide appropriately robust assessments for projects in smaller regions, such as these proposals. TAI has recognised the issues

with CGE modelling elsewhere, including in a recent article, in which TAI describes CGE models as 'complex' and 'bizarre'.¹ BAEconomics notes that CGE models are useful tools if data of sufficiently high quality are available and the models are used appropriately as is the case with any analytical technique.

¹ Dennis, R., 2014. 'Economic models often biased by vested interests', Canberra Times, 1 August; <http://www.canberratimes.com.au/comment/economic-models-often-biased-by-vested-interests-20140731-zyumj.html#ixzz39UXrjeZy>.

2 TAI's counterfactual

The fundamental premise of TAI's critique of BAEconomics' findings is based on two contradictory arguments. In order to understand the premise of TAI's critique these two contradictory arguments are addressed upfront:

- TAI say that MTW, like many other mines in NSW, is not financially viable. TAI therefore states that NSW policy makers cannot assume that MTW will continue to generate employment and pay significant royalties.
- Notwithstanding the claim that neither MTW, nor 'many other coal mines' are financially viable, TAI says that, in the event that the proposals are not approved, MTW employees and contractors would have no difficulty in finding similarly well paid employment in mining or related sectors.

These statements are inconsistent and are based on flawed reasoning as is shown below.

2.1 Whether MTW is financially viable

TAI's recommendation that the proposals should be rejected relies on their assessment that MTW would not be financially viable, and would therefore deliver no economic benefits to the NSW community (p.1):

What BAEconomics omit to tell readers is that under these price assumptions, the project would lose money in every year of its 21 year life. They ignore the fact that no project would continue paying hundreds of millions in royalties and wages each year while indefinitely losing money for its largely foreign shareholders.

In other words, TAI suggests that policy makers should discount the employment and royalty benefits of the project, because they are unlikely to materialise given the project is not financially viable.

TAI's characterisation of MTW's profitability is based on their own analysis of MTW's profits, and is described on pp. 5-9. At the end of that analysis, TAI concludes (p.9):

We see that at current prices and exchange rates the project has a net value of negative \$805 million – it is not financially viable. ...

TAI's findings are somewhat surprising. Presumably Rio Tinto would not go to the trouble of applying for development consents and engaging in the associated stakeholder consultation processes if it did not believe that the proposals would generate a positive return.

As we set out in the following sections, TAI's findings are flawed in a number of respects.

- 1) TAI mischaracterise the purpose of the cost benefit analysis (CBA) prepared by BAEconomics.

Furthermore, TAI's assessment that MTW is not financially viable is an artefact of two *key* assumptions:

- 2) that it is appropriate to use *today's* coal prices and exchange rates to evaluate future revenues and the economics of a long-term project; and
- 3) the decision to substitute the operating costs of a *different* mine for those of MTW.

1) Difference between a cost benefit analysis and a financial analysis

TAI state (p.1) that:

BAEconomics ignore this financial pressure in their assessment, by focusing not on the overall finances of the project, but on benefits to NSW – mainly royalties and employment.

TAI appears to misunderstand the purpose of an economic impact assessment within the broader NSW planning and assessment framework. NSW guidelines require the economic impact assessment to take the form of a CBA. First, a CBA differs in material respects from the financial analysis that TAI has attempted. For instance, a financial analysis incorporates financing costs, depreciation, and taxation items. Second, the purpose of the cost benefit analysis within the NSW planning and assessment framework is to identify the *public* benefits of the proposals for NSW, rather than assessing the *private* benefits (profits) of the proposals for Rio Tinto. This is because what matters from a public policy perspective are not Rio Tinto's profits, but the benefits of the proposals to the NSW community.

2) MTW's future revenues

TAI explains (pp. 5-6) that while BAEconomics' coal price and exchange rate assumptions are 'in line with some analysts' forecasts', they differ from today's coal prices and exchange rates. TAI accordingly uses *today's* coal prices and exchange rates to estimate MTW's future revenues over the life of the mine. As a result, TAI's estimate of the net present value (NPV) of MTW's coal production, as shown in Table 2, is \$6,232 million, compared to the \$7,527 million estimated by BAEconomics.

However, TAI's approach to determining MTW's future revenues is not appropriate. In evaluating the net benefits of a long-lived project such as MTW, which would operate until 2035 if approved, today's coal prices and exchange rates are not important. What matters instead, are coal price and exchange rate expectations over the term of the investment, that is, long-term forecasts for a proposed 21 year continuation of operations in the case of the MTW proposals.

This distinction has also been recognised by the Bureau of Resources and Energy Economics (BREE 2014, p.12):

New South Wales has 10 coal projects at the Feasibility Stage; however, as these are mainly expansions to existing mines they are generally lower in cost than the greenfield developments in Queensland. While current market conditions are not supportive of these projects being approved, it should be noted that most of them have very long operating lives and decisions to commence will be based more on long term assessments of market conditions rather than today's prevailing market prices. [emphasis added]

3) MTW's operating costs

To derive the results shown in Table 2, TAI has made a second important assumption: to replace BAEconomics' estimate of MTW operating costs (which reflect the figures provided to BAEconomics by Rio Tinto) with an alternative operating cost figure (p.8):

In Table 2 below, we compare BAEconomics estimates with revenues under current market conditions and operating costs similar to [sic] neighbouring Bulga mine

In other words, TAI determines that MTW is not financially viable by substituting Rio Tinto's actual estimate of operating costs, with those of a different mine – namely the neighbouring Bulga mine.

No clear justification is provided for this substitution.

What is clear, is that TAI replaces its own estimate of MTW's operating costs, with the operating costs of a different mine. In summary, and as Table 2 of the submission shows, TAI's finding that MTW is not viable and would make a loss of \$805 million in NPV terms depends on TAI having made two material changes to BAEconomics' calculations:²

- by substituting long-term coal prices and exchange rates with today's coal prices and exchange rates TAI claim that the NPV of MTW's projected revenues over the life of the mine is *reduced* by \$1,295 million; and
- by substituting MTW's operating costs with those of its neighbouring mine, the NPV of MTW's operating costs over the life of the mine is *increased* by \$1,017 million.

By assuming that costs from one mine can be applied to another mine, TAI shows very limited understanding of the coal mining industry. Other than noting that the Bulga Coal Complex is a 'neighbouring mine', TAI provides no indication why they elected to substitute the costs of a different mine for those of MTW. MTW and Bulga Coal Complex are different mines and, as such, would have different operating costs. For instance, strip ratio (ratio of waste to coal) is a key driver of cost. MTO has a different strip ratio to Warkworth Mine, so the strip ratio would likely be different again at Bulga Coal. In addition each mine has different equipment (eg. MTW has 3 draglines, Bulga has one), MTW has 2 coal handling and preparation plants (Bulga has one), Bulga is an integrated open-cut and underground complex while MTW is entirely open-cut, each will have different mine plans and while the geology of the two mines will be similar, it is not identical. As a result, substituting the operating costs of one for the other is simply not appropriate.

It also appears that TAI has made a mistake in their estimate of Bulga mine's operating costs. TAI refers to a Deloitte Access Economics report (DAE, 2013) to derive an operating cost estimate for Bulga mine of \$78 per tonne, to which they add an additional \$6 per tonne to account for royalties. However, the \$78 per tonne figure in the DAE report seems to be a typographical error, given that it is said to be comprised of the cost of mining (\$57.07 per tonne) plus the cost of transport to port (\$11.40 per tonne), making a total of \$68.5 per tonne. That error is then carried over into TAI's analysis, where it results in an overestimate of Bulga's operating costs of around \$716 million.³

2.2 Employment in economic assessment

MTW currently employs around 1,300 workers who are expected to be made redundant if the proposals are not approved. In order to assess the eventual employment outcomes in the event that the proposals do not proceed, assumptions need to be made about what proportion of these workers would be re-employed in NSW and at what 'alternative' wage. TAI describes BAEconomics' assumptions in this regard as 'highly pessimistic' (p.2), suggesting that they serve to overstate the employment benefits of the proposal.

TAI mischaracterise BAEconomics' re-employment assumptions; these are discussed in greater detail in Section 3.4.5 of this rejoinder. However, TAI's comments highlight a more fundamental inconsistency in their commentary.

² We also note that while TAI claims that 'the project would lose money in every year of its 21 year life' (p.1), Table 2 does not show this. Table 2 only shows that using TAI's assumptions results in a negative NPV over the life of the project.

³ Furthermore, DAE's figures are themselves very uncertain, given that they are sourced from a 2009 (now out of date) econometric analysis by Shafiee et al. (2009). Shafiee et al. note that their cost estimates fall within a +/- 20 per cent range of accuracy.

On the one hand, TAI makes a general claim that the NSW mining sector is experiencing a prolonged downturn, for instance in the context of the discussion of MTW's (claimed) lack of profitability (p.9):

This will not come as a surprise to observers of the Australian coal industry, with many mines operating at a loss for prolonged periods.

Similarly TAI says at p.5:

.. the Warkworth project, along with many Hunter coal projects, is under considerable financial pressure. This is no secret; these issues are widely discussed in the press.

If it is the case that few coal projects are viable, as TAI says, the prospects that MTW's current workforce will be re-employed in the mining sector, in NSW, and at anything like their current wages are presumably questionable at best. Yet TAI discounts the employment consequences if the proposals are not approved (p.16):

.. workers in the Warkworth project will be able to find employment either within the mining industry or other industries they have come from, to a degree that workers in few other industries can.

Accordingly, (p.17):

.. it is likely that minimal costs of unemployment would be experienced by workers due to the nature of industry worker turnover, robust mining employment and a generally strong Hunter and NSW economy.

In summary, notwithstanding their own statements that the NSW coal mining sector is in a pronounced downturn, TAI's assessment is that, upon becoming unemployed, MTW workers would have no difficulty in soon finding equally high-paid jobs reflecting their (mining) qualifications.

This view is at odds with that of many economic commentators, including those cited by TAI as set out below.

Trends in the broader resources sector

From an economy-wide perspective, Ross Garnaut argues in his book *Dog Days, Australia after the Boom* (2013) that the resources boom in Australia effectively ended in 2011, and will cut incomes, spending and living standards. At an Australian Agricultural and Resource Economics society conference in Sydney, Professor Garnaut warned of a 'very big and painful' adjustment as Chinese demand for Australia's coal, iron ore and gas drops, causing an economic downturn to rival that experienced by the US and Europe in the past five years, and resulting in a long period without income growth (Neales 2013). Professor Garnaut's assessment is consistent with that of BREE, which first identified a sharp fall in the value of committed resources investment projects in 2013 (Daily 2013). As of April 2014, BREE noted that the number of publicly announced coal projects has been further cut by six, with an associated reduction in investment of \$1.9 to \$2.9 billion, and that six coal projects were removed from the major projects list (Barber et al. 2014).

Trends in the Hunter Valley

Specifically where the Hunter Valley is concerned:

- TAI cites a May 2013 report that highlights 9,000 lost jobs in the Australian coal sector (Heber 2013);

- Australian Bureau of Statistics (ABS, 2014) figures show that unemployment in the Hunter Valley has increased noticeably over the past two years, rising from 3.2 per cent in July 2012 to 6.7 per cent in July 2014 (having risen to 9.2 per cent in May of this year);
- the President of the Singleton Chamber of Commerce is quoted as saying that hundreds of laid-off mineworkers are nervous about the future, and that economic activity in towns such as Singleton and Muswellbrook has slowed down markedly (ABC News 2014); and
- significant additional job losses have been announced in recent months that were not referenced in the BAEconomics Report, including:
 - additional redundancies of 163 at the Mount Arthur open cut mine (Muswellbrook), bringing the total to 250 (Pritchard 2014); and
 - 500 redundancies at the Glennies Creek and Camberwell mines (Singleton, ABC News 2014a).

In summary, notwithstanding their own statements that the NSW coal mining sector is in a pronounced downturn, TAI's assessment is that, upon becoming unemployed, MTW employees would have no difficulty in soon finding equally high-paid jobs reflecting their (mining) qualifications.

3 Q&A of TAI's detailed comments

This section reviews in detail other comments made by TAI.

3.1 Overview of BAEconomics' analysis

TAI variously describes BAEconomics' analysis as 'unorthodox' (p.2, 5) or 'brave' (p.12). TAI's concerns appear to relate to the economic framework applied in BAEconomics' CBA, namely that the fact that MTW would employ a significant number of NSW residents constitutes a benefit to the NSW community.⁴

A number of economic impact analyses of coal projects, including TAI's analysis (Table 2) are based on the mistaken supposition that the 'net value of production' or profit of a coal mine constitutes a *public* benefit. This is not the case: the profit of a coal mine is a *private* benefit; the NSW community benefits only indirectly, and to a limited extent if, say, Rio Tinto's profits are high.

As set out in the BAEconomics report, whether a project such as continuation of mining at MTW contributes to the welfare of a State such as NSW is instead measured with reference to 'value added' (ABS 2013). Value added is a concept that is used in Australia's (and all countries') national accounts, and which refers to wealth creating activities: value added is the increase in the value of goods or services as a result of the production process. Summed across all industries, (gross) value added equals gross domestic product (GDP) or gross state product (GSP). In other words, from an (economic) public policy perspective, activities that increase NSW GSP improve the welfare of the community of NSW.

The calculation of GSP is governed by strict, internationally accepted accounting standards; in Australia these are referred to as the Australian System of National Accounts (ASNA). BAEconomics strictly adhered to the ASNA standards; this is in contrast to other economic impact evaluations where *private* and *public* benefits are often confused. The ASNA standards establish a clear framework within which the wage and salary incomes received by a State's residents, as well as royalty payments received by the State and various other smaller items increase GSP and therefore constitute a benefit.

In the case of the CBA conducted by BAEconomics, the incremental wages and salaries earned by MTW workers (which BAEconomics termed 'employment benefits') have additionally been estimated conservatively, namely by:

- incorporating only the additional *disposable income* earned by MTW workers;
- assuming that most MTW workers who would be made redundant would be re-employed elsewhere in NSW; and
- assuming that the majority of any additional workers that MTW might hire would have previously worked in NSW, so that only their additional disposable income (when employed by MTW) would be counted as a benefit to NSW.

⁴ To be precise, the extent to which MTW would employ people at a higher wage than they would earn elsewhere in NSW is considered a benefit.

3.2 Comparison with previous assessments

In the Introduction to their submission (pp. 4-5), TAI suggests that BAEconomics' 2014 assessment of MTW to the NSW community differs from that derived by Gillespie Economics (2012), and that there are therefore either '*serious errors*' in Gillespie Economics' work or '*major uncertainties*' around BAEconomics' work.

BAEconomics' analysis differs from the previous assessment in many ways, which means that the numbers are not comparable:

- different methodology - the focus of BAEconomics' analysis is on the benefits that would accrue to the NSW community. From an economic perspective, the *public* benefit of a project is measured with reference to value added: the additional value of goods and services that are newly created in an economy. In contrast, the net value of production, which is also estimated by TAI (Table 2) includes a private benefit; only a share of this benefit accrues to NSW;
- different proposals – the Gillespie Economics' assessment related considered a different production scenario for MTW, with up to 21Mtpa of ROM coal to be extracted up to 2017 when MTO's development consent expired. Extraction rates were then assumed to reduce to 18Mtpa of ROM coal to 2031;
- different levels of assessment - the cost benefit analysis done by Gillespie (2012) was for Australia, whereas the focus of the BAEconomics analysis is NSW; and
- different timeframe – BAEconomics' analysis was based on the most recent (2014) data available for MTW, whereas the Gillespie Economics' 2012 analysis referred to by TAI reproduces their earlier 2009 analysis. Over the 2009 to 2014 timeframe, Rio Tinto has revised its mine plan and operational approach, as reflected in the operating and capital expenditure estimates provided to BAEconomics. Market conditions have also changed substantially over this period.

3.3 Certainty and timing of estimated outcomes

TAI suggests that there are major uncertainties around the costs and benefits of the proposals, while the negative environmental and social impacts of the proposals are up-front and certain (p.5):

The impacts on Bulga and rare woodlands are up-front and certain, while payments to NSW are spread over many years and dependent on market conditions.

This contention is disputed. The EISs show that there will be both benefits and impacts of the proposals, with the cost benefit analysis concluding that, on balance, the benefits far outweigh the costs. Any costs are ongoing over the life of the proposals as are the benefits.

MTW is an existing operation with a long track record of providing highly paid jobs to the NSW community. What is certain is that if the proposals are not approved, around 1,300 people are expected to lose their current jobs. It is also certain that if the proposals are not approved, MTW will not pay royalties to the NSW Government, for the benefit of the NSW community. In addition, and as discussed in Section 2, TAI's analysis of the finances of the project is flawed and cannot be supported.

- It is also not the case that any negative environmental and social impacts of the proposals would be up front and certain: the ecological impacts of the project will be mitigated by a

biodiversity offset strategy prepared and certified in accordance with contemporary government policy (ie the Framework for Biodiversity Assessment) with land-based offsets quantified by the NSW Biodiversity Certification Assessment Methodology (BCAM), in accordance with the Upper Hunter Strategic Assessment (UHSA), and as required by the NSW Office of Environment and Heritage. Rio Tinto has committed itself to ensuring that the offsets will result in a 'maintain or improve' outcome for the relevant ecological communities, as required under the policy.

- Rio Tinto has committed to operational procedures and significant expenditures to mitigate the environmental and social impacts over the life of the proposals. They include progressive rehabilitation, fitting noise attenuation equipment to its heavy vehicle fleet, measures to mitigate visual impacts at affected third party sites and around the mine site, as well as a suite of management strategies to manage Aboriginal and European cultural heritage impacts.

3.4 Financial aspects of the project

TAI suggests at various points in its submission that MTW is not financially viable, and has undertaken its own analysis to attempt to demonstrate that this is the case. TAI's analysis is discussed in detail in Section 2.1. In the following additional points of detail that arise from TAI's analysis are discussed.

3.4.1 Price of coal and exchange rate

TAI is critical of the coal price and exchange rate assumptions used by BAEconomics, saying that (p.6):

- 1) BAEconomics' coal price and exchange rate assumptions are higher than today's coal prices and exchange rates;
- 2) these coal price and exchange rate assumptions are higher than those referred to by Rio Tinto elsewhere; and
- 3) BAEconomics does not discuss the impact of lower coal prices on the overall finances of MTW, in particular on MTW's gross operating surplus.

1) Relevance of today's coal prices and exchange rates

BAEconomics' coal price and exchange rates reflect long-term forecasts by independent brokers. Information was sourced from four broker commodity reports published in January and February 2014 (Goldman Sachs, Deutsche Bank, Macquarie Bank, UBS).

As discussed in Section 2.1, for the purpose of an economic evaluation of an infrastructure project with an approval length of 21 years, it is appropriate to apply coal price and exchange rate expectations over the term of the investment, that is, long-term forecasts.

We also note that NSW Government budget estimates are based on a thermal coal price of US\$90 per tonne, higher than the long-term figure of US\$85 per tonne assumed by BAEconomics based on broker forecasts (NSW Government 2014-15, pp. 6-28).

2) Rio Tinto's coal and exchange rate forecasts

BAEconomics was commissioned to undertake an independent economic evaluation of the MTW proposals. We did not have access to, nor would it have been appropriate, to apply Rio Tinto's internal coal price and exchange rate forecast for this purpose. As noted above, the forecasts used by BAEconomics instead reflect those published by independent brokers.

We also note that the reference to Rio Tinto using 'a far lower coal price in its own work' refers to a Rio Tinto document produced for the purposes of reporting exploration results and coal resources⁵. What TAI fail to mention in relation to the study in this document is that:

- the study was completed in 2010 and, therefore, would represent 2010 dollars rather than dollars of today. As such the US\$72.58 per tonne estimate is not comparable to prices used in the BAEconomics analysis;
- the study essentially conducts analysis using the prevailing average analyst forecast prices at the time. The BAEconomics analysis of the proposals is similarly in line with current prevailing average analyst forecast prices. As stated above, Rio Tinto's internal pricing forecasts are commercially sensitive and are not disclosed. This was made clear in the document referred to by TAI (p. 9):⁶

Rio Tinto applies a common process to the generation of commodity prices across the group. This involves generation of long-term price curves based on current sales contracts, industry capacity analysis, global commodity consumption and economic growth trends. In this process, a price curve rather than a single price point is used to develop estimates of mine returns over the life of the project. The detail of this process and of the price point curves is commercially sensitive and is not disclosed. [emphasis added]

3) Impact of lower coal prices

BAEconomics was commissioned to undertake an economic impact assessment of the proposals. As discussed in Section 2.1, a cost benefit analysis differs in material respects from a financial analysis.

We also note that the impacts of different (including lower) coal prices and various exchange rates on the net benefits of the proposals to the NSW community are explored in depth in Tables 3-5 and 3-6 in BAEconomics' report:

- Table 3-5 shows that the incremental royalty and tax benefits accruing to NSW are substantial, irrespective of the coal price and exchange rate assumptions used. These benefits range from \$549 million to \$852 million, depending on the coal price and exchange rate assumptions.
- Table 3-6 shows that the overall benefits accruing to NSW are also substantial, irrespective of the coal price and exchange rate assumptions used. These benefits range from \$1,235 million to \$1,839 million, depending on the coal price and exchange rate assumptions.

⁵ The Australasian Code for the Reporting of Exploration Results, Mineral Resources and Ore Reserves (The JORC Code, 2012 Edition).

⁶ http://www.riotinto.com/documents/RT_Table1_HVO_ORSC_2013.pdf

3.4.2 Project revenue

Royalties

TAI suggests that BAEconomics did not consider royalty deductions and that BAEconomics' royalty estimates therefore '*serves to overstate the value of royalties*' accruing to NSW (Footnote 10, p.7).

The above statement is not correct. The royalties figures used by BAEconomics reflect the outcome of a full financial model. Royalty calculations in both the expansion and reference cases include allowable deductions for beneficiation and levies.

3.4.3 Operating costs

Per tonne operating costs

TAI suggests that BAEconomics should have estimated MTW's operating cost per tonne, given that this is said to be a "*key statistic*" (p.7) for a (financial) mine analysis.

BAEconomics was commissioned to undertake an economic impact assessment. NSW guidelines require the assessment to take the form of a CBA. As noted in Section 3.1, a CBA designed to determine the net benefit of a project to a state or region differs in material respects from a financial analysis of the private net benefits that accrue to the project proponent. The purpose of the cost benefit analysis undertaken by BAEconomics was to identify the *public* benefits of the proposals to NSW, rather than assessing the *private* benefits of the proposals to Rio Tinto, which is the focus of TAI's analysis. Whether or not a proposal is *privately profitable* and worth pursuing in the first place is a matter for its proponent, that is in this case, Rio Tinto.

Future operating cost trends

TAI derives its own estimates of MTW's operating costs per tonne, which are said to be relatively low (p.8). TAI asserts that, in future, operating costs per tonne would increase, and that BAEconomics failed to discuss this "*likely cost increase*" (p.8).

The following comments can be made in respect of TAI's assessment of MTW's operating costs and future trends:

- TAI's own view that MTW's operating costs are low would seem to contradict the claim that MTW is not viable. It also raises questions as to why TAI elected to substitute the operating costs of a *different* mine to estimate MTW's production-related profits.
- BAEconomics' figures for MTW's operating costs reflect the data provided to BAEconomics by Rio Tinto; these cost estimates are, in turn, a function of Rio Tinto's long-term mine plan.
- The nature and timing of operating and capital expenditures over the life of a mine depends on the long-term mine plan, which is highly specific to a particular project. TAI is not privy to the MTW long-term mine plan. TAI therefore has no basis for any claims about how MTW's operating costs may evolve in the future.

3.4.4 Capital costs

In relation to the capital costs of the proposals, TAI claims that (p.8):

- 1) BAEconomics' estimate of gross operating surplus does not consider the capital costs of the project, which, it is suggested, would overstate the profitability of the project; and

2) BAEconomics characterises capital costs as an 'incremental benefit'.

1) Gross operating surplus

TAI's reference to the 'gross operating surplus' reflects a misunderstanding of basic national accounting concepts. As explained in the BAEconomics report, the gross operating surplus (GOS) should not be confused with a 'profit' or similar concept, as TAI seems to do (p.8).

Only a subset of the items that make up MTW's GOS constitute a benefit to NSW in the BAEconomics Report, namely payments that will accrue to different levels of NSW government. These are:

- coal royalty payments;
- the estimated share of MTW's corporate income taxes attributable to NSW;
- the estimated share of personal income taxes and Medicare payments attributable to NSW;
- payroll taxes;
- land taxes; and
- council / shire rates.

Capital costs play no role in deriving any of the above items, so that it is not the case that the net benefits of the proposals have somehow been overstated.

2) Capital costs as an incremental benefit

Table 1-1, which is cited by TAI, does not constitute a part of the net benefits calculation undertaken by BAEconomics. As is highlighted in the text, Table 1-1 has been included to meet the requirements of Section 12AA of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP). The Mining SEPP requires proponents of a project to identify the project-related benefits, in particular: employment generation; expenditures, including capital investment; and the payment of royalties to the State.

3.4.5 Sensitivity analysis

TAI dismisses the sensitivity analysis undertaken by BAEconomics not on the basis of the methodology used but on the presumption that MTW is not a viable project in the long term based on their own analysis. As already noted, the financial viability of a long term project such as the continuation of MTW is assessed on the basis of expectations of long term commodity prices and exchange rates and not on the basis of today's prices (whether they be low or high).

3.5 Employment assumptions and benefits

TAI discusses BAEconomics' findings in respect of the employment benefits of the proposals on pp. 10 -20.

3.5.1 Rio Tinto's statements on employment

TAI quotes various statements by Rio Tinto management to the effect that reducing staffing costs is an objective of the business (pp. 10-11). It would seem that these reflect general company statements and do not refer specifically to MTW.

TAI then suggests that BAEconomics claims that maintaining jobs is 'a key objective of the project', and that (p.11):

The economic assessment is wrong to assume, contrary to the statements of their clients, that staffing levels would be maintained throughout the life of the project and that no effort will be made to increase the productivity of the workforce.

We note that:

- BAEconomics has made no statements to the effect that maintaining jobs is a key objective of the proposals and has not based its assessment on such an objective;
- future employment projections at MTW reflect MTW's planned production profile, which in turn reflects the long-term mine plan, and were provided to BAEconomics by Rio Tinto; and
- as TAI may be aware, productivity improvements in mining typically arise from a combination of factor inputs. For instance, 'multifactor productivity', an indicator used by the Productivity Commission (PC) is the ratio of output to a combination of inputs, such as labour and capital or capital, labour, energy, materials, and intermediate inputs (Topp et al. 2008). Staffing levels therefore provide only a limited indication of the productivity of a mining enterprise.

3.5.2 Re-employment prospects of MTW workers

As outlined in Section 2, TAI makes contradictory statements about the economic prospects of the Australian coal mining industry. On one hand, TAI argues that MTW and many other mines are not financially viable, so that the employment benefits of these proposals cannot be expected to materialise. On the other hand, TAI suggests that the workers who would be made redundant if the proposals are not accepted would have no difficulty finding new employment, because (p.12-14):

- 1) employment in Australian coal mining has increased over the past two years, and under-employment in the Australian mining sector is low;
- 2) BAEconomics' source for data on coal employment is said to be an article in Section 2 of the BAEconomics Report that, according to TAI, was indirectly sourced by the Minerals Council of Australia (and should therefore be discounted); and
- 3) references to lay-offs in particular coal projects are anecdotal and should not be given any weight.

TAI's assessment of the employment prospects for miners in the Hunter Valley is discussed in Section 2.2. Section 2.2 highlights that the negative local and regional unemployment trends described in the BAEconomics report are ongoing. In addition, we note the following in relation to the points referred to above.

1) Employment in Australian coal mining

BAEconomics' economic assessment of the proposals refers to their specific impacts on the local and NSW economy. Australia-wide employment statistics are not relevant for discovering employment trends in a local and regional context.

2) Coal employment

Section 2 of the BAEconomics report provides an overview of the current and medium term employment perspective in the Mid and Upper Hunter region of NSW. The section sets out the

economic context for the proposals. BAEconomics did not rely on the background material presented in Section 2 of the report to derive the re-employment and redeployment assumptions used for the cost benefit analysis. As discussed in the BAEconomics Report, these assumptions are instead based on a literature review of employment outcomes in circumstances where workers are made redundant, and which is summarised in Appendix A of the BAEconomics Report.

3) 'Anecdotal' evidence

It is also not the case that the background material presented in Section 2 of the BAEconomics relied on a single (and supposedly biased) source. BAEconomics referred to numerous publications, including:

- a number of 2013 and 2014 publications by the Hunter Valley Research Foundation;
- data from the Australian Bureau of Statistics (ABS) in relation to NSW mining investment, and local employment trends, respectively;
- 2013 and 2014 publications from the Australian Journal of Mining; as well as
- two articles from the Australian newspaper, one of which is referred to by TAI.

In addition, two references cited by TAI ('Ten thousand coal mining jobs gone in two years', and 'Thin margins, job losses: Coal sector troubles') appear to confirm the contents of the article that TAI says is 'biased'.

3.5.3 Re-employment assumptions

In the event that the proposals are not approved, around 1,300 workers are expected to be made redundant. BAEconomics made a number of assumptions about the re-employment prospects of these workers in NSW.

NSW vs. Australian labour market effects

In the 'reference case', BAEconomics assumed that 30 per cent of MTW workers would immediately be re-employed *in NSW*, 40 per cent of workers would be re-employed *in NSW* in the next financial year, and 30 per cent would leave the NSW labour force, either by retiring or by moving interstate. Table 3-7 in the BAEconomics report shows the results of a range of additional sensitivities to explore the implications of these assumptions, including the assumption that *all* MTW workers who are made redundant are immediately re-employed in NSW. Table 3-7 shows that the employment benefits to NSW are robust to changes in these assumptions.

BAEconomics' labour market assumptions are the subject of a number of comments by TAI, which are discussed in the following. However, it would appear that there is a key misconception that underlies a number of TAI's comments, namely, that it is appropriate to apply Australia-wide figures to estimate the share of workers that would be re-employed in NSW.

The purpose of the economic impact assessment, and therefore the labour market assumptions incorporated in the cost benefit analysis, is to identify the benefits that would accrue to NSW. Saying that 30 per cent of workers that are made redundant would leave the *NSW labour force* is therefore not the same as saying that 30 per cent of redundant workers would leave *the Australian labour force*. Indeed, it would seem likely that some share of MTW workers who are made redundant would move interstate to seek employment elsewhere. Nonetheless, and for the purpose of the economic impact assessment, MTW workers who are made redundant and who

move to, say, Western Australia to find employment, have left the NSW labour force. The disposable income of these workers no longer counts as a benefit to NSW.

Specific comments

BAEconomics referred to a Reserve Bank of Australia (RBA) publication to derive the labour market assumptions, which, TAI suggests, are inappropriate:

- the mining sector has a high rate of worker turnover, suggesting that workers who have been made redundant would have no trouble finding new employment (p.16);⁷ and
- the RBA statistics referenced by BAEconomics relate to 'involuntary separations', which, TAI suggests, is not appropriate since MTW workers would have plenty of notice of the need to find new employment (p.17).

First, as noted above, TAI is correct in saying that mining employees are generally highly mobile. However, for the purpose of the economic impact assessment, MTW workers who are made redundant and who move interstate no longer contribute to NSW gross state product (GSP). The assumption that 30 per cent of MTW workers made redundant leave the NSW labour force means just that: they may either retire or they may move interstate.

Second, BAEconomics undertook a complete literature review of employment outcomes in circumstances where workers are made redundant. As is stated in discussion of these assumptions in Appendix A in the BAEconomics report, there is very little information about the eventual labour market outcomes relating to workers who are made redundant at some stage during their working lives. To our knowledge, the only study of these labour market outcomes undertaken during the past ten years is the RBA (2012) study referenced by BAEconomics.⁸

Third, the RBA study groups unemployment situations into three types – involuntary unemployment, voluntary unemployment in the form of 'job sorting' and voluntary unemployment for life-cycle and personal reasons. It would be very difficult to argue that the closure of MTW and subsequent redundancy of MTW workers constitutes any form of voluntary unemployment.

Finally, the MTW labour force has some characteristics that would additionally suggest that MTW workers would be less likely to seek new employment, either elsewhere in NSW or interstate. Specifically:

- more than a quarter of MTW employees are 50 years old and older; and
- almost a quarter (23 per cent) of MTW employees have been employed by MTW for 10 years or more, and 16 per cent of employees for 20 years or more.

These workers would receive a redundancy benefit when the mine closes, and may be less likely to move or take other measures to find alternative employment in the mining industry.

⁷ At Page 16, TAI say: "... more than any other industry, mining has recruited skilled workers from other sectors. This suggests that workers in the Warkworth project will be able to find employment either within the mining industry or other industries they have come from, to a degree that workers in few other industries can."

⁸ BAEconomics additionally cited data from the most recent Household, Income and Labour Dynamics in Australia (HILDA) survey conducted by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute 2013).

3.5.4 Alternative wages assumption

BAEconomics assumed that the majority of any MTW workers made redundant would find alternative employment in NSW, albeit at a lower wage. BAEconomics also assumed that any additional workers hired by MTW if the proposals are approved would not reflect 'new' jobs, but would move from jobs in other sectors of the economy to work at MTW.

TAI points out that:

- 1) BAEconomics appears to have assumed a wage figure of \$168,543 per annum (p.17); and
- 2) the assumption that re-employed workers would earn the average Mid and Upper Hunter region wage of \$58,853 is not appropriate (p. 18). TAI instead suggests that MTW employees are experienced mine workers who would not have to take lower paying jobs, and who would find work in the mining or other skilled industries (p.18).

1) MTW wages & salaries

We note that all MTW wage and employment figures have been verified with Rio Tinto, and do not rely on BAEconomics assumptions, as TAI suggests.

2) Alternative wage

We note that TAI's statement that MTW workers would be re-employed at high wages in the NSW mining industry is not consistent with their opposing claim that MTW and many other mines are not viable. As set out in Section 2 and in the BAEconomics report, there have been multiple coal mine closures in the Hunter Valley and in NSW. MTW workers who would be made redundant with no mine continuation and are highly skilled may indeed find new employment in mining, but, given recent employment conditions, this is unlikely to be in NSW and also unlikely to be at their current level of remuneration.

TAI suggests that an annual wage figure of \$133,000 would be more appropriate for assessing the employment benefits of MTW. As set out in Table 3-1 over, this sensitivity does not change the fundamental conclusions of BAEconomics' analysis. Table 3-1 reproduces Table 3-7 in the BAEconomics report, but assumes a significantly higher alternative wage. Even under the most optimistic assumption put forward by TAI, namely that all MTW would immediately find alternative high-paid employment in NSW, the net benefits to the NSW community of the proposal would still equate to almost \$900 million in NPV terms, of which \$220 million would consist of the additional disposable income earned by MTW workers. As discussed in this rejoinder, we do not believe that this assumption is credible, nor is it consistent with TAI's statement that multiple Hunter Valley coal mines are operating at a loss.

Table 3-1. Re-employment sensitivity – High alternative wage calculation

Re-employment assumptions	Incremental benefits of the proposals to NSW (NPV A\$ m 2014)	
	Net employment benefits (disposable income) (NPV A\$2014 m)	Net production-related benefits to NSW (NPV A\$2014 m)
0%	\$861	\$1,825
30% Year 1, 40% Year 2	\$361	\$1,094
50% Year 1, none thereafter	\$541	\$1,356
70% Year 1, none thereafter	\$412	\$1,169
100% Year 1	\$220	\$888

Notes: Average alternative wage and salary income is assumed to be \$133,000 (A\$2014). NPVs have been derived using a discount rate of 7 per cent.

3.5.5 Sensitivity analysis of labour assumptions

On pp. 2 and 19, TAI comments that BAEconomics' analysis is '*counterintuitive*', with reference to Table 3-8 in the BAEconomics Report. Table 3-8 shows the effect of varying assumptions in relation to any additional workers that MTW may hire ('redeployment' assumptions). TAI questions the result that a higher share of additional workers hired by MTW that come from NSW results in lower employment benefits to NSW.

TAI does not recognise that there is a distinction between benefits that accrue to NSW and those that accrue to the broader Australian economy. NSW GSP increases either if, on net, additional jobs are created in NSW, and/or if workers that are already employed in NSW earn higher incomes if they move to (are employed by) MTW. If MTW were to employ only workers who are already employed elsewhere in NSW, then NSW GSP only increases by the additional disposable income that these workers would receive as a result of being employed by MTW *relative to their previous salaries*. On the other hand, if MTW were to hire additional workers from interstate, NSW GSP would unambiguously increase.

3.6 External effects

3.6.1 Noise, air quality and visual amenity

On pp. 20-21, TAI states that:

- 1) BAEconomics has not valued noise and other effects on the basis of market instruments (p.20);
- 2) BAEconomics assumes that compliance with government guidelines implies that there are no economic costs (p.20);
- 3) while BAEconomics suggests that properties within the zone of acquisition would be purchased at above-market rates, anecdotal evidence suggests that property prices in a mine-affected area (Gloucester) have fallen (p.21); and

- 4) BAEconomics has assumed that the proposals will comply with all government criteria, which, TAI suggests is not correct, given that the Bulga Milbrodale Progress Association has documented 'many instances of non-compliance' (p.21).

1) Whether a market-based valuation approach has been used

TAI does not correctly characterise the concept of a market-based valuation. As explained in the BAEconomics Report, market-based (also referred to as direct revealed preference) valuation techniques refer to consumer behaviour and/or prices in a similar or related market (Department of Treasury and Finance 2013). These valuation approaches include:

- defensive expenditures: the costs incurred by individuals to mitigate the impact of changes and/or to recreate a situation that existed before a change, for instance by investing in noise insulation; and
- replacement costs: the cost of replacing or repairing a damage, for instance, to restore the environment to its previous condition.

BAEconomics used defensive and replacement expenditures – a form of market-based valuation - to value the noise, air quality and visual amenity impacts of the proposals.

2) Whether BAEconomics assumes that compliance with guidelines implies that there is no economic cost

The BAEconomics Report is explicit in saying that government guidelines as they relate to noise, dust or other impacts represent a 'line in the sand', which may be acceptable to some affected parties but not to others.⁹ Nonetheless, and imperfect as they may be viewed by some, government guidelines in respect of these effects reflect a common, agreed standard as to what constitutes a permissible degree of disturbance from economic activity.

If TAI's apparent position, that such guidelines should play no role were to be accepted, then this is tantamount to saying that the democratically elected government has no right to determine environmental standards. That is clearly an untenable position.

3) Whether properties would be acquired at depressed market values

BAEconomics does not make any claim in its report that the value of properties in the vicinity of a mine would likely increase. The point made in the BAEconomics Report is that it is common practice – and it is Rio Tinto's practice – to acquire residents' properties within a zone of acquisition, at prices that are substantially above market value, should the landowner exercise their right to have their property acquired.

4) Whether MTW will comply with all relevant criteria

The EIS provided details regarding the operational performance of MTW with respect to prescribed environmental criteria for noise and dust. An assessment of monitoring data (publically available via the Rio Tinto Coal Australia website (www.riotintocoalaustralia.com.au)) demonstrates that a high level of compliance with noise criteria has been achieved throughout the life of the mine. Non-

⁹ For instance, at p.24, the BAEconomics Report states: "Irrespective of the criteria that may be set down in statutes or regulations, peoples' personal preferences may also vary, so that what may be an acceptable disturbance to some, may be considered distressing by others. While these variations in perceived impacts should be acknowledged, there is no way in which they could be measured or assessed in a reliable manner, and we have not attempted to do so here."

compliant noise measurements account for only 0.37 per cent of the monitoring dataset (10 non-compliances measured from 2,689 individual assessments undertaken from 2004 to September 2014).

Similarly, analysis of air quality monitoring results in the most recent (2012 and 2013) annual reviews for MTW show that there was 100 per cent compliance during this period: there were no non-compliances. This is despite dust generation recorded in 2012 being generally higher than for previous years, attributed to lower rainfall.

To ensure continued compliance with prescribed criteria for the proposal, the EISs were prepared in accordance with current legislation and government policy and used the most recent and accurate scientific data relevant to the proposal. Feedback received from the community and government stakeholder engagement together with the Secretary's requirements and the L&E Court judgement, provided guidance to the assessment approach, ensuring that all potential matters of relevance associated with the proposal were assessed.

Technical studies adopted conservative assumptions to enable the upper limit of potential environmental impacts to be determined. Noise and vibration and groundwater studies were independently reviewed. The proposal complies with all of the non-discretionary standards of the Mining SEPP, including standards relating to cumulative noise, airblast overpressures, ground vibration and aquifer interference with the exception of air quality where two properties already within the acquisition zone of neighbouring mines exceed cumulative annual average air quality criteria.

The applicant has committed to proposal specific management measures where adverse impacts were assessed irrespective of the implementation of existing best practice environmental management safeguards. Residual impacts were identified to noise, dust, Aboriginal cultural heritage and ecology. Compensation measures have been developed in consultation with the relevant stakeholders to ensure residual impacts are fully offset and the proposal provides a net environmental benefit.

3.6.2 Ecology

Where ecological impacts are concerned, TAI states that:

- 1) BAEconomics have not used a market-based valuation approach, since (p.21) "*the project will not be making purchases on a well-traded ecological offset market*". TAI suggests instead that the value of ecological impacts should be established on the basis of (p.21) "*.. the value that the community places on the existence of parts of the environment such as the Warkworth Sands Woodland*".
- 2) The cost of establishing offsets is not relevant to valuing ecological impacts, since it (p.22) "*.. depends not on the value of the environment, but on the government regulations*".

1) Whether a market-based valuation approach has been used

As noted in Section 3.6.1, TAI does not correctly characterise the concept of a market-based valuation. A market-based valuation does not require 'ecological offset' markets. In the context of ecological impacts, and as is set out in the BAEconomics Report, a market-based valuation refers to those expenditures required to 'make good' any damages or other impacts.

TAI's comments are questionable in other respects. First, there are no 'well-traded' markets for ecological offset relating to Warkworth Sands Woodlands (WSW). The recommendation that this ecological resource should be valued on that basis is therefore specious.

Second, attempts to establish '*the value that the community places on the existence of parts of the environment such as the Warkworth Sands Woodland*' would (rightly) be criticised for being unreliable and subjective. Such valuations can only be established with reference to 'stated preference' (survey) methods. As discussed in the BAEconomics Report, stated survey methods have a number of limitations, including (Pearce et al. 2006, Commonwealth 2006):

- the presence of hypothetical bias, since the situations described to respondents is not a real-world decision, and is therefore difficult to assess for respondents;
- susceptibility to strategic behaviour, whereby the respondent may, for one reason or another, give an exaggerated response;
- scope problems, whereby responses are insensitive to the size or coverage of the good being valued;
- anchoring bias, if the valuation given depends on prior options being presented; and
- information bias, whereby how the question is framed unduly influences the answer.

Finally, a cost benefit analysis relies on the 'opportunity cost' principle (NSW Treasury 2007; Commonwealth 2006). Opportunity costs are determined with reference to the next best option. In the case of the Warkworth Sands Woodlands (WSW), the next best option available is to re-establish and preserve these ecological communities in a different suitable location. This is the approach that has been adopted in the BAEconomics report.

2) Whether or not offsets, as determined by government regulations, compensate for ecological impacts

BAEconomics does not purport to have any expertise in assessing the qualitative aspects of different ecological offsets.

However, as noted above, government guidelines in respect of these effects reflect a common and agreed standard as to what is acceptable to 'make good' environmental and other damages. As is set out in the BAEconomics Report, the offsets offered by Rio Tinto for identified ecological impacts would be deemed as being as 'as good or better' than the status quo by the relevant NSW authorities and under current legislation.

3.7 Regional Economic Impact Assessment

The regional impact assessment (REIA) undertaken by BAEconomics is both transparent and conservative: regional adjustments are made explicit and only Type 1A multipliers are reported in the results.

Nonetheless, and where the REIA undertaken by BAEconomics is concerned, TAI claims that the estimated impacts identified by BAEconomics are overestimated. Specifically, TAI states that (pp. 23-24):

- 1) BAEconomics does not give adequate consideration to fixed price assumptions in the REIA (p.23);

- 2) Computable General Equilibrium (CGE) modelling would overcome the shortcomings of BAEconomics' input-output modelling (p.23); and
- 3) BAEconomics' modelling approach is rejected by, among others, the ABS and the PC (pp.23-24).

1) Fixed price assumption

The BAEconomics Report sets out that the accounting conventions that form the basis of input-output models impose a number of restrictive assumptions (pp. 41-42), including that relative prices do not change as a result of a project, and discusses these in the context of the proposals. Specifically, the assumption that relative prices, in particular wages, do not change as a result of the proposals is appropriate, since the proposals relate to the *continuation of existing* mining operations. In the event that the proposals are approved, MTW's existing employees and contractors would be retained. If the proposals are approved, MTW would continue operating, and there would be no effect on relative wages in the Mid and Upper Hunter region.

2) Whether GCE modelling would have been more appropriate

As set out in the BAEconomics Report, the principal advantage of the impact multiplier method is its simplicity and transparency, particularly given the limited statistical information that is available about regional and state economies in Australia.

In contrast, CGE models are complex. CGE models additionally require information that is not generally available at a regional or state level in Australia, namely:

- detailed regional input and output, and trade data; and
- information about price induced substitution of inputs and outputs within and between regions, for which there are few, if any, empirical foundations.

TAI is also aware of these issues, and TAI's critique of BAEconomics' approach contradicts statements recently made by TAI. In an interview with the Canberra Times in August 2014, Richard Dennis, one of the co-authors of the TAI submission said:¹⁰

CGE models attempt to take some of these macroeconomic linkages between sectors into account, but their complexity serves primarily to conceal the key assumptions that drive the results of the model. For example, the models typically assume that when factories close down, employees are easily re-employed. Bizarrely, they also usually assume that there are no economies of scale, which raises the question of why factories would have been built in the first place.

We now question why TAI believe it would, however, be appropriate to use CGE modelling in respect of the proposals.

¹⁰ Dennis, R., 2014. 'Economic models often biased by vested interests', Canberra Times, 1 August; <http://www.canberratimes.com.au/comment/economic-models-often-biased-by-vested-interests-20140731-zyumj.html#ixzz39UXrjeZy>.

3) Whether BAEconomics' modelling approach is rejected by the ABS and the Productivity Commission

BAEconomics does not wish to comment on the economic modelling qualifications of either Mr Jerome Fahrer of ACIL Allan or Preston CJ of the NSW Land and Environment Court. We note, instead that:

- the input-output modelling approach adopted by BAEconomics reflects the recommended 'best practice' approach to regional input-output modelling advocated by the U.S. Bureau of Economic Analysis, as referenced in the BAEconomics Report (Bess and Ambargis 2011);
- the input-output modelling approach adopted by BAEconomics is furthermore consistent with the use, as recommended in the ABS Information Paper (Australian National Accounts: Introduction to Input-Output Multipliers); and
- while the Productivity Commission paper referenced by TAI points out a number of 'misuses' of input-output multipliers, it also highlights the circumstances where input-output analysis is a valuable research tool (Gretton 2013, pp. 12-13):

While there are clear concerns about input-output multipliers and their misuse, the input-output tables on which multipliers are based provide a rich source of information about the structure of economies that is not available from other frameworks.

- *Input-output tables provide key information for analysing linkages between activities.*
- *The tables also provide the underlying core database used in a range of economic models. While these models can overcome many of the limitations of input-output multipliers, they too, rely on restrictive assumptions, which need to be tested before the models are applied.*
[emphasis added]

It should also be noted that in any event, input output tables form part of the building blocks generally used in the construction of CGE models.

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Appendix I

Response to the Day Design review (Appendix 3 of BMPA submission)



29 September 2014

Re: Warkworth Continuation 2014 and Mount Thorley Operations 2014 - Day Design submission on acoustic studies

Bulga Milbrodale Progress Association Inc (BMPA) engaged Day Design Pty Ltd to review the acoustic studies for the proposals on its behalf to accompany its submission. This letter provides responses to matters raised in the review.

The headings and paragraph numbering reflect those in the Day Design review.

1 Introduction (para 1 to 6) and About the author (para 17 to 21)

Mr Stephen Gauld describes the process under which he has been engaged, ie as instructed by the Environment Defenders Office NSW (EDO) on behalf of the BMPA. He references a site visit completed on 18 July 2014 and acknowledges the code of conduct for expert witness and civil procedures rules 2005. Mr Gauld also states at para 21 "My evidence in this statement is within my area of expertise ...".

It should be noted that from review of Mr Gauld's CV (attached as Appendix A to the Day Design report) it is evident his experience is limited to relatively small scale noise impact assessment and does not include any major industrial site noise experience, for example mining developments such as the proposal.

2 Executive summary (para 7 to 16)

Points made in this section are addressed in response to matters raised in the following sections of this document.

3 Description of the site and surrounding area (para 22 to 24)

Matters raised in this section are notes only and do not require a response.

4 Background noise levels (para 25 to 32)

Paragraph 25, Table 1 is purported to show the RBL values from both the Warkworth Mine and MTO studies. This is not the case. The presented data reflects the RBL values in the MTO study only. The RBL values in the Warkworth Mine study are lower for the night period at three of the presented locations. Nonetheless, the final adopted RBL values are correctly quoted as being between 30dB(A) to 33dB(A). It should be noted that variances in noise levels of 3dB are equal to the threshold of human perception and hence such a range in RBL values is marginal.

It is stated that an Infobyte iM4 Type 2 noise logger was used alongside the applicant's device (BarnOwl monitoring Location A in the EISs) at 98 Wollemi Peak Road in Bulga NSW. This was installed by Mr Gauld on 18 July 2014, measured noise for seven days and was returned by the property owner Mr John Krey on 30 July 2014.

It is assumed that reference to Type 2 relates to Class 2 as per Australian Standard AS IEC 61672.1 Electroacoustics - Sound level meters. This instrumentation is inferior to Class 1 hardware, used by the applicant (BarnOwl). The BarnOwl statistical data (ie $L_{90,15\text{minute}}$, the metric used to calculate background noise) is captured by one of the three microphones and in this configuration the BarnOwl satisfies a Class 1 sound level meter in accordance with AS IEC 61672.1. This implies a measurement tolerance limit difference between the two devices of generally $\pm 1\text{dB}$ for the frequency range relevant to environmental noise and used to derive RBL values as per AS IEC61672.1 Table 2. That is, the BarnOwl has a superior tolerance limit as compared with the Class 2 device used by Mr Gauld.

It is unclear why only seven days of data is provided and analysed if the device was in place for 12 days (18 to 30 July 2014 as stated). The security of the data could be compromised in that time and it is unclear whether calibration of the unit was completed at the commencement and conclusion of monitoring as is required practice for mobile devices to ensure the data is valid.

At paragraph 27 it is stated that an RBL was calculated to be 30dB(A) for the day, evening and night period, with charts presented in Appendix D. It is not apparent how this result was derived. It is normal practice to provide the daily Assessment Background Levels (ABLs) used to define the RBL. The RBL is the median value of at least seven valid ABL values (refer to the EPA's INP for definitions). The ABLs have not been provided and, as such, the RBL cannot be verified. It is therefore concluded that Mr Gauld has not applied the EPA's INP methods to determine the RBL. Similarly, there is no mention of effects of weather on the data set in accordance with the INP.

To provide further information on the period in question EMM analysed the same period Mr Gauld addressed (18 to 25 July 2014) and beyond (to 11 August 2014) using the applicant's BarnOwl data. This is attached in daily ABL tabular form derived in accordance with the INP and in daily charts. Weather data from the applicant's Charlton Ridge meteorological station was assessed in conjunction to filter out rain or excess wind effects on the monitor in accordance with the INP. Due to these effects, the RBL derivation had to be extended beyond Mr Gauld's monitoring period to obtain seven valid daytime ABL samples as required by the INP. It follows that had Mr Gauld analysed his data in accordance with the INP, he too would discover that at least one of the days in his monitoring period (25 July 2014) does not satisfy the INP's weather exclusion rules and, therefore, must be removed and monitoring extended.

The BarnOwl data shows that ABL levels (used to calculate RBL) rarely drops below 30dB(A), in the period 18 to 25 July 2014 (Day Design sampling period). Further, only 10 single 15 minute L_{90} samples (used to calculate ABL) drop below 30dB(A) from a total of 768 samples (ie approximately 1%). For the Day Design seven day period (18 to 25 July 2014), the applicant's BarnOwl data was analysed in accordance with the INP and shows RBL values of 33dB(A), 36dB(A) and 37dB(A) for the day, evening and night, respectively. That is, a minimum RBL of 33dB(A) and not 30dB(A) as suggested by Mr Gauld's analysis that has not been appropriately disclosed in his submission. Refer to Appendix A for ABL, RBL and chart data.

At paragraph 30 Mr Gauld suggests that the BarnOwl logger has been located at 98 Wollemi Peak Road for more than two years and therefore must be outside of the two year NATA calibration period. EMM confirms that this is not the case. The applicant has advised the BarnOwl was only deployed to this location on 21 June 2013 (ie just over one year from the date of the Day Design report). Mr Gauld states that the BarnOwls are not appropriately calibrated. EMM has been provided with field calibration certificates conducted by Benchmark Monitoring on behalf of the applicant. For the 98 Wollemi Peak Road BarnOwl, the relevant calibration events for the analysed monitoring period (18 July to 11 August 2014) were performed on 23 April 2014 and again on 29 July 2014. Both calibration tests show strong agreement with the reference level (94.0dB) and present drifts of 0.1dB to 0.4dB. These are considered acceptable levels of calibration drifts.

The calibration of all BarnOwl units throughout the period of sampling used to establish RBL values for the Warkworth Mine and MTO acoustic studies have also been provided. EMM considers these field calibration reports to confirm strong agreement with reference levels with minimal drift between calibration tests, demonstrating a strong commitment to data availability and integrity. Refer to attached calibration reports by Benchmark Monitoring for BarnOwl locations adopted in the EIS acoustic studies that resulted in RBL values higher than 30dB(A) - ie 98 Wollemi Peak Road (Location A), 128 Wambo Road (Location C) and Scout Hall (Location F)).

In addition, historic data presented by others also support RBL values greater than 30dB(A) for some areas in Bulga. These include the EIS for the Extension of Warkworth Coal Mine (August 2002) as described in Section 8.1 of the noise and vibration report. Also the independent review by SKM prepared on behalf of the NSW Department of Planning & Infrastructure (April 2012), whilst not specifically commissioned to review background noise, does at Appendix C provide 134 L_{A90} 15-minute samples at various locations in Bulga between 2 December 2011 and 30 January 2012 that are all greater than 30dB(A).

In conclusion, the reported and adopted RBL values in the EISs are supported by an overwhelming dataset as shown in the acoustic studies for both proposals and these are further supported by data collected by others.

5 Past judgements (para 33 to 38)

Matters raised in this section are predominantly notes or are addressed in other sections of this document.

6 Noise monitoring (para 39 to 45)

This section describes the management tools used to assist MTW with achieving noise limits in real time. It is important to distinguish this process from compliance monitoring.

At paragraph 42, Mr Gauld interprets the BarnOwl alarms as a demonstration of exceedances of noise criteria. This is not the case as triggers are set below the criteria as described in Section 3.2.1 of the noise and vibration report. Further, such alarms ignore weather conditions and therefore do not represent a non-compliance for times when atypical weather means noise criteria do not apply. The statement by Mr Gauld "*that further expansion of the mines is likely to intensify the noise impact with more exceedances more often*" is therefore based on a lack of understanding of such alarms and real time management systems. This statement also ignores the plant attenuation program that will reduce emission levels of all major noise sources. The Table 6.2 of the noise and vibration study in the Warkworth Continuation 2014 EIS presents the annual breakdown (between 2006 and 2014) of noise measurements for Warkworth Mine and demonstrates a very high level of compliance. This table has been updated to include compliance assessment data up to and including August 2014, and is presented below at Table 6.1.

Table 6.1 Yearly breakdown of noise compliance measurements for Warkworth Mine

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total number of assessments	230	276	280	279	292	275	269	290	261	201	138
Total number of exceedances ¹	1	0	1	1	1	8	1	4	4	3	0
Total number of non-compliances	1	0	0	0	0	4	1	2	1	1	0
Non-compliant assessments (%)	0.43	0.00	0.00	0.00	0.00	1.45	0.37	0.69	0.38	1.14	0.00

Note: 1. Exceedance refers to a measured result greater than the relevant consent limit, but within the 2dB allowable tolerance listed in Chapter 11 of the INP.

At paragraph 45 Mr Gauld states "the mine should be installing acoustic kits on all plant that contribute to the overall noise level at residences, to reduce the occurrence of acoustic non-compliance." This is being proposed and the installation of attenuation packages are well advanced on the truck fleet and advancing for all major plant as described in the EIS. All drill, truck, dozer and excavator fleet would continue to be sound attenuated with completion expected by the end of 2016 calendar year.

7 Saddleback Ridge (para 46 to 50)

Mr Gauld agrees and states at paragraph 47 "...agreed that the ridge provides good attenuation during calm weather, which occurs for the majority of the time." The statement that calm weather occurs for the majority of the time is incorrect and is relied upon by Mr Gauld in his argument later in the report. The presence of calm weather and its occurrence is well documented through analysis of weather data at this and many mining developments in the Hunter Valley. The condition of zero (or <0.5m/s) wind speed and no temperature inversion (calm or still-isothermal) is relatively infrequent as depicted in the wind roses at Figure 11.2 of the EIS. These windroses show calm conditions are very rare for the area. EMM's analysis of the Charlton Ridge Automatic Weather Station (AWS) data between 2007 and 2013 shows for example that at most only 4% of a particular season and period (eg winter nights) are calm conditions (ie wind speeds less than 0.5 m/s).

The statements at paragraphs 49 and 50 are unclear, but appear to suggest a significant increase to current mine noise post removal of the ridge, even though Mr Gauld notes at paragraph 48 that the noise benefit of the ridge during calm weather is virtually nullified during adverse weather. Notwithstanding, the noise and vibration studies provide predicted noise levels during calm and adverse weather for pre and post removal of the ridge. All calm weather predictions are well below noise criteria for Bulga locations irrespective of the Ridge's presence. The predicted noise levels during adverse weather post removal of the ridge are also presented and impacts identified in accordance with the INP.

8 Low frequency noise criteria (para 51 to 70)

Paragraphs 55 and 56 imply the assessment of low frequency noise was only done against the Broner and DEFRA methods. This is not correct. The INP LFN method was applied to the assessment of low frequency noise as described in Section 9.7.1 and 10.9.1 of the noise and vibration study for the proposal.

The EPA's submission on the current EISs acknowledges the limitations in the INP's LFN method.

To assist in understanding the potential for LFN impacts, the noise model developed as part of the EIS was used to quantify the L_{eq} dB(C) minus L_{eq} dB(A) levels as per the INP requirement. This was done for a representative set of residential locations in and around Bulga. The results are shown in Table 4.3.

Predicted L_{eq} dB(C) minus L_{eq} dB(A) are less than 15dB and, therefore, demonstrate the INP penalty is not expected to apply during times when mine noise is predicted to be at its highest (ie worst case weather). This was done for a representative set of assessment locations within, and to the, east, west, north and south of Bulga village therefore covering a wide expanse of that community. The results reaffirm the predicted noise levels in the EIS for these areas in accordance with the INP.

These results address also paragraph 65 of Mr Gauld's submission that contends the IN LFN penalty should apply to predicted levels.

It is also demonstrated that dB(C) levels are predicted to be well below the Broner night criterion of 60dB(C) at all locations.

Table 8.1 Modelled dB(C) and dB(A) mine noise levels - Bulga area

Location ID	dB(A)	dB(C)	Difference, dB
1	35	48	14
14	38	50	12
19	40	51	11
237	38	51	13
65	39	51	11
87	40	50	11
Criteria, dB			
Broner (night)	-	60	-
INP	-	-	15

Notes: 1. Note that quoted levels are rounded to the nearest whole number.

Another consideration in assessing LFN is that measurements need to quantify dB(C) levels from the mine only in order to assess potential impacts. That is, the mine is not responsible for low frequency noise outside of its control. This is often very difficult in practice, particularly at large distances because of influences from the ambient environment (eg wind or road vehicles), leading to the C minus A INP approach being very impractical and unrepresentative of the mine's contribution. Another complication in the subject case is delineating low frequency noise from neighbouring mines.

At paragraph 61 Mr Gauld disagrees with the assertion around the original application of the INP's LFN penalty. As stated earlier, the EPA acknowledged in its submission the limitations of the INP LFN method and this is well documented (eg Broner 2010 and SKM Independent Review 2012).

Mr Gauld at paragraph 62 asserts "*The fact is the residents receive the low frequency noise...*". Mr Gauld suggests acoustic kits should be used to reduce low frequency noise at the source. This is a consideration of the 'in-service' target noise levels presented in the EIS (Table 10.3 of the noise and vibration study). The targets include both a linear (dB(L)) as well as a weighted (dB(A)) target to ensure attenuation does address low frequency noise. Having these two targets means the attenuation cannot focus on the dB(A) while ignoring dB(L), which is important in reducing low frequency noise.

To demonstrate this, the attenuation package used on trucks for example has been tested to show the improvement (at source) of the differential between dB(C) and dB(A). This is shown in Table 5.2 for one such tested truck at site. It should be noted that the attenuation achieved is a 'work-in-progress' and does not reflect the final outcome. From this test data, it is shown that attenuated trucks have a smaller differential between C and A weighted noise. This at source improvement will also hold true at distance and mean a better outcome for the community with respect to low frequency noise.

Table 8.2 CAT795 at source noise emission, dB

	dB(C)	dB(A)	dB(C) minus dB(A)
Dynamic, forward			
Baseline	132	122	10
Attenuated	123	115	8

Source: 1. Global Acoustics Reports:

"Mount Thorley Mount Thorley Warkworth - Sound Power Survey September 2013", Global Acoustics, 2012.

Caterpillar 795FXQ AC Mt Thorley Warkworth "Caterpillar 795FXQ AC Mt Thorley Warkworth Unit 434 - Sound power and operator noise exposure assessment", Global Acoustics, 2014.

At paragraph 68 Mr Gauld states "*The EMGA Reports predict low frequency noise has and will occur after the proposed continuation (Table 10.12), however ...*". This statement is not correct. Table 10.12 of the EIS noise and vibration study summarises monitoring data from 2013 and therefore has nothing to do with future or predicted levels, does not include attenuated plant and is not representative of the proposal. Tables 5.1 and 5.2 above address this matter and Mr Gauld's statement at paragraph 69 which contends the INP's 5 dB penalty should apply.

9 Best practice noise controls - attenuate whole of fleet (para 71 to 72)

Mr Gauld acknowledges "*It would appear that the best way to reduce the noise emission from the site would be to attenuate the whole of the fleet*". This approach is one of the mitigation measures being adopted at MTW as described earlier in response to Mr Gauld's paragraph 45 (See Section 3).

10 Best practice noise controls - bund wall (para 73 to 76)

The "*considerable land*" referred to by Mr Gauld at paragraph 75 is the Non Disturbance Area (NDA) and cannot be used for the large expanse needed for the base of a substantial noise bund. At paragraph 76 Mr Gauld concedes that Saddleback Ridge is "*more effective during calm weather conditions,...*". The discounting of a bund between Warkworth Mine and Bulga residences was not discounted due to cost and was considered as discussed in the EIS noise and vibration study Section 10.1. Such a bund would also be impractical as it would take years to construct.

Noise mitigation, such as a large noise bund, along the transmission path was found to be ineffective for the assessment locations in Bulga. The slope of the terrain between the mine and Wollombi Brook to the west would require a bund to be considerable in extent (ie kilometres) and height (ie over 20m) and would only provide minimal noise benefit to Bulga residences during adverse weather. Notwithstanding, if line of sight to residences could be obstructed, the benefit would be marginal during adverse weather conditions. The impractical nature of such a bund includes the need for considerable land area to accommodate the base of the bund and would need to be adjacent the Wollombi Brook in the proposed offset areas so as not to sterilise coal resources. The bund would also take multiple years to construct. Therefore, this is not a reasonable and feasible noise mitigation option. This matter was discussed in further detail in Chapter 23 of the EIS.

11 Best practice noise controls - relocation of plant (para 77 to 80)

Mr Gauld implies that meeting PSNL at all assessment locations in Bulga is reasonable "*...at a reported cost of \$100million over the life of the mine.*"

Chapters 3 to 6 of the noise and vibration study for the proposal are dedicated to reasonable and feasible management. They describe the existing and proposed noise management system, controls implemented, engineering measures, elimination measures, continual improvement practices and compliance history. "Feasible and reasonable" measures are a term defined in the INP as follows:

Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors:

- noise mitigation benefits (amount of noise reduction provided, number of people protected);
- cost of mitigation (cost of mitigation versus benefit provided);
- community views (aesthetic impacts and community wishes); and
- noise levels for affected land uses (existing and future levels, and changes in noise levels)."

The above INP notes are considered in Chapter 10 of the noise and vibration study (EIS Appendix F). The application of the terms 'reasonable and feasible' are consistent with the INP and, therefore, appropriate.

12 Predicted non-compliance (para 80 to 83)

As discussed in Section 5, application of the LFN modifying factor penalty of 5dB to predicted levels is inappropriate based on predicted dB(C) minus dB(A) values.

Appendix: A. ABL, RBL data and charts

Appendix B. BarnOwl calibration reports

Appendix A

ABL, RBL data and charts - 98 Wollemi Peak Rd 16 July to 11 August 2014

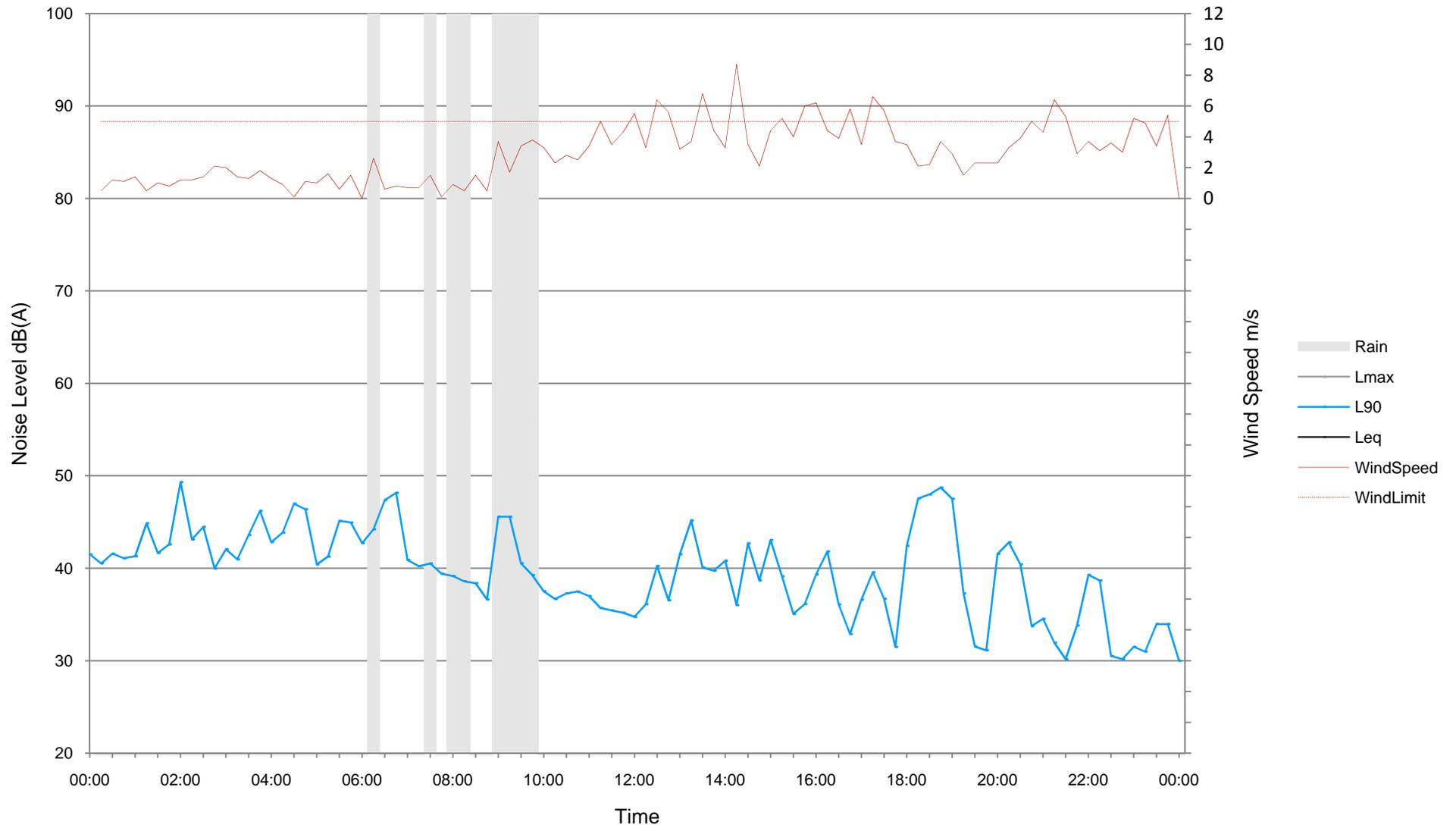
Table A.1 98 Wollemi Peak Rd BarnOwl - Background data

Date	ABL Day	ABL Evening	ABL Night
Wednesday, 16-07-14	-	31.1	31
Thursday, 17-07-14	32.7	30.8	31.9
Friday, 18-07-14	34.9	30.6	27.5
Saturday, 19-07-14	33.8	31.1	34.4
Sunday, 20-07-14	32	32.3	36.8
Monday, 21-07-14	31.5	35.6	38.9
Tuesday, 22-07-14	-	40.1	36.6
Wednesday, 23-07-14	33	41.2	37.1
Thursday, 24-07-14	35	41.7	38.9
Friday, 25-07-14	-	35.7	-
Saturday, 26-07-14	-	43.1	38.2
Sunday, 27-07-14	34.3	32.9	31.6
Monday, 28-07-14	31.2	30.1	31.1
Tuesday, 29-07-14	34.9	31.8	32
Wednesday, 30-07-14	33.8	32.3	33.8
Thursday, 31-07-14	38	37.5	33.6
Friday, 01-08-14	36	-	-
Saturday, 02-08-14	-	-	-
Sunday, 03-08-14	-	-	-
Monday, 04-08-14	-	38.9	36
Tuesday, 05-08-14	30	35.3	38.2
Wednesday, 06-08-14	35.2	29.4	30
Thursday, 07-08-14		39.4	37.2
Friday, 08-08-14	33.4	39.6	37.6
Saturday, 09-08-14	34.7	35.8	33
Sunday, 10-08-14	33.1	27.8	26.6
Monday, 11-08-14	32.8	34.6	-
RBL Values			
Day Design period (18 to 25 July 2014)	33.4	35.65	36.8
Whole period (16/7/14 to 11/8/14)	33.8	34.95	34.1

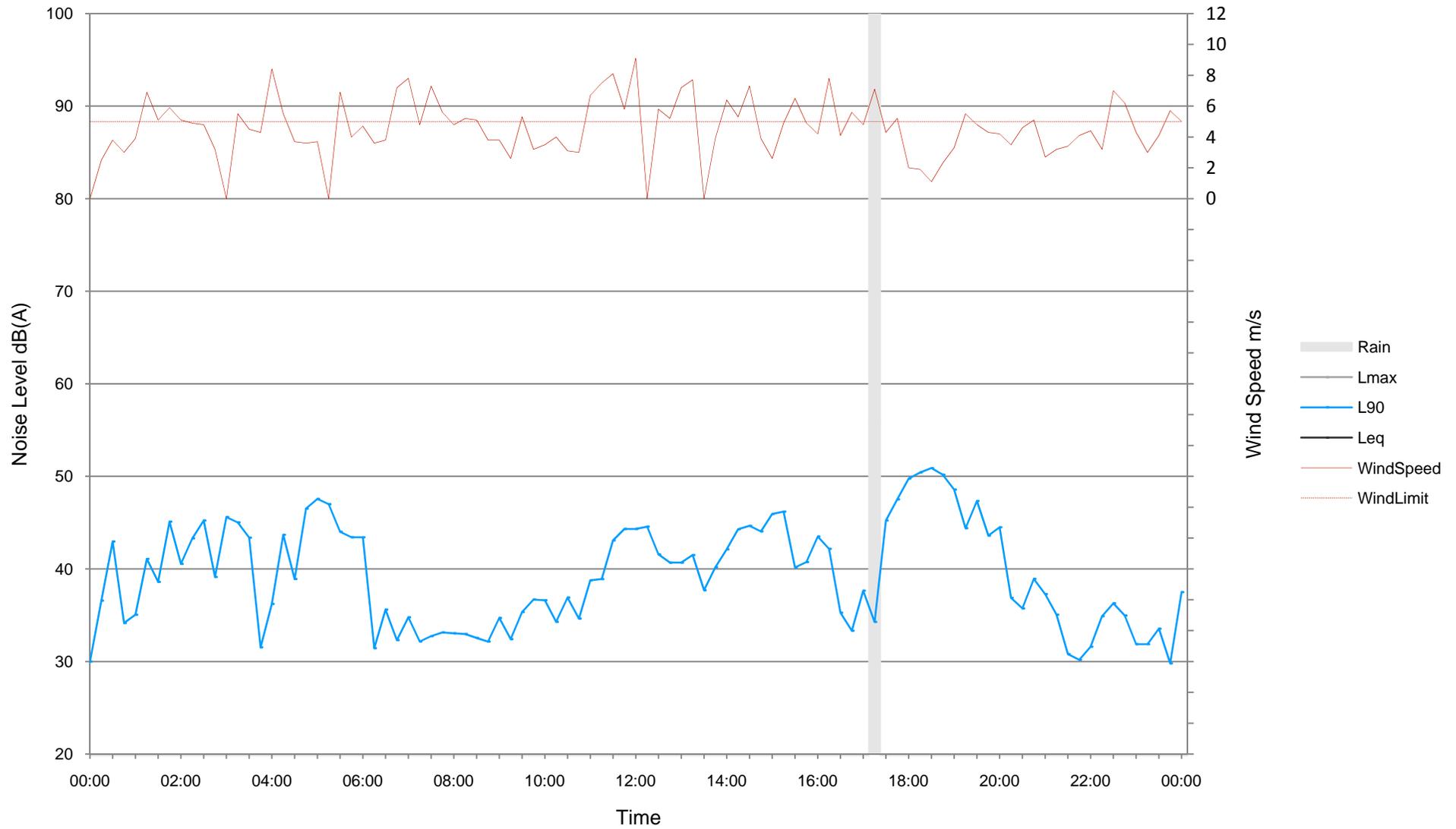
Notes: "-" indicates periods with too few valid samples due to weather or logger operation.

Wind speed at microphone was calculated based on height corrections of 10m (met station position) to 1.5m (microphone position) in accordance with AS1170.2. Wind speed in charts that follow are the raw 10m above ground from the met station.

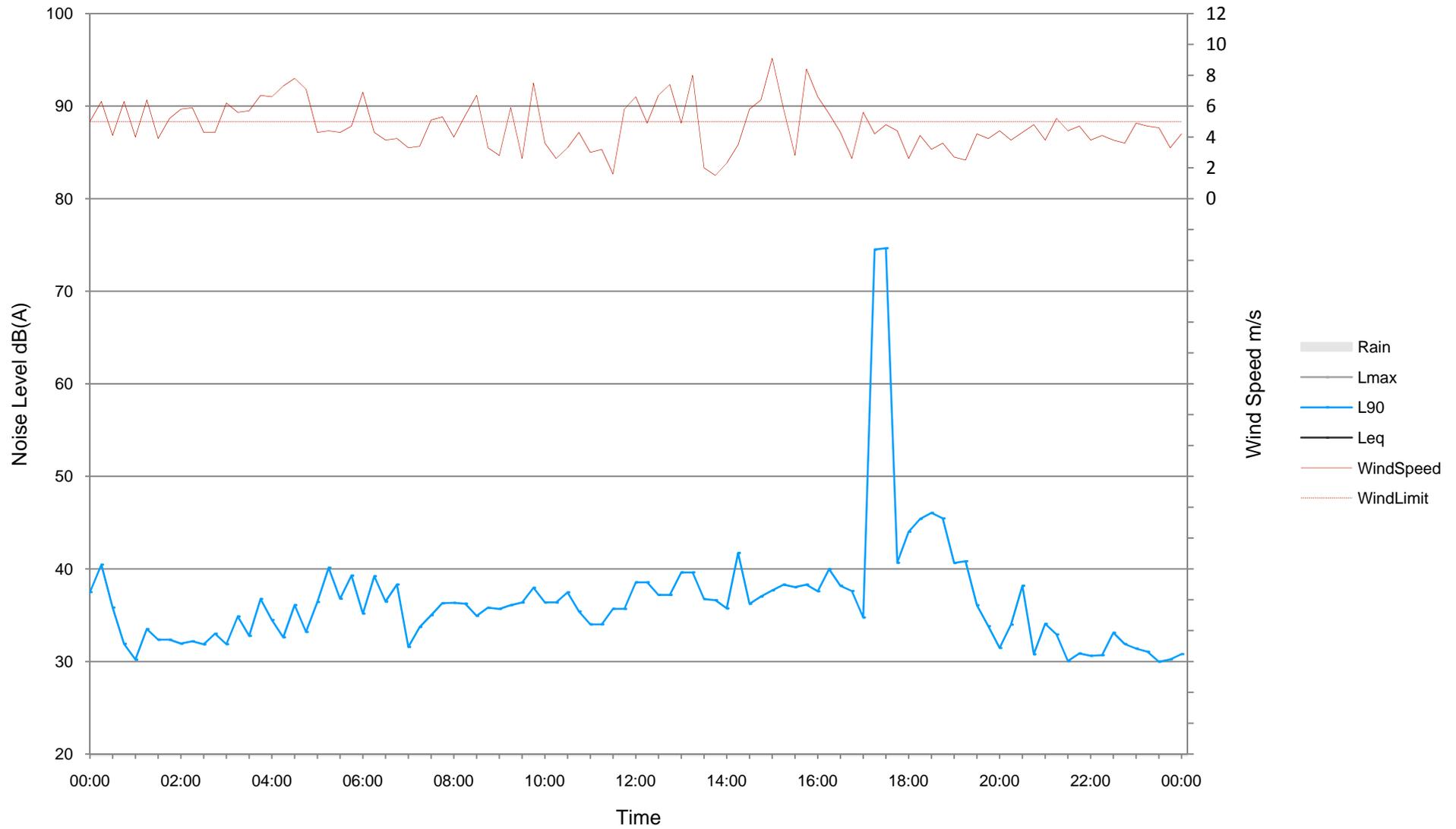
Measured Ambient Noise Levels Wollemi Peak Road Wednesday, 16-07-14



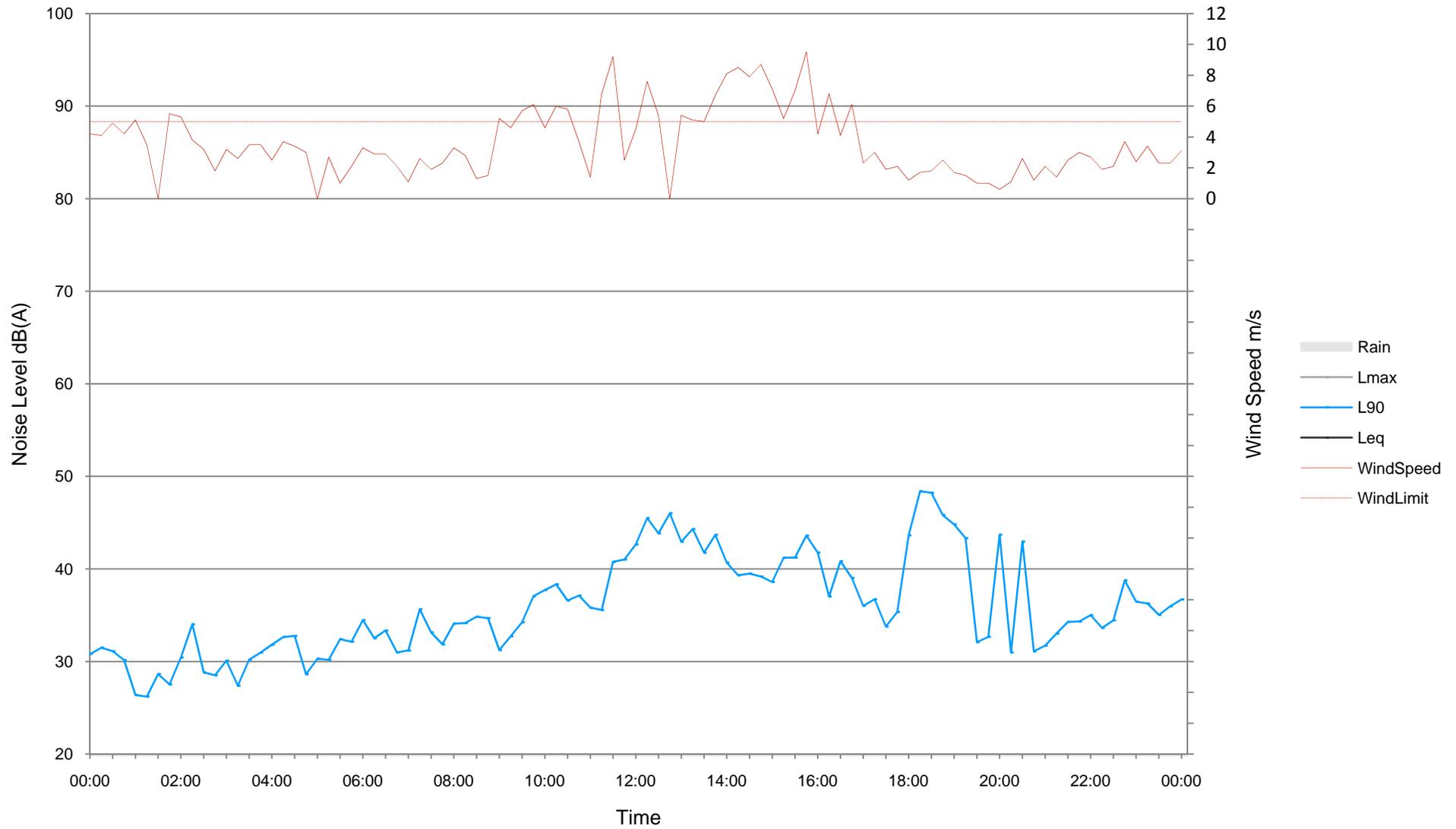
Measured Ambient Noise Levels Wollemi Peak Road Thursday, 17-07-14



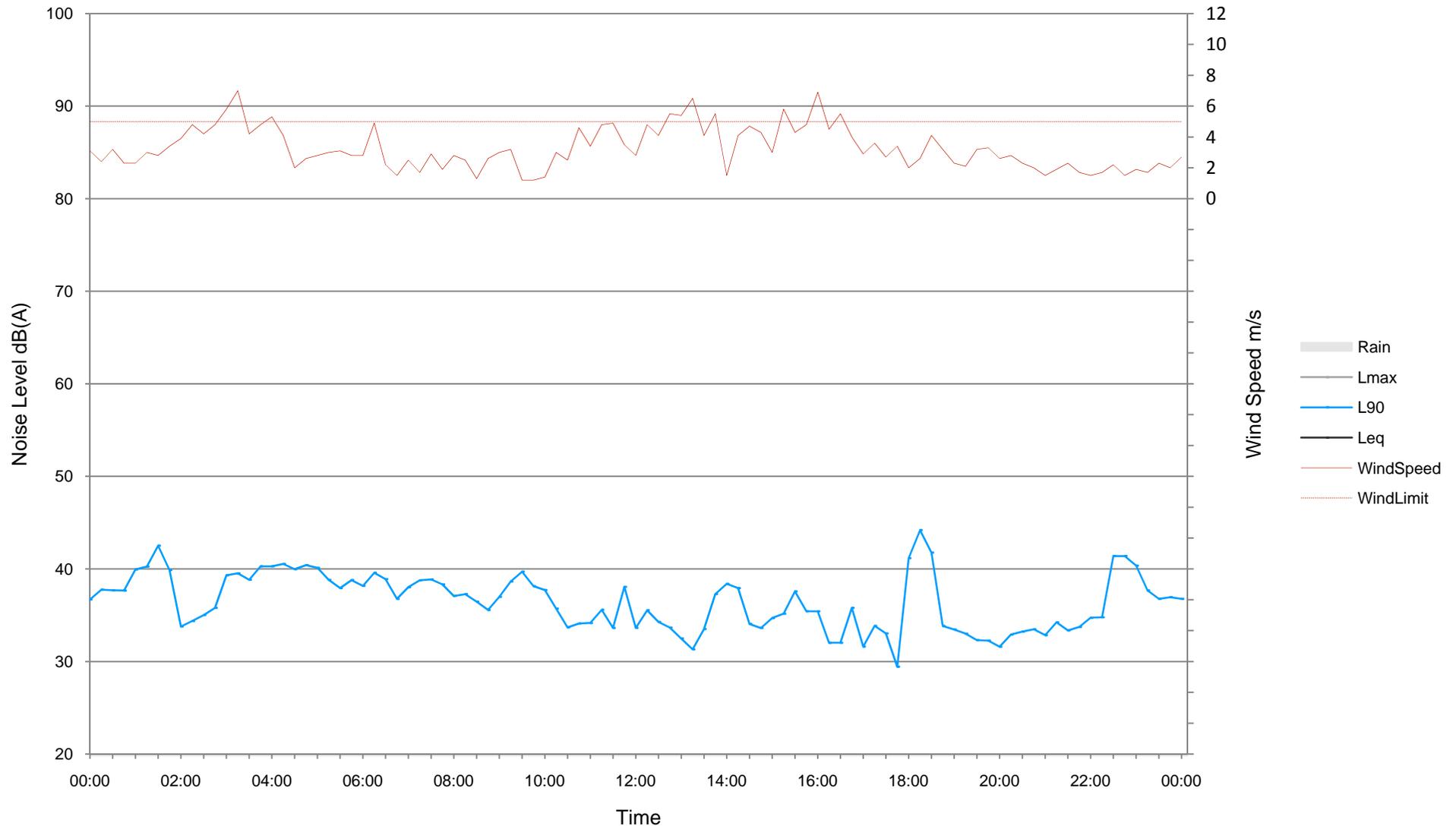
Measured Ambient Noise Levels Wollemi Peak Road Friday, 18-07-14



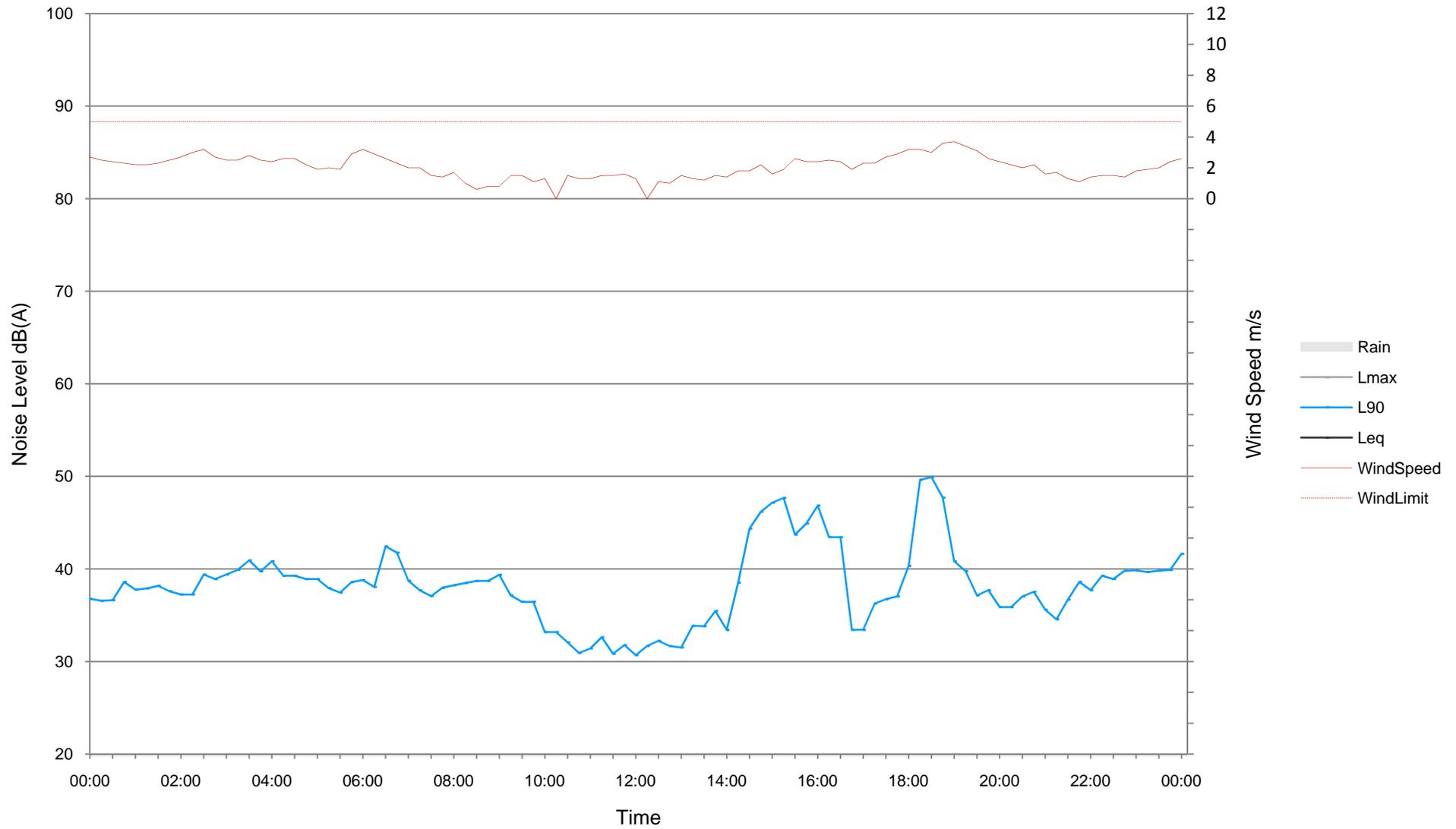
Measured Ambient Noise Levels Wollemi Peak Road Saturday, 19-07-14



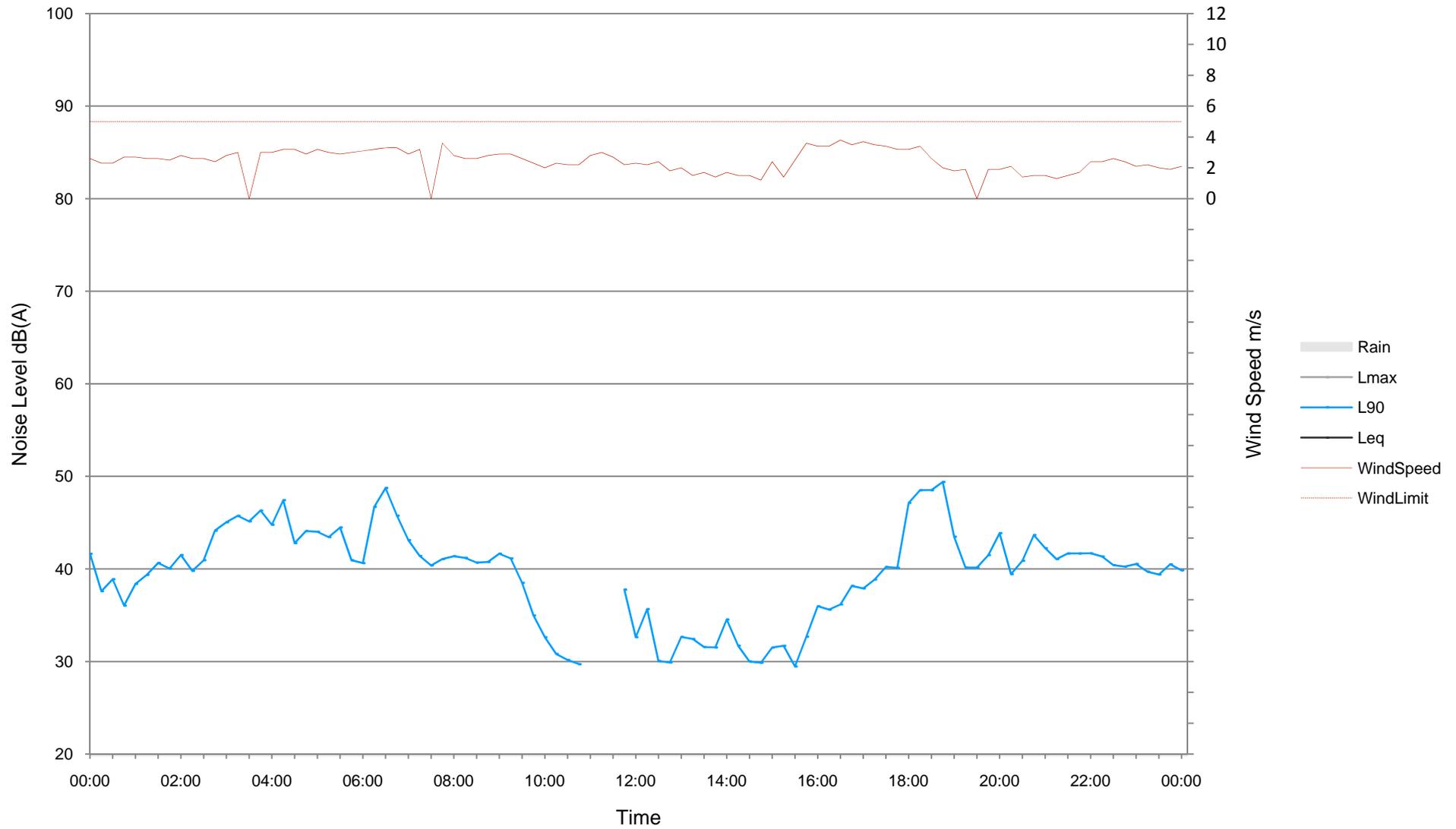
Measured Ambient Noise Levels Wollemi Peak Road Sunday, 20-07-14



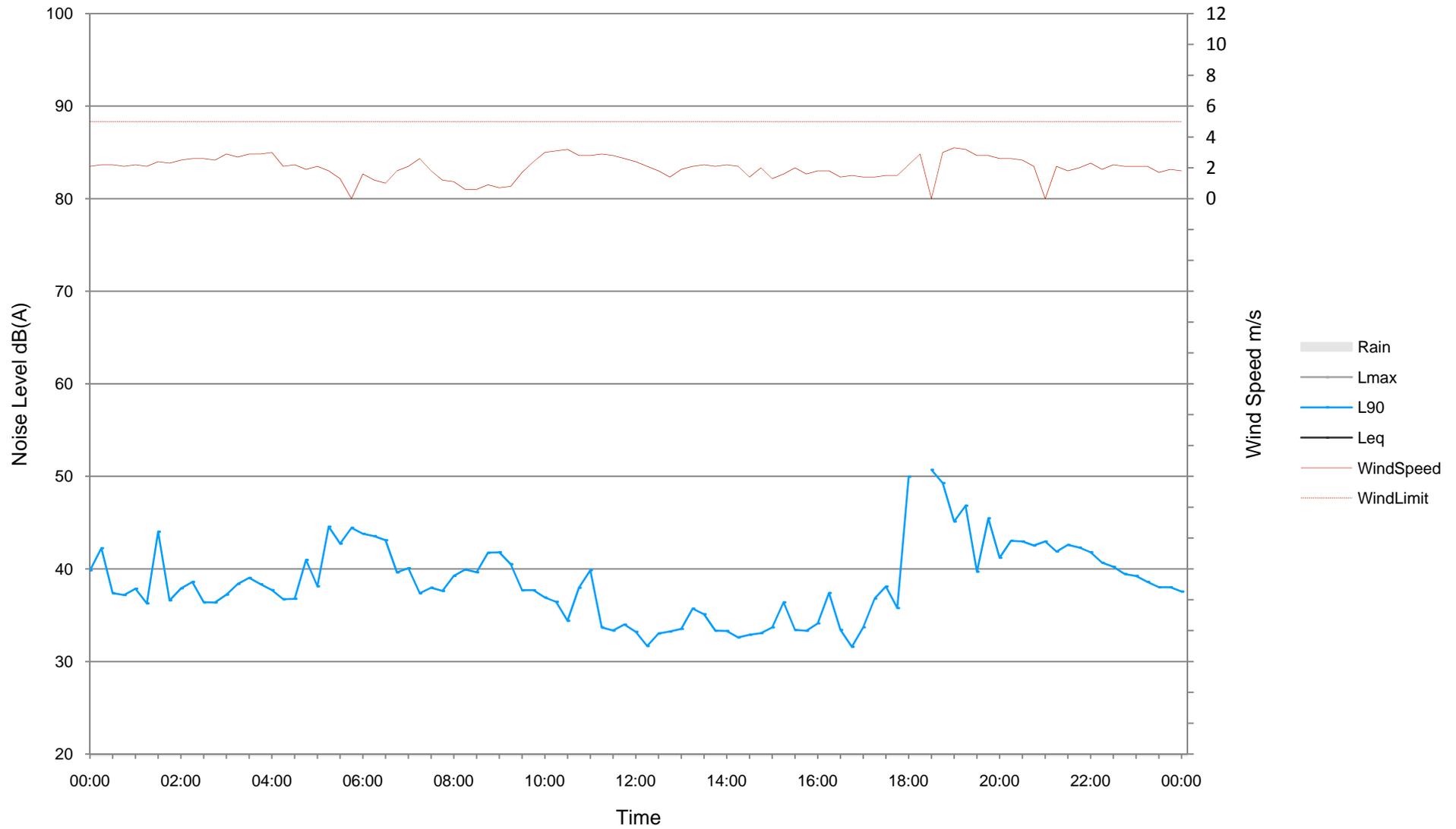
Measured Ambient Noise Levels Wollemi Peak Road Monday, 21-07-14



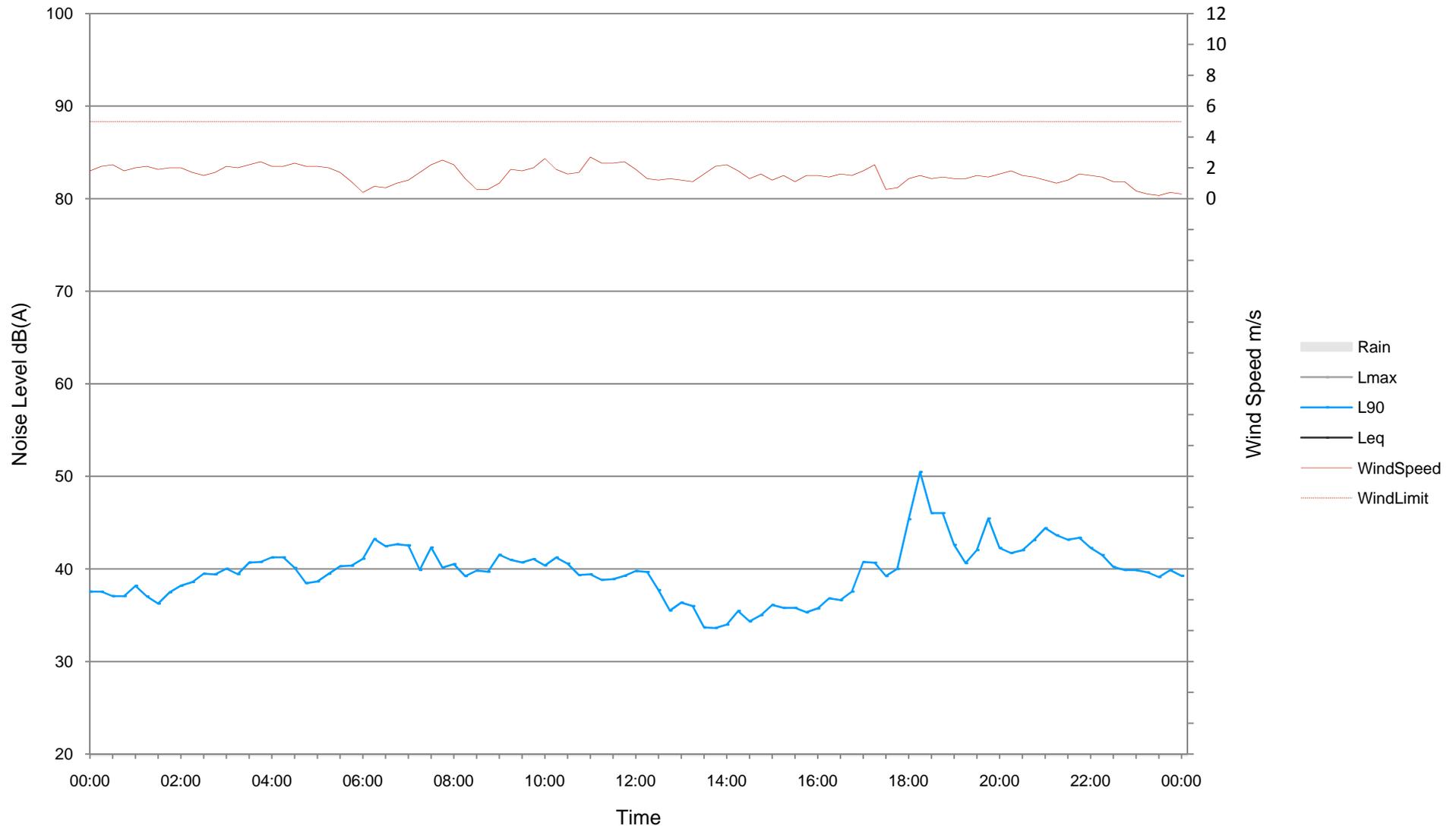
Measured Ambient Noise Levels Wollemi Peak Road Tuesday, 22-07-14



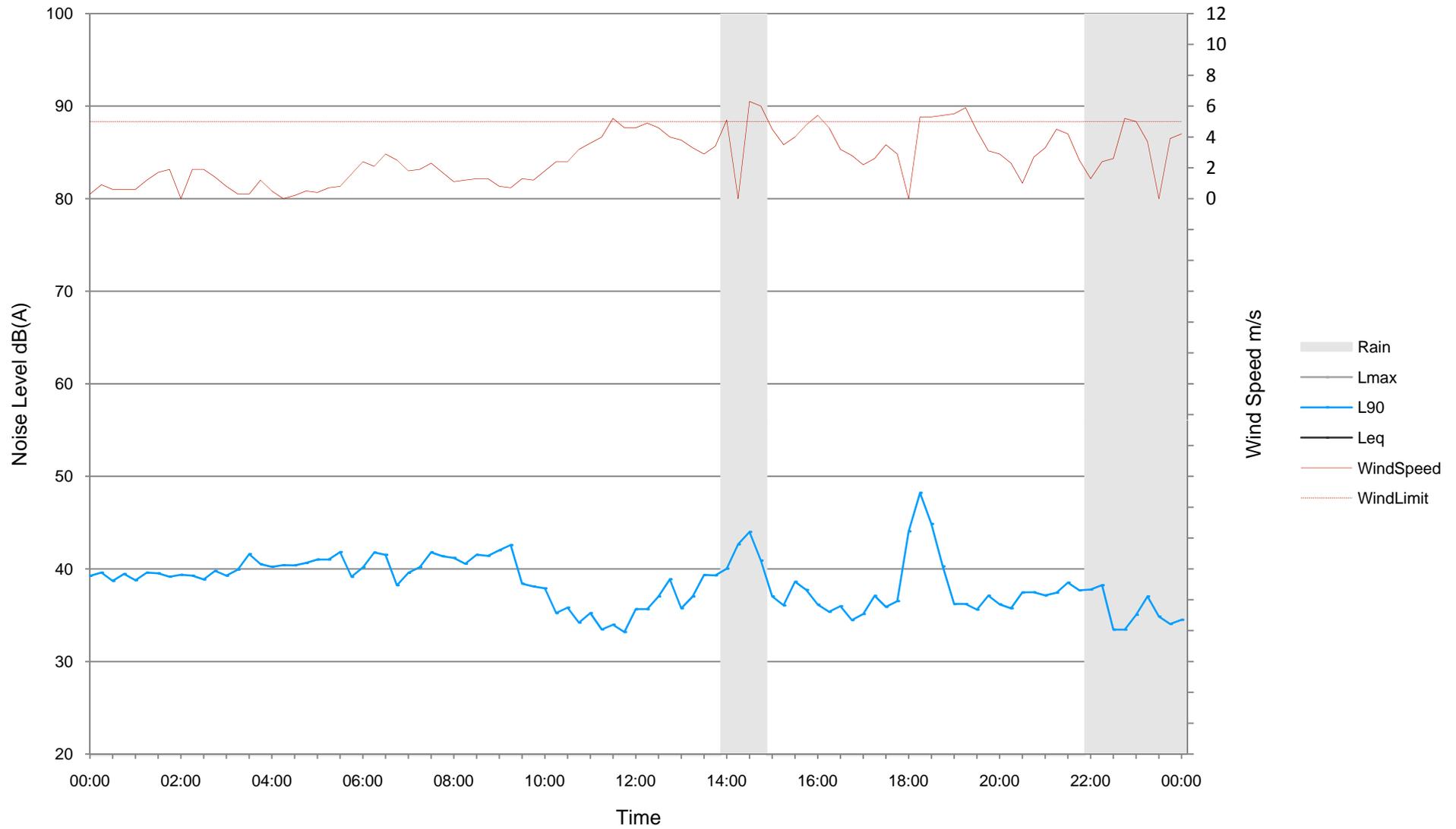
Measured Ambient Noise Levels Wollemi Peak Road Wednesday, 23-07-14



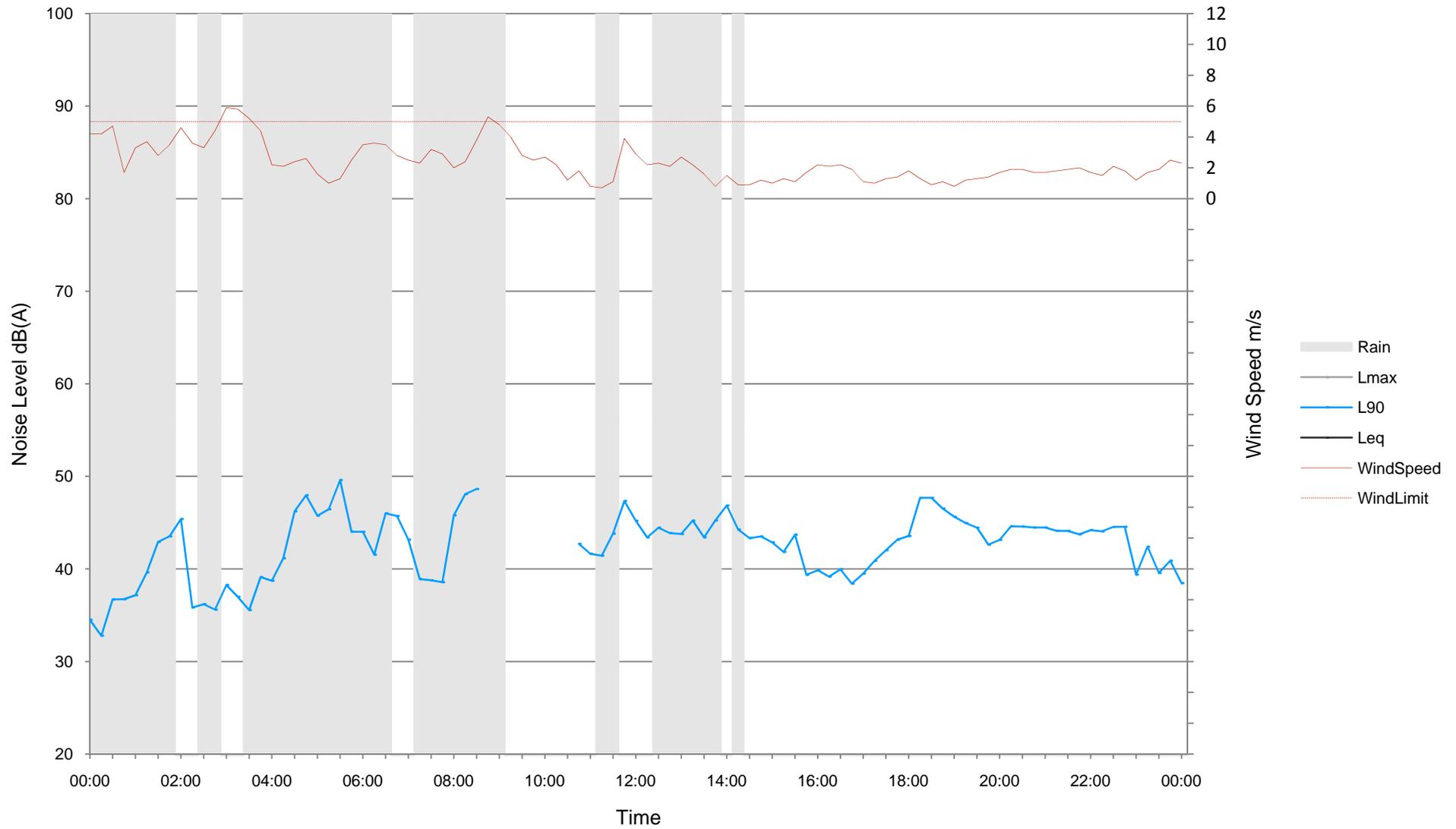
Measured Ambient Noise Levels Wollemi Peak Road Thursday, 24-07-14



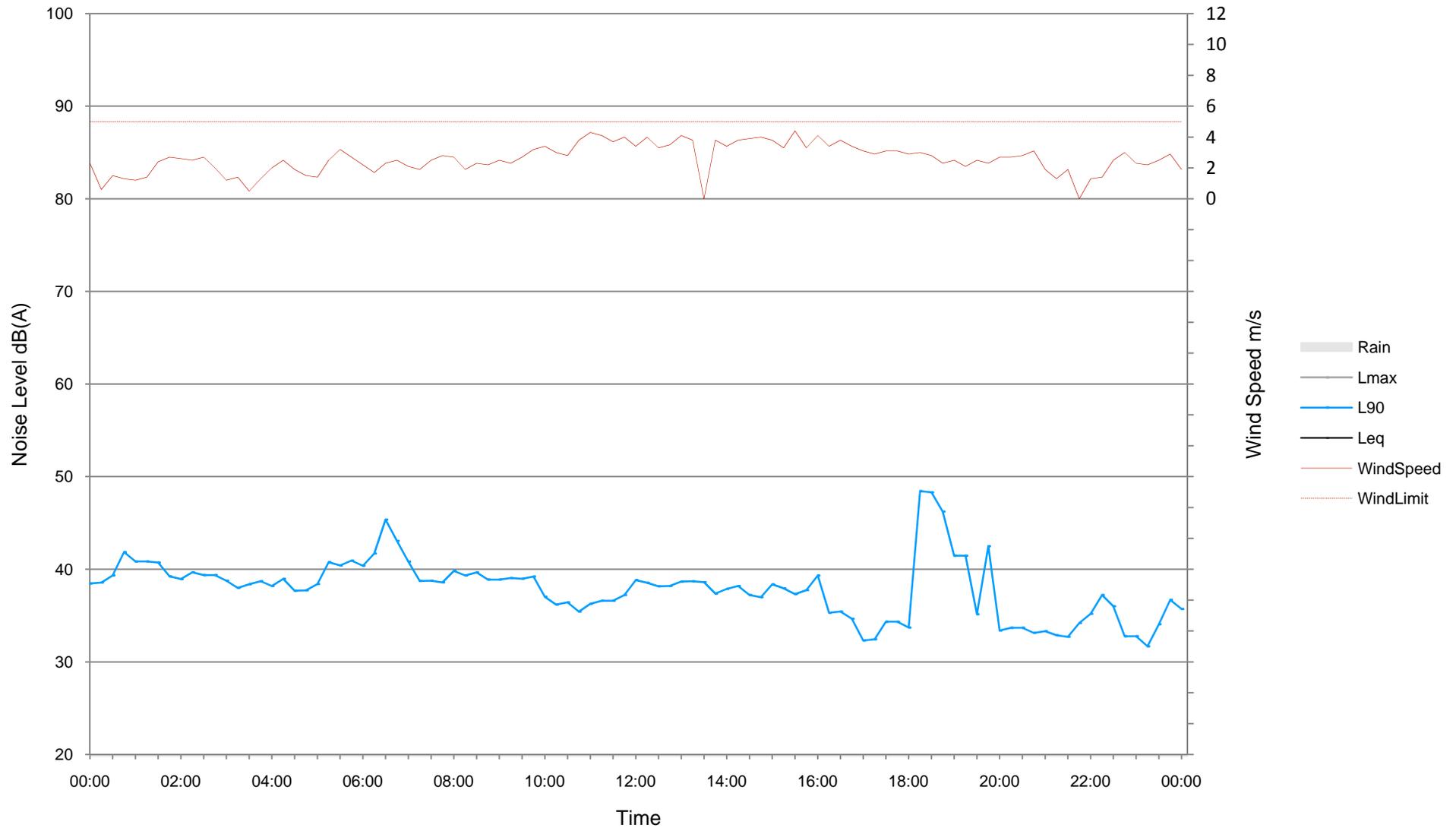
Measured Ambient Noise Levels Wollemi Peak Road Friday, 25-07-14



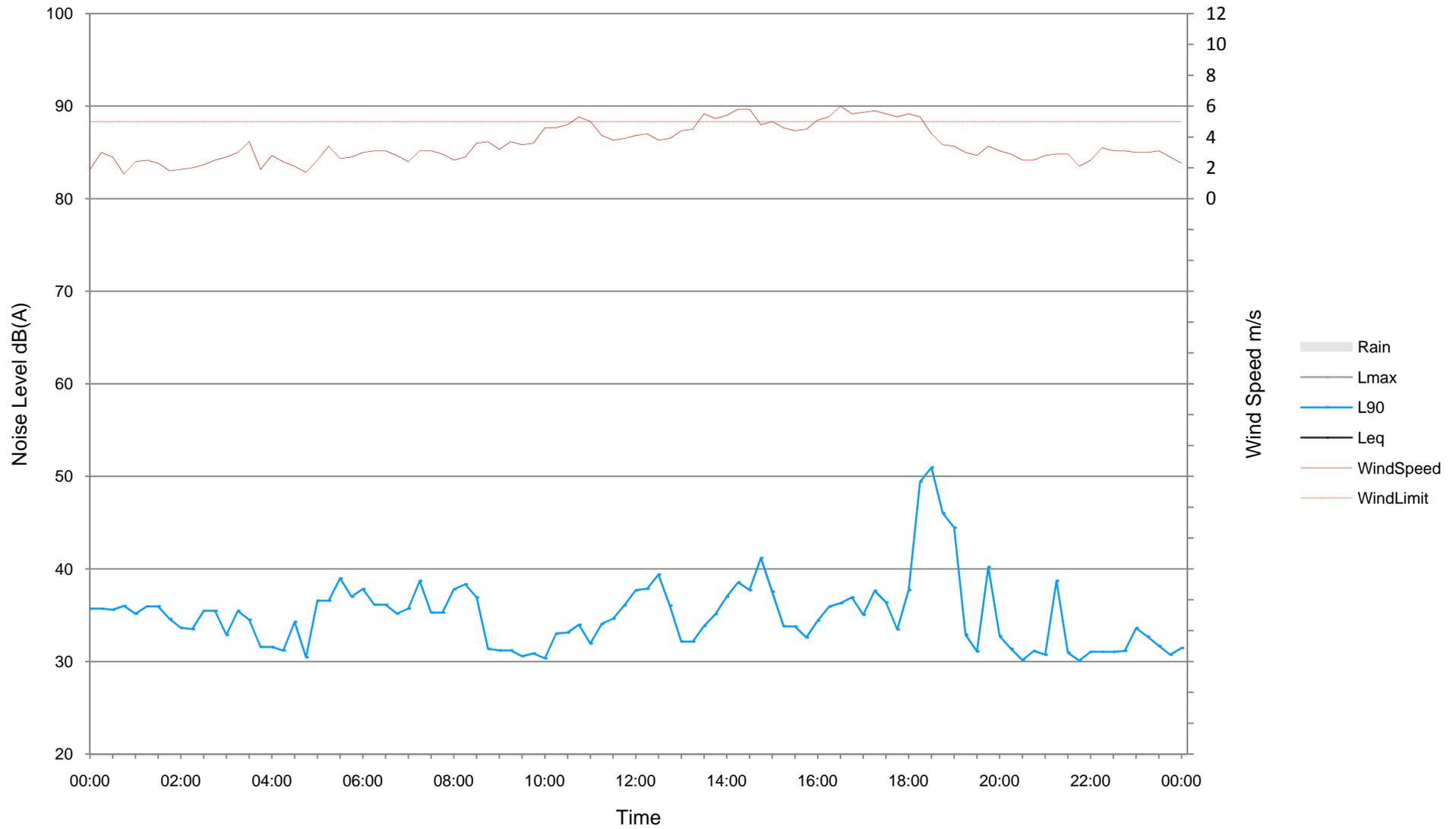
Measured Ambient Noise Levels Wollemi Peak Road Saturday, 26-07-14



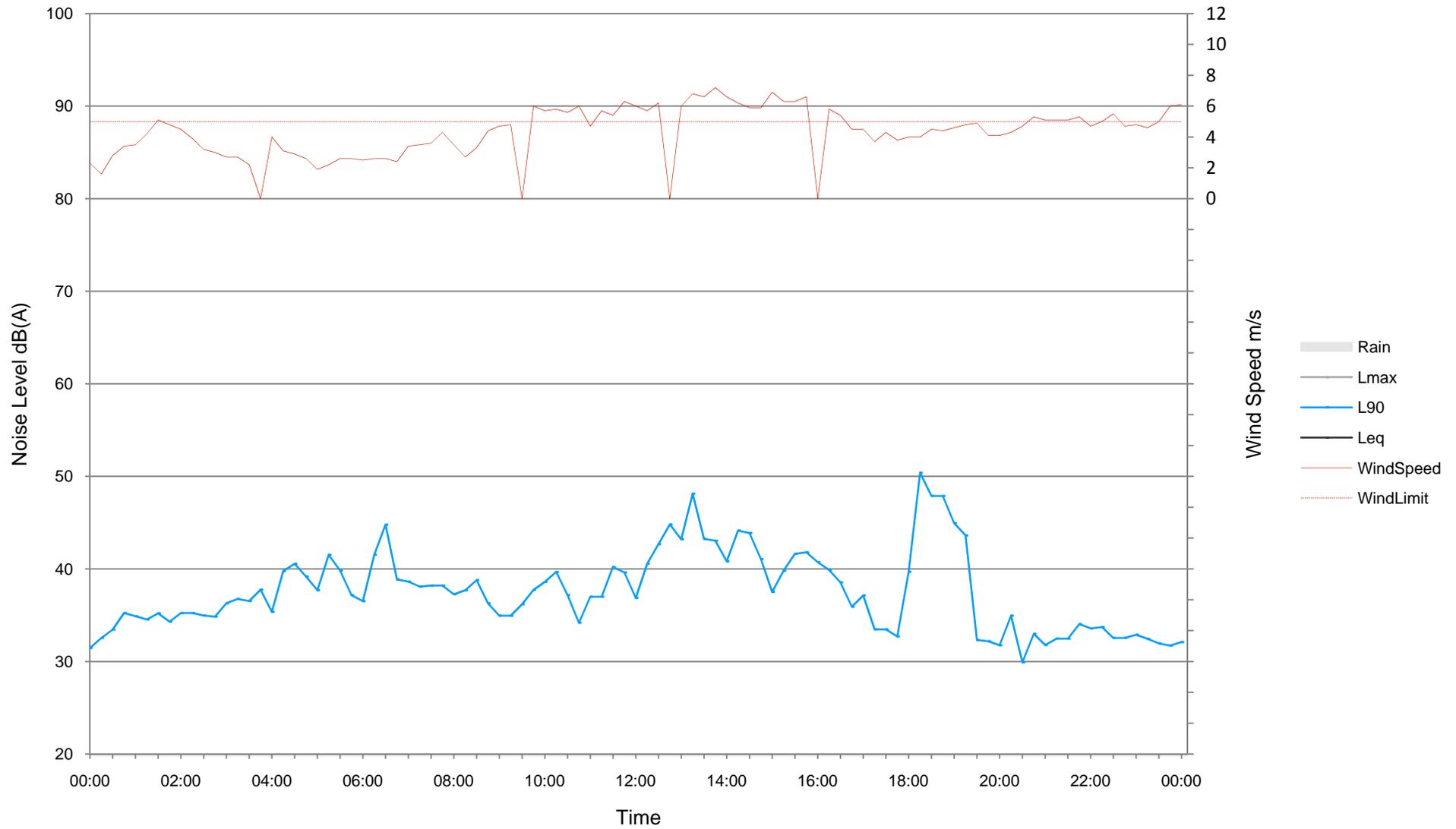
Measured Ambient Noise Levels Wollemi Peak Road Sunday, 27-07-14



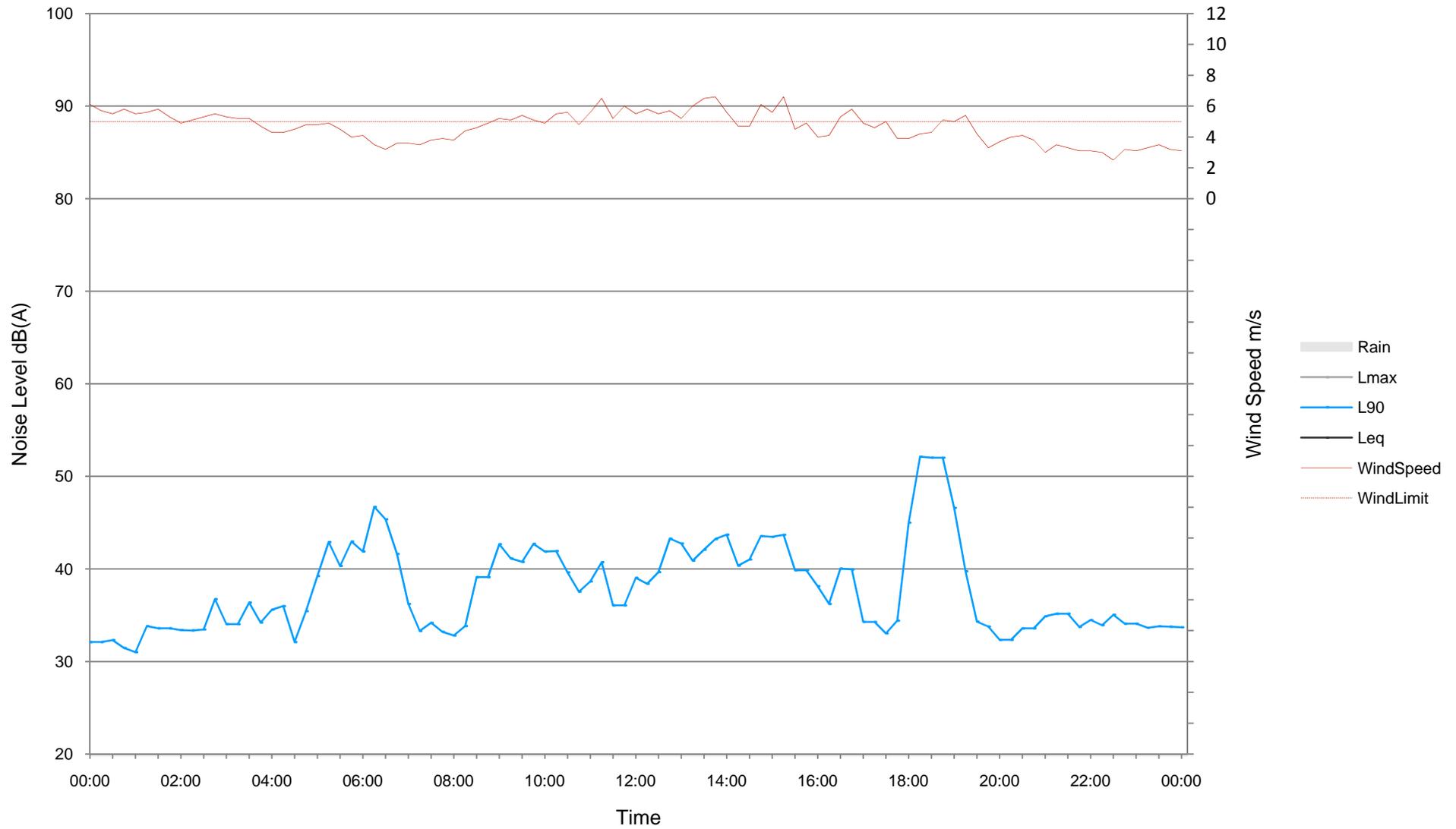
Measured Ambient Noise Levels Wollemi Peak Road Monday, 28-07-14



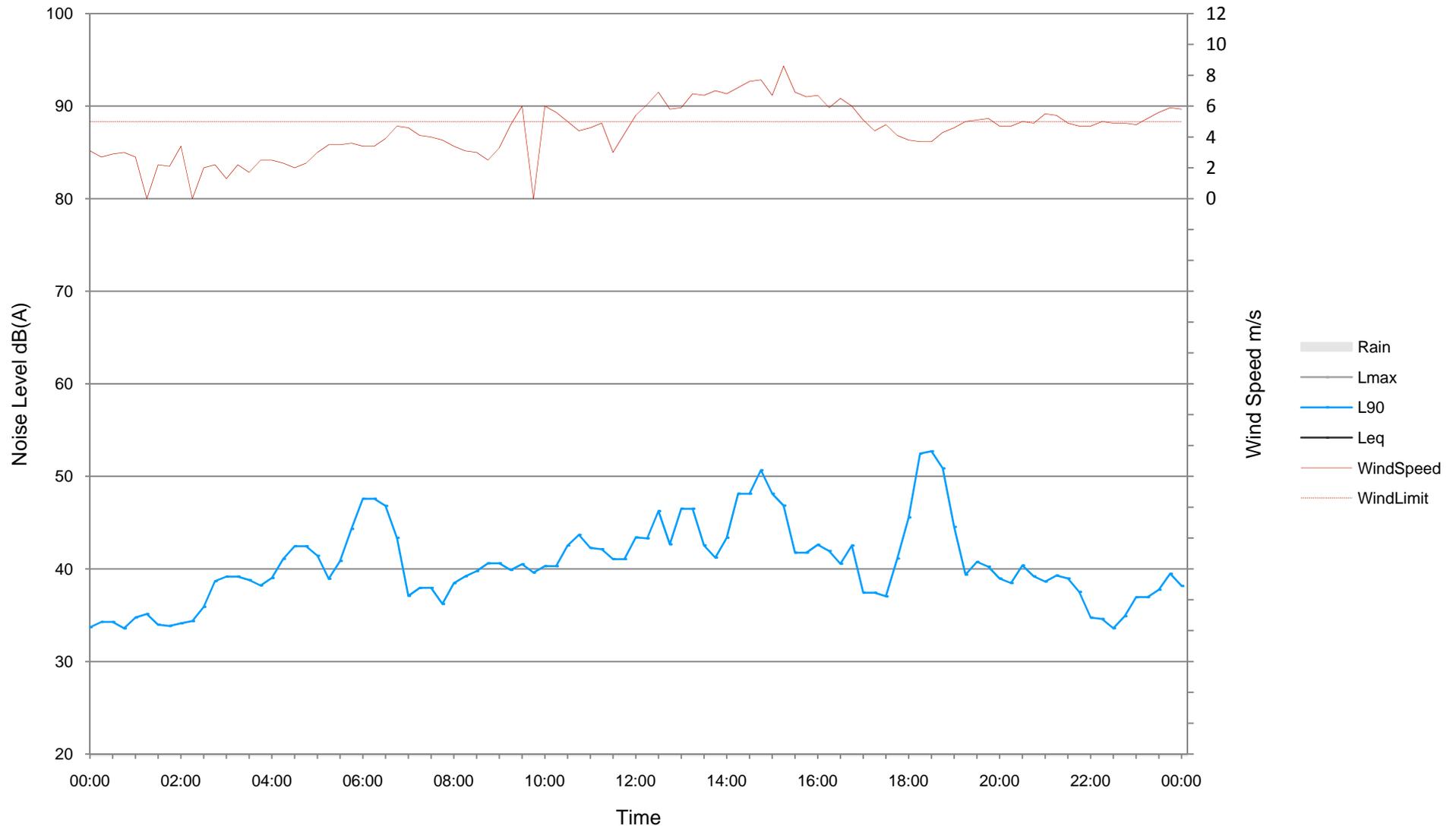
Measured Ambient Noise Levels Wollemi Peak Road Tuesday, 29-07-14



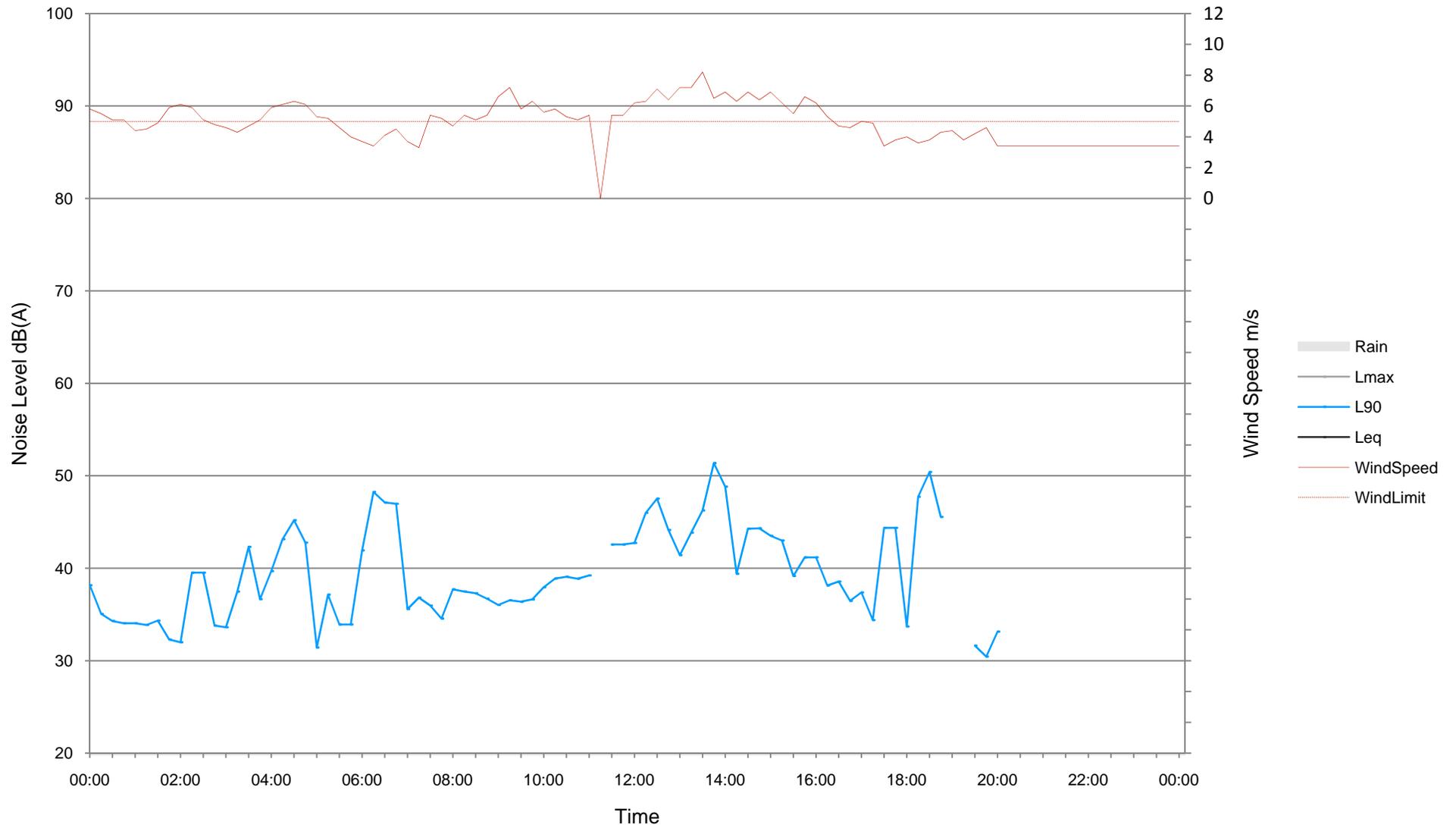
Measured Ambient Noise Levels Wollemi Peak Road Wednesday, 30-07-14



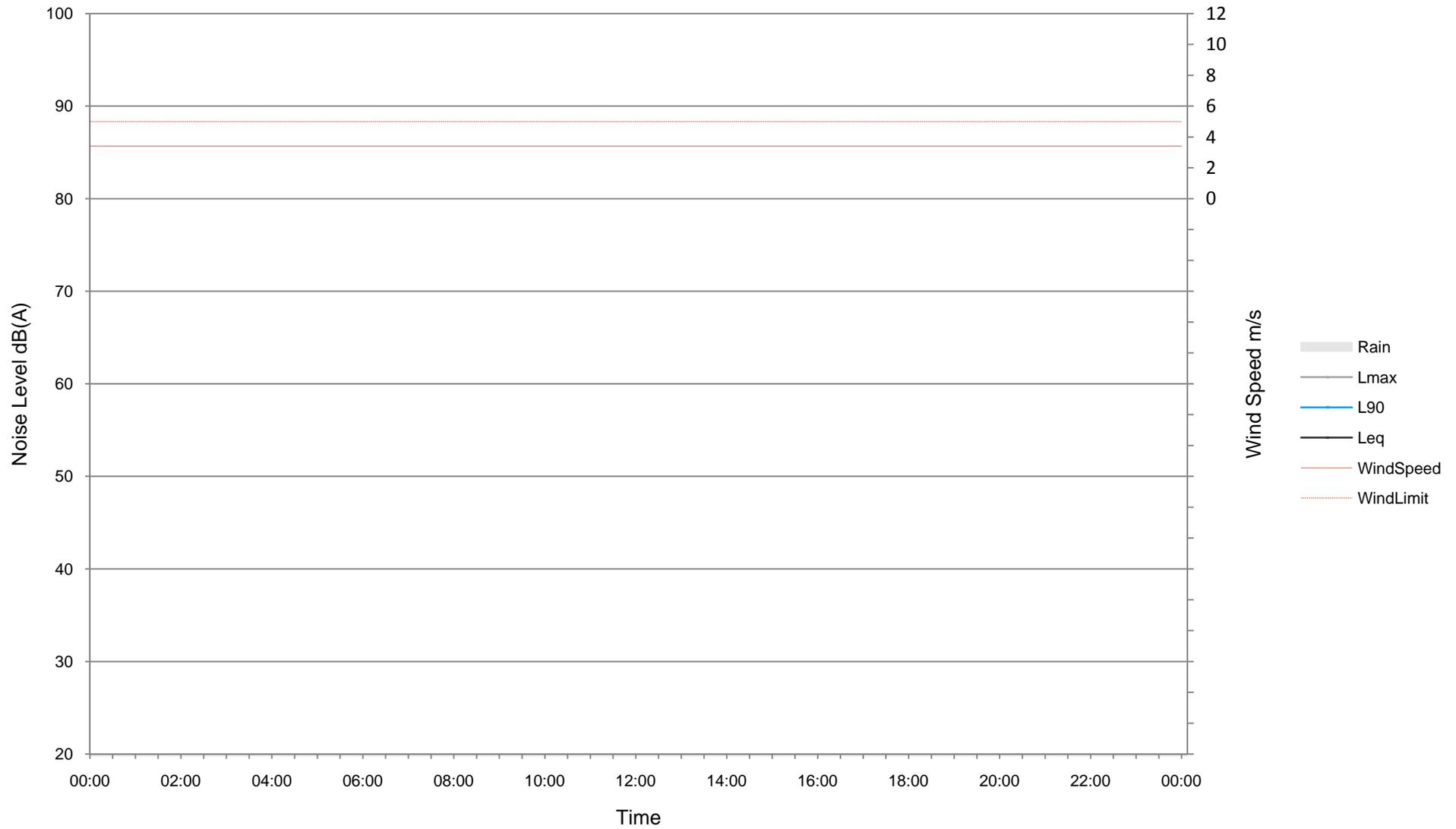
Measured Ambient Noise Levels Wollemi Peak Road Thursday, 31-07-14



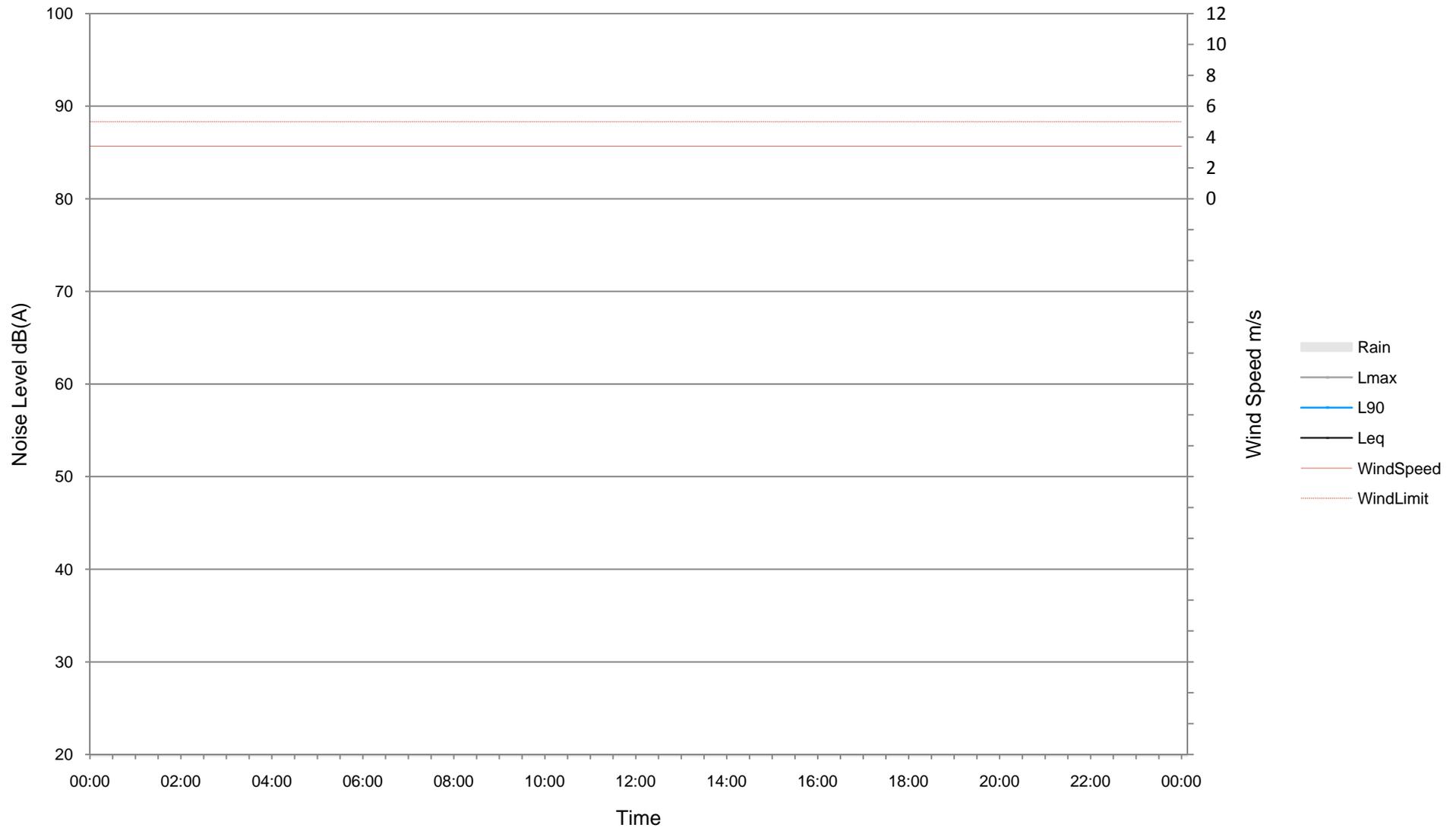
Measured Ambient Noise Levels Wollemi Peak Road Friday, 01-08-14



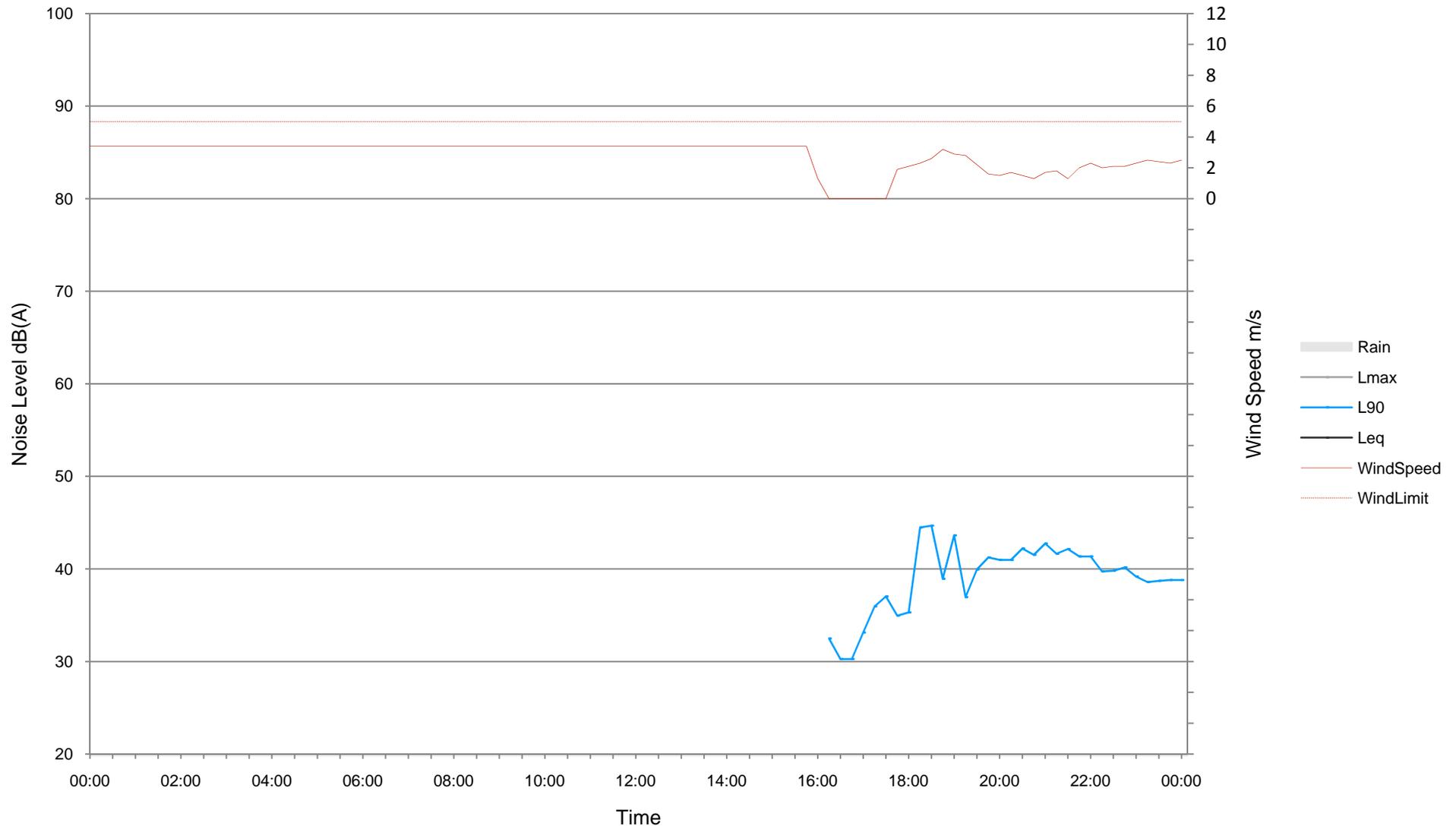
**Measured Ambient Noise Levels
Wollemi Peak Road
Saturday, 02-08-14**



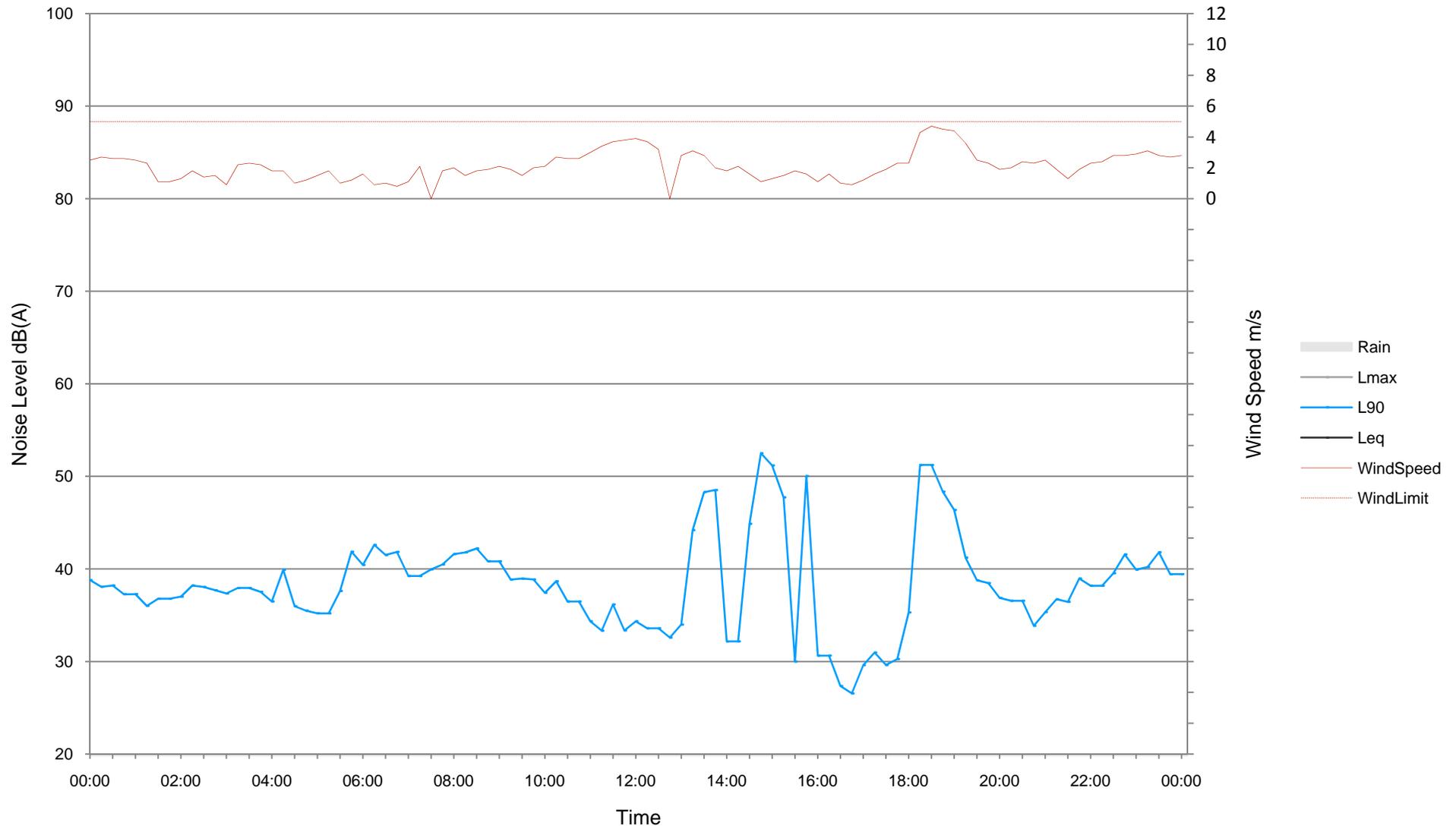
Measured Ambient Noise Levels Wollemi Peak Road Sunday, 03-08-14



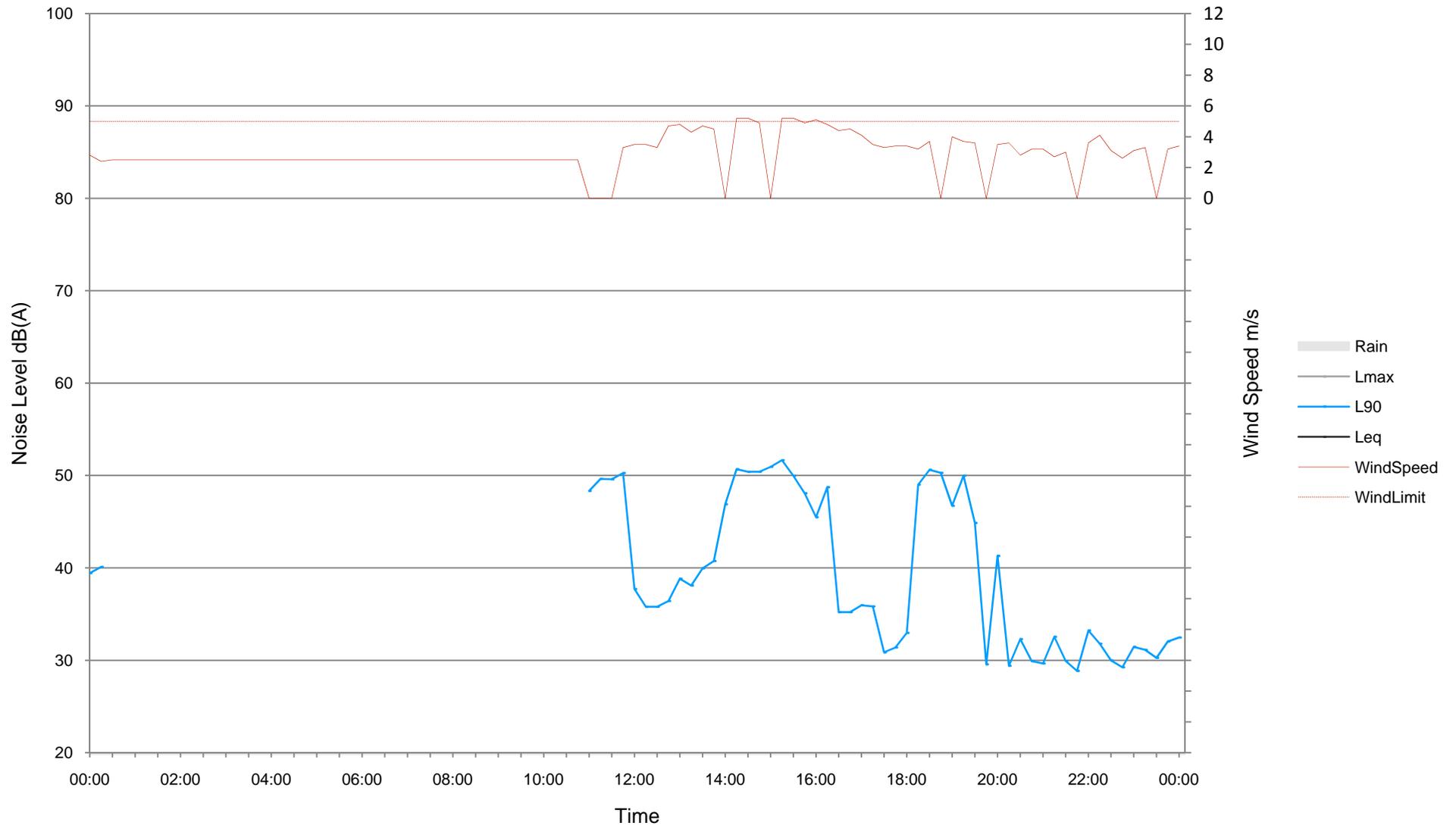
Measured Ambient Noise Levels Wollemi Peak Road Monday, 04-08-14



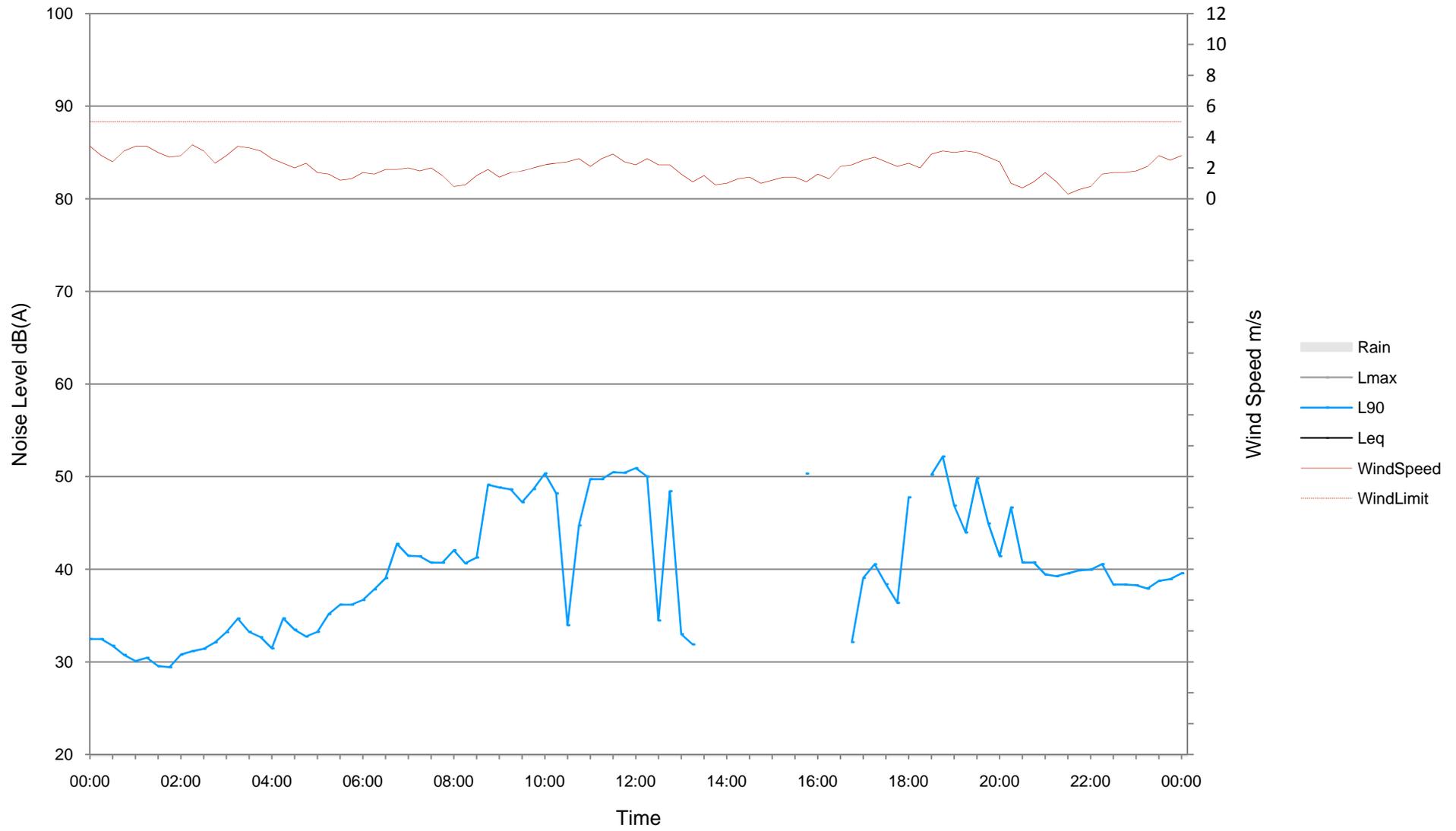
**Measured Ambient Noise Levels
Wollemi Peak Road
Tuesday, 05-08-14**



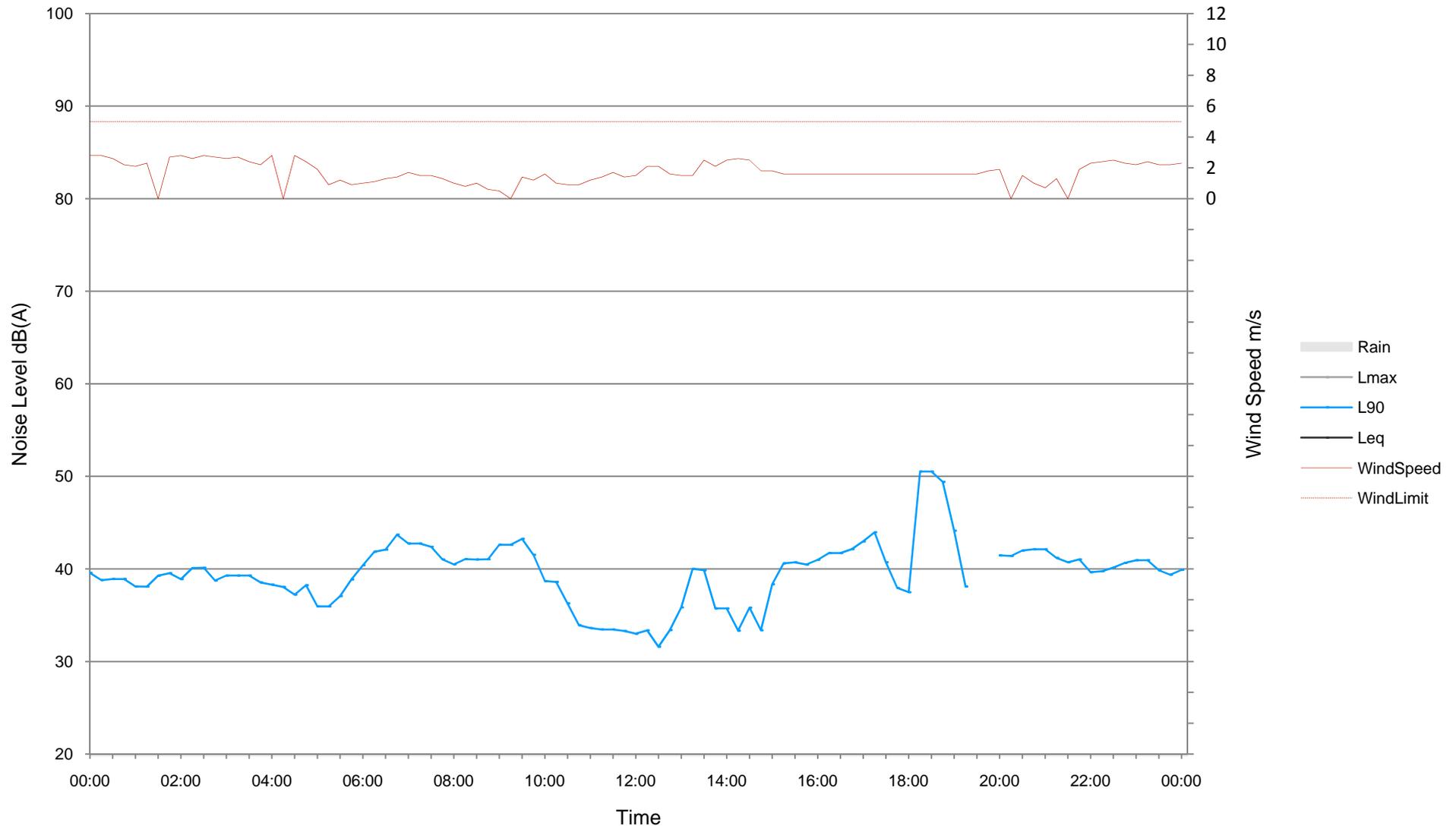
Measured Ambient Noise Levels Wollemi Peak Road Wednesday, 06-08-14



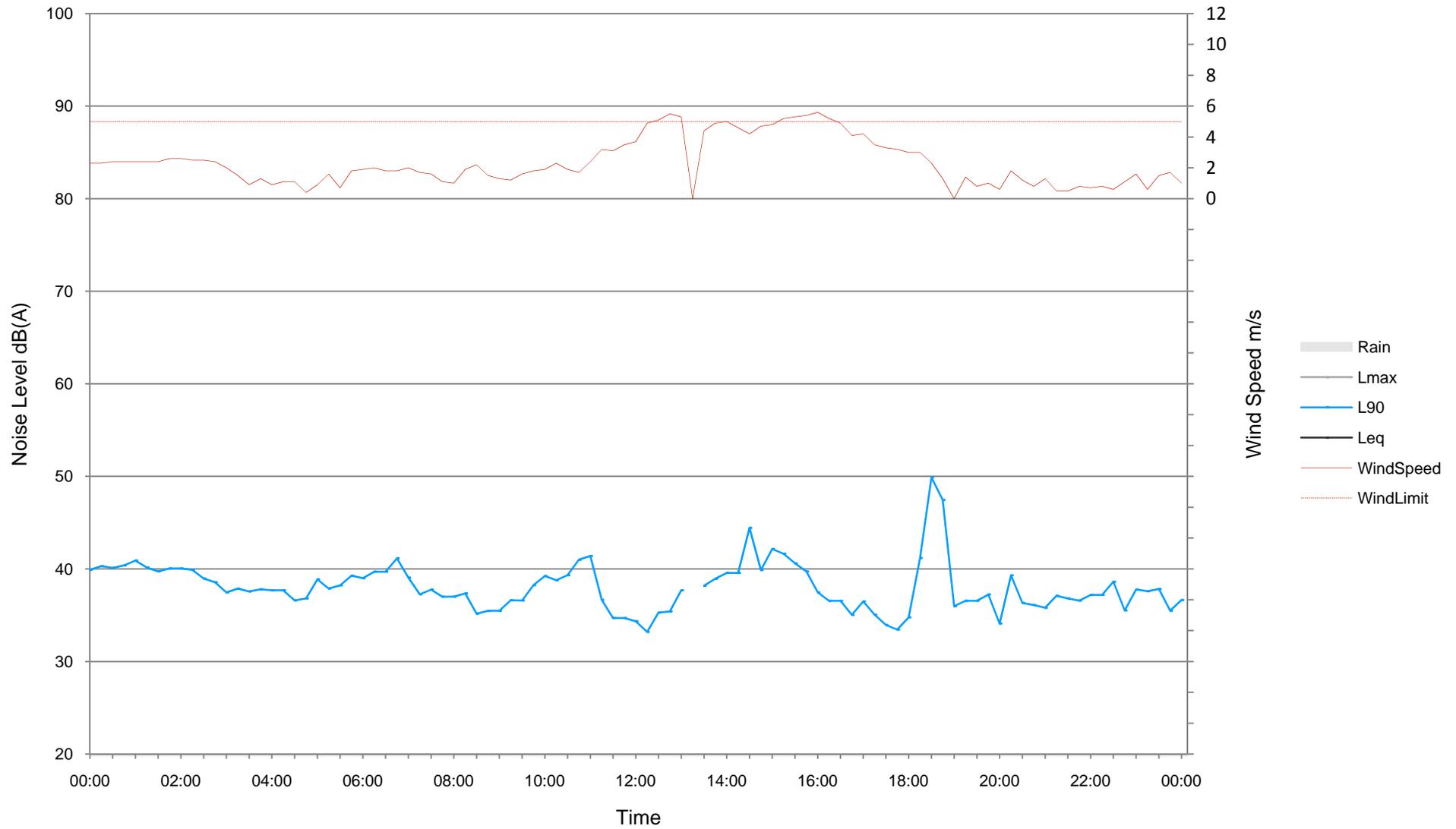
Measured Ambient Noise Levels Wollemi Peak Road Thursday, 07-08-14



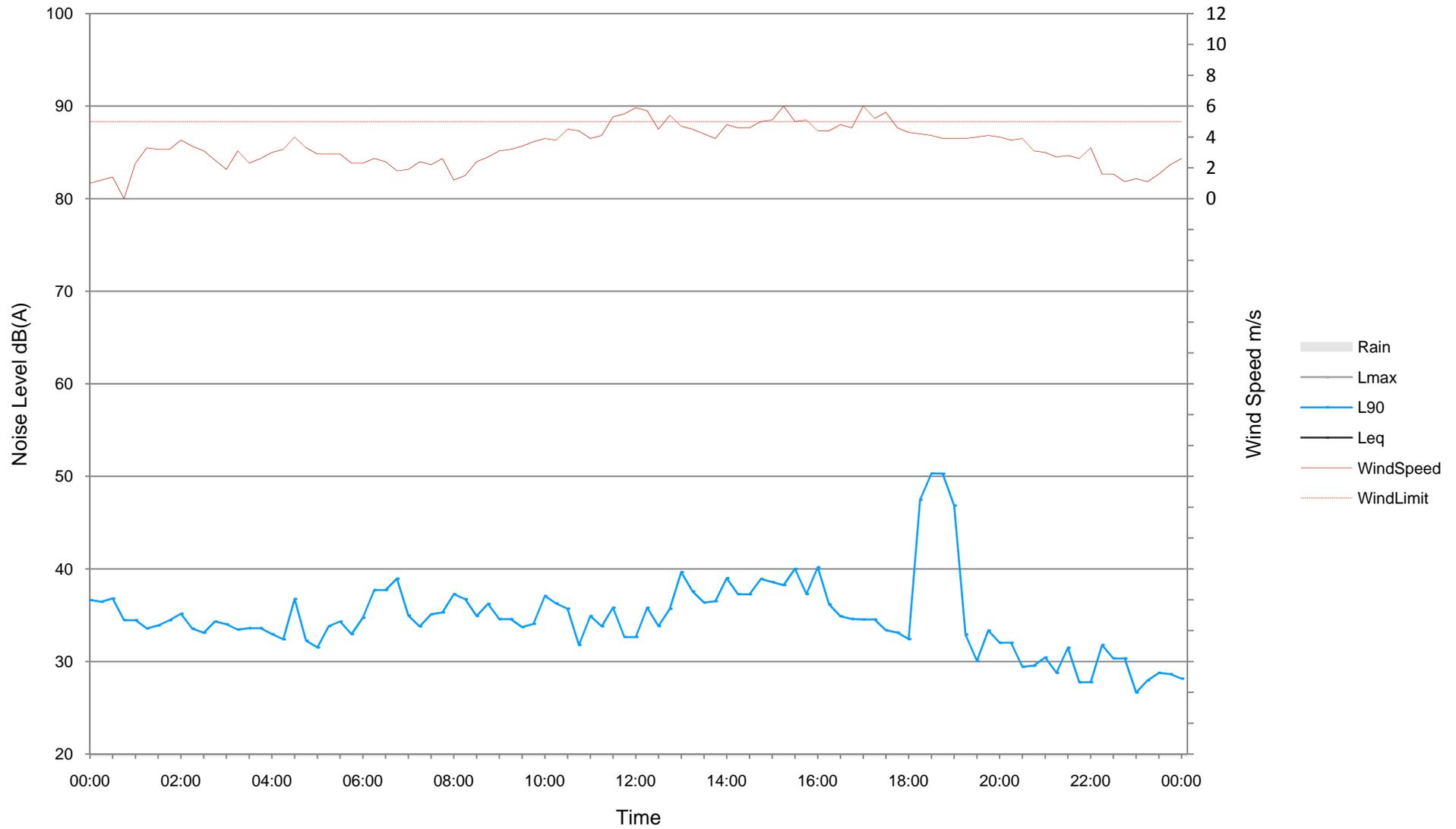
Measured Ambient Noise Levels Wollemi Peak Road Friday, 08-08-14



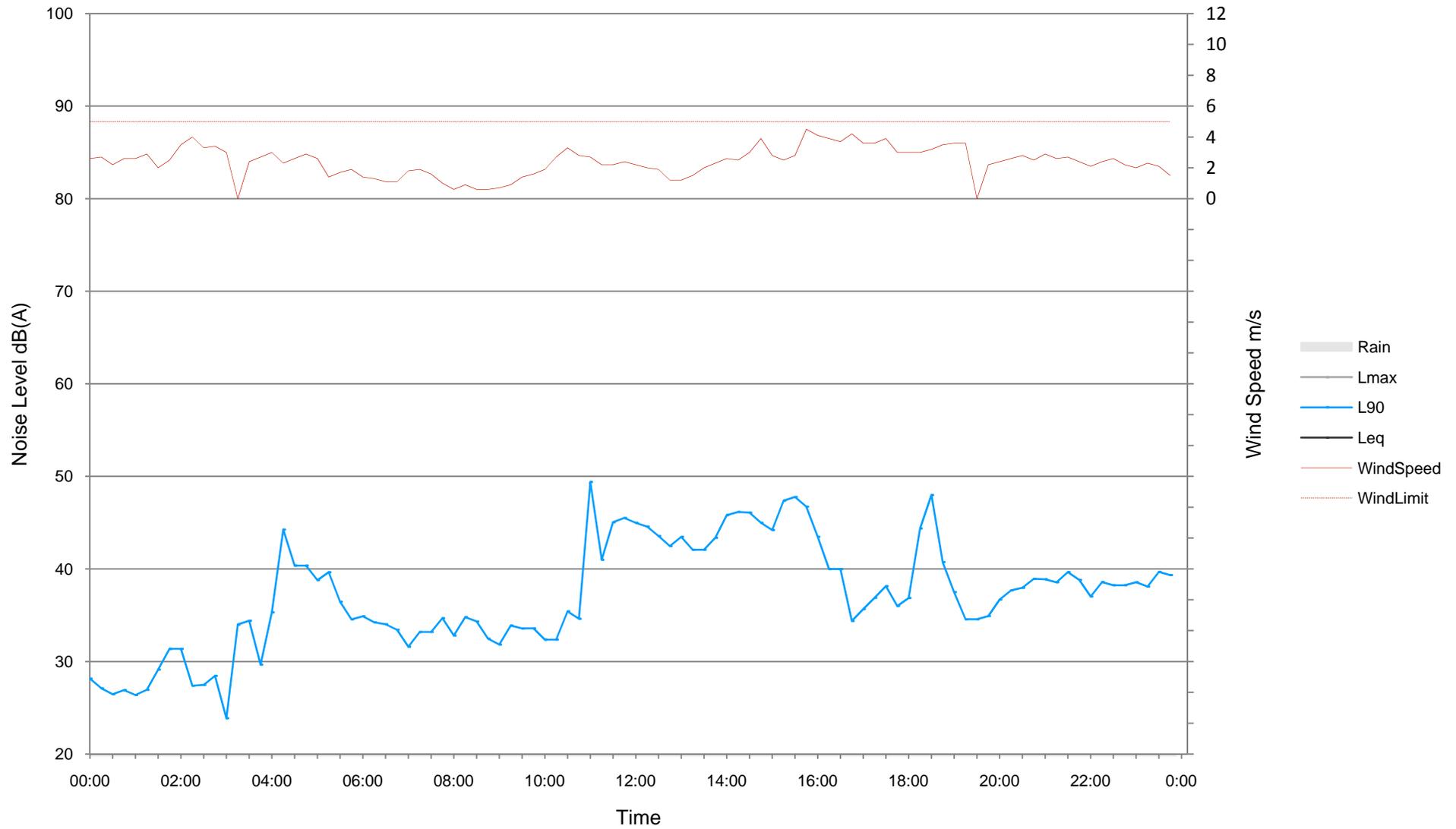
Measured Ambient Noise Levels Wollemi Peak Road Saturday, 09-08-14



Measured Ambient Noise Levels Wollemi Peak Road Sunday, 10-08-14

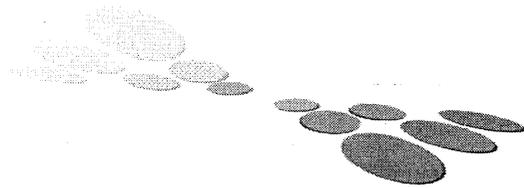


Measured Ambient Noise Levels Wollemi Peak Road Monday, 11-08-14



Appendix B

BarnOwl Calibration Certificates



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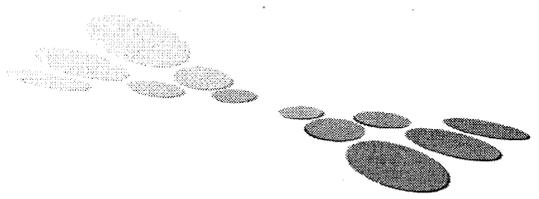
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	BTC
Date	20-Jun-13
Location	Noses Rd
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.4	94.1	94.1
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.3	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Distance Between Microphones (500mm)	Microphone 1-2 500.0	Microphone 2-3 500.0	Microphone 3-1 500.0

Technicians Signature: Ben Clydsdale	Date: 20/6/2013
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Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	BTC
Date	10-Sep-13
Location	Noses Rd
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.1	93.8	94.1
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Ben Clydsdale	Date: 10/9/2013
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BENCHMARK MONITORING

Template Document Number:
 Template Document Location:

Calibration Report: BarnOwl

Customer	RTCA
Location	Noses Road
Instrument type	Barn Owl
Model	-
Serial Number	-

PASS

Date	23/04/2014
Technician	Matt
Time in	12:00
Time out	12:30
Maintenance cycle	3 Monthly

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
----------	------

Test Equipment

Equipment	Serial	Date of Expiry	Status
SvanteK Calibrator	BMAS-0007	24/05/2014	PASS

Calibration

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	41	44	42

Point Check 94dB

Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	94.3	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	94.3	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	94.1	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	40	43	43

Technican:	Matt Anderson
Date:	23/04/2014



Template Document Number:
 Template Document Location:

Calibration Report: BarnOwl

Customer	RTCA
Location	Noses Road
Instrument type	BarnOwl
Model	-
Serial Number	-

PASS

Date	30/10/2013
Technican	Matt
Time in	-
Time out	-
Maintenance cycle	3 Monthly

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
----------	------

Test Equipment

Equipment	Serial	Date of Expiry	Status
Svantek Calibrator	BMAS-0007	24/05/2014	PASS

Calibration

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	45	43	43

Point Check 94dB

Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	93.7	PASS
Tone Test Post Adjust (dB)	94	PASS
Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	93.5	PASS
Tone Test Post Adjust (dB)	94	PASS
Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	93.1	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	44	44	47

Technican:	Matt Anderson
Date:	30/10/2013



Template Document Number:
 Template Document Location:

Calibration Report: BarnOwl

Customer	RTCA
Location	Noses Road
Instrument type	Barn Owl
Model	-
Serial Number	-

PASS

Date	25/02/2014
Technician	Matt
Time in	13:00
Time out	13:30
Maintenance cycle	3 Monthly

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
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Test Equipment

Equipment	Serial	Date of Expiry	Status
Svantek Calibrator	BMAS-0007	24/05/2014	PASS

Calibration

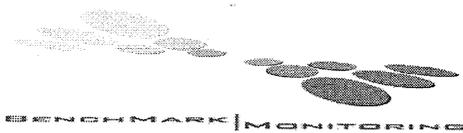
	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	37	39	39

Point Check 94dB

Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	93.7	PASS
Tone Test Post Adjust (dB)	94	PASS
Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	93.9	PASS
Tone Test Post Adjust (dB)	94	PASS
Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	93.6	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	41	43	43

Technician:	Matt Anderson
Date:	25/02/2014



Calibration Report: BarnOwl	
Customer	RTCA
Location	Noses Road

Instrument type	Barn Owl
Model	Barn Owl
Serial Number	-

Date	29/07/2014
Technician	Matt
Time in	11:00
Time out	11:30
Maintenance cycle	3 Monthly

PASS

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
----------	------

Test Equipment

Equipment	Serial	Date of Expiry	Status
Svantek Calibrator	BMAS-0007	31/12/2014	PASS

Calibration

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arrival (dB)	39	43	40

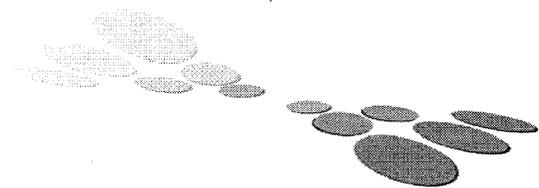
Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	93.7	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	93.9	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	94.1	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arrival (dB)	44	41	42

Technician:	Matt Anderson
Date:	29/07/2014



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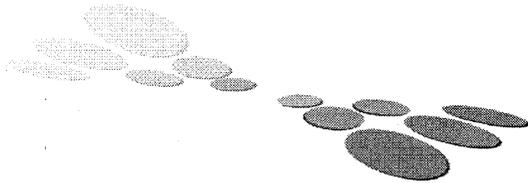
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	BTC
Date	22-Dec-11
Location	Scout Hall
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.3	94.3	94.1
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Ben Clydsdale	Date: 22/12/2011
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BENCHMARK | MONITORING

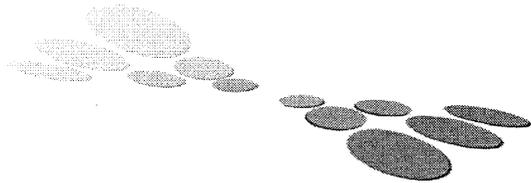
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	LG
Date	14-Mar-12
Location	Scout Hall
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	93.8	93.7
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Luis Gonzalez	Date: 14/3/2012
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BENCHMARK | MONITORING

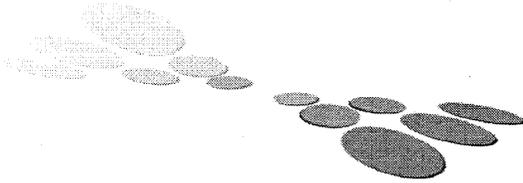
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	LG
Date	6-Jun-12
Location	Scout Hall
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.4	94.0	94.4
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Luis Gonzalez	Date: 6/6/2012
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BENCHMARK | MONITORING

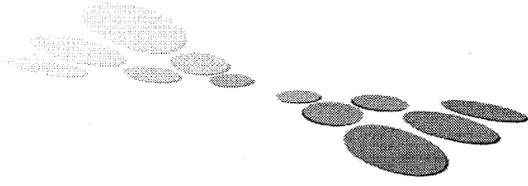
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	LG
Date	4-Sep-12
Location	Scout Hall
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	93.7	93.8	94.2
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Luis Gonzalez	Date: 4/9/2012
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BENCHMARK | MONITORING

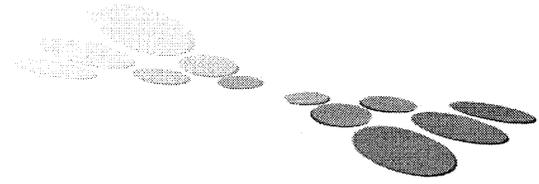
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	BTC
Date	1-Dec-12
Location	Caban
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	93.8	94.1	94.4
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Ben Clydsdale	Date: 1/12/2012
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BENCHMARK | MONITORING

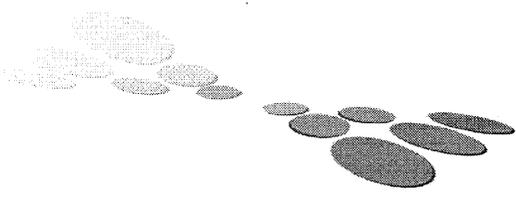
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	LG
Date	15-Feb-13
Location	Caban
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	93.3	93.9	94.1
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Luis Gonzalez	Date: 15/2/2013
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BENCHMARK | MONITORING

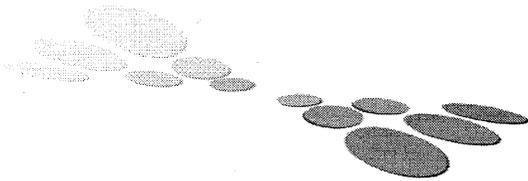
Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	JP
Date	20-May-13
Location	Caban
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.4	94.0	94.3
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Jason Potts	Date: 20/5/2013
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BENCHMARK | MONITORING

Customer	Coal and Allied
Instrument	Barnowl
Model	NA
ID No.	NA

Calibration Performed by	JP
Date	9-Aug-13
Location	Caban
System/Job No.	NA

Calibration Results

Microphone 1	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.1	93.8	93.8
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 2	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
Microphone 3	Test 1	Test 2	Test 3
Recorded Output with Tone test (dB) pre	94.0	94.0	94.0
Recorded Output with Tone test (dB) post	94.0	94.0	94.0
	Microphone 1-2	Microphone 2-3	Microphone 3-1
Distance Between Microphones (500mm)	500.0	500.0	500.0

Technicians Signature: Jason Potts	Date: 9/8/2013
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Calibration Report: BarnOwl

Template Document Number:
 Template Document Location:

Customer	RTCA
Location	Wombo Road
Instrument type	BarnOwl
Model	-
Serial Number	-

PASS

Date	30/10/2013
Technican	Matt
Time in	-
Time out	-
Maintenance cycle	3 Montlhy

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
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Test Equipment

Equipment	Serial	Date of Expiry	Status
Svantek Calibrator	BMAS-0007	24/05/2014	PASS

Calibration

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	51	49	50

Point Check 94dB

Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	94	PASS
Tone Test Post Adjust (dB)	94	PASS
Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	94	PASS
Tone Test Post Adjust (dB)	94	PASS
Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	94	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	53	49	51

Technican:	Matt Anderson
Date:	30/10/2013



BENCHMARK | MONITORING

Template Document Number:
 Template Document Location:

Calibration Report: BarnOwl

Customer	RTCA
Location	Wambo Road

Instrument type	Barn Owl
Model	-
Serial Number	-

PASS

Date	25/02/2014
Technican	Matt
Time in	12:00
Time out	12:30
Maintenance cycle	3 Monthly

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
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Test Equipment

Equipment	Serial	Date of Expiry	Status
Svantek Calibrator	BMAS-0007	24/05/2014	PASS

Calibration

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	41	41	43

Point Check 94dB

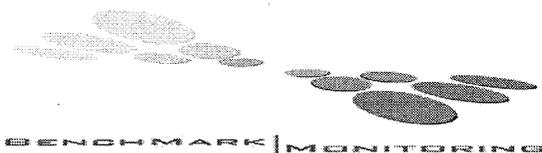
Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	94	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	94	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	94	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	40	38	38

Technican:	Matt Anderson
Date:	25/02/2014



BENCHMARK | MONITORING

Template Document Number:
 Template Document Location:

Calibration Report: BarnOwl

Customer	RTCA
Location	Wambo Road
Instrument type	Barn Owl
Model	-
Serial Number	-

PASS

Date	2/04/2014
Technican	Matt
Time in	14:00
Time out	16:00
Maintenance cycle	3 Monthly

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
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Test Equipment

Equipment	Serial	Date of Expiry	Status
SvanteK Calibrator	BMAS-0007	24/05/2014	PASS

Calibration

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	45	43	43

Point Check 94dB

Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	94.8	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	94.4	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	94.4	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arival (dB)	38	40	37

Technican:	Matt Anderson
Date:	2/04/2014



Calibration Report: BarnOwl

Customer	RTCA
Location	Wambo Road

Instrument type	Barn Owl
Model	Barn Owl
Serial Number	-

PASS

Date	29/07/2014
Technician	Matt
Time in	12:00
Time out	12:30
Maintenance cycle	3 Monthly

Note: Only fill in white cells. All white must be filled in or calibration will result in MISSING DATA

Status :	PASS
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Test Equipment

Equipment	Serial	Date of Expiry	Status
Svantek Calibrator	BMAS-0007	31/12/2014	PASS

Calibration

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arrival (dB)	45	43	45

Microphone 1	Test 1	Status
Tone Test Pre Adjust (dB)	94.3	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 2	Test 1	Status
Tone Test Pre Adjust (dB)	94.3	PASS
Tone Test Post Adjust (dB)	94	PASS

Microphone 3	Test 1	Status
Tone Test Pre Adjust (dB)	94.2	PASS
Tone Test Post Adjust (dB)	94	PASS

	Microphone 1	Microphone 2	Microphone 3
Recorded Output on Arrival (dB)	45	43	44

Technician:	Matt Anderson
Date:	29/07/2014

Appendix J

Response to Eastcoast Flora Survey review (Appendix 2 of BMPA submission)



Appendix J — Response to Eastcoast Flora Survey review (Appendix 2 of BMPA submission)

J

COAL & ALLIED

Managed by Rio Tinto Coal Australia

Bulga Milbrodale Progress Association Inc (BMPA) engaged Eastcoast Flora Surveys Pty Ltd, led by Dr Stephen Bell, to review the ecology studies for the Warkworth Continuation 2014 proposal (the proposal) on its behalf to accompany its submission. This letter provides response to matters raised in the review.

The first two chapters of the submission comprise an introduction and background information to Warkworth Sands Woodland (WSW). The review of the proposal commences in Chapter 2 of which this response is largely based.

Warkworth Mining Limited (WML) has provided a response in the table below.

1. Variable Condition of Warkworth Sands Woodland

Contention

31 – 36. Much of the highest quality Warkworth Sands Woodland (WSW) will be removed, and will be offset predominantly with medium to low quality WSW elsewhere.

Response

The long term conservation goal of the offset strategy for WSW providing a greater extant of WSW, this represents approximately 87ha more than the current extant in the long term. The proposed Biodiversity Offset Strategy (BOS) anticipates that lower quality WSW and WSG will transition to higher quality WSW over time. This is consistent with the concepts of additionality contained in the NSW *draft NSW Biodiversity Offsets Policy for Major Projects* (BOP) and the calculations supporting BBAM. This is also consistent with federal government's offsetting policy. If offsets were provided with only like for like quality, then the only conservation gain would be greater protection for the existing, and not an increase in extant and quality as proposed.

The proposed BOS for WSW includes:

- Land based offsets (75ha) of extant vegetation.
- Re-establishment of Warkworth Sands Grassland (WSG) to WSW.
- Additional Supplementary measures including:
 - Integrated Management Plan;
 - contribution to Saving Our Species – Regent Honeyeater;
 - Implementation bond;
 - conservation of WSG established under the 2003 development consent; and
 - the development of completion criteria for WSW.

The long term conservation goal of the offset strategy for WSW is to provide a greater extant of WSW than currently exists. Following public exhibition of the EIS, the OEH has extensively considered and assessed the BOS and provided certification in accordance with clause 14(3) of the Mining SEPP which requires the consent authority to consider any certification by the Chief Executive of the OEH that measures to mitigate or offset the biodiversity impact of the proposal (ie the BOS) will be adequate.

2. Key differences between the 2010 and 2014 proposals

Contention

39. No assessment of the precautionary principle in the 2014 application.

Response

It is inappropriate to apply the precautionary principle to a single component (i.e. restoration of WSW) of a larger comprehensive offset package.

The precautionary principle as defined in the *Protection of the Environment Administration Act 1991* states:

- (a) the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
- (ii) an assessment of the risk-weighted consequences of various options,

It is inappropriate to apply the precautionary principle to a single component (i.e. restoration of WSW) of a larger comprehensive offset package. The BOP provides a framework for applicants to develop offset packages through a combination of measures. The policy states that while most offset requirements can be determined during assessment, some impacts will require further consideration by a consent authority. In accordance with the policy, when considering impacts on WSW, the consent authority may make the following recommendation: can the project with additional offset, supplementary measures or other actions to be undertaken regarding offsetting that impact.

Consistent with the BOP, the application of the precautionary principle requires a decision-maker to evaluate the impacts with consideration of the full suite of offsetting measures provided, including that of restoration of WSW and its likelihood of success.

In light of this, the biodiversity assessment undertaken in the ecology study concludes there is low risk of WSW not being viable in the short term, and the viability of the community should be increased in the long term. This is due to:

- clearing of WSW being progressive;
- 75.5ha of existing WSW of varying quality (from low to high), being protected and managed to transition to a higher quality WSW in the short-term;
- approximately 160ha of Warkworth Sands Grassland (WSG) proposed to be re-established to WSW from former grazing lands;
- the long-term conservation goal of the offset strategy for WSW providing a greater extent of WSW, this represents approximately 87ha more than the current extent in the long-term;
- improvements in protection mechanisms, ie BioBanking agreements on the WSW within the proposed Southern Biodiversity Area (SBA) and (Northern Biodiversity Area (NBA));
- under the 2003 development consent, areas of WSG in the SBA and NBA were identified for re-establishment but not protected as part of the offset. These will be protected using BioBanking agreement; and
- increase in patch size in the SBA and the development of a separate patch of WSW in the NBA. This reduces catastrophic risk of fire and disease to the WSW.

If the proposal is not approved and the BOS secured then:

- only approximately 75ha of existing WSW required to be protected by the 2003 development consent (DA-300-9-2002) will remain protected and managed;
- the WSW required to be re-established under the 2003 development consent will remain unprotected;
- the remaining WSW will not be permanently protected (ie 75.5ha in SBA and NBA as proposed);
- the opportunity for long-term extent to be increased by approximately 19 per cent (or net increase of approximately 87ha) to the current 465ha WSW extent through implementation of a re-establishment programme will not be realised;
- key threatening processes (for example, weeds, fire and catastrophic failure) to WSW would not be managed through a regime of ongoing regular and systematic site management practices;
- no ongoing funding to manage and protect the WSW; and
- less education and knowledge transfer among restoration ecologists and practitioners through the development and implementation of conservation management and re-establishment practices.

In summary, the consent authority is required to apply the precautionary principle in consideration of the full comprehensive offset package regarding the impacts of the proposal, rather than a singular component.

Contention

39. No discussion on the risk of extinction in the 2014 Application.

Response

This matter is addressed in detail in Section 3 below.

Contention

39. No Biodiversity Management Plan with the 2014 Application.

Response

The draft Local Offset Management Plan (LOMP) is attached to the Warkworth Continuation 2014 response to submissions report as Appendix B.

Contention

39. Three new vegetation communities in the 2014 Application.

Response

This matter is addressed in detailed in Section 11 below.

Contention

39. Closure of Wallaby Scrub Road rather than its relocation in the 2014 Application.

Response

The relocation of WSR was considered in Section 23.2.4 of Volume 1 of EIS and was also considered in the 2010 EA as a potential measure to mitigate the closure of Wallaby Scrub Road. The proposal to close the road (and not relocate it) is based on a number of technical studies showing that the impacts of road relocation are greater than the impacts associated with closure.

Most significantly, it was found that the relocation of the road would have additional impacts to:

- travel time for users as the alignment would require a longer road to negotiate around the proposal;
- Aboriginal cultural heritage, including the removal of an additional nine Aboriginal heritage sites and intersection with the Wollombi Brook Aboriginal Cultural Heritage Conservation Area; and
- ecology, including clearance of approximately 32.1ha of native forest and woodland (including 3.3ha of Warkworth Sands Woodland) and the loss and fragmentation of habitat for native fauna, including threatened woodland birds and bats.

It was for the reasons outlined above that the relocation of Wallaby Scrub Road was not considered as part of the proposal.

Contention

39. Recognised extent of WSW reduced from 1,133ha to 465ha, following the L&E Court judgment.

Response

This matter is addressed in detail in Sections 5 and 6 below.

Contention

39. WSW assessed as groundwater dependent in the 2014 application.

Response

An assessment has been made of WSW's potential to be a groundwater dependent ecosystem, see Section 4.2.3 of Appendix H of the EIS. The assessment considered the ephemeral aquifer in the aeolian Warkworth sands that overlie the coal measures. The fine-grained sands overlie a low permeability base of residual clay associated with the underlying strata. The presence of this impermeable clay layer is thought to impede downward percolation of recharge forming a locally perched aquifer system at the base of the sand mass. The permanence of groundwater with the formation is unknown but the water table would be expected to fluctuate with climatic patterns or rainfall and also from evapotranspiration. The thick relatively low permeability Permian overburden is thought to impede leakage of groundwater from the Warkworth sands towards the Warkworth Mine area. This community was assessed as a groundwater dependent ecosystem due to the potential for groundwater drawdown as a result of the proposal to affect this community.

According to the groundwater model presented in the EIS (see Chapter 16 and Appendix K), the shallow aquifer in this location would not be impacted by water table drawdown and therefore the proposal will not impact on these vegetation communities.

Indirect impacts to perched aquifers beneath the WSW, Section 16.3.2 (v) of the EIS outlined that the water table formed at the base of the Warkworth Sands is perched and is not directly connected with the underlying Permian. Further, the Warkworth Sands does not occur as one large sand sheet, but many smaller isolated sheets, separated by areas where sand is not present. In between these sand sheets, clay based bedrock derived soils occur at the surface. The topography of the area also means that these separate sand sheets can be considered different and not interconnected hydrogeologic units. The northern boundary of the proposed 2014 disturbance area largely follows a natural division between the sand sheets (AGE 2011). Groundwater flow in the area to be disturbed by mining is predominantly to the west, whereas groundwater in the sand sheets outside the proposed 2014 disturbance area flows to north. As shown in figure 16.6 of the EIS.

Contention

39. A reduction in the amount of vegetation to be cleared from 2010 (765ha) to 2014 (611ha).

Response

The vegetation contained within the proposed disturbance area and assessed for the proposal is shown in Figure 2.3 of Volume 1 of the EIS.

Contention

39. A reduction in the amount of WSW to be cleared from 2010 (104ha) to 2014 (72ha).

Response

The WSW contained within the proposed disturbance area and assessed for the proposal is shown in Figure 2.3 of Volume 1 of the EIS.

Contention

39. The removal of potential habitat of *Macrozamia flexuosa* in the 2014 Application.

Response

Potential habitat of *Macrozamia flexuosa* was assessed in the ecology study (Appendix H of the EIS).

Macrozamia flexuosa has been recorded within Central Hunter Grey Box – Ironbark Woodland. Only two individuals of this species are known to occur within the study area, one of which will be removed. In addition, some areas of potential habitat will be removed.

Large areas of potential habitat for this species will be retained in the study area and although not recorded, it is considered likely that other individuals may occur. The retained areas of known habitat are not considered likely to be indirectly impacted by the proposal. The removal of a single known individual and potential habitat is not likely to impact on this species on a local or regional scale.

Contention

39. A reduction in the amount of vegetation to be removed from fauna corridors from 2010 (765ha) to 2014 (456ha).

Response

Section 5.3.1 of the ecology study assesses the proposed impacts on fauna corridors.

This proposal assesses removal of vegetation from fauna corridors only for the additional clearing of vegetation not already approved by earlier development consents. This resulted in 456ha of additional disturbance.

The proposed BOS includes mine rehabilitation that will form a north/south connecting corridor of vegetation between the existing vegetation to the north of the mine through the rehabilitation areas of MTO and Bulga Coal Complex (see Figure 7.6 of the ecology study) and in the future will connect to the large tract of intact vegetation at Singleton Military Training Area. The proposed rehabilitation corridor reduces the impacts of edge effects by forming one large linear block of vegetation rather than numerous scattered patches allowing for easier management due to reduced weed invasion and similar edge effects. With time, the rehabilitation areas will provide additional suitable habitat for threatened fauna species that may be impacted by the proposal.

WML believes the proposed land based offsets and contributions to the Upper Hunter Strategic Assessment (UHSA) fund, will achieve a more beneficial outcome for the existing wildlife, as in the short term, should the proposal be approved. The long term conservation outcomes would be an overall increase of extant vegetation protected, re-established in offset area and rehabilitated on site.

Contention

39. A reduction in Biodiversity Management Areas to NBA and SBA only in the 2014 Application.

Response

This matter is addressed in detail in Sections 5, 6 and 7 below.

Contention

39. No discussion of the Putty Road Conservation Area in the 2014 Application, despite its inclusion on Figure 7.1 and others (Appendix H of the EIS).

Response

The Putty Road Conservation Area was assessed and approved as a modification to the 2003 consent (known as Modification 6); subsequently it is not a part of this proposal.

Contention

39. A small decrease in the extent of forest & woodland in the SBA from 2010 (661ha) to 2014 (559ha).

Response

This matter is addressed in detail in Sections 5 and 7 below.

Contention

39. A small increase in the extent of forest & woodland in the NBA from 2010 (123ha) to 2014 (124ha).

Response

This matter is addressed in detail in Sections 5 and 6 below.

Contention

39. A reduction in the amount of EEC vegetation in the SBA from 2010 (635ha) to 2014 (497ha).

Response

This matter is addressed in detail in Sections 5 and 7 below.

Contention

39. A small increase in the amount of EEC vegetation in the NBA from 2010 (123ha) to 2014 (124ha).

Response

This matter is addressed in detail in Sections 5 and 6 below.

Contention

39. An increase in the total area of the SBA from 2010 (718ha) to 2014 (788ha).

Response

This matter is addressed in detail in Sections 5 and 7 below.

Contention

39. A reduction in the total area of the NBA from 2010 (342ha) to 2014 (306ha).

Response

This matter is addressed in detail in Sections 5 and 6 below.

Contention

39. Inclusion of an Integrated Management Plan and development of completion criteria for WSW in the 2014 Application.

Response

This matter is addressed in Section 8 below.

Contention

39. A reduction in the amount of WSW to be conserved in the SBA from 2010 (85ha) to 2014 (56ha).

Response

This matter is addressed in detail in Sections 5 and 7 below.

Contention

39. No change in the amount of WSW to be conserved in the NBA from 2010 to 2014 (both 20ha).

Response

This matter is addressed in detail in Sections 5 and 6 below.

Contention

39. Limited discussion of the 5 year \$5.5 million research program undertaken by the University of New England on WSW restoration, and no detail on the results of that study.

Response

This matter is addressed in detail in Section 4 below.

Contention

39. While these differences are many they do not constitute a substantially different project to that applied for in 2010 and rejected by the L&E Court and the Supreme Court.

Response

It is important to recognise and understand the context of the proposal with regard to the Warkworth Extension 2010, specifically the consistency with the L&E Court judgment and whether a precedent had been set. The L&E Court judgment was in respect of a merit appeal under the L&E Court's Class 1 jurisdiction in regard of the Warkworth Extension 2010. As stated in the L&E Court judgment, in a merit appeal:

The Court re-exercises the statutory power originally exercised by the Minister to determine Warkworth's project application by either approval or disapproval. The Court stands, metaphorically speaking, in the shoes of the Minister and determines for itself, on the facts and law that exist at the time of determination of the appeal, whether to approve or disapprove the application for the Project.

Given this, merits appeals are of limited precedent value as the function the L&E Court is performing in a merit appeal is that of a consent authority in respect of a project application. Accordingly, merits appeals are decided specifically on the facts relevant to the specific development they relate to and have no more precedent value than any other decision of a consent authority.

Further, it should be noted that WML is within its rights to lodge a development application for the proposal, despite that the application for the Warkworth Extension 2010 was refused by the L&E Court. The NSW planning system permits an applicant to make as many applications as it wishes in respect of the same parcel(s) of land.

The above position is further supported by the following:

- there are numerous changes that have been made to the development the subject of the Warkworth Extension 2010 which differentiate the proposal from it. Given this, the proposal is clearly a new development different from the previous application;
- the proposal will be determined under a different statutory regime. The Warkworth Extension 2010 was determined under the now repealed Part 3A of the EP&A Act whereas the proposal will be determined under the new SSD provisions in Part 4.1 of the EP&A Act;
- the Mining SEPP has been amended since the Warkworth Extension 2010 was refused providing a different regime for consent authorities to make their determination under from the regime in which the Warkworth Extension 2010 was determined; and
- recent changes to government policies have been released which provide new context for assessments for major projects. In particular the principles and strategies for biodiversity assessment outlined in the BOP, the Framework for Biodiversity Assessment (FBA) and the UHSA Interim policy.

In summary, given the changed legislative regime, differences between the Warkworth Extension 2010 and the proposal, and the fact that the NSW planning system supports the making of multiple development applications in respect of the same parcel of land, there is no basis for any submission that the development application for the proposal is unlawful or improper.

3. Risk of Extinction & the Precautionary Principle

Contention

42. Offsetting the removal of established WSW with promises of restoration of this same community on current grassland areas does not acknowledge the precautionary principle.

It has not yet been established that successful restoration of WSW is achievable, particularly on cleared sites that have been used for grazing over many decades. For this reason, the precautionary principle would dictate that successful restoration of WSW is not yet possible, and that further clearing of intact WSW should be treated with extreme caution.

Response

The re-establishment of WSW forms a part of a comprehensive BOS for the proposal. As previously stated, the scientific research undertaken to date has contributed to an extensive scientific understanding of the vegetation community to enable restoration activities to commence. Other offsetting measures to compensate for impacts on WSW include land-based offsets and other supplementary measures such as contributions to an Integrated Management Plan, development of completion criteria and upfront provision of an Implementation Bond valued at \$1million. The Implementation Bond is provided as security that the expected results of appropriate applied land management restoration interventions be achieved within a 15 year target. If the 15 year targets are not met, the Implementation Bond does not remove the requirement to deliver the WSW re-establishment programme. The bond provides WML an incentive to continually commit resources to delivering WSW in a timely manner.

Further details of restoration program are outlined below, and section 2.4 of the Response to Submission.

The precautionary principle as defined in the *Protection of the Environment Administration Act 1991* states:

(a) the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
- (ii) an assessment of the risk-weighted consequences of various options,

It is inappropriate to apply the precautionary principle to a single component (ie restoration of WSW) of a larger comprehensive offset package. The BOP provides a framework for applicants to develop offset packages through a combination of measures. The policy states that while most offset requirements can be determined during assessment, some impacts will require further consideration by a consent authority. In accordance with the policy, when considering impacts on WSW, the consent authority may make the following recommendation: *the project can proceed with additional offsets, supplementary measures or other actions to be undertaken to mitigate that impact.*

Consistent with the BOP, the application of the precautionary principle requires a decision-maker to evaluate the impacts with consideration of the full suite of offsetting measures provided, including that of restoration of WSW and its likelihood of success.

In light of this, the biodiversity assessment undertaken in the ecology study concludes there is low risk of WSW not being viable in the short term, and the viability of the community should be increased in the long term. This is due to:

- clearing of WSW being progressive;
- 75.5ha of existing WSW of varying quality (from low to high), being protected and managed to transition to a higher quality WSW in the short-term;
- approximately 160ha of WSG proposed to be re-established to WSW from former grazing lands;
- the long-term conservation goal of the offset strategy for WSW providing a greater extant of WSW, this represents approximately 87ha more than the current extant in the long-term;
- improvements in protection mechanisms, ie BioBanking agreements on the WSW within the proposed SBA and NBA;

- under the 2003 development consent, areas of WSG in the SBA and NBA were identified for re-establishment but not protected as part of the offset, these will be protected using BioBanking agreement; and
- increase in patch size in the SBA and the development of a separate patch of WSW in the NBA. This reduces catastrophic risk of fire and disease to the WSW.

If the proposal is not approved and the BOS secured then:

- only approximately 75ha of existing WSW required to be protected by the 2003 development consent (DA-300-9-2002) will remain protected and managed;
- the WSW required to be re-established under the 2003 development consent will remain unprotected;
- the remaining WSW will not be permanently protected (ie 75.5ha in SBA and NBA as proposed);
- the opportunity for long-term extant to be increased by approximately 19 per cent (or net increase of approximately 87ha) to the current 465ha WSW extant through implementation of a re-establishment programme will not be realised;
- key threatening processes (for example, weeds, fire and catastrophic failure) to WSW would not be managed through a regime of ongoing regular and systematic site management practices;
- no ongoing funding to manage and protect the WSW; and
- less education and knowledge transfer among restoration ecologists and practitioners through the development and implementation of conservation management and re-establishment practices.

In summary, the consent authority is required to apply the precautionary principle in consideration of the full comprehensive offset package regarding the impacts of the proposal, rather than a singular component.

4. UNE research

Contention

48. Most likely, this paper was not included in the Ecology study (Appendix H of the EIS) due to its recent publication date (June 2014); however, given that it does contain useful insights into the practicalities of WSW restoration, it is surprising that the raw results of this research were not made available and cited in support of the Application.

Response

The University of New England (UNE) is an independent research institution. The unpublished document “*A blueprint for the restoration of Warkworth Sands Woodland*” was a commissioning document outlining the scope of the research to be undertaken by the UNE. As an independent body research body the research must follow strict scientific protocols. Setting up research, undertaking trials, collecting data, data analysis and writing up of reports takes considerable time. The conversion of these reports into published papers requires internal review, peer review, acceptance by a journal and publishing.

As an independent research body it is unlikely that the UNE would release publically, the results of research until this process is completed.

WML has worked closely with UNE whilst this research has been undertaken and has a sound knowledge based on this research on an approach to restoring WSW. The proposed WSW regeneration programme in the SBA and NBA builds on comprehensive scientific understanding of the vegetation community compiled with the assistance of the UNE and other regeneration practitioners.

A WSW Restoration Manual (Appendix A of the Warkworth Continuation 2014 response to submissions report) has also been prepared (Niche 2013), which summarises the previous work undertaken by UNE, Dr Anne Marie Clements and Associates, and Cumberland Ecology. This Restoration Manual provides a sound basis for guiding best management practices to restore WSW. The manual also sets out a process for tracking the recovery of WSW sites toward a reference state as a result of appropriate applied land management restoration interventions.

Contention

49. Clearly, the outcomes of the UNE research were that, in fact, more research is required before we can be confident of successfully restoring WSW. Relying on passive restoration alone will not return a disturbed WSW site to an analogue condition (Gross & Vary 2014 reported depauperate species diversity, skewed towards introduced species), and restoring a degraded site using only above-ground species as a guide will skew the recovery (“it is critical to [describe the below-ground diversity] where there is an expectation to match Green Offsets with analogue habitats”: Gross & Vary 2014).

Response

As mentioned above WML has a clear approach to re-establishing WSW as outlined in both the WSW Restoration Manual and draft LOMP, which are Appendix A and B to the Warkworth Continuation 2014 response to submissions report, respectively. As with any project adaptive management is fundamental and continued learning is part of this process. The research papers outlined by Bell are only part of the WSW story.

Contention

49. As I outlined in my Statement of Evidence (Bell 2012), the promises of ecosystem restoration are rarely met in practice, and there is still much research (like that reported on in Gross and Vary 2014) still to be done for WSW.

Response

The restoration of WSW forms a part of a comprehensive BOS for the proposal. As previously stated, the scientific research undertaken to date has contributed to an extensive scientific understanding of the vegetation community to enable restoration activities to commence. Other offsetting measures to compensate for impacts on WSW include land-based offsets and other supplementary measures such as contributions to an Integrated Management Plan, development of completion criteria and upfront provision of an Implementation Bond valued at \$1million. The Implementation Bond is provided as security that the expected results of appropriate applied land management restoration interventions be achieved within a 15 year target. If the 15 year targets are not met, the Implementation Bond does not remove the requirement to deliver the WSW reestablishment programme. The bond provides WML an incentive to continually commit resources to delivering WSW in a timely manner.

WML is committed to the successful re-establishment of WSW in the areas mapped as WSG in the SBA and NBA. The flora species that make up the unique assemblage that is WSW are not in themselves unique and are found in various other ecosystems. Propagation of most species such as the keystone eucalyptus in the overstorey and understorey species such as banksia, acacia and native grasses have been successfully germinated by UNE and elsewhere. The re-establishment areas are on in-situ sand deposits that once would have grown WSW. These sand deposits have the same water regimes, micro-organisms, climate, and in many cases component species already present. Re-establishment would provide a large, fully functioning example of the EEC through the enhancement of areas that are currently in reasonable ecological condition, and by re-establishing the community in areas where it is currently degraded.

A review of the WSW in Figure 5.2 of the ecology study (EIS Appendix H) and the historical aeriels shown in Figure 4.3 (EIS Appendix H) indicate that WSW was heavily cleared in the early 1960s. By 1979, the vegetation had undergone significant regeneration and is now considered a good quality example of this community. Modern restoration techniques when applied to similar areas will enhance the natural regeneration of the WSW providing a high likelihood of successfully re-establishing WSG to WSW.

Further, the proposed WSW re-establishment programme in the SBA and NBA builds on comprehensive scientific understanding of the vegetation community compiled with the assistance of the UNE and other regeneration practitioners.

A WSW Restoration Manual (Appendix A of the Warkworth Continuation 2014 response to submissions report) has also been prepared (Niche 2013), which summarises the previous work undertaken by UNE, Dr Anne Marie Clements and Associates, and Cumberland Ecology. This Restoration Manual provides a sound basis for guiding best management practices to restore WSW. The Manual also sets out a process for tracking the recovery of WSW sites toward a reference state as a result of appropriate applied land management restoration interventions.

The draft LOMP (Appendix B of the Warkworth Continuation 2014 response to submissions report) establishes conservation objectives, key performance criteria and indicators for the SBA and NBA, as well as outlining conservation management actions and monitoring programmes that have been formulated based on the existing ecological condition of the SBA and NBA to achieve the conservation objectives.

The WSW / WSG offsets add to existing protected areas containing WSW and other extant vegetation in the locality. Together, these would form the largest known area of WSW under long-term conservation in the region. Assessments indicate that this is likely to provide the best long term viable community of WSW.

WML acknowledges that due to the limited extent of WSW, consideration of supplementary measures is required.

As all of the WSW offset requirements cannot be met via land based offsets and retirement of the remaining impact credits using the rules of the UHSA, WML's proposed supplementary measures are additional to the 'normal' offset requirements outlined in item 5 of the policy. These additional supplementary measures do not retire credits but provide significant conservation value for WSW.

The additional supplementary measures proposed by WML to offset the impacts of the proposal on the WSW include:

- Integrated Management Plan;
- contribution to Saving Our Species – Regent Honeyeater;
- Implementation bond;
- conservation of WSG established under 2003 development consent; and
- the development of completion criteria for WSW.

Each of these is outlined in further detail below.

1. Integrated Management plan

An Integrated Management Plan would be prepared to establish an effective mechanism to work with neighbouring owners of WSW to provide improved conservation outcomes through:

- coordinated management and re-establishment activities;
- exchange of knowledge;
- education; and
- consistency in monitoring programmes.

The Integrated Management Plan for WSW will be prepared by WML in consultation with relevant stakeholders, including OEH and neighbouring mines. This plan is a significant conservation initiative for WSW, and considers the requirements of WSW across the known extant. It identifies the actions to be taken to ensure the long-term viability of the WSW, and the parties who will undertake these actions.

The Integrated Management Plan will collect information on the description of WSW, its distribution, land tenure and zoning, habitat and ecology, ecological processes and ability to recover. This plan will also examine threats, management issues, and limits to current knowledge including; fire frequencies, inter-fire intervals, seasonality and intensity. Below in Table 1 are the preliminary priority actions for WSW that have been identified.

The plan will also examine proposed recovery actions including; active restoration, re-establishment techniques, regrowth control, passive restoration, weed control, pest and animal control and fire management. The biodiversity benefits of the conservation and study of WSW will benefit numerous threatened species that occur in the WSW community.

Table 1 Preliminary priority actions for WSW EEC

Action	Priority
Accurately survey and map the extent and condition of all remnants	High
Undertake an assessment of the conservation significance of remnants and prioritise sites for protection and active management on this basis of this assessment	High
Nominate WSW as an EEC under the EPBC Act	High
Notify landowners / managers and other stakeholders of the presence of WSW remnants under their care and / or control	High
Determine the tenure of all remnants of the EEC and identify relevant stakeholders	High
Prepare community profile and EIA guidelines and provide to Singleton Council, the DP&E and any other bodies that have a consent or approval role	High
Seek to increase the level of legislative protection for sites through landuse planning mechanisms and conservation agreements	High
Undertake rehabilitation works at priority sites using approved bush regeneration techniques	Medium
Undertake regeneration works to maintain or improve connectivity between remnants	Medium
Fence remnants to exclude livestock and encourage regeneration	Medium
[Guidelines] Prepare best practice management guidelines for remnants and provide to landowners / managers as well as other stakeholders (consent / determining authorities)	Medium
Establish incentives programs to promote and encourage best practice management of remnants on private land	Medium
Determine location, species composition and threats to remaining remnants to assist with prioritising restoration works	Medium
Collect seed for NSW Seedbank. Develop collection program in collaboration with BGT - all known provenances (conservation collection)	Medium
Investigate seed viability, germination, dormancy and longevity (in natural environment and in storage)	Medium
Undertake management-focused research (including investigation of an appropriate fire regime, population viability analysis)	Medium
Prepare a recommendation for the identification of critical habitat on the basis of the outcomes of extent, condition and tenure assessment	Medium
Assess opportunities for incorporating land supporting WSW into the reserve estate (BioBanking)	Low

Preliminary discussions have been undertaken with the relevant stakeholders and WML will be responsible for the drafting of the plan. Stakeholders have expressed interest in forming a conservation working group to aid the development of the plan. The plan will be made publically available via the Rio Tinto Coal Australia website.

2. Contribution to Saving Our Species programme

WML recognises that there may be a time lag between impact and re-establishment of WSW. In recognition, WML proposes to contribute \$1million to the OEH's Saving Our Species (SOS) conservation programme. This additional supplementary measure will be targeted to benefit an endangered species found in WSW.

One initiative under the SOS programme is directed towards the conservation of the Regent Honeyeater, an endangered species under the NSW Threatened Species Conservation Act 1995 (TSC Act). The Regent Honeyeater has been identified as potentially using WSW as foraging habitat. Contribution to this programme provides an immediate biodiversity benefit.

The quantum of the contribution was discussed with OEH. OEH suggested that an appropriate mechanism would be similar to that provided in the policy for calculating additional supplementary measures, and should be equivalent to retiring the entire proposed impact on WSW.

The area required to offset the proposed impact ecosystem credits, is calculated from the BBAM credit calculator tool. The contribution was calculated using OEH's draft Upper Hunter Offset Fund calculator.

The details of the implementation of this contribution will be discussed with OEH following the determination of the proposal.

3. Implementation bond

OEH identified that re-establishment of WSW on WSG has a risk that the end outcomes may not be achieved. WML considers the risk of this occurring as being very low but recognises the concern, which has also been expressed by other stakeholders.

WML proposes managing the risk through a well-designed re-establishment programme of the WSW that leads to long term conservation outcomes. Allocation to funding and resourcing for the re-establishment programme is committed.

Research has been undertaken by UNE since 2006 on WSW. Also, as part of the now rescinded project approval for the Warkworth Extension 2010, \$500,000 was spent on research for WSW. This research has helped inform several programmes in place to assist with the re-establishment of WSW; these are outlined in the Restoration Manual and draft LOMP (provided in Appendix A and B of the Warkworth Continuation 2014 response to submissions report, respectively).

The re-establishment implementation is well resourced and supported by a substantial operational budget, an internal Offsets Manager, Offsets Specialist, Rehabilitation Specialist and external restoration technical experts.

WML recognises that demonstrable results for re-establishment of WSW need to be provided within a reasonable timeframe but acknowledges stakeholders perceptions that there is a risk that this may not occur, despite the historical regeneration and scientific research.

WML commits to demonstrating that WSW will be on a trajectory towards a reference state as a result of appropriate applied land management restoration interventions within 15 years from approval. WML propose to provide an upfront implementation bond of \$1million to OEH, as security that the expected results will be achieved. It is envisaged that this bond will be held by Government in the form of a bank guarantee, which can be drawn upon if results are not demonstrated. This is in addition to the conservation bond which is included in contemporary project approvals.

Calculation of \$1million for the implementation bond was based on the same rationale as calculation for the contribution to the SOS programme. The \$1million is equivalent to retiring the entire proposed impact credit of WSW.

If the 15 year targets are not met, the proposed implementation bond does not remove the requirement to deliver the WSW re-establishment programme. This bond provides WML an incentive to continually commit resources to delivering WSW in a timely manner.

The monitoring of the trajectory of re-establishment will be reported in the annual report. The annual reports will be a critical tool to review re-establishment performance and adapt conservation management strategies. The reports will include a summary of monitoring data and management highlights in the land based offsets and the outcome of those actions, including identifying any need for improved management. The annual reports will be prepared and submitted to the DP&E (as part of the Annual Environmental Review).

The sharing of information will be facilitated through an online Biodiversity Offsets Portal. This portal has been designed to centralise and share information among authorised users and will include spatial data, an image library, reports and other non-spatial data as well as project management information such as stakeholder details and safety information. The portal will greatly improve communication among stakeholders, transparency of management and monitoring activities and will ensure data security and integrity (for example, preventing risks of data loss due to staff turnover and minimising the risk of using superseded information). Ultimately, this innovation tool will result in improved decision making and adaptive management that is responsive to seasonal conditions and current operational challenges.

The annual reports and Biodiversity Offsets Portal will provide OEH with a process to monitor and regulate the annual performance of the re-establishment of WSW. This initiative provides an incentive for WML to remain diligent to the re-establishment of WSW whilst providing absolute transparency the relevant stakeholder's surety of results.

4. Conservation of WSG established under 2003 development consent

Under the 2003 development consent, areas of WSG in the SBA and NBA were identified for re-establishment but not protected as part of the offset. As part of this proposal, these re-established areas will now be protected and conserved as part of the proposed BOS in the long term; the mechanism for conservation in perpetuity will be BioBanking agreements. This results in an increased area of WSW being protected and managed in the long term.

5. Development of completion criteria

Since the lodgement of the EIS, the draft LOMP has been developed, and outlines the completion criteria for WSW.

Contention

50. I have not had access to this restoration manual to examine its contents, nor to determine whether or not it is directly based on the research outcomes of the UNE project. Given that the UNE appeared to focus on 'pure' science topics such as gene flow, pollination biology, faunal interactions and food webs, it is uncertain how much of this will be incorporated into the restoration manual.

Response

The WSW Restoration Manual and draft LOMP are attached to the Warkworth Continuation 2014 response to submissions report as Appendix A and B respectively.

Contention

51. Ultimately, the \$5.5 million spent on WSW research has not yet been incorporated into the proposed restoration of WSW, and consequently this component of the offset package for the mine continuation should be considerably downplayed. The precautionary principle should remain in place for this aspect of the package, as quite clearly there remain many research questions unresolved.

Response

As stated previously UNE's research has informed the Restoration Manual and draft LOMP (Appendix B of the Warkworth Continuation 2014 response to submissions report).

WML is committed to the successful re-establishment of WSW in the areas mapped as WSG in the SBA and NBA. The flora species that make up the unique assemblage that is WSW are not in themselves unique and are found in various other ecosystems. Propagation of most species such as the keystone eucalyptus in the over storey and understorey species such as banksia, acacia and native grasses have been successfully germinated in the UNE greenhouse and elsewhere.

The re-establishment areas are on in-situ sand deposits that once would have grown WSW. These sand deposits have the same water regimes, micro-organisms, and climate and in many cases component species already present. Re-establishment would provide a large, fully functioning example of the EEC through the enhancement of areas that are currently in reasonable ecological condition, and by re-establishing the community in areas where it is currently degraded. A review of the WSW in Figure 5.2 of the ecology study (EIS Appendix H) and the historical aerials shown in Figure 4.3 (EIS Appendix H) indicate that WSW was heavily cleared in the early 1960s. By 1979, the vegetation had undergone significant regeneration and is now considered a good quality example of this community. Modern restoration techniques when applied to similar areas will enhance the natural regeneration of the WSW.

The proposed WSW regeneration programme in the SBA and NBA builds on comprehensive scientific understanding of the vegetation community compiled with the assistance of the UNE and other regeneration practitioners.

A WSW Restoration Manual (Appendix A of the Warkworth Continuation 2014 response to submissions report) has also been prepared (Niche 2013), which summarises the previous work undertaken by UNE, Dr Anne Marie Clements and Associates, and Cumberland Ecology. This Restoration Manual provides a sound basis for guiding best management practices to restore WSW. The manual also sets out a process for tracking the recovery of WSW sites toward a reference state as a result of appropriate applied land management restoration interventions.

The draft LOMP has also been developed, the LOMP establishes conservation objectives, key performance criteria and indicators for the SBA and NBA, as well as outlining conservation management actions and monitoring programmes that have been formulated based on the existing ecological condition of the SBA and NBA to achieve the conservation objectives.

The WSW/WSG offsets add to existing protected areas containing WSW and other extant vegetation in the locality. Together, these would form the largest known area of WSW under long-term conservation in the region.

The precautionary principle is addressed above in section 3.

5. Biodiversity of offsetting

Contention

52. The 2014 Application has reduced the offset from seven parcels of land to two, presumably in response to the judgment in the NSWLEC which found many of the proposed offsets to be inappropriate (NSWLEC 48, 2013, paragraph 202-207)...This approximates to 1/5th of that originally proposed.

Response

The proposal has not put forward the same offset package following the L&E Court judgment. The proposal outlines a new 2014 BOS that meets contemporary NSW Government policies as outlined in the EIS. The notion that the BOS approximates to 1/5th of that originally proposal is incorrect and irrelevant to this proposal.

Contention

54. To compensate for this reduction in suitable land-based offsets, the 2014 Application offers instead what it calls a '*range of supplementary measures*'.

Response

Mr Bell may have misunderstood the range of offset measures provided in the proposed BOS. The BOS calculates impact credits (calculated using BCAM) and proposes to retire the entire credits using a range of measures:

- Land based offsets;
- Rehabilitation;
- Retire credits via UHSA;
- Purchase credits on open market; and
- Additional supplementary measures for WSW.

Following public exhibition of the EIS, the OEH has extensively considered and assessed the BOS and provided certification in accordance with clause 14(3) of the Mining SEPP which requires the consent authority to consider any certification by the Chief Executive of the OEH that measures to mitigate or offset the biodiversity impact of the proposal (ie the BOS) will be adequate.

Contention

55. Retirement of credits under the UHSA scheme will compensate for the removal of WSW. I do consider, however, that these credits will require recalculation given the over-mapping of WSW that has occurred in the NBA.

Response

Mapping is consistent with L&E court judgment (par. 227). "I find therefore that the areas of extant WSW and CHGBIW should remain as previously estimated, most recently in the BOS, namely 19.5ha of WSW". The BBAM credits calculated based on this mapping will be verified by OEH.

6. Northern Biodiversity Area

Contention

58 – 65. The amount of WSW that had been mapped within the NBA, some of which I believed to be inaccurately portrayed.

For the 2014 application, the NBA is stated to support 176 hectares of WSW (19.5 hectares WSW + 156.5 hectares WSG), which is a little under double my 2012 estimate.

Sampled vegetation (my sample plots Q01 & Q02) within stands of vegetation mapped by Cumberland Ecology as WSW. That vegetation was dominated ...but these species were included in the 'uncommon' species list in the original nomination. The remaining species are not listed at all.

Application accepts that the overall extant distribution of WSW is ~465 hectares as stipulated by Justice Preston (a reduction from the ~746 hectares put forward by Dr Robertson during the LEC hearing); however, for the NBA the current estimate of 19.5 hectares of WSW remains unchanged yet they have not accepted the LEC decision that over-mapping of WSW has occurred within the NBA (19.5 hectares in both 2010 & 2014 Applications).

Response

Mapping is consistent with L& E court judgment para 227. “I find therefore that the areas of extant WSW and CHGBIW should remain as previously estimated, most recently in the Biodiversity Offset Strategy [sic 2010 Warkworth Extension EIS], namely 19.5ha of WSW”. The ecology study uses 19.5ha of WSW in the NBA, and calculates BBAM credits which will be verified by OEH.

Contention

66 – 67. In the 2010 Application, WSW Grassland was mapped across 190.8 hectares of the NBA, while in the 2014 Application it has been mapped across 156.5 hectares, a reduction of 34.3 hectares. There is no explanation in the Ecology... this 2003 WSW Re-establishment Area was the subject of a previous approval and cannot be included as part of a new offset package.

The 2014 Application for the NBA has neglected to reduce the extent of current WSW back from 19.5 to 10.2 hectares (effectively halving the conserved amount) in keeping with the findings of the NSWLEC. By extension, the 2014 Application has also neglected to reduce the amount of WSW Grasslands that may be suitable for restoration of WSW.

Response

The mapping of WSG is consistent with L&E Court judgment (par. 227). Mapping is consistent with L& E court par. 227. “I find therefore that the areas of extant WSW and CHGBIW should remain as previously estimated, most recently in the Biodiversity Offset Strategy [sic 2010 Warkworth Extension EIS], namely 19.5ha of WSW”. The ecology study uses 19.5ha of WSW in the NBA, and calculates BBAM credits which will be verified by OEH.

156.5ha of WSG is available for offsetting in the NBA for this proposal. The remaining area of WSG within the NBA is part of the Warkworth 2003 offset package.

7. Southern Biodiversity Area

Contention

68. The Southern Biodiversity Area (SBA) is stated in the 2014 Application to be 788 hectares in size, which is an increase of 70 hectares from the SBA discussed in the 2010 Application. On comparison of the SBA from the two Applications, it appears that the increase is due mainly to the addition of the former ‘Springwood’ property near the north, and a separate parcel of land adjacent to Bulga. The former Putty Road Conservation Area has also been excised from the SBA.

Response

In the Preferred Project Report for the Warkworth Extension 2010, the total area of the SBA was mapped to be 977.5ha (refer to Table 3.1), which includes the Springwood property.

The 2014 EIS does not include the Putty Road Conservation Area which was removed from the SBA calculations as it was used as an offset for Modification 6 to the current development consent.

Contention

69. WSW, the area conserved has reduced from 85 hectares (2010) to 56 hectares (2014), a difference of 29 hectares. I assume that this difference is due to the excising from the SBA of the WSW conservation areas which were part of the 2003 consent conditions, and could not be used again for offsetting purposes. In addition, 2.5 hectares of WSW Grassland are contained within the SBA

Response

Mr Bell is correct in assuming that this difference is due to the excising from the SBA of the WSW conservation areas which were part of the 2003 consent conditions, and could not be used again for offsetting purposes.

8. Supplementary measure 1: Integrated Restoration Implementation Plan

Contention

71. Integrated Management Plan ... little information as to how this will be undertaken, nor who will be responsible for its implementation.

Response

An Integrated Management Plan would be prepared to establish an effective mechanism to work with neighbouring owners of WSW to provide improved conservation outcomes through:

- coordinated management and reestablishment activities;
- exchange of knowledge;
- education; and
- consistency in monitoring programmes.

The Integrated Management Plan for WSW will be prepared by WML in consultation with relevant stakeholders, including OEH and neighbouring mines. This plan is a significant conservation initiative for WSW, and considers the requirements of WSW across the known extant. It identifies the actions to be taken to ensure the long-term viability of the WSW, and the parties who will undertake these actions.

The Integrated Management Plan will collect information on the description of WSW, its distribution, land tenure and zoning, habitat and ecology, ecological processes and ability to recover. This plan will also examine threats, management issues, and limits to current knowledge including; fire frequencies, inter-fire intervals, seasonality and intensity. Below in Table 2.3 are the preliminary priority actions for WSW that have been identified.

The plan will also examine proposed recovery actions including; active restoration, reestablishment techniques, regrowth control, passive restoration, weed control, pest and animal control and fire management. The biodiversity benefits of the conservation and study of WSW will benefit numerous threatened species that occur in the WSW community.

Table 2 Preliminary priority actions for WSW EEC

Action	Priority
Accurately survey and map the extent and condition of all remnants	High
Undertake an assessment of the conservation significance of remnants and prioritise sites for protection and active management on this basis of this assessment	High
Nominate WSW as an EEC under the EPBC Act	High
Notify landowners / managers and other stakeholders of the presence of WSW remnants under their care and / or control	High
Determine the tenure of all remnants of the EEC and identify relevant stakeholders	High
Prepare community profile and EIA guidelines and provide to Singleton Council, the DP&E and any other bodies that have a consent or approval role	High
Seek to increase the level of legislative protection for sites through landuse planning mechanisms and conservation agreements	High
Undertake rehabilitation works at priority sites using approved bush regeneration techniques	Medium
Undertake regeneration works to maintain or improve connectivity between remnants	Medium
Fence remnants to exclude livestock and encourage regeneration	Medium
[Guidelines] Prepare best practice management guidelines for remnants and provide to landowners / managers as well as other stakeholders (consent / determining authorities)	Medium
Establish incentives programs to promote and encourage best practice management of remnants on private land	Medium
Determine location, species composition and threats to remaining remnants to assist with prioritising restoration works	Medium
Collect seed for NSW Seedbank. Develop collection program in collaboration with BGT - all known provenances (conservation collection)	Medium
Investigate seed viability, germination, dormancy and longevity (in natural environment and in storage)	Medium
Undertake management-focused research (including investigation of an appropriate fire regime, population viability analysis)	Medium
Prepare a recommendation for the identification of critical habitat on the basis of the outcomes of extent, condition and tenure assessment	Medium
Assess opportunities for incorporating land supporting WSW into the reserve estate (BioBanking)	Low

Preliminary discussions have been undertaken with the relevant stakeholders and WML will be responsible for the drafting of the plan. Stakeholders have expressed interest in forming a conservation working group to aid the development of the plan. The plan will be made publically available via the Rio Tinto Coal Australia website.

Contention

72. Implementation Plan proposed as a supplementary offset measure is not mentioned in Appendix Q, although admittedly the Plan would involve liaison with a number of other land holders, and hence would be logistically difficult to document here. I understand too that Appendix Q is centred on the rehabilitation of mined land, and that no WSW will be restored and managed in those areas.

Response

The proposed additional supplementary measure of the integrated management plan is discussed above. However, any implementation plan for the proposed offsets will be managed using a local offset management plan.

Appendix Q of the EIS is an example of the performance criteria of rehabilitation of mined land contained within the current Mining Operation Plan. Performance criteria for WSW re-establishment are contained within the draft LOMP which is Appendix B to the Warkworth Continuation 2014 response to submissions report.

9. Supplementary measure 2: research into completion criteria

Contention

73. There is no indication as to what form this “research into completion criteria” will take.

Response

Performance criteria for WSW re-establishment are contained within the draft LOMP, which is Appendix B to the Warkworth Continuation 2014 response to submissions report.

Contention

74. I do question why new research into these basic community criteria (such as the 7 listed in Section 7.2.4) is being proposed as a supplementary offset measure, when clearly there already exists a wealth of information that could be readily used to formulate suitable completion criteria for WSW.

Response

Performance criteria for WSW re-establishment are contained within the draft LOMP, which is Appendix B to the Warkworth Continuation 2014 response to submissions report.

10. Re-establishment of WSW

Contention

76 – 78. Supported by Justice Preston and the NSW Court of Appeal, there is a high risk of failure in achieving high quality restoration of natural ecosystems because the science lags well behind the policy:

- there is little evidence in support of claims that restoration of WSW is achievable.
- no discussion of the results of this “extensive research” included in the 2014 Application, and hence it is difficult to be confident of success.
- uncertainty of successful restoration of the factually Critically Endangered WSW should be clearly acknowledged in any offsets package, and I do not consider that this has been done for the 2014 Application.
- what preventions will be in place to prevent removal of this sand by wind erosion, prior to establishment of sufficient vegetative cover (which may take 3-5 years)?

Response

The L&E Court judgment does not acknowledge the restoration of natural ecosystems is at high risk of failure because the science lags well behind the policy. However, Judge Preston does discuss the risk and uncertainty that derived grasslands would not become EECs.

The restoration of WSW forms a part of a comprehensive BOS for the proposal. As previously stated, the scientific research undertaken to date has contributed to an extensive scientific understanding of the vegetation community to enable restoration activities to commence. Other offsetting measures to compensate for impacts on WSW include land-based offsets and other supplementary measures such as contributions to an Integrated Management Plan, development of completion criteria and upfront provision of an Implementation Bond valued at \$1million. The Implementation Bond is provided as security that the expected results of appropriate applied land management restoration interventions be achieved within a 15 year target. If the 15 year targets are not met, the Implementation Bond does not remove the requirement to deliver the WSW reestablishment programme. The bond provides WML an incentive to continually commit resources to delivering WSW in a timely manner.

WML is committed to the successful re-establishment of WSW in the areas mapped as WSG in the SBA and NBA. The flora species that make up the unique assemblage that is WSW are not in themselves unique and are found in various other ecosystems. Propagation of most species such as the keystone eucalyptus in the over storey and understorey species such as banksia, acacia and native grasses have been successfully germinated in the UNE greenhouse and elsewhere.

The re-establishment areas are on in-situ sand deposits that once would have grown WSW. These sand deposits have the same water regimes, micro-organisms, climate and in many cases component species already present. Re-establishment would provide a large, fully functioning example of the EEC through the enhancement of areas that are currently in reasonable ecological condition, and by re-establishing the community in areas where it is currently degraded.

A review of the WSW in Figure 5.2 of the ecology study (EIS Appendix H) and the historical aerials shown in Figure 4.3 (EIS Appendix H) indicate that WSW was heavily cleared in the early 1960s. By 1979, the vegetation had undergone significant regeneration and is now considered a good quality example of this community. Modern restoration techniques when applied to similar areas will enhance the natural regeneration of the WSW.

The proposed WSW regeneration programme in the SBA and NBA builds on comprehensive scientific understanding of the vegetation community compiled with the assistance of the UNE and other regeneration practitioners.

A WSW Restoration Manual (Appendix A to the Warkworth Continuation 2014 response to submissions report) has also been prepared (Niche 2013), which summarises the previous work undertaken by UNE, Dr Anne Marie Clements and Associates, and Cumberland Ecology. This Restoration Manual provides a sound basis for guiding best management practices to restore WSW. The manual also sets out a process for tracking the recovery of WSW sites toward a reference state as a result of appropriate applied land management restoration interventions.

The draft LOMP has also been developed, the LOMP establishes conservation objectives, key performance criteria and indicators for the SBA and NBA, as well as outlining conservation management actions and monitoring programmes that have been formulated based on the existing ecological condition of the SBA and NBA to achieve the conservation objectives.

The WSW/WSG offsets add to existing protected areas containing WSW and other extant vegetation in the locality. Together, these would form the largest known area of WSW under long-term conservation in the region.

Following public exhibition of the EIS, the OEH has extensively considered and assessed the BOS and provided certification in accordance with clause 14(3) of the Mining SEPP which requires the consent authority to consider any certification by the Chief Executive of the OEH that measures to mitigate or offset the biodiversity impact of the proposal (ie the BOS) will be adequate.

11. Other Endangered Ecological Communities

Contention

80. The 2014 Application adds three new vegetation types to the description of vegetation diversity within the project area, which were otherwise not present in the 2010 Application:

- Regenerating Central Hunter Grey Box – Ironbark Woodland;
- Regenerating Hunter Valley River Oak Forest; and
- Central Hunter Grey Box.

Response

Vegetation types recorded were matched to the closest community described in the Biometric Vegetation Types database for use in the BCAM calculator.

12. Concluding comments

Contention

83. Much of the highest quality WSW will be removed, and will be offset predominantly with medium to low quality WSW elsewhere.

Response

This is addressed in detail in Section 1 above.

Contention

84. The offset package presented in the 2014 Application ("Component 1") proposes to compensate for the loss of 72 hectares of high quality WSW with:

- 75.5 hectares of WSW [but I consider this to be over-mapped in the NBA, and a figure of 66.2 ha is more realistic]
- restoration of 159.5 hectares of WSW Grassland [but I consider this to be over-mapped in the NBA, and a figure of 88.8 ha is more realistic]
- preparation of an Integrated Management Plan for WSW [no indication of how this will be done]
- development of Completion Criteria for WSW [unnecessary, and can be compiled from the wealth of existing data on WSW. May also duplicate information already contained in the WSW Restoration Manual]
- retirement of credits under the UHSA [but these would require recalculation given the change in extent of conserved WSW listed above]

Response

This is addressed in detail in sections 1, 5, 6, 7, 8 and 9 above.

Contention

85. it can only be assumed that the results of UNE's studies were not considered conducive to the 'successful' restoration efforts as claimed in the Application.

Response

This is addressed in detail in Section 4 above.

Contention

86. I have not been able to source a copy of the Thackway et. al. (2013) document.

Response

The WSW Restoration Manual is attached as Appendix A to the Warkworth Continuation 2014 response to submissions report.

Contention

86. I can find no evidence of previous experience with WSW or other endangered ecosystems on Associate Professor Thackways Google Scholar profile, and I suspect that the Thackway et. al. (2013) document deals more with generalisations of ecosystem restoration than it does with WSW-specific restoration.

Response

The WSW Restoration Manual builds on research by the UNE and other technical experts whom have considerable experience with restoration of sand ecosystems.

Contention

87. Over-map the extent of WSW and WSW Grassland within the Northern Biodiversity Area, and downplayed the significance that removal of ~70 hectares of this factually Critically Endangered community will affect.

I maintain that more certainty in the restoration of WSW is required prior to the granting of approval to remove ~70 hectares of high (50ha) and medium (22ha) quality WSW.

Response

This is addressed in detail in Section 6 above.

Contention

87. I consider that the results of the 5-year \$5.5 million research program undertaken by the UNE on the restoration of WSW, formerly promoted as 'flagship' research, has been downplayed in favour of a newly compiled Restoration Manual prepared by a leading research scientist with no experience in WSW ecology

Response

This is addressed in detail in Section 4 above.

Contention

87. Key impacts that may be expected should this proposal proceed would include the loss of ~70 hectares of largely high quality WSW, representing a 15-18% reduction in the current extant distribution of this community.

Response

This is addressed in detail in Section 1 and 3 above.

Contention

87. Given the uncertainties of success for the proposed restoration of WSW, the range of conditions and fragment sizes, removal of ~70 hectares of WSW would send this community further toward the extreme end of the irreplaceability spectrum

Response

This is addressed in detail in Section 3 above.

References

Draft NSW Biodiversity Offsets Policy for Major Projects, OEH 2014.

Warkworth Continuation Environmental Impact Statement, EMM 2014.

Warkworth Continuation Response to Submissions, EMM 2014.

Submission on Warkworth Sands Woodland EEC: Warkworth / Mt Thorley Continuation Project, Eastcoast Flora Survey 2014.

State Significant Development – Secretaries' Requirements Warkworth Continuation Project (SSD 6464).

Upper Hunter Strategic Assessment – Interim Policy.

Warkworth Mine, Warkworth Sands Woodlands Restoration Manual, Niche 2014.

Draft Local Offset Management Plan, Rio Tinto Coal Australia, 2014.

Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited [2013] NSWLEC 48.

Appendix K

Social impact assessment interview guide



Appendix K — Social impact assessment interview guide

K

K.1 MTW Interview Guide

Introduction: EMGA Mitchell McLennan (EMM) has been contracted by Coal & Allied to undertake the Social Impact Assessment (SIA) for the proposed projects at Mount Thorley Warkworth (MTW) as part of the environmental assessment process. We are conducting an independent assessment of the social impacts of the projects and therefore it is important that we consider the perspectives of key stakeholders regarding current and future impacts of the proposed project that they are concerned about and any management strategies that may help to alleviate these impacts. Any information or concerns you have regarding the project will be assessed and reported on as part of this process.

Confidentiality Statement: All information you provided will be kept confidential and will not be linked to you in any way.

K.1.1 The Project

Section introduction: We will be asking a series of questions related to the project specifically, and also about MTW operations more generally. Firstly, we will be discussing the proposed project.

1. Having heard the project description, what impacts do you think will occur as a result of the project? (main issues/impacts; description – eg why do you think the impacts will occur, will it impact you directly, how...; severity of impact - low, moderate, high)
2. Do you think these impacts can be appropriately managed or mitigated (yes, no, unsure)?
 - a) If yes, how can they be managed? How do you think these management strategies could be monitored and reported on?
 - b) If no/unsure, why?
3. What opportunities do you think will occur as a result of the project?
4. What do you think would be the impacts if the project did not go ahead?
5. Do you think the benefits of the project outweigh the impacts/costs (yes, no, unsure/don't know)? Why?

K.1.2 MTW Operations

Section introduction: we also want to ask you a number of questions about MTW operations more generally.

i Opinion of the company/operation

6. How would you describe your relationship with the company / MTW operation to date (very negative; negative; neither positive/negative; positive; very positive)?

ii Issues and Management

7. What have been your main issues with / impacts from MTW operations to date? (main issues/impacts; description – eg why do you think the impacts will occur, will it impact you directly, how...; severity of impact - low, moderate, high)

8. How satisfied are you with the company's response and management of these issues/impacts (very satisfied; satisfied; neither satisfied/unsatisfied; somewhat unsatisfied; very unsatisfied)?
9. What do you think the company has been doing well in relation to managing its impacts?
10. What needs improvement? How?

iii Cost/benefit

11. What do you see as the key benefits / contributions of mining in the area? (Interviewer: please list key benefit items rather than describe in detail)
12. What do you see as the key costs/impacts of mining in the area? (Interviewer: please list key cost items rather than describe in detail)
13. Do you consider the disadvantages of mining outweigh the advantages of the presence of mining in the area (yes; no; unsure/don't know)?

iv Opportunities

14. What do you see as the key needs of the community? How could the company provide expertise/resources (time/money) to address these needs?
15. How would you describe the aspirations of the community? How do you see/envisage the community in the future?
16. How could the company support these aspirations? Do you think the project fits within the community's vision for the future?

v Information and engagement

17. What are some of the better ways for Coal & Allied to provide information to you about the project moving forward (ie throughout the assessment process)?
18. Is there any specific information about the project you would like to receive?
19. Do you have anything else you would like to add?

Thank you for your time today.

If you would like any further information on the project, please contact Andrew Turner in the Community Relation Team via the Community Information Line 1800 727 745.

Appendix L

Biodiversity Offset Strategy certification from OEH



Appendix L — Biodiversity Offset Strategy certification from OEH

L

Decision Report

Decision whether to certify that measures to mitigate or offset the biodiversity impact of a proposed development will be adequate under clause 14(3) of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

Decision Maker	Terry Bailey, Chief Executive of the Office of Environment and Heritage
Recommending Officer	Andrew McIntyre
Project Name	SSD 6464 Warkworth Continuation 2014
Consent authority	New South Wales Planning and Assessment Commission

Part 1: Background Information

Background

Warkworth Mine is located 8 km west south west of Singleton in the Hunter Valley. Warkworth Mine is bounded by the Golden Highway to the east and north. Wallaby Scrub Road runs north-south through the western portion of the mining lease. The Hunter River is located approximately 4.5 km north of Warkworth Mine.

Warkworth Mining Limited operates the Warkworth mine in the Hunter Valley under a development consent DA 300-9-2002 issued in 2003 (**2003 Consent**). Warkworth Mining Limited is managed by Coal and Allied, which is owned by Rio Tinto Coal Australia.

Warkworth Mining Limited was given planning approval for a major expansion of the mine in 2012. An appeal was subsequently upheld by the Land and Environment Court in April 2013 (*Bulga Millbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited* [2013] NSWLEC48, Tab1).

Warkworth Mine retains Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* for the Warkworth Extension 2010.

On 29 January 2014, the Planning Assessment Commission approved a minor modification to the existing development consent for the Warkworth mine. This is separate to the current proposed expansion.

In March 2014, Warkworth Mining Limited submitted a revised proposal for the expansion of the Warkworth Mine and this revised proposal is now being assessed. The project subject to this development application is also part of the Strategic Assessment of a Biodiversity Plan for Coal Mining in the Upper Hunter Valley, NSW under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (referred to as the Upper Hunter Strategic Assessment) (in development – see Tab 2).

The Secretary's Environmental Assessment Requirements for this project were issued on 22 May 2014 (Tab 3). Warkworth Mine Limited submitted the development application on 23 June 2014. The Development Application was publicly exhibited between 25 June 2014 and 6 August 2014.

On 28 October 2014 Warkworth Mining Limited wrote to Terry Bailey, Chief Executive of the Office of Environment and Heritage (OEH) seeking his certification under Clause 14 of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive

Industries) 2007 (Mining SEPP) that measures to mitigate or offset the biodiversity impacts of Warkworth Continuation 2014 are adequate (Tab 4).

In State Significant Development Application 6464, Warkworth Mining Limited is applying for development consent to allow an extension of North and West pits further west (Warkworth Continuation Project). The Warkworth Continuation Project comprises:

- Extension of the mine footprint by approximately 698 hectares to the west of current operations extending the life of North and West pits by 21 years;
- Ability to transfer overburden and coal to Mount Thorley Operations (MTO) to assist in the final landform for MTO and processing of Run Of Mine (ROM) coal from the Warkworth Mine;
- Ability to transfer and accept mine water from neighbouring operations (Bulga Coal Complex, Wambo Mine, Mount Thorley Operations and Hunter Valley Operations);
- Closure of Wallaby Scrub Road;
- An optional underpass for the approved but yet to be constructed third bridge crossing on Putty Road;
- Minor changes to the design of the Northern out-of-pit dam;
- Use of existing secondary access gates to the mine sites and offset areas to allow for infrequent vehicle movements for management purposes; and
- Maintenance of the approval for all aspects of the existing operations for Warkworth Mine approved under DA 300-9-2002-1.

Figure 2.2 in EMM (2014) (Tab 5) shows the proposed boundary of the Warkworth Continuation Project.

Legislation and Policies

Legislation and Government Policies
<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
<i>Environmental Planning and Assessment Act 1979</i>
<i>Threatened Species Conservation Act 1995</i>
NSW Biodiversity Offset Policy for Major Projects NSW Biodiversity Offsets Policy for Major Projects NSW Office of Environment & Heritage
Framework for Biodiversity Assessment, NSW Biodiversity Offset Policy for Major Projects NSW Biodiversity Offsets Policy for Major Projects NSW Office of Environment & Heritage
A Section 146 Agreement, Strategic Assessment of a Biodiversity Plan for Coal Mining in the Upper Hunter Valley, NSW between the Commonwealth of Australia and the State of New South Wales.
Biodiversity Certification Assessment Methodology Biodiversity certification NSW Office of Environment & Heritage
BioBanking Assessment Methodology 2014 BioBanking Credit Calculator version 2 NSW Office of Environment & Heritage
NSW State Groundwater Dependant Ecosystem Policy
Upper Hunter Strategic Assessment Interim Policy -- Projects requiring approval prior to completion of the strategic assessment. Planning and Infrastructure October 2012.

OEH Submission

The submission provided by OEH to the Environmental Impact Statement (8 August 2014) related specifically to deficiencies in the assessment and requested further information or clarification, particularly in relation to the Biodiversity Certification Assessment Methodology (BCAM) of the mine footprint and the Biodiversity Banking Assessment Methodology (BBAM) for offset sites. Warkworth Mining Limited subsequently provided the raw data that the assessments were based on to OEH. After reviewing the raw data, OEH is now satisfied with the BCAM and BBAM assessments.

Part 2: The Decision to be Made

Under clause 14 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*, in determining a development application for development for the purposes of mining, the consent authority must consider any certification by the Chief Executive of the Office of Environment and Heritage or the Director-General of the Department of Primary Industries that measures to mitigate or offset the biodiversity impact of the proposed development will be adequate.

The Chief Executive of the Office of Environment and Heritage must now decide whether to certify, or not to certify, that the measures to mitigate or offset the biodiversity impact of the proposed development, the Warkworth Continuation Project, will be adequate.

Part 3: List of documents before the Decision Maker

The following documents are attached to this report.

Tab	Document
1	NSWLEC 48 Bulga Millbrodale Progress Association Inc vs Minister for Planning and Infrastructure and Warkworth Mining Limited [2013]
2	A Section 146 Agreement, Strategic Assessment of a Biodiversity Plan for Coal Mining in the Upper Hunter Valley, NSW between the Commonwealth of Australia and the State of New South Wales
3	Secretary's Environmental Assessment Requirements State Significant Development SSD 6464
4	Letter from Warkworth Mining Limited to Terry Bailey Chief Executive Office of Environment and Heritage – Final Warkworth Continuation Biodiversity Offset Strategy dated 28 October 2014
5	EMM (2014) <i>Warkworth Continuation 2014, Environmental Impact Statement, Volume 1 – Main Report</i> , prepared by EMGA Mitchell McLennan for Warkworth Mining Limited
6	Cumberland Ecology (2014a) <i>Warkworth Continuation 2014, Environmental Impact Statement, Volume 3 Appendix H – Ecological Impact Assessment</i> , prepared by Cumberland Ecology for EMGA Mitchell McLennan
7	Upper Hunter Strategic Assessment: Interim Policy: Projects requiring approval prior to completion of the strategic assessment (October 2012)
8	Rio Tinto – Coal Australia (2014) Draft Local Offset Management Plan Warkworth Mine, NSW
9	Email Anthony Russo to Andrew McIntyre 29 October 2014
10	Niche (2013), Warkworth Mine, Warkworth Sand Woodland Restoration Manual, report prepared for Coal and Allied Industries Limited
11	Cumberland Ecology (2014b) <i>Warkworth Continuation Project 2014: Response to OEH</i> , 7 October 2014 and subsequent emails regarding the application of the BCAM and BBAM
12	Letter from Warkworth Mining Limited to Terry Bailey, Chief Executive OEH dated 3 November 2014
13	Warkworth Continuation Project EIS (SSD 6464) http://majorprojects.planning.nsw.gov.au/index.pl?action=vlew_job&job_id=6464

Part 4: The Measures to Mitigate or Offset the Biodiversity Impact

Methodology

The Warkworth Continuation Project is being considered under the NSW Biodiversity Offsets Policy for Major Projects as a project subject to the Upper Hunter Strategic Assessment (UHSA). In accordance with Offset Principle 2 the proponent has assessed impacts on biodiversity values using the Biodiversity Certification Assessment Methodology (BCAM) on the development site (consistent with the requirement for projects subject to the UHSA), and likely gains in biodiversity on offset sites by using the BioBanking Assessment Methodology (BBAM) (consistent for securing offsets as Biobank sites). Each methodology utilises its own calculator. The BCAM uses the Biodiversity Certification Credit Calculator (BCCC), the BBAM uses the BioBanking Credit Calculator (BBCC).

The BCAM methodology assesses impacts to general biodiversity values based on the conservation significance of native vegetation types, condition and the spatial configuration of native vegetation, including connectivity and the extent of native vegetation cover. The vegetation type, condition and extent to be impacted upon, as well as a number of other attributes, is used in the calculator to derive a value of the impacts which are expressed in the form of ecosystem credits. As part of an assessment of impacts to general biodiversity values BCAM assesses changes in landscape value resulting from the development of a site. Impacts to landscape values consider three attributes:

- Overall change in percent of native vegetation cover in the landscape as a result of a development
- Impacts to the connectivity value of state, regional, and local biodiversity links, as well as impacts to riparian vegetation of major and minor rivers, creeks and minor watercourses
- The impact to adjacent remnant area that a proposed development forms part of. The adjacent remnant area score is determined by the percent native vegetation cleared in the Mitchell Landscape in which most of the proposal occurs.

The BCAM methodology assesses impacts to threatened species in two ways, some species are assessed when they are predicted to occur based on the presence of habitat surrogates and the subsequent impacts to this habitat, these are ecosystem credit species. The impacts to other species cannot be assessed through habitat surrogates, as they cannot reliably be predicted to occur on land through vegetation, distribution, and habitat criteria as identified by the Threatened Species Profile Database or a species may require protection of particular habitat elements, such as breeding habitat, these species are Species Credit species.

In a BCAM assessment an average of the Tg score (ability of the species to respond to improvement in Site Value with management actions) of ecosystem credit species predicted to occur within the site is used to calculate ecosystem credit requirements; whereas Species credits generate credits which are additional to ecosystem credits and are generated based on number of individuals or area of habitat to be impacted upon by the proposal.

A BBAM assessment uses very similar attributes as the BCAM in deriving a value for the offsets. The main difference is that in BBAM, the credit calculation includes a measure of credits generated on an offset site due to improvements in Site Value that are to be achieved through implementing management actions.

Additional Information

As part of the 2003 consent two conservation categories were established: the Non Disturbance Areas and the Habitat Management Areas. The Non Disturbance Areas were established to be conserved in perpetuity and the Habitat Management Areas were established to be managed for conservation for an undefined period, but with the expectation that they might be mined in the future. The 2014 Warkworth Continuation Project will result in the removal of portions of the Habitat Management Areas and the Non-Development Areas established as part of the 2003 consent. As such Warkworth Mining Limited is proposing to re-offset the 2003 impact (see Tables 3 and 4).

4.1 Biodiversity Impact

The *Threatened Species Conservation Act 1995* provides that biological diversity means the diversity of life and is made up of the following three components:

Genetic diversity – the variety of genes (or units of heredity) in any population,
Species diversity – the variety of species,
Ecosystem diversity – the variety of communities or ecosystems.

The proposal impacts upon the following biodiversity values:

- clearing of areas of native vegetation in moderate to good condition and greater than 30 ha extent, in addition to the loss of a minor watercourse means that this vegetation qualifies as a 'local biodiversity link, as described in the Biodiversity Certification Assessment Methodology;
- approximately 459 ha of forest and woodland and 152 ha of grassland (611 ha in total) will be progressively cleared for the proposal over the 21 year project life. The impacts include the removal of six vegetation communities. This includes three Endangered Ecological Communities:
 - *Warkworth Sands Woodland in the Sydney Basin Bioregion*
 - *Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions; and*
 - *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions;*
- the impact on any threatened species or populations (as described below).

Exact numbers of species that occur within the mining footprint of the Warkworth Continuation Project are not available within the EIS. However, within the Study Area (defined in Cumberland Ecology 2014) (Tab 6) for the Warkworth Continuation Project, records were made of 13 species of amphibian, 18 species of reptile, 146 species of bird and 45 species of mammal. Approximately 400 flora species were recorded in the study area; with over 75% of the species being native (Cumberland Ecology 2014) (Tab 6).

The Study Area supports populations of a variety of species and thus the diversity of their gene pool. While no studies have been done to describe the genetic diversity on the site or determine if there is genetic structuring within populations it can be assumed that the clearing of vegetation and habitat for fauna will result in the loss of some of the genetic diversity present. The occurrence of areas of habitat offsite that are managed for conservation, and the proposed establishment and management of biodiversity offset areas will contribute to the maintenance of local genetic diversity.

No threatened flora species were recorded within the Warkworth Continuation Project area. The following threatened fauna species were recorded:

- Little Lorikeet (*Glossopsitta pusilla*) – Vulnerable
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) – Vulnerable
- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) – Vulnerable
- Speckled Warbler (*Chthonicola sagittata*) – Vulnerable
- Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*) – Vulnerable
- Diamond Firetail (*Stagonopleura guttata*) – Vulnerable
- Varied Sittella (*Daphoenositta chrysoptera*) – Vulnerable
- Scarlet Robin (*Petroica boodang*) – Vulnerable
- Glossy Black-Cockatoo (*Calyptorhynchus lathamii*) – Vulnerable
- Spotted Harrier (*Circus assimilis*) – Vulnerable
- Little Eagle (*Hieraaetus morphnoides*) – Vulnerable
- Regent Honeyeater (*Anthochaera phrygia*) – Critically Endangered
- Swift Parrot (*Lathamus discolor*) – Endangered
- Black-breasted Buzzard (*Hamirostra melanosternon*) – Vulnerable
- Squirrel Glider (*Petaurus norfolcensis*) – Vulnerable
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – Vulnerable
- Eastern Freetail Bat (*Mormopterus norfolkensis*) – Vulnerable
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) – Vulnerable
- Little Bentwing-bat (*Miniopterus australis*) – Vulnerable
- Southern Myotis (*Myotis macropus*) – Vulnerable

2014 Warkworth Continuation Project Impact

The primary impacts of the proposal include the removal of 611 ha of native vegetation and the loss of habitat for threatened fauna species recorded within the site. The impacts of the proposal on the vegetation types and habitat have been assessed using the Biodiversity Certification Assessment Methodology (BCAM). Table 1 provides a summary of the vegetation types, the area proposed to be impacted, and the resulting number of credits required to offset these impacts.

Table 2 provides a similar summary of the species credits required using the same methodology.

Table 1: Summary of ecosystem credits required to be offset from the proposed project arising from the "2014 impacts", as calculated by BCAM.

Vegetation Community	Code	Vegetation zone details	Area (ha)	Endangered Ecological Community (EEC)	Number of credits required
Warkworth Sands Woodland (EEC)	HU872	Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area	72.12	Warkworth Sands Woodland in the Sydney Basin Bioregion EEC	3,043
Warkworth Sands Grassland	HU872	Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area	0.67	Not an EEC	16
Central Hunter Grey Box - Ironbark Woodland (EEC)	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	365.54	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	14,192
Regenerating Central Hunter Grey Box - Ironbark Woodland (EEC)	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	6.43	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	108
Central Hunter Grey Box - Ironbark Derived Grassland	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	151.50	Not an EEC	1,773
Central Hunter Ironbark - Spotted Gum - Grey Box Forest (EEC)	HU818	Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	15.11	Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions EEC	576
		TOTAL	611.37		19,708

Table 2: Summary of species credits required to be offset from the proposed project arising from the "2014 impacts".

Species Credit Species	Area of habitat (ha)	Number of credits required
Southern Myotis	165	12,684
Regent Honeyeater	459	12,246

2003 Consent Offsets Impact

The 2014 Warkworth Continuation Project will result in the removal of portions of the Habitat Management Areas and the Non-Disturbance Areas established as part of the 2003 consent. As such Warkworth Mine Limited is proposing to re-offset the 2003 impact. A BCAM assessment of the Impacts for this portion of the proposal is summarised in Table 3 (ecosystem credits) and Table 4 (species credits).

Table 3: Summary of ecosystem credits required to be offset from the Warkworth Continuation Project arising from the 2003 consent offsets impacts.

Vegetation Community	Code	BioMetric Vegetation Type	Area (ha)	Endangered Ecological Community (EEC)	Number of credits required
Central Hunter Grey Box - Ironbark Woodland	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	249.1	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	9,192
Central Hunter Grey Box - Ironbark Derived Grassland	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	227.1	Not an EEC	2,743
Central Hunter Ironbark - Spotted Gum - Grey Box Forest	HU818	Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	1.5	Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions EEC	57
		TOTAL	477.7		11,992

Table 4: Summary of species credits required to be offset from the Warkworth Continuation Project arising from the 2003 consent offsets impacts.

Species Credit Species	Area of habitat (ha)	Number of credits required
Southern Myotis	72	5,538
Regent Honeyeater	250.5	6,683
Large-eared Pied Bat	10.5	139

Utilising the BCAM and BBAM all threatened species that are known to occur within the development site have been accounted for as either ecosystem credits or species credits. Species that are assessed as ecosystem credit species are: Spotted Harrier, Glossy Black-Cockatoo, Little Lorikeet, Swift Parrot, Brown Treecreeper, Speckled Warbler, Grey-crowned Babbler, Varied Sittella, Hooded Robin, Diamond Firetail, Scarlet Robin, Black-breasted Buzzard, Little Eagle, Squirrel Glider, Eastern Bentwing-bat, Little Bentwing-bat, Eastern Freetail Bat and Southern Myotis. Species that have been assessed as species credit species are Regent Honeyeater and Large-eared Pied Bat. The Southern Myotis, Eastern

Bentwing-bat and Little Bentwing-bat can be assessed as either ecosystem credit species or species credit species depending upon the habitat components being impacted. Roosting habitat for these species is assessed as requiring species credits and foraging habitat is assessed as requiring ecosystem credits.

Significance of Warkworth Sands Woodland EEC

Warkworth Sands Woodland Endangered Ecological Community (EEC) is a unique vegetation community in the central Hunter Valley that occurs on local aeolian sand lenses, and given the limited original extent of the underlying substrate the vegetation community it supports had a maximum pre 1750 extent of between 800 and 3,000 ha. It has a current extent of about 464 ha and comprises a mix of typically coastal species, such as Coast Banksia (*Banksia integrifolia*) with more inland species, such as Woolly Mat-Rush (*Lomandra leucocephala*), with plant species found in other local vegetation communities. Warkworth Sands Woodland EEC provides shelter and foraging resources for a number of threatened species, although none are unique to the ecological community (Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited [2013] (Tab 1)).

The proposed project will result in clearing of 72 hectares or 15.5% of the remaining extent of the Warkworth Sands Woodland EEC over the life of the project. The Land and Environment Court heard evidence that the area to be cleared was one of the largest remaining patches of the Warkworth Sands Woodland EEC, and is in good condition (Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited [2013] (Tab 1)).

The proposed impact upon Warkworth Sands Woodland EEC will not result in the extinction of the ecological community per se, given the occurrences of the Warkworth Sands Woodland EEC elsewhere on the mine site and in the general locality. However, the impact is likely to increase the risk of extinction of the Warkworth Sands Woodland EEC (Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited [2013] (Tab 1)). Warkworth Mining Limited has proposed measures to mitigate that risk. Those measures are outlined in Part 4.2 Measures to Mitigate, below.

Warkworth Mining Limited had stated it recognises the significance of the impact upon the Warkworth Sands Woodland EEC and is treating the impacts upon the Warkworth Sands Woodland EEC as an impact requiring further consideration in line with the NSW Biodiversity Offsets Policy for Major Developments (WML 28 October 2014) (Tab 4).

The NSW Biodiversity Offsets Policy for Major Developments states that impacts likely to cause the extinction or significantly reduce the viability of a threatened species, population or ecological community requires further consideration of the consent authority. The consent authority may recommend the project can proceed with additional offsets, supplementary measures or other actions to be undertaken to mitigate the impact (p17-18 NSW Biodiversity Offsets Policy for Major Projects).

4.2 Measures to Mitigate

The measures to mitigate the biodiversity impact of the proposed development are:

- i. WML has made a commitment within the letter from Warkworth Mining Limited to the Chief Executive, Office of Environment and Heritage – Final Warkworth Continuation Biodiversity Offset Strategy dated 28 October 2014 to implement existing, as well as a

number of mitigation measures specific to the Warkworth Continuation 2014, to minimise impacts of the proposed development. These measures are detailed within the *Warkworth Continuation 2014 EIS – Volume 1 Main Report* prepared by EMM and further elaborated upon within Section 5.1.2 of the *Warkworth Continuation 2014 EIS – Volume 3 EIS Appendix H – Ecology Study* prepared by Cumberland Ecology. Minimisation measures include:

1. procedures to minimise clearing and avoid unnecessary disturbance;
2. pre-clearance surveys;
3. clearing protocols to minimise impacts on fauna;
4. relocation habitat features;
5. seed collection and propagation;
6. weed and feral animal control measures;
7. erosion and sedimentation control measures; and
8. specifications for replanting native trees where appropriate

4.3 Measures to Offset

The measures to offset the biodiversity impact of the proposed development are (see references at end of Part 4):

1. The biodiversity offset strategy (WML 28 October 2014) (Tab 4) for the Warkworth Continuation 2014 Project comprises a land-based offset of remnant native vegetation, rehabilitation of post-mined land, supplementary measures to improve Warkworth Sands Woodland EEC, and retirement of any unmet credits in accordance with the rules for the Upper Hunter Strategic Assessment Offset Fund.
2. The land-based offset comprises three areas: The Northern Biodiversity Area, the Southern Biodiversity Area and Rehabilitation of the post-mined landscape of the mine. Rehabilitation of the post-mined landscape to a recognisable and self-sustaining vegetation community attracts 50% of the credits generated by remnant native vegetation in an offset due to the uncertainty about meeting all expectations.
3. The Biodiversity Offsets Strategy includes the protection and management of 75.5 ha of Warkworth Sands Woodland EEC (56 ha in the Southern Biodiversity Area and 19.5 ha in the Northern Biodiversity Area). In addition, the strategy includes the rehabilitation of 156 ha of Warkworth Sand Woodland EEC from native grasslands derived from Warkworth Sands Woodland EEC. Activities to support the rehabilitation of the Warkworth Sands Woodland EEC include preparation of "Warkworth Mine – Warkworth Sands Woodland Restoration Manual" which has been prepared (Niche 2014) (Tab 10), and the finalisation of the "Draft Local Offset Management Plan Warkworth Mine, NSW". Warkworth Mining Limited is proposing as supplementary measures to:
 - a. pose an implementation bond of \$1 million to ensure achievement of specific rehabilitation criteria by year 15, in the event the company fails to achieve those criteria the bond will be relinquished to an appropriate conservation fund.
 - b. the preparation of an integrated management plan for the ecological community to co-ordinate management and recovery efforts across the various landholders.
 - c. The contribution of \$1 million dollars towards the Saving Our Species Program for the Regent Honeyeater.

- d. The conservation of Warkworth Sands Grasslands established under the 2003 development consent; and
 - e. The development of completion criteria for rehabilitation of the Warkworth Sands Woodland EEC.
4. Warkworth Mining Limited is committed to securing an additional land based offset of equal or greater biodiversity value to the Warkworth Sands Woodland EEC impacted by the Warkworth Continuation Project.
 5. Any unmet credits generated by the impact site that are unable to be retired by the above actions would be retired in accordance with the rules for the Upper Hunter Strategic Assessment Offset Fund. Warkworth Mining Limited confirmed that the company intended to retire credits using offset properties referred to at the Goulburn River Biodiversity Area and the Bowditch Biodiversity Area identified in Figure 1 Draft Local Biodiversity Offsets Management Plan (Rio Tinto 2014) (Tab 7) (email from Anthony Russo to Andrew McIntyre of 29 October 2014) (Tab 9).

The biodiversity value of the Northern Biodiversity Offset and Southern Biodiversity Offset areas have been calculated using BBAM.

Table 5 Summary of ecosystem credits calculated for the Northern and Southern Biodiversity Areas and post mined land rehabilitation for the Warkworth Continuation Project

Vegetation Community	Code	BioMetric Vegetation Type	Area (ha)	EEC	Estimated number of credits generated
Warkworth Sands Woodland	Hu60-0	Rough-barked Apple – Coast Banksia shrubby woodland on Warkworth Sands of the central Hunter Valley, Sydney Basin Bioregion	75.65	Warkworth Sands Woodland EEC	593
Warkworth Sands Woodland Derived Grasslands	HU600	Rough-barked Apple – Coast Banksia shrubby woodland on Warkworth Sands of the central Hunter Valley, Sydney Basin Bioregion	159.18	Not an EEC	1,731
Hunter Lowlands Redgum Forest	HU544	Forest Red Gum – Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin Bioregion	32.48	<i>Hunter Lowland Redgum Forest In the Sydney Basin and New South Wales North Coast Bioregions</i> EEC	332
Central Hunter Grey Box – Ironbark Woodland	HU551	Grey Box – Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, NSW North Coast Bioregion and Sydney Basin Bioregion	503.06	Central Hunter Grey Box – Ironbark Woodland In the NSW North Coast and Sydney Basin Bioregions	4,839

Central Hunter Grey Box – Ironbark Woodland Derived Grassland	HU55 1	Grey Box – Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, NSW North Coast Bioregion and Sydney Basin Bioregion	167.25	Not an EEC	1,545
Central Hunter Grey Box – Ironbark Woodland – restored farmland	HU55 1	Grey Box – Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, NSW North Coast Bioregion and Sydney Basin Bioregion	72.07	Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	496
Central Hunter Grey Box – Ironbark Woodland – post-mine rehabilitation	HU55 1	Grey Box – Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, NSW North Coast Bioregion and Sydney Basin Bioregion	2100	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	22,408 x 50% discount for post-mine rehabilitation = 11,204
White Box Woodland	HU65 3	White Box – Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin Bioregion	28.0	White Box - Yellow Box - Blakely's Red Gum Woodland EEC	313
River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	HU59 9	River Red Gum - Yellow Box riparian woodland in the Hunter Valley (Benson 42)	42.05	<i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i>	425
River Red Gum / River Oak riparian woodland wetland in the Hunter Valley - Regeneration	HU59 99	River Red Gum - Yellow Box riparian woodland in the Hunter Valley (Benson 42)	0.73	<i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i>	6
Native Olive – Rusty Fig semi-evergreen vine thicket of the upper Hunter Valley, Sydney basin Bioregion	HU57 8	Native Olive – Rusty Fig semi-evergreen vine thicket of the upper Hunter Valley, Sydney basin Bioregion	1.01	<i>Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions EEC</i>	11
		TOTAL	3,180.59		21,495

Any additional offset areas will need to be assessed using BBAM to calculate the credits to be retired.

A number of ecosystem credit species and species credit species have been recorded within the Northern Biodiversity Area and the Southern Biodiversity Area. These species are listed below.

Northern Biodiversity Offset

- Grey-crowned Babbler (Ecosystem Credit Species)
- *Cymbidium canaliculatum* Endangered Population (Species Credit Species)
- Eastern Bentwing-bat (Ecosystem & Species Credit Species)
- Eastern Freetail Bat (Ecosystem Credit Species)

Southern Biodiversity Offset

- Spotted Harrier (Ecosystem Credit Species)
- Brown Treecreeper (Ecosystem Credit Species)
- Speckled Warbler (Ecosystem Credit Species)
- Grey-crowned Babbler (Ecosystem Credit Species)
- Eastern Freetail-bat (Ecosystem Credit Species)
- Eastern Bentwing-bat (Ecosystem & Species Credit Species)
- *Eucalyptus glaucina* (Species Credit Species)
- Little Bentwing-bat (Ecosystem & Species Credit Species)
- Southern Myotis (Ecosystem & Species Credit Species)
- Squirrel Glider (Ecosystem Credit Species)
- Little Eagle (Ecosystem Credit)

The Northern and Southern Biodiversity Offset Areas also includes vegetation types impacted by the project.

(References: EMM (2014) *Warkworth Continuation 2014, Environmental Impact Statement, Volume 1 – Main Report*, prepared by EMGA Mitchell McLennan for Warkworth Mining Limited, and Cumberland Ecology (2014a) *Warkworth Continuation 2014, Environmental Impact Statement, Volume 3 Appendix H – Ecological Impact Assessment (Tab 6)*, Cumberland Ecology (2014b) (Tab 11)).

Part 5: Evaluation

The adequacy of the impact of the measures to mitigate and the measures to offset the biodiversity impacts of the Warkworth Continuation Project was assessed against the policy principles of the NSW Biodiversity Offsets Policy for Major Projects and the Secretary's Environmental Assessment Requirements for State Significant Development application number SSD 6464 (Tab 3).

1. Policy Principles NSW Biodiversity Offsets Policy for Major Projects

Principle 1: Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

The measures to avoid the biodiversity impact of the proposed development are:

- i. locating mine associated infrastructure away from natural habitats where possible; and
- ii. the closure of Wallaby Scrub Road rather than its relocation. The closure versus relocation of Wallaby Scrub Road reduces the area of vegetation to be removed by approximately 30 ha.

The measures to mitigate the biodiversity impact of the proposed development are:

WML has made a commitment within the letter from Warkworth Mining Limited to the Chief Executive, Office of Environment and Heritage – Final Warkworth Continuation Biodiversity Offset Strategy dated 28 October 2014 to implement existing, as well as a number of mitigation measures specific to the Warkworth Continuation 2014, to minimise impacts of the proposed development. These measures are detailed within the *Warkworth Continuation 2014 EIS – Volume 1 Main Report* prepared by EMM and further elaborated upon within Section 5.1.2 of the *Warkworth Continuation 2014 EIS – Volume 3 EIS Appendix H – Ecology Study* prepared by Cumberland Ecology. Minimisation measures include:

- 1. procedures to minimise clearing and avoid unnecessary disturbance;
- 2. pre-clearance surveys;
- 3. clearing protocols to minimise impacts on fauna;
- 4. relocation habitat features;
- 5. seed collection and propagation;
- 6. weed and feral animal control measures;
- 7. erosion and sedimentation control measures; and
- 8. specifications for replanting native trees where appropriate

Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains.

The impacts and proposed offsets for the Warkworth Continuation Project were assessed in accordance with the Upper Hunter Strategic Assessment and the Upper Hunter Strategic Assessment interim policy (Tab 8). Assessment of impacts was undertaken using the Biodiversity Certification Assessment Methodology. Assessment of the local land based offsets was undertaken using the BioBanking Assessment Methodology. Assessment of both losses and gains has been based on a reliable and transparent method. OEH has reviewed the biodiversity data provided by Warkworth Mining Limited and found the results are in accordance with both calculators (see Table 5).

Warkworth Mining Limited has stated that retiring of the remaining biodiversity credits using land based offsets will be done through the establishment of BioBanking sites.

Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

The land based offsets currently identified by Warkworth Mining Limited support some of the same vegetation communities being impacted. The identified land based offsets also support a suite of species including some of those impacted. The credit calculations show that there are some residual credits that will remain after the land based credits are retired. Some of the remaining credits may be retired by way of supplementary measures as outlined in Principle 6. The NSW Major Projects Offsets Policy provides for variation rules where it can be demonstrated suitable like-for-like offsets cannot be found.

Principle 4: Offsets must be additional to other legal requirements.

Warkworth Mining Limited has indicated it will secure the land based offsets as BioBanking sites. There are currently no other existing conservation agreements over these lands.

Principle 5: Offsets must be enduring, enforceable and auditable.

Warkworth Mining Limited has stated it will secure the land based offsets as BioBanking sites. BioBanking sites are secured in perpetuity and have enforceable undertakings with regard to the protection and ongoing management of the sites. The security and implementation of the agreed management plan for BioBanking sites is audited by OEH.

Principle 6: Supplementary measures can be used in lieu of offsets.

Warkworth Mining Limited has identified the impacts upon the Warkworth Sands Woodland EEC as an impact requiring further consideration consistent with the NSW Major Projects Offsets Policy. The Biodiversity Offsets Strategy for the project identifies a number of land based offset actions as well as a number of supplementary measures to offset those impacts, including a commitment of securing an additional land based offset of equal or greater biodiversity value to the 72 ha of Warkworth Sands Woodland EEC impacted by the Warkworth Continuation Project. This is consistent with the NSW Major Project Offsets Policy.

2. Secretary's Environmental Assessment Requirements (SEARs) for State Significant Development application number SSD 6464.

The SEARs (Tab 3) state that the EIS must address an assessment of the likely biodiversity impacts having regard to the principles and strategies in the draft *NSW Biodiversity Offsets Policy for Major Projects* and the *Upper Hunter Strategic Assessment – Interim Policy*. In accordance with those documents Warkworth Mining Limited has used the Biodiversity Certification Assessment Methodology to calculate biodiversity credits required, and the BioBanking Assessment Methodology to assess offset sites.

The SEARs required a specific assessment of the likely impacts upon the Warkworth Sands Woodland EEC. An assessment of the impacts upon the Warkworth Sands Woodland EEC and a description of the offsets strategy to address those impacts is provided in EMM (2014)(Tab 5), Cumberland Ecology (2014a) (Tab 6), Cumberland Ecology (2014b) (Tab 11), and WML 28 October 2014 (Tab 4)

The SEARs required the provision of alternative offsets for the disturbance area approved under the 2003 development consent, using both the BCAM and BBAM. Warkworth Mining Limited provided details of the BCAM assessment of the 2003 impacts, using the Non-Disturbance Area and Habitat Management Areas established under the 2003 consent. Warkworth Mining Limited identified how it would retire some of the biodiversity credits using the local land based offsets. Warkworth Mining Limited states that the additional credits required will be retired through either additional land based offsets or making a financial contribution to an offsets fund. The calculations for these assessments are provided in Tables 3 and 4 above.

3. Evaluation of the measures to offsets

Warkworth Mining Limited describes their measures to offset in the Biodiversity Offsets Strategy which has three components: impacts on Warkworth Sands Woodland EEC, impacts of non-Warkworth Sands Woodland EEC, and impacts on non-Warkworth Sands Woodland in the 2003 Non Disturbance Area. The adequacy of those offsets is described below.

The impact of the proposed development on Warkworth Sands Woodland EEC would remove about 72 ha, which is about 15.5% of the current extent of this EEC. Warkworth Mining Limited is required to retire 3,059 ecosystem credits for the Warkworth Sands Woodland EEC. The proposed securing of 75 ha of existing Warkworth Sands Woodland EEC in the Southern and Northern Biodiversity Areas, and the rehabilitation of an additional 160 ha of Warkworth Sands EEC delivers an estimated 2,303 ecosystem credits, leaving

756 ecosystem credits to be retired. Warkworth Mining Limited will retire those credits in accordance with the rules for the Upper Hunter Strategic Assessment Offsets fund.

The Land and Environment Court found that, whilst the clearing of 15% of the extent of the Warkworth Sands Woodland EEC will not result in the extinction of the Warkworth Sands Woodland EEC per se, it is considered that it is likely to increase the risk of extinction of the Warkworth Sands Woodland EEC (*Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited [2013] (Tab 1)*).

Warkworth Mining Limited is proposing a number of measures that mitigate that risk. These include:

- the protection and management for conservation of 75.5 ha of Warkworth Sands Woodland EEC in BioBanking sites;
- the rehabilitation of approximately 160 ha of native grasslands derived from Warkworth Sands Woodland back to Warkworth Sands Woodland;
- finalising and implementing both the Draft Local Offsets Management Plan and the Warkworth Sands Woodland Restoration Manual to inform management efforts on the offset lands;
- preparation of an integrated management plan for the ecological community to co-ordinate management and recovery efforts across landholders, and
- additional supplementary measures including a \$1 million financial contribution to the Saving Our Species program for the Regent Honeyeater.

Warkworth Mining Limited has stated that it recognises the significance of the impact upon the Warkworth Sands Woodland, and is treating the impacts upon the EEC as an impact requiring further consideration in line with the NSW Biodiversity Offsets Policy for Major Developments (WML 28 October 2014) (Tab 4).

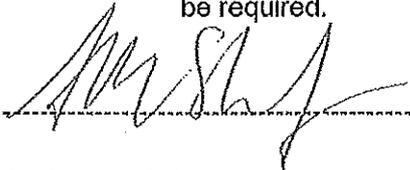
OEH considers that the consent authority should give further consideration to Warkworth Mining Limited's commitment of securing an additional land based offset of equal or greater biodiversity value to the 72 ha of Warkworth Sands Woodland EEC impacted by the Warkworth Continuation Project.

The Offset Package component for the non-Warkworth Sands Woodland EEC component of the Warkworth Continuation Project, including the 2003 extension, comprises land-based offsets, the rehabilitation of approximately 1,227 ha of post-mined land, and the retirement of any unmet credits through land at Goulburn River or Bowditch properties or by appropriate payment into the Upper Hunter Strategic Assessment Offset Fund. These measures to offset the impact of the proposed development on the non- Warkworth Sands Woodland EEC component of the Warkworth Continuation Project are considered adequate as they are consistent with the NSW Biodiversity Offsets Policy for Major Projects.

Part 6: Recommendation

It is recommended that the Chief Executive of the Office of Environment and Heritage:

- Reviews the documents listed at Part 3 and attached to this report; and
- Considers the matters set out in this report; and
- Makes a decision to:
 - A. certify that the measures to mitigate or offset the biodiversity impact of the Warkworth Continuation Project described and evaluated at Parts 4 and 5 of this report, including the additional land based offset of equal or greater biodiversity value to the 72 ha of Warkworth Sands Woodland EEC impacted by the Warkworth Continuation Project, are adequate; and
 - B. Recommend to the consent authority that an additional land based offset of equal or greater biodiversity value to the 72 ha of Warkworth Sands Woodland EEC impacted by the Warkworth Continuation Project should be required.



Andrew McIntyre

Date 4 November 2014

Regional Manager, Hunter Central Coast

Regional Operations Group

Office of Environment and Heritage

Part 7: Decision

I, Terry Bailey, Chief Executive of the Office of Environment and Heritage, having reviewed this report and the documents attached to this report, decide to:

- A. Certify under Clause 14 of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 that the measures to mitigate or offset the biodiversity impact of the Warkworth Continuation Project, described and evaluated at Parts 4 and 5 of this report, including the additional land based offset of equal or greater biodiversity value to the 72 ha of Warkworth Sands Woodland EEC impacted by the Warkworth Continuation Project, are adequate;

AND

- B. Recommend to the consent authority that an additional land based offset of equal or greater biodiversity value to the 72 ha of Warkworth Sands Woodland EEC impacted by the Warkworth Continuation Project should be required.

OR

- C. ~~Not certify that that the measures to mitigate or offset the biodiversity impact of the Warkworth Continuation Project, described and evaluated at Parts 4 and 5 of this report, including the additional land based offset of equal or greater biodiversity value to the 72 ha of Warkworth Sands Woodland EEG impacted by the Warkworth Continuation Project, are adequate.~~



Terry Bailey
Chief Executive
Office of Environment and Heritage

4 November 2014.

Date

Appendix M

Revised Statement of Commitments



Appendix M — Revised Statement of Commitments



Table M.1 Commitments

Item	Commitments
General	Upon receipt of development consent, all management plans relevant to the proposal would be updated with requirements as specified in this EIS and any subsequent response to submissions report.
Noise	<p>Management and monitoring of noise would continue to be undertaken in accordance with the MTW noise management plan. The noise management plan would be reviewed and updated to include the following additional management measures:</p> <ul style="list-style-type: none"> • Land acquisition: <ul style="list-style-type: none"> - acquisition rights would be afforded to one additional privately-owned assessment location (34) predicted to experience noise levels above the relevant criteria for operational noise under prevailing meteorological conditions.
Air quality and GHG	Management and monitoring of air quality would continue to be undertaken in accordance with the MTW AQMP. The MTW AQMP would be reviewed and updated to incorporate the proposal.
Groundwater	<p>Management and monitoring of groundwater would continue to be undertaken in accordance with the MTW WMP. The MTW WMP would be reviewed and updated to include the additional management measures prescribed below.</p> <ul style="list-style-type: none"> • Updates to current groundwater monitoring programme: <ul style="list-style-type: none"> - installation of nested monitoring bores along the Wollombi Brook (PZ10, PZ11, PZ12); and - installation of monitors bores with the Warkworth Sands system as part of an update to the existing Warkworth Sands Ephemeral Perched Aquifer Management Plan within the MTW WMP. • Mine seepage monitoring programme: <ul style="list-style-type: none"> - recording of the time, location and estimated volume of any unexpected increased groundwater outflow from the highwall and endwall; - measurement of water pumped from the mine, preferably using flow meters or other suitable gauging apparatus; - correlation of rainfall records with mine seepage records so groundwater and surface water can be separated; and - monitoring of coal moisture content. • Data management and reporting: <ul style="list-style-type: none"> - establishment of trigger levels; - quarterly review of groundwater levels and field water quality against trigger levels, with site-specific investigations initiated; - formal review of depressurisation of coal measures and alluvium would be undertaken annually by a suitably qualified hydrogeologist; - annual reporting (including all water level and water quality data); and - all groundwater data being stored in a database customised for MTW with suitable QA/QC controls. • Future model iterations:

Table M.1 Commitments

Item	Commitments
	<ul style="list-style-type: none"> - assess the validity of the model predictions every three years; and - incorporate into the model and revise predictions, if required. • Licensing: <ul style="list-style-type: none"> - retain and obtain appropriate water licences, as required, to account for modelled take.
Surface water	<p>Management and monitoring of surface water would continue to be undertaken in accordance with the MTW WMP. The MTW WMP will be reviewed and updated to include the following additional management measures:</p> <ul style="list-style-type: none"> • Licensing: <ul style="list-style-type: none"> - retain and obtain appropriate water licences, as required, to meet operational requirements. • Surface water monitoring programme: <ul style="list-style-type: none"> - update to include locations of new dams as they are constructed (ie NOOP and Sediment Dam B) with EC, pH and TSS monitored monthly and a comprehensive analysis six monthly.
Ecology	<p>Management and monitoring of ecology would be undertaken in accordance with the OEH certified biodiversity offset strategy which would include:</p> <ul style="list-style-type: none"> • establishment of two offset sites (SBA and NBA) for the conservation of WSW and non-WSW vegetation; • contribution to the UHSA and the use of supplementary measures to meet the outstanding credit requirements; • proposed rehabilitation of mined areas; and • secure and manage land-based offsets of equal or greater conservation value with a spend of up to \$3million within 12 months of development consent
Aboriginal and cultural heritage	<p>Management and monitoring measures to be implemented for Aboriginal and cultural heritage comprise:</p> <ul style="list-style-type: none"> • Preparation of an integrated HMP. • Management of Aboriginal cultural heritage at the Site, including: <ul style="list-style-type: none"> - implement only the agreed impact management measures for those places for which development impacts are unavoidable, with avoidance through design planning being the preferred option; - continue investigations into the feasibility of moving the Site M grinding grooves (37-6-0163); and - involve the Aboriginal community in the implementation of all impact management measures consistent with the existing CHWG processes and protocols with such being formalised and conducted under a terms of reference. • Establish and manage WBACHCA in accordance with a customised management plan developed in consultation with the CHWG and other stakeholders including DP&E and OEH.

Table M.1 Commitments

Item	Commitments
Historic heritage	<ul style="list-style-type: none"> • Management of other 'onsite' Coal & Allied owned lands in accordance with such procedures and protocols as outlined within the provisions of the CHMS and ACHMP (or HMP). • Implement the outcomes of the Hunter Valley Sand Bodies Research Study. <hr/> <p>Management and monitoring to be implemented for historic heritage comprise:</p> <ul style="list-style-type: none"> • Conservation Management Plans: <ul style="list-style-type: none"> - adopt the measures of existing CMPs for the former RAAF Base Bulga Complex, Brick Farm House and the Great North Road Complex; - prepare a CMP for the Springwood Homestead. • Archaeological investigations: <ul style="list-style-type: none"> - test pit along locations of Wallaby Scrub Road where there is potential for subsurface remains associated with the early road system; - mechanical excavation and recording of Well #2; and - test excavation of the eastern runway of the former RAAF Base Bulga Complex. • Salvage of moveable heritage items: <ul style="list-style-type: none"> - approach Singleton Local Historical Society and Museum to offer opportunity for salvage of moveable heritage items. • Implement a Chance Finds Procedure. • Heritage interpretation: <ul style="list-style-type: none"> - establish an interpretation programme of the heritage values of the RAAF Base Bulga Complex and the Great North Road Complex, in collaboration with the local community groups. • Local Community Historic Heritage Conservation Initiative: <ul style="list-style-type: none"> - establish two historic heritage funds – the Mount Thorley Warkworth Historic Heritage Conservation Fund and the Great Northern Road Conservation Fund.
Traffic and transport	<p>Management and monitoring measures to be implemented for traffic and transport comprise:</p> <ul style="list-style-type: none"> • Wallaby Scrub Road: <ul style="list-style-type: none"> - prepare a road closure implementation plan for Wallaby Scrub Road, in conjunction with the relevant road authorities and emergency services, which will include strategies to minimise potential impacts of the closure. • Emergency services access road: <ul style="list-style-type: none"> - construct an emergency access road, in accordance with the guidelines provided in <i>Planning for Bush Fire Protection</i> (RFS 2006) and the NSW Bushfire Coordinating Committee Policy No. 2/2007, between Putty Road and the Golden Highway prior to the closure of Wallaby Scrub Road.

Table M.1 Commitments

Item	Commitments
	<ul style="list-style-type: none"> • Road safety review: <ul style="list-style-type: none"> - review the existing speed advisory and curve warning signs for all the curves on the roads which are likely to be used by detoured traffic (ie Putty Road, Broke Road, and Golden Highway) prior to the closure of Wallaby Scrub Road.
<p>Final landform and rehabilitation</p>	<p>Rehabilitation will continue to be undertaken in accordance with the MOP. Should the proposal and the Mount Thorley Operations 2014 be approved, the plan will be updated to include objectives for combined MTW rehabilitation as described below.</p> <ul style="list-style-type: none"> • Rehabilitation domain objectives: <ul style="list-style-type: none"> - progressively establish approximately 2,100ha of EEC woodland (an ironbark community) across the combined MTO and Warkworth Mine; and - create an additional north/south wildlife corridor providing connectivity to other habitat. • Post-mining management: <ul style="list-style-type: none"> - upon determination of the closure of Warkworth Mine, prepare a Closure Strategy and subsequent Closure Management Plan, in consultation with employees and relevant external stakeholders. The Closure Management Plan would include: <ul style="list-style-type: none"> ▪ a description of specific technical solutions related to infrastructure and facilities for the preferred closure option or options; ▪ full auditable details of closure cost; ▪ a detailed communication plan that is executed in a timely, consistent and transparent manner. This must target all internal and external stakeholders; and ▪ a socio-economic mitigation programme. - prepare a final void management plan at least five years prior to completion of mining and include: <ul style="list-style-type: none"> ▪ identification of possible beneficial uses for the void; ▪ review of modelling and predictions of long-term hydrological behaviour and water quality responses, including final void water quality and level; ▪ long-term integrity of void slopes; ▪ waste characterisation and containment as pertains to runoff into final voids; ▪ coal seam capping; and ▪ long-term management, monitoring and mitigation measures.

Table M.1 Commitments

Item	Commitments
Visual amenity	<p>Management and monitoring of visual amenity will continue to be undertaken in accordance the draft MTW VIMP which will be updated to include the following additional measures:</p> <ul style="list-style-type: none"> • SSVA: <ul style="list-style-type: none"> - develop a process to enable any landowner who perceives a significant visual impact from the proposal to receive a SSVA. The assessment will recommend appropriate mitigation if required for high impacts which will be implemented in consultation and agreement with the landowner. • Onsite mitigation: <ul style="list-style-type: none"> - examine, in detail, high sensitivity viewing points and determine opportunities for relevant screening treatments including site boundary treatments; - minimise the amount of pre-rehabilitation areas exposed to view by establishing grass cover to remove colour contrast; and - establish planting patterns of trees and grasses in rehabilitation areas to create a high level of visual integration with the surrounding landscape.
Social	<p>Socio-economic initiatives to be implemented under the proposal comprise:</p> <ul style="list-style-type: none"> • the development of a Social Impact Management Plan (SIMP) to manage and monitor the implementation of strategies to reduce identified social impacts and enhance social opportunities. The SIMP would detail implementation responsibilities; timing; performance indicators and targets; and monitoring measures. The SIMP would be prepared in consultation with key stakeholders, following the EIS public exhibition and submissions process. The key aims of the SIMP would be to: <ul style="list-style-type: none"> - reflect the findings and recommendations of the SIA and provide a short summary of findings; - summarise for all stakeholders the potential positive and negative impacts of the proposal, proposed mitigation and management strategies, and implementation actions; - be developed for the life of the proposal; and - promote an active and ongoing role for communities, local authorities and all levels of government through construction, operation and decommissioning of a proposal. • the negotiation of a VPA with Singleton Council. The VPA would present an opportunity to ensure a proportion of the funds are dedicated to maintaining and/or improving facilities and services in Bulga, other local neighbouring communities, and the Singleton LGA as a whole. • the contribution of the establishment of a Near Neighbour Amenity Resource to provide support to residents surrounding the operation.



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