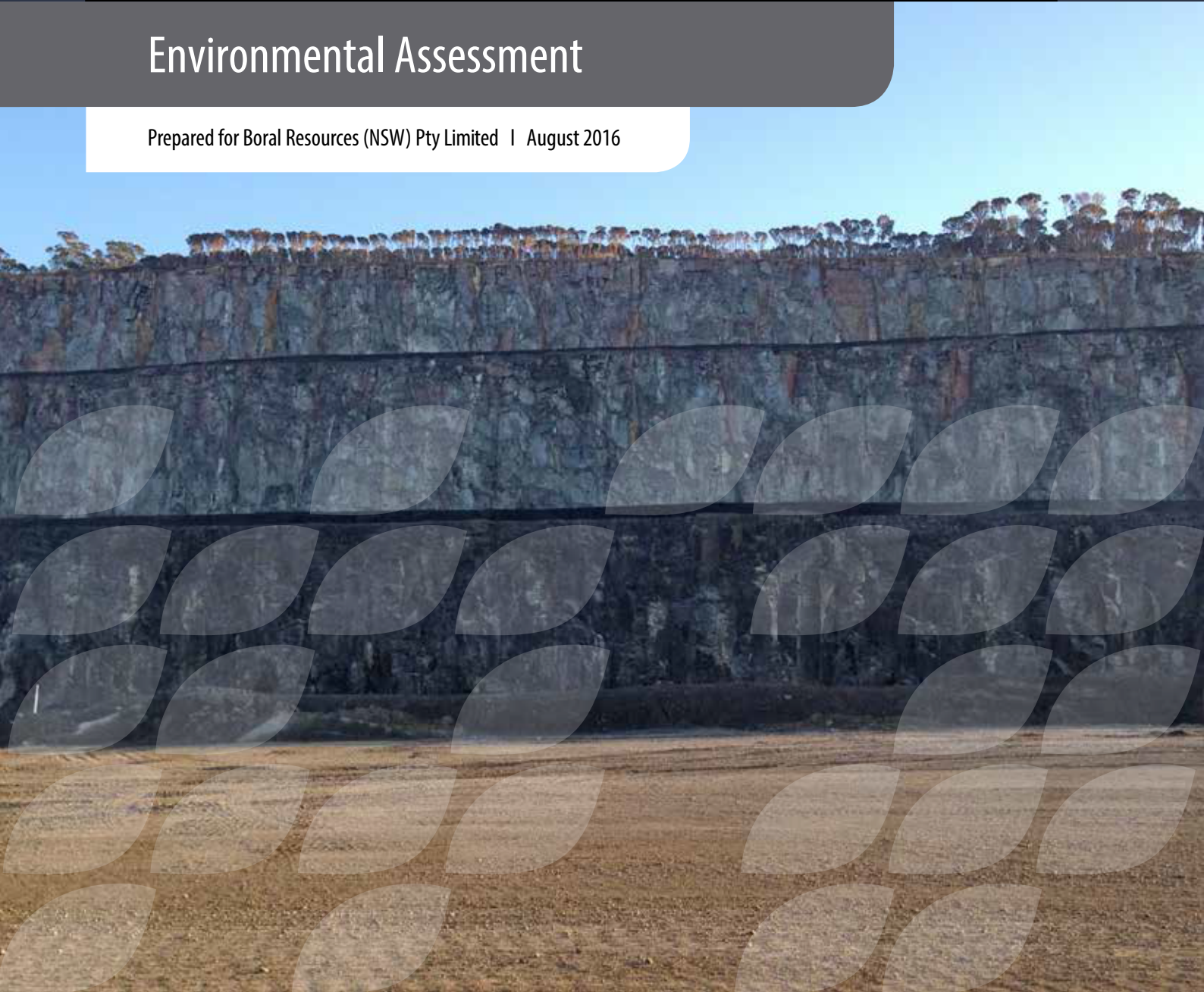




Dunmore Quarry – Modification 8

Environmental Assessment

Prepared for Boral Resources (NSW) Pty Limited | August 2016



Environmental Assessment

Dunmore Hard Rock Quarry

Modification 8

Prepared for Boral Resources (NSW) Pty Limited | 8 August 2016

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Environmental Assessment

Final

Report J16050RP1 | Prepared for Boral Resources (NSW) Pty Limited | 8 August 2016

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1 Introduction

1.1 Overview

Dunmore Hard Rock Quarry (the quarry) is located at the end of Tabbita Road, Dunmore in the Shellharbour local government area (LGA). It is owned and operated by Boral Resources (NSW) Pty Limited (Boral).

This environmental assessment (EA) has been prepared to accompany an application to modify the existing development consent for the quarry (Development Consent 470-11-2003) originally approved in September 2004 and subsequently modified seven times. This modification application is Modification 8 and is referred to in this document as 'the proposed modification'.

It is proposed to remove overburden located in the southern section of the approved Croome Farm Pit extraction area at the quarry to enable extraction of approved hard rock reserves under the overburden. The extracted overburden will be used to construct a bund around part of the future Croome Farm Pit extension area (Croome Farm West Pit), which will be subject to a subsequent application to modify the development consent, namely Modification 9.

The bund and Croome Farm West Pit (subject to Modification 9) have been designed taking into account the results of a number of preliminary assessments, including ecological, noise, groundwater, visual and heritage assessments. In particular, the results of the ecological assessment have meant that the bund and Croome Farm West Pit were designed to avoid endangered ecological communities and significant stands of native vegetation.

The proposed modification also includes some minor administrative amendments to some of the conditions of quarry's development consent to remove redundant conditions and to reflect contemporary management practices at the quarry.

The proposed modification is sought under section 75W of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 Project need

Hard rock has been extracted from the quarry for approximately 90 years. The quarry has an extensive and high quality resource and, due to its ability to rail product into the Sydney metropolitan market, is a key asset for Boral. In April 2016 there was approximately 1.4 million tonnes (Mt) of accessible rock remaining within the approved extraction boundary for the quarry. At the current extraction rate of 130,000 tonnes per month (tpm), it is estimated that these rock reserves will be exhausted by February 2017.

To enable continuation of the current operations until Modification 9 is approved, it is proposed to extract an area of approved reserves within the southern corner of the Croome Farm Pit extraction area. Approximately 130,000 cubic metres (m³) of overburden (including 64,800 m³ free dig material and 62,200 m³ of weathered hard rock) is located in this area. To avoid double handling and to provide pre-emptive noise and visual management, approximately 50% of the extracted overburden will be used to construct a bund along the proposed boundary of the future Croome Farm West Pit.

1.3 The proponent

Boral is the proponent for the proposed modification. Boral is a wholly owned subsidiary of Boral Limited.

Boral Limited is an Australian owned, international building and construction materials group, with its headquarters in Sydney, Australia. With more than \$5.2 billion worth of annualised sales, Boral Limited primarily serves customers in the building and construction industries with operations concentrated in three key geographical markets – Australia, the USA and Asia. Boral Limited has around 11,000 full-time equivalent employees.

In Australia, Boral Limited has around 500 operating sites. Boral Limited produces and distributes a broad range of construction materials, including quarry products, cement, fly ash, pre-mix concrete and asphalt; and building products, including clay bricks and pavers, clay and concrete roof tiles, concrete masonry products, plasterboard and timber.

The Boral Construction Materials and Cement division employs around 5,000 people alone in its quarry, concrete, asphalt, concrete placing and cement operations.

Boral operates 30 quarries across NSW and the ACT. These quarries extract hard rock, sand and gravel with products being supplied to both internal and external customers for the production of:

- asphalt and concrete, for the construction of road pavement by government, major private civil engineering companies and smaller road building contractors;
- for general construction materials by small and large builders and developers; and
- for general landscaping and related works.

1.4 Approvals pathway and environmental assessment requirements

Under Clause 8J(8) of the *NSW Environmental Planning and Assessment Regulations 2000* (EP&A Regulation), a development consent relating to State significant development (SSD) that was granted by the Minister under Part 4 of the EP&A Act before 1 August 2005 is taken to be an approval under Part 3A of the EP&A Act, for the purposes of a modification only, and section 75W of the EP&A Act applies to any modification of such a consent. Under section 75W, the request for the Minister's approval for a modification is to be lodged with the Secretary of the Department of Planning and Environment (DP&E). The Secretary may notify the proponent of formal environmental assessment requirements (SEARs) with respect to the proposed modification that the proponent must comply with before the modification will be considered by the Minister or the Minister's delegate.

Representatives from Boral and EMM Consulting Pty Limited (EMM) met with representatives from DP&E on 13 May 2016 to discuss issues to be assessed in this EA. Representatives from DP&E stated that while formal SEARs would not be required for the proposed modification, they would provide environmental assessments requirements via email. These were provided by DP&E on 14 May 2016.

Table 1.1 details the environmental assessments requirements and notes the relevant section of the EA where they are addressed.

Table 1.1 Environmental assessment requirements

Requirement	EA reference
General requirements	
A comprehensive description of the development, an assessment of the potential impacts of the development, and the reasons why the development should be approved, having regard to the economic, social and environmental aspects of the development and taking into consideration the objects of the <i>Environmental Planning & Assessment Act 1979</i> .	Chapters 3, 6 - 10
Biodiversity	
- accurate predictions of any vegetation clearing on site; - a detailed assessment of the potential biodiversity impacts of the development, paying particular attention to threatened species and/or populations (or their habitats) and endangered ecological communities; and - a detailed description of the proposed measures to maintain or improve the biodiversity values of the site in the medium to long term, as relevant.	Chapter 6
Air	
An assessment of the likely air quality impacts of the development in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW. The assessment is to give particular attention to potential dust impacts on any nearby private receivers due to construction activities, the operation of the quarry and/or road haulage.	Chapter 7
Noise	
An assessment of the likely construction and operational noise and vibration impacts of the development in accordance with the NSW Industrial Noise Policy and the Interim Construction Noise Guideline.	Chapter 8
Visual	
Including an assessment of the likely visual impacts of the development on any surrounding private landowners and key vantage points in the public domain, paying particular attention to impacts on any nearby private residences and road users.	Chapter 9
Consultation	
You should consult with relevant local, State or Commonwealth Government authorities, infrastructure and service providers and any surrounding landowners that may be impacted by the development	Chapter 4

2 Background

2.1 Site and surrounds

The quarry is located at Boral's Dunmore landholdings on and surrounding Tabbita Road approximately 12 kilometres (km) north-west of Kiama and 110 km south of Sydney (see Figures 2.1 and 2.2). Tabbita Road can only be accessed from the Princes Highway and provides access to the quarry and Boral's adjacent operations – Dunmore Sand and Soil (DSS) Quarry and the Dunmore Concrete Batching Plant (CBP).

Nearby residential suburbs to the quarry include Shell Cove, Minnamurra, Kiama Downs, Mount Terry and Albion Park. Surrounding land uses are primarily rural, rural residential and industrial. Jamberoo Action Park is approximately 2.5 km south-west of the quarry. There are a number of other quarrying operations in the local area including Holcim's Albion Park Quarry, Cleary Brothers' Albion Park Quarry, and Hanson's Bass Point Quarry. Other industrial land uses proximate to the quarry include Dunmore Resources and Recycling, Integral energy, and Dunmore Waste Depot.

The landownership of the quarry, its surrounds, and the location of nearby residential dwellings ('receivers') are shown in Figure 2.3. Nearby privately owned and quarry owned residential dwellings that were assessed in the EA and technical studies are listed in Table 2.1.

Table 2.1 Assessment locations

Reference ID	Description	Comments	Easting	Northing
A	Boral owned	Tenanted	298737	6168168
B	Boral owned	Tenanted	298098	6167942
C	Boral owned	Tenanted	298173	6168084
D	Privately owned		298183	6169201
E	Boral owned	Tenanted	298513	6169517
F	Privately owned		298285	6169804
G	Privately owned		298176	6169349
H	Boral owned	Tenanted	300340	6167584
I	Boral owned	Dunmore Sand and Soil, tenanted	301331	6167096
J	Privately owned	Negotiated agreement in place	301505	6167630
K	Privately owned		301395	6167360
L	Boral owned	Dunmore Sand and Soil, tenanted	300747	6168671
M	Other quarry owned	Holcim	300879	6168919
N	Boral owned	Dunmore Sand and Soil, tenanted	301589	6168870
O	Privately owned		301486	6166699
P	Privately owned		300905	6166707
Q	Boral owned	Tenanted	298925	6166759
R	Boral owned	Tenanted	298298	6167363
S	Privately owned		298214	6167335
T	Privately owned		297519	6168261
U	Privately owned		302001	6168472
V	Privately owned		302177	6168691
W	Privately owned		302224	6169262
X	Privately owned		301651	6169245

Table 2.1 **Assessment locations**

Reference ID	Description	Comments	Easting	Northing
Y	Boral owned	Tenanted	297557	6167925
Z	Privately owned		298173	6169276
AA	Privately owned		297979	6169974
AB	Privately owned		297587	6170062
AC	Privately owned		297304	6169436
AD	Privately owned		297401	6167717

The quarry is on Locking Hill, which slopes down from the west to the east. Elevation decreases from approximately 160 m Australian Height Datum (AHD) at the western extent of the quarry to approximately 30 m AHD in the east. Rocklow Creek is to the south of the quarry. To the north and south of the quarry are large stands of remnant vegetation, with smaller pockets of vegetation to the west. A generally continuous vegetated buffer lies between the residential areas of Albion Park and Mount Terry and the quarrying operations to the east.

2.2 Climate

Boral has been collecting meteorological data since July 2002 from a meteorological monitoring station north-west of the Croome Farm extraction area within the property boundary. Data has also been obtained from the Bureau of Meteorology's (BoM) climate station at Kiama Bowling Club.

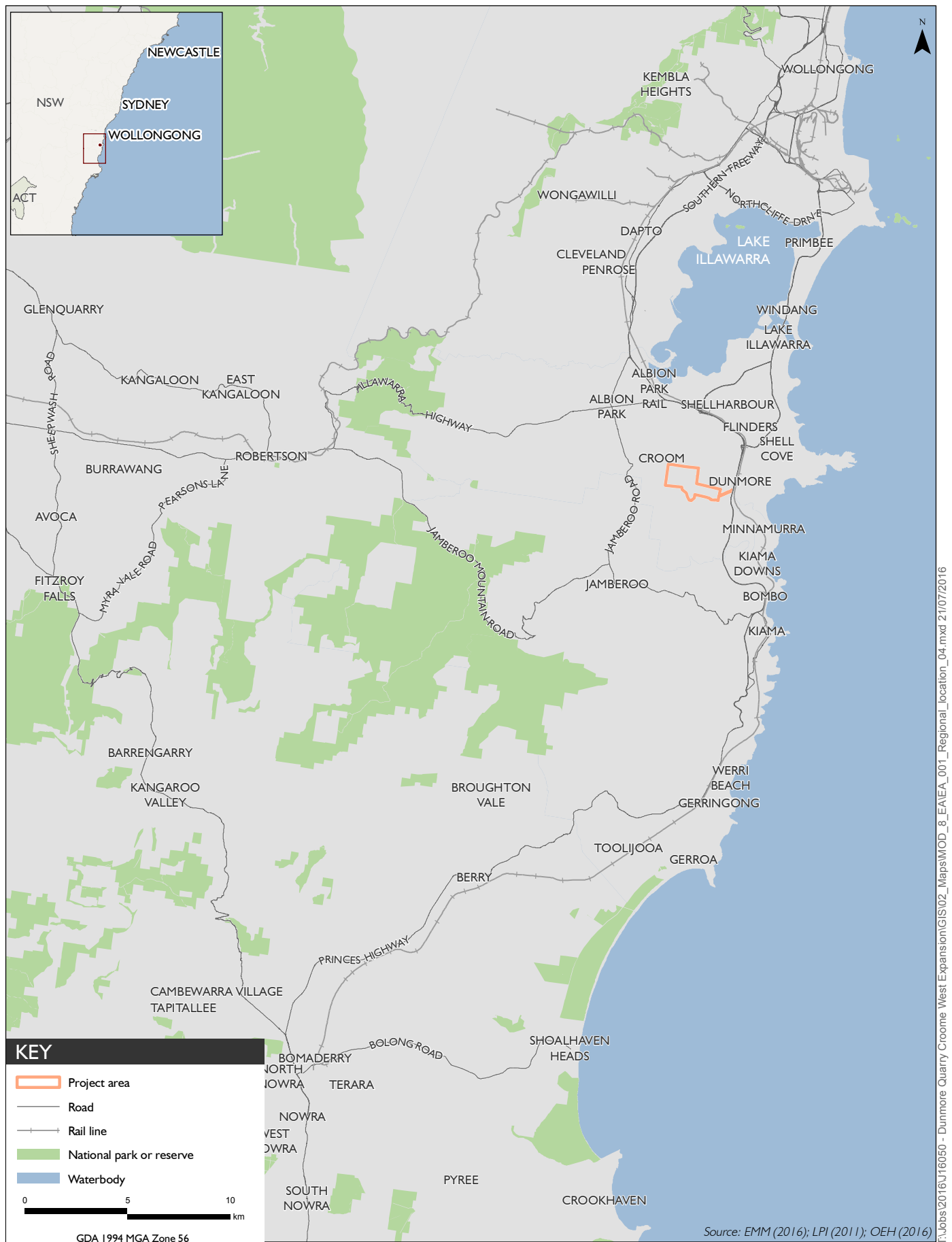
Monthly mean minimum temperatures are in the range of 9 degrees Celcius (°C) to 18°C, with mean maxima of 17°C to 25°C. Peaks occur during summer months with the highest temperatures typically being recorded between December and February. The lowest temperatures are usually experienced between June and August. The area is characterised by high rainfall, with a mean annual rainfall of approximately 1,250 millimetres (mm), and an annual rainfall range between 600 mm and 2,715 mm. Rainfall is most pronounced in late summer to early winter months, peaking in March.

2.3 Landownership

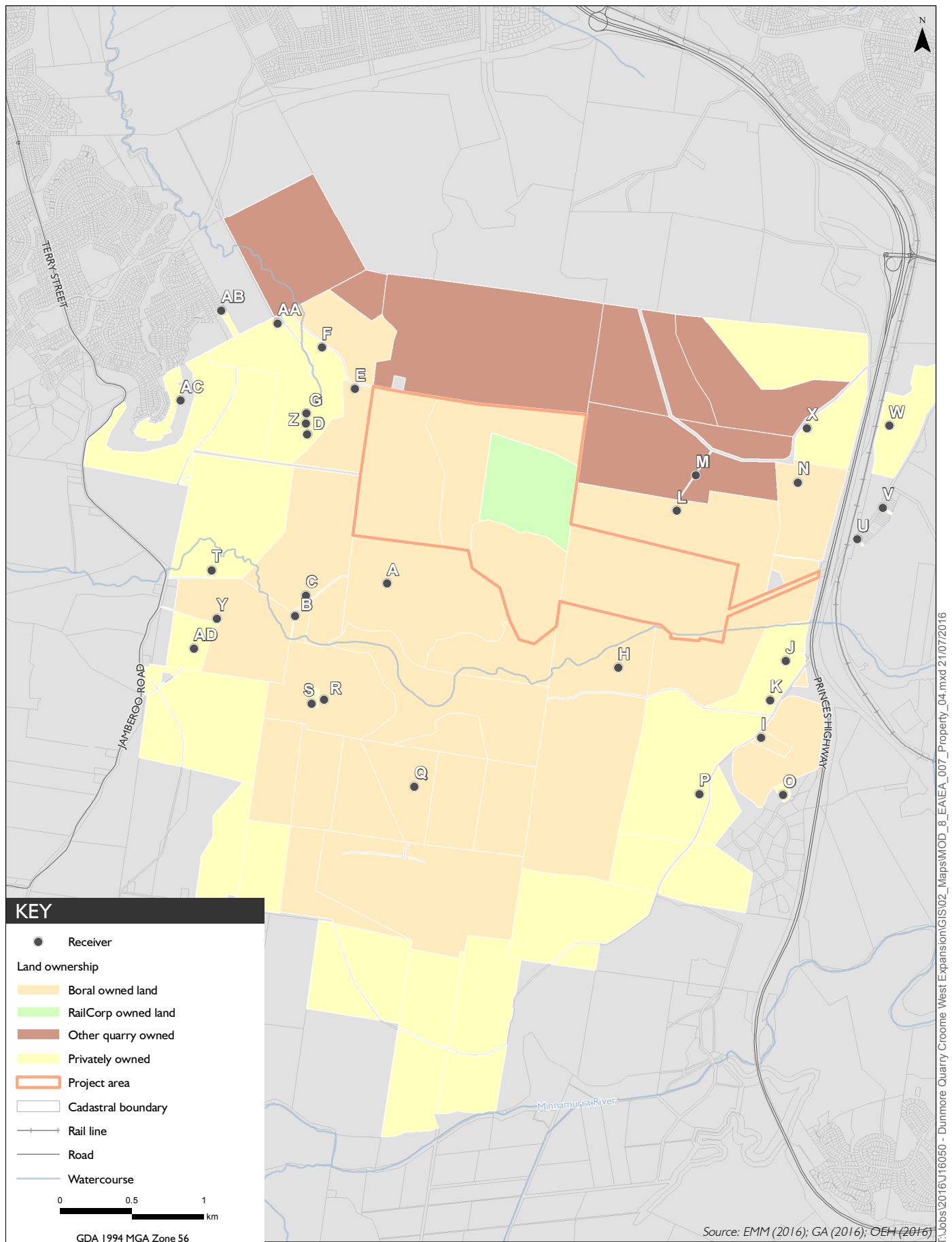
The quarry project area is 245.4 hectares (ha) in size and contains five cadastral lots as shown in Figure 2.4.

- Lot 2 in Deposited Plan (DP) 224597, contains the Croome Farm Pit.
- Lot 1 in DP 224597, the location of the future Croome Farm West Pit.
- Lot 1 in DP 1002951, the Rail Corp extraction area.
- Lot 4 in DP 227046, a heavily vegetated area south of the quarry.
- Lot 3 in DP 1030504, the location of the original Dunmore Quarry, currently used for stockpiling and processing.

Lot 1 in DP 1002951 is owned by Rail Corp with the remaining land owned by Boral.







Surrounding land ownership
Dunmore Quarry Modification 8
Environmental Assessment
Figure 2.3



2.4 Existing operations

2.4.1 Approvals history

In September 2004, the then Minister Assisting the Minister of Infrastructure and Planning issued Development Consent 470-11-2003 under Part 4 of the EP&A Act, which allowed production at the quarry to increase from 1.2 million tonnes per annum (Mtpa) to 2.5 Mtpa. The development was classified as SSD, under section 76A(7) of the EP&A Act, because it is an extractive industry where the proposed rate of production exceeds the threshold limits specified in the Ministerial declaration of 3 August 1999.

Subsequent to issue of the consent, a number of modifications under section 96 of the EP&A Act were approved. These were:

- Modification 172-11-2005 (approved in December 2005) which allowed for the construction of a new amenities block on the site;
- Modification 59-4-2006 (approved in June 2006) which amended the vegetation offset requirements and the approved transport route, extended the deadline for dam upgrade works, and removed the Croome Farm Catchment water management works;
- Modification 3 (approved in May 2008) which allowed for the construction of a new workshop, office and amenities buildings;
- Modification 4 (approved in November 2008) which extended the approved extraction area on land owned by RailCorp by 2.82 ha and changed the stormwater management design criteria for the site; and
- Modification 5 (approved in November 2008) which allowed for a truck parking facility, including amenities, for company trucks that service the quarry.

Since the above approvals, two applications have been approved under section 75W of the EP&A Act:

- Modification 6 (approved in February 2014) which allowed for an increase in the amount of material approved for road transport and an extension of the approved extraction area by 2 ha; and
- Modification 7 (approved in October 2015) which allowed for construction and operation of a mobile blending plant and the cessation of continuous noise monitoring at a nearby residence.

The proposed modification, subject of this EA, is Modification 8.

2.4.2 Approved project

i Principal activities and infrastructure

The principal activities and infrastructure at the quarry are shown on Figure 2.4 and comprise the following.

- existing and former extraction areas known as the original Dunmore Quarry, Croome Farm and RailCorp extraction areas with approximately 100 ha of approved extraction area;
- processing plant, which incorporates staged crushing and screening facilities;

- product stockpiles;
- fines stockpiles;
- office, car park and weighbridge;
- workshop and maintenance area;
- rail siding for the loading of product;
- laboratory for the testing of materials; and
- water control structures including dams, pumps and water tanks.

ii [Extraction operations](#)

Hard rock has been extracted from the quarry for approximately 95 years. The quarry has an extensive resource and, due to its ability to rail product into the Sydney metropolitan market, is a key asset for Boral. Resources within the approved extraction area include latite and breccia agglomerate, hard rocks used in road, rail and engineering applications. Due to its superior strength and structure, latite is used mainly as rail ballast, in sea walls, and other aggregate applications, whereas breccia agglomerate is used in fill or in a blend for road base.



Photograph 2.1 **Looking east-south-east from the north-western corner of the Croome Farm Pit towards the RailCorp extraction area**



Photograph 2.2 Looking south-east over of the Croome Farm Pit from the north-western corner of the pit



Photograph 2.3 Looking south-west over the Croome Farm Pit from the north-eastern corner of the pit

As stated above, Boral has approval for the production of 2.5 Mtpa of quarry products which is up to 12,000 t of rock extracted per day. The quarry is currently extracting around 5,000 t per day or 130,000 t per month.

iii Product transportation

The quarry is part of Boral's integrated quarry and distribution network that supplies quarry products to the greater Sydney region, which includes metropolitan Sydney and the outer lying regional areas of the Hunter, lower Blue Mountains, Illawarra, Southern Highlands and Southern Tablelands. The quarry currently supplies products to the local Illawarra and Southern Highland markets by road and eastern metropolitan Sydney by road and rail for direct use on site or road distribution.

The quarry currently has approval to transport up to 2.5 Mtpa of quarry products by road and rail, with road transport limited to 1.5 Mtpa. Two train deliveries carrying approximately 1,600 t each of aggregates and manufactured sand from DSS depart to Sydney each day. Currently quarry products are railed to Boral's terminals at Enfield and St Peters.

The remainder of product is trucked along Tabbita Road and then onto the Princes Highway primarily by six axle truck and dog trailer combination vehicles, each carrying approximately 33 t of material per load. Approximately 87.5% of truck deliveries are currently to the north with the remainder (12.5%) to the south. The majority of current road deliveries to the north supply the local Illawarra and Southern Highland markets.

iv Hours of operation and employment

The approved hours for extraction and processing activities at the quarry are 6 am to 10 pm Monday to Saturday. Drilling activities during the evening period (ie between 6 pm and 10 pm) are confined to the second or third bench levels and blasting is undertaken between 9 am and 5 pm Monday to Saturday, as approved by the Environment Protection Authority (EPA). Product transfer to stockpiles is allowed between 6 am to midnight Monday to Saturday. Maintenance can be undertaken 24 hours a day, seven days a week.

Approved hours for distribution of material by road are 24 hours Monday to Saturday with distribution on Sundays allowed between 8 am and 6 pm for 15 Sundays per year. Distribution by rail can be undertaken 24 hours a day, seven days a week.

Around 30 people are currently employed at the quarry as well as 10 road truck drivers for deliveries.

3 Proposed modification

3.1 Overview

Boral propose to construct a bund in preparation for an extension of the Croome Farm Pit (Croome Farm West Pit). The bund will be constructed using overburden in the southern end the Croome Farm Pit which has approval to be removed under Development Consent 470-11-2003. In addition, it is proposed to amend a number of conditions within the development consent, including removing conditions that are no longer relevant to the quarry's operations. The location of the bund and the associated area of disturbance are shown in Figure 3.1.

No other changes to approved operations at Dunmore Quarry are proposed, including approved production volumes, transportation volumes and hours of operation.

Details on the construction of the bund and the proposed amendments to the development consent are provided below.

3.2 Construction of bund

3.2.1 Extraction of overburden

Boral propose to remove approximately 130,000 m³ of overburden in the south of the approved Croome Farm Pit extraction area (Figure 2.4), which will comprise 64,800 m³ free dig material and 62,200 m³ of weathered hard rock. The free dig material will be used to construct the bund and the remaining material will be used in Dunmore Quarry for rehabilitation or for construction of ramps. Once accessible, hard rock under the overburden will be extracted, processed and dispatched to customers consistent with existing operations.



Photograph 3.1 Looking south towards overburden to be removed in the south of the Croome Farm Pit

Approval is not sought for this activity as it will be undertaken in the approved extraction area under Development Consent 470-11-2003. However, it is described here to demonstrate that the material required to construct the bund will be sourced from the quarry without requiring material to be imported to site from other sources in the region.

The removal of the overburden to construct the bund will also eliminate the double handling of the material.

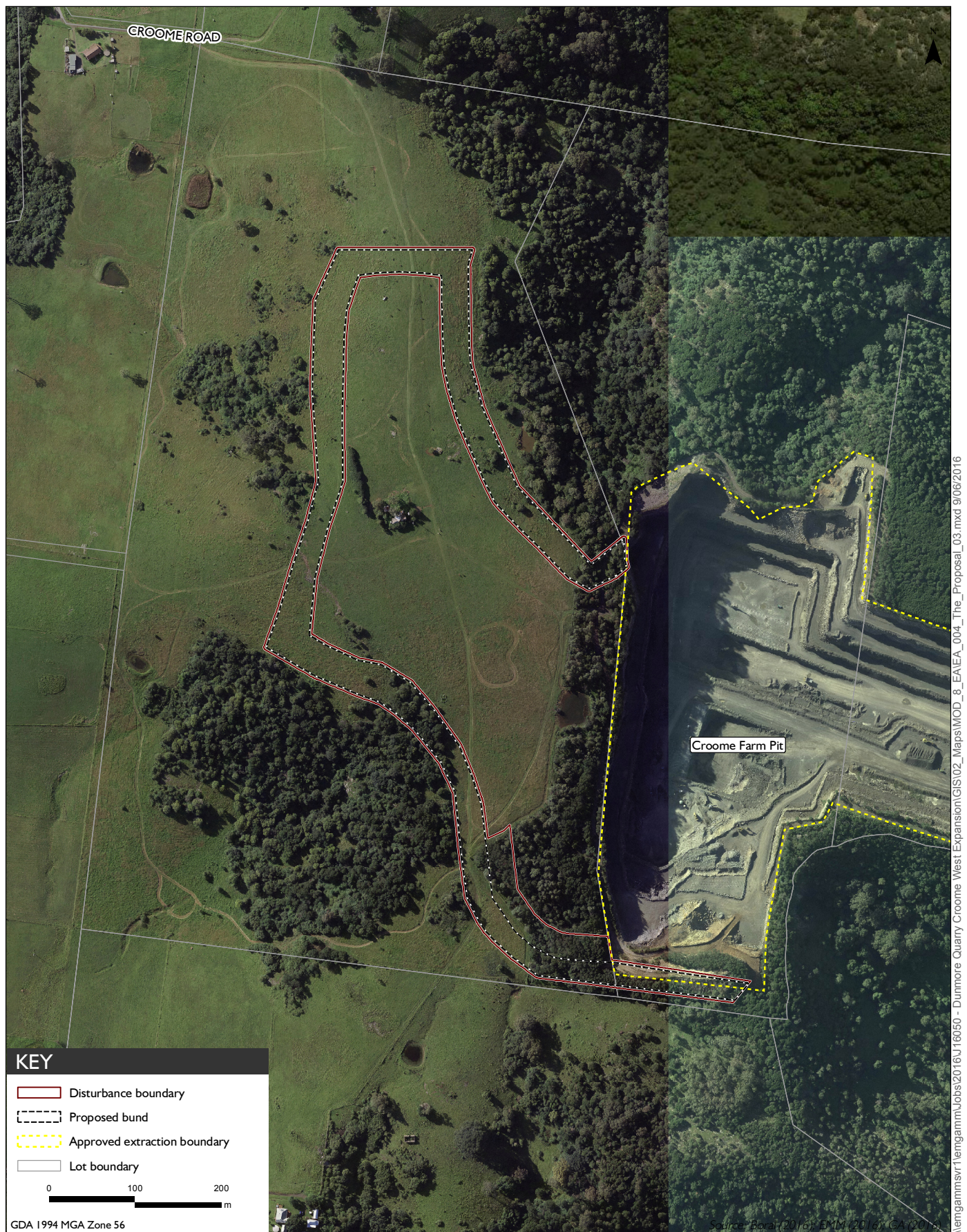
3.2.2 Construction of bund

The bund will be constructed on Boral owned land to the west of the Croome Farm Pit. The purpose of the bund is to provide a visual and noise buffer to residences along Jamberoo and Croome Vale roads and suburban areas of Albion Park from the proposed extension of the Croome Farm Pit to form the Croome Farm West Pit.

The bund will be approximately 1,750 m long with a height of around 5 m. The bund base width will vary between 24 m and 41 m. It will initially run west from south of the Croome Farm Pit, curving north-west along the eastern extent of a stand of vegetation, then run north along cleared land, east to a large area of native vegetation, then run south adjacent to the native vegetation to the north-west corner of the Croome Farm Pit.



Photograph 3.2 The site of the bund - the planted Eucalypt forest to the west of the existing Croome Farm Pit is located on the left hand side of the photograph



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Photograph 3.3 The site of the bund - the planted Eucalypt forest to the west of the existing Croome Farm Pit is located on the right hand side of the photograph



Photograph 3.4 Looking north-west to the site of the bund from the planted Eucalypt forest to the west of the existing Croome Farm Pit

As described above, 64,800 m³ of overburden will be extracted from the Croome Farm Pit for bund construction. The material will be transported by truck via an access route to be prepared between the Croome Farm Pit and the bund location, where it will be dumped and emplaced by an excavator and a dozer.

Machinery will comprise:

- dozer;
- three articulated dump trucks;
- a 45 t excavator; and
- a water cart.

A 3 m buffer will be maintained around the perimeter of the bund for the provision of sediment and erosion control measures and light vehicle access. Sediment and erosion control measures will include the provision of a rock lined drainage channel near the base of the bund.

Immediately following construction, the bund will be covered with an erosion control blanket such as jute blanket. These blankets significantly reduce erosion while the bund is being rehabilitated with native species (see below).

The bund will be rehabilitated with a range of locally sourced and propagated native species, including Illawarra Zieria (*Zieria granulata*). Rehabilitation will occur soon after provision of the erosion blanket and sediment and erosion controls. Further details on rehabilitation are provided in Chapter 6.

The area is used for grazing and contains some native vegetation, some of which will require clearing. Approximately 1.94 ha of predominantly planted native vegetation will be cleared under the proposed modification for construction of the bund, erosion and sediment control measures and a 30 m heavy vehicle access route along the inside of the bund wall to the south-west of the Croome Farm Pit..

It is estimated it will take up to eight weeks to construct the bund. Construction will occur during standard construction hours, that is:

- 7 am to 6 pm weekdays; and
- 8 am to 1 pm Saturdays.

No work will be undertaken on Sundays or public holidays.

3.3 Amendments to development consent

Ten amendments are proposed to the development consent (refer to Table 3.1). As the table demonstrates, the amendments are largely administrative and request deletion of conditions no longer applicable to operations at the quarry, or amendment to reflect contemporary management practices at the quarry.

Table 3.1 **Proposed amendments to conditions of development consent**

Condition no.	Condition wording	Proposed amendment	Suggested condition wording
Schedule 3			
8	Within 6 months of the date of this consent, the Applicant shall surrender all existing development consents and existing use rights associated with the site, in accordance with clause 97 of EP&A Regulation.	Delete condition as this condition has been satisfied and is no longer applicable.	
Schedule 4			
2	Upon receiving a written request for acquisition from the landowner of the land listed in Table 1, the Applicant shall acquire the land in accordance with conditions 3 and 4 below.	Boral formally acquired the McParland property on 8 July 2016 and, therefore, the McParland properties should be removed from the table in this condition.	
7	The Applicant shall ensure that the noise generated by the development does not exceed the criteria specified in Table 2.	Boral formally acquired the McParland property on 8 July 2016 and, therefore, the McParland property (Location A) should be removed from the table in this condition.	
8	Within 6 months of the date of this consent, the Applicant shall undertake noise investigations, which may include sound power levels emitted from plant at the site, to determine near-field trigger levels that would assist in demonstrating compliance and verify the effectiveness of noise mitigation works to the satisfaction of the EPA. Note: The purpose of this condition is to capture the proposed noise verification program where near field monitoring will be undertaken for groups of plant detailed in Richard Heggie and Associates letter dated 2 March 2004.	Delete condition, as this has been satisfied and audited as a part of the 2006 audit.	

Table 3.1 Proposed amendments to conditions of development consent

Condition no.	Condition wording	Proposed amendment	Suggested condition wording
19	During the life of the development, the Applicant shall: (a) operate a blasting hotline, or alternative system agreed to by the Secretary, to enable the public to get up-to-date information on blasting operations at the development; and (b) notify landowners and other interested persons about this hotline or system by placing annual notices in the local newspaper.	Experience has shown that very few residents and people within the local area are interested in blasting operations at the quarry. Therefore, rather than keeping and operating a blasting hotline, it is proposed to operate a register of landowners and other interested persons and providing them directly with up-to-date information on blasting at the quarry. It is also proposed to place a notice of the register on the quarry's website rather than placing annual notices in the local newspaper.	During the life of the development, the Applicant shall: (a) keep a register of landowners and other interested persons who have indicated they would like up-to-date information on blasting operations, or alternative system to the satisfaction of the Secretary; (b) provide blasting notice to all parties on the register for every blast at the quarry; and (c) provide a notice on the quarry's website which provides information on the register and its operation.
20	Before carrying out any development within 250m of Lot 10 DP977931 (see figure 4.4 of the EIS), the Applicant shall prepare, and subsequently implement, a Blast Management Plan for the development in consultation with the landowner(s), and to the satisfaction of the Secretary. This plan must describe the measures that would be implemented to: (a) avoid and/or minimize any blasting impacts of the development on either the property, or use of the property; (b) monitor the blasting impacts of the development on the property; (c) mitigate, remediate or compensate for any blasting impacts of the development on either the property, or the use of the property.	The lot referred in condition 20 (lot 10 DP 977931) is now known as Lot 10 DP 1125853. Boral formally acquired the McParland property on 8 July 2016 and hence this condition can be deleted.	
21	The Applicant shall monitor the airblast overpressure and peak particle velocity impacts of the development at the permanent monitoring station at Croome Farm, or any alternative location approved by the EPA, to the satisfaction of the EPA and Secretary, using the specified units of measure, frequency, sampling method, and location in Table 6.	The permanent airblast overpressure monitor is located at Lot 10 DP 1125853, which is land now owned by Boral. Condition 21 should therefore be amended to reflect this.	The Applicant shall monitor the airblast overpressure and peak particle velocity impacts of the development at a permanent monitoring station as approved by the EPA, to the satisfaction of the EPA and Secretary, using the specified units of measure, frequency, sampling method, and location in Table 6.

Table 3.1 Proposed amendments to conditions of development consent

Condition no.	Condition wording	Proposed amendment	Suggested condition wording
24	Within 3 months of the date of this consent, the Applicant shall prepare, and subsequently implement, a Fines Management Plan to the satisfaction of the EPA. This plan must include the measures that would be implemented to stabilise the surface of stockpiles of fines to minimise wind-blown dust emissions and the erosion/product loss due to stormwater run-off.	This condition was imposed at a time when the quarry contained large stockpiles of fines (aggregate generally less than 5 mm in diameter). At the time, there was very little use for fines. Fines are now used in manufactured sand (as opposed to natural sand) and stockpile sizes and volumes of fines are small. It is proposed to delete this condition.	
30	Each year, the Applicant shall: (a) review the site water balance for the development against the predictions in the EIS; (b) re-calculate the site water balance for the development; and (c) report the results of this review in the Annual Review.	It is proposed to modify this condition as the water balance contained in the EIS is no longer valid. It is proposed to provide information on the previous year's water demand rainfall and inflow (compared with the average from the water balance); evaporative losses and dust suppression; and dam storage levels and implications of outsourcing demand. This information will be provided annually in the quarry's Annual Review.	Each year the Applicant shall provide information on: (a) water demand, rainfall and inflow; (b) evaporative losses and dust suppression; (c) dam storage levels and implications of outsourcing demand; and (d) report the information in the Annual Review
36	The Applicant shall not use a flocculant, other than alum or ferric chloride, without the written approval of the EPA.	It is proposed to delete this condition as flocculants are no longer used at the quarry. If required, Boral would be happy with a condition which prohibits the use of flocculants at the quarry.	
37	Prior to carrying out any of the construction works required in condition 33 above, the Applicant shall prepare, and subsequently implement, a Flocculant Management Plan for the development to the satisfaction of the EPA. This plan must: (a) describe the proposed dosing system, including procedures for dosing in different operating conditions procedures, and procedures to ensure excess flocculant dosing is prevented; and (b) describe how the performance of this system would be monitored over time.	As above, it is proposed to delete this condition as flocculants are no longer used at the quarry.	

Table 3.1 **Proposed amendments to conditions of development consent**

Condition no.	Condition wording	Proposed amendment	Suggested condition wording
38	Within 18 months of the date of this consent, the Applicant shall carry out the following works: (a) Workshop and Fuel Storage Area - desilt drains and culverts upstream of the workshop to limit flooding; - construct a first flush collection basin to capture and store the first 13 mm of run-off from the external service bays before it is treated by the oil/water separator; and - bund and roof the drum storage area; (b) Magazine Area - reinstate drain through access road to magazines to direct stormwater flows to the main drain; (c) <i>deleted</i> to the satisfaction of EPA and the Secretary.	It is proposed to delete this condition as actions have been completed and were reported back to the EPA and the Secretary through the quarry's Annual Review.	
40	The Applicant shall: (a) measure: - the volume of water discharged from the site via licenced discharge points; water use on the site; - water transfers across the site; - dam and water structure storage levels; (b) monitor the quality of the surface water: - discharged from the licence discharge point/s of the development; - upstream and downstream of the development; (c) monitor flows in Rocklow Creek; and (d) monitor regional groundwater levels and quality; to the satisfaction of the EPA and the Secretary.	It is proposed to delete condition (d) as regional groundwater monitoring information is not being used for decision making at the quarry. In addition, historic observations indicate that there is no groundwater ingress into the quarry and the pit rock face is consistently dry.	The Applicant shall: (a) measure: - the volume of water discharged from the site via licenced discharge points; water use on the site; - water transfers across the site; - dam and water structure storage levels; (b) monitor the quality of the surface water: - discharged from the licence discharge point/s of the development; - upstream and downstream of the development; and (c) monitor flows in Rocklow Creek; to the satisfaction of the EPA and the Secretary.

Table 3.1 **Proposed amendments to conditions of development consent**

Condition no.	Condition wording	Proposed amendment	Suggested condition wording
44	The Ground Water Monitoring Program shall include: (a) detailed baseline data on ground water levels and quality, based on statistical analysis; (b) ground water impact assessment criteria; and (c) a program to monitor regional ground water levels and quality.	As above, it is proposed to delete condition (c) as regional groundwater monitoring information is not being used for decision making at the quarry. In addition, historic observations indicate that there is no groundwater ingress into the quarry and the pit rock face is consistently dry.	The Ground Water Monitoring Program shall include: (a) detailed baseline data on ground water levels and quality, based on statistical analysis; and (b) ground water impact assessment criteria.

4 Consultation

4.1 Overview

On 13 April 2016, representatives of Boral and EMM met with officers from DP&E to discuss the proposed extension of Dunmore Quarry, including the proposed modification and the future Croome Farm West Pit (Modification 9). On 14 April 2016, an officer from DP&E provided a number of requirements to Boral via email for the proposed modification; including requirements for consultation (refer Table 1.1).

In response, Boral and EMM have undertaken consultation with relevant stakeholders, including government agencies and the local community, as follows:

- surrounding landowners and residents;
- NSW Office of Environment and Heritage (OEH);
- Shellharbour City Council (SCC);
- NSW Environment Protection Authority (EPA); and
- NSW Department of Primary Industries - Water (DPI-Water).

Consultation was not undertaken with the Commonwealth Department of the Environment (DoE) or infrastructure and service providers because they will not be impacted by the proposed modification. In relation to DoE, the proposed modification will not impact on any matters of national environmental significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), including EPBC Act listed threatened species. This matter is discussed in more detail in Section 5.2. In relation to infrastructure and service providers, the proposed modification will not impact or place any additional demand on any infrastructure or services (ie transmission lines, roads or rail).

The matters raised during consultation with the relevant stakeholders are detailed in the following sections. It should be noted that details of both Modification 8 and Modification 9 were provided and discussed with each of the stakeholders identified above. Only matters relevant to Modification 8 are provided below.

4.2 Outcomes of consultation

4.2.1 Surrounding landowners and residents

Regular engagement with neighbours and other interested stakeholders who live and work around Boral's operational sites forms an important part of the business' approach to production activities.

In advance of the development of this EA, Boral elected to conduct an assessment of current stakeholder perceptions of the quarry. This was carried out during February 2016 and focussed upon 17 individual residences identified to the north and west of the current operations along Croome, Croome Vale and Jamberoo Roads.

The assessment involved the issuing of pre-notification letters on 10 February, with follow-up visits by Boral representatives on 17 February. Of the 17 residences, representatives were able to attend 10, speaking with residents at six. During each visit, representatives asked residents for their observations of the quarry's performance at that time. Those interviewed were also informed of Boral's intent to investigate the potential extension of the current quarry pit into the Croome Farm West area (Modification 9).

The most mentioned subject by residents during discussions in relation to the Croome Farm West proposal was the need to retain existing views of the nearby ridgeline which screens the quarry, and also to the coastline for those with a coastal outlook. In response, representatives explained that Boral would in the first instance seek approval to construct a bund from overburden moved from the already approved extraction area (the proposed modification). This proposal appeared to meet with satisfaction from all residents engaged.

Other subjects receiving minor commentary included experiences of blast vibration, and observance of distant faint noise from the operations on occasion.

Property owners who did not receive a visit during this exercise were able to participate via online means using Boral's dedicated feedback email address and questionnaire website. Details for accessing these channels were left at each premises. No submissions have been received via these means.

The next stage of Boral's engagement with the broader Dunmore will occur ahead of any works approved as part of Modification 8. This will allow Boral to fully explain the works to be undertaken, and to also foreshadow the full detail of the future Modification 9 which will be subject to its own planning process.

In the interim, Boral will attend to any queries via one-on-one meetings and other means as are suitable to the relevant stakeholders.

4.2.2 Community consultative committee

The Dunmore Quarry Community Consultative Committee (CCC) meets bi-annually as per the quarry's conditions of approval. The independently-chaired CCC provides a vital communication link between Boral and the broader local community. Its membership consists of neighbouring residents, and representatives from Shellharbour City Council and the local Boral operations. Matters discussed at each meeting include operational and environmental performance, issues of importance for the community, and site improvement efforts.

As a consequence, details of the proposed modification were shared with CCC members at their meeting of 17 February 2016. This is captured within the minutes of the meeting which have been published to the quarry's website (www.boral.com.au/dunmore).

The next meeting of the CCC has been scheduled for 17 August 2016, where members will be updated on the proposed modification.

4.2.3 NSW Office of Environment and Heritage

A meeting was held at OEH's offices on 27 April 2016 to brief OEH officers on the proposed modification and the EA being prepared to accompany the application. Subsequent discussions were held by telephone on 24 June 2016. Discussions centred on the assessment pathway for ecological matters (ie assessment under the Framework for Biodiversity Assessment (FBA) or alternative approach).

It was acknowledged that the majority of vegetation being cleared under the proposed modification (1.5 ha of planted Eucalypt forest) was planted (ie as part of rehabilitation in the mid 2000s) which does not conform with any Plant Community Types (PCTs) under the FBA. However, it was also acknowledged that there were two small areas of native vegetation that would be disturbed by the proposed modification, including regrowth Acacia scrub (0.39 ha) and disturbed rainforest (0.05 ha) that do conform with PCTs under the FBA, and that the rehabilitated vegetation contains several planted individuals of a threatened species, namely Illawarra Zieria (*Zieria granulata*). It was acknowledged that the removal of the regrowth Acacia scrub and disturbed rainforest, and the planted Illawarra Zieria would need to be offset.

It was acknowledged that, given the majority of vegetation being cleared does not conform to any PCTs it would be difficult to apply the FBA as an assessment tool for the proposed modification. Officers from OEH stated that the clearance of the small areas of the regrowth Acacia scrub and disturbed rainforest and small numbers of Illawarra Zieria could be offset using a negotiated outcome. This could involve improving the biodiversity values of the remaining area of regrowth Acacia scrub, regenerating other areas of rainforest and replacing the Illawarra Zieria removed as part of the proposed rehabilitation of the bund, but at a higher ratio to ensure a net biodiversity gain. It was also agreed that the negotiated outcome offset could be agreed with OEH after determination of the proposed modification and, in this regard, it was generally agreed that Boral would provide a negotiated offset package within 12 months from the date of the determination of the proposed modification.

4.2.4 Shellharbour City Council

A meeting was held at SCC's offices on 1 June 2016 to brief SCC officers on the proposed modification and the EA being prepared to accompany the application.

Officers from SCC stated that it seemed that all matters relevant to SCC are being addressed in the EA.

Officers from SSC also stated that they would review the final EA when it is placed on exhibition by DP&E and provide comments if required.

4.2.5 NSW Environment Protection Authority

A meeting was held at EPA's offices on 1 June 2016 to brief EPA officers on the proposed modification and the EA being prepared to accompany the application.

The officers from EPA stated that the noise and air quality assessments for the proposed modification would be required to address the EPA's *Industrial Noise Policy* (INP) and *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods), respectively. The officers also questioned what measures would be put in place to prevent erosion during construction of the bund and its establishment with vegetation. They recommended that erosion matting be applied to the bund immediately following its construction.

The officers stated that, other than the matters raised above, it seemed that all matters relevant to EPA are being addressed in the EA. Officers from EPA stated that they would review the final EA when it is placed on exhibition by DP&E and provide comments if required.

A follow up call was made to EPA officer Anthony Savage in Air Technical Policy on 5 August 2016 to discuss the use of the *Guidance on the Assessment of Dust from Demolition and Construction* (GADDC, IAQM 2014) method as alternative to the Approved methods. It was confirmed that the use of the IAQM construction dust procedure is acceptable in lieu of a detailed dispersion modelling study in cases where the proposed construction is unlikely to represent a significant risk of impact to the surrounding receptors and emissions can be effectively controlled by onsite practices. Due to the short-term nature of the proposed construction activities and the low risk of impact identified through the IAQM process, it is considered that the proposed modification represents such a case. See Section 7.2 for further information.

4.2.6 NSW Department of Primary Industries - Water

On 18 May 2016, EMM wrote (via email) to DPI-Water providing details on the proposed modification, including potential interaction of the future Croome Farm West Pit with local and regional groundwater. The email included details of the proposed approach to assessing water related impacts. It also requested a meeting be arranged to discuss the proposed modification in further detail.

On 24 May 2016, an officer from DPI-Water wrote to EMM (via email) stating that the approach to assessing water related impacts seemed reasonable and appropriate and that a meeting to discuss issues any further was not required.

5 Legislative framework

5.1 General

This chapter describes the legislative framework that applies to the proposed modification, including the statutory planning approval process under the EP&A Act. An overview of the potential approval requirements under relevant Commonwealth and NSW legislation and environmental planning instruments (EPIs) is also provided.

5.2 Commonwealth legislation

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES. MNES, as defined under the EPBC Act, include:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have an impact on a MNES is to be referred to DoE for determination as to whether or not it is a controlled action.

The proposed modification will not have an impact on any MNES and, therefore, is not required to be referred to DoE and does not require approval from the Commonwealth Minister for the Environment.

5.3 NSW legislation

5.3.1 NSW Environmental Planning and Assessment Act 1979

i General

Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils. The EP&A Act contains three parts that impose requirements for planning approval:

- Part 4 which provides for control of 'development' that requires development consent from the relevant consent authority;

- Part 5 which provides for control of ‘activities’ that do not require development consent under Part 4; and
- Part 5.1 which provides for control of State significant infrastructure (SSI) that does not require approval or development consent under Part 4.

The requirement for developments that require development consent, and activities and SSI that do not require development consent is set out in EPIs – State environmental planning policies (SEPPs), regional environmental plans (REPs), and local environmental plans (LEPs).

The objects of the EP&A Act are:

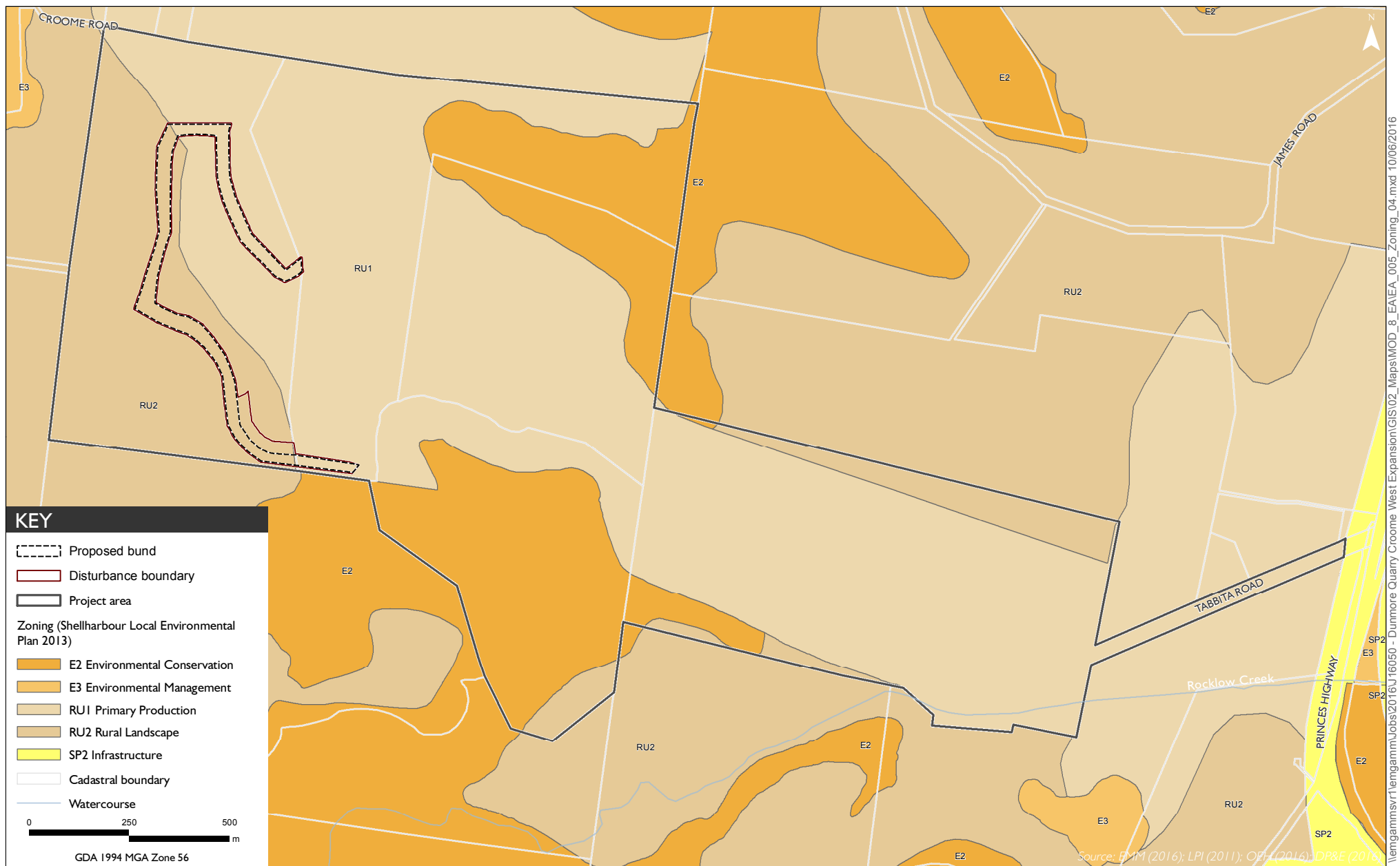
- (a) to encourage:
 - (i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,
 - (ii) the promotion and co-ordination of the orderly and economic use and development of land,
 - (iii) the protection, provision and co-ordination of communication and utility services,
 - (iv) the provision of land for public purposes,
 - (v) the provision and co-ordination of community services and facilities, and
 - (vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and
 - (vii) ecologically sustainable development, and
 - (viii) the provision and maintenance of affordable housing, and
- (b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and
- (c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

Consideration of the above is given in Chapter 10.

ii Permissibility

The proposed bund is located on land zoned RU1 Primary Production and RU2 Rural Landscape under the *Shellharbour Local Environmental Plan 2013* (Shellharbour LEP). The location of the bund in relation to the RU1 Primary Production and RU2 Rural Landscape zones can be seen in Figure 5.1.

The proposed bund is associated with an extractive industry (ie Dunmore Quarry).



The Shellharbour LEP defines extractive industry as:

... the winning or removal of extractive materials (otherwise than from a mine) by methods such as excavating, dredging, tunnelling or quarrying, including the storing, stockpiling or processing of extractive materials by methods such as recycling, washing, crushing, sawing or separating, but does not include turf farming.

Extractive materials are defined as:

... sand, soil, gravel, rock or similar substances that are not minerals within the meaning of the *Mining Act 1992*.

Breccia agglomerate and latite are not minerals within the meaning of the *Mining Act 1992*.

The proposal is to remove overburden from the approved extraction area of Dunmore Quarry and use it to form a bund around the future Croome Farm West Pit which will be subject to a subsequent modification application (Modification 9). The overburden is an extractive material (soil and rock) which will be removed by quarrying methods and stored to form a bund.

Therefore, the proposed bund can be defined as an extractive industry for the purposes of the Shellharbour LEP.

Under the RU1 Primary Production zone, extractive industry is permissible with development consent. However, under the RU2 Rural Landscape zone, extractive industry is prohibited. Notwithstanding this, the proposed bund is permissible within the RU2 Rural Landscape zone pursuant to the provisions of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Extractive Industries SEPP) which permits extractive industry in any zone where agriculture or industry is permissible with or without development consent. Within the RU2 Rural Landscape zone, agriculture is permissible with development consent.

The quarry currently operates under Development Consent 470-11-2003 which was granted by the then NSW Minister of Infrastructure and Planning in September 2004. The development consent allows the quarry to produce up to 2.5 Mtpa of quarry materials. The development was classified as SSD under section 76A(7) of the EP&A Act, because it is an extractive industry where the proposed rate of production exceeded the threshold limits specified in the Ministerial declaration of 3 August 1999.

iii Development consent modification process

The modification to the development consent can be considered under the repealed Part 3A of the EP&A Act. As part of the repeal by the *NSW Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011* (Part 3A Repeal Act), transitional provisions were introduced (Schedule 6A of the EP&A Act) enabling 'transitional Part 3A projects' to continue to be subject to Part 3A of the EP&A Act (as in force immediately before the repeal and as modified by the Part 3A Repeal Act).

Specifically, the modification can be considered under section 75W of the EP&A Act which allows a proponent to request that the NSW Minister for Planning modify an approval for a project. Section 75W of the EP&A Act states:

(1) In this section:

Minister's approval means an approval to carry out a project under this Part, and includes an approval of a concept plan.

Modification of approval means changing the terms of a Minister's approval, including:

- (a) revoking or varying a condition of the approval or imposing an additional condition of the approval, and
 - (b) changing the terms of any determination made by the Minister under Division 3 in connection with the approval.
- (2) The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.
 - (3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.
 - (4) The Minister may modify the approval (with or without conditions) or disapprove of the modification.

While the development consent for the site was a consent issued under Part 4 of the EP&A Act, transitional provisions within the EP&A Regulation allow for a consent to be modified under section 75W of the EP&A Act as if the consent were an approval under Part 3A.

Clause 8J(8) of the EP&A Regulation states:

For the purposes only of modification, the following development consents are taken to be approvals under Part 3A of the Act and section 75W of the Act applies to any modification of such a consent:

- (a) a development consent granted by the Minister under section 100A or 101 of the Act,
- (b) a development consent granted by the Minister under State Environmental Planning Policy No 34—Major Employment-Generating Industrial Development,
- (c) a development consent granted by the Minister under Part 4 of the Act (relating to State significant development) before 1 August 2005 or under clause 89 of Schedule 6 to the Act,
- (d) a development consent granted by the Land and Environment Court, if the original consent authority was the Minister and the consent was of a kind referred to in paragraph (c).

The development consent, if so modified, does not become an approval under Part 3A of the Act.

The development consent for the site was issued by the then Minister of Infrastructure and Planning in September 2004 as SSD under section 76A(7) of the EP&A Act. Therefore, in accordance with clause 8J(8)(c) of the EP&A Regulation, Development Consent 470-11-2003 is taken to be an approval under Part 3A of the Act and section 75W of the Act applies to the proposed modification.

The NSW Minister for Planning is the consent authority for modifications under section 75W of the EP&A Act. However, pursuant to section 23 of the Act, the Minister may delegate the consent authority function to a range of public officers or authorities.

When accepting an application for a modification under section 75W of the EP&A Act, the NSW Minister for Planning has to be satisfied that the proposal is a modification of the original proposal, rather than being a new project in its own right. In this regard it is noted that:

- the primary purpose of the modification is to allow for the construction of a bund surrounding the future Croome Farm West Pit which will be subject to Modification 9;
- the primary function and purpose of the operations of the quarry would not change as a result of the modification (ie hard rock quarry); and
- the noise, air quality, ecology and visual assessments (see Chapter 6) demonstrate that the potential environmental impacts of the proposed modification are negligible, compared to the impacts of the approved operations.

Therefore, it is considered that the proposed modification is within the scope of section 75W of the EP&A Act.

An application for a modification under section 75W must be accompanied by an EA (this document). Once finalised, this EA may be publicly exhibited (based on the discretion of officers from DP&E). If the EA is exhibited, any person can make a written submission about the proposal (including objecting to it). DP&E may require Boral to provide a written response to any issues raised in submissions.

iv Environmental planning instruments

Section 75R(3) of the EP&A Act, prior to its repeal, in respect of Part 3A stated:

Environmental planning instruments (other than State environmental planning policies) do not apply to or in respect of an approved project.

Further, Section 75J(3) of the EP&A Act, prior to its repeal, in respect of Part 3A, stated:

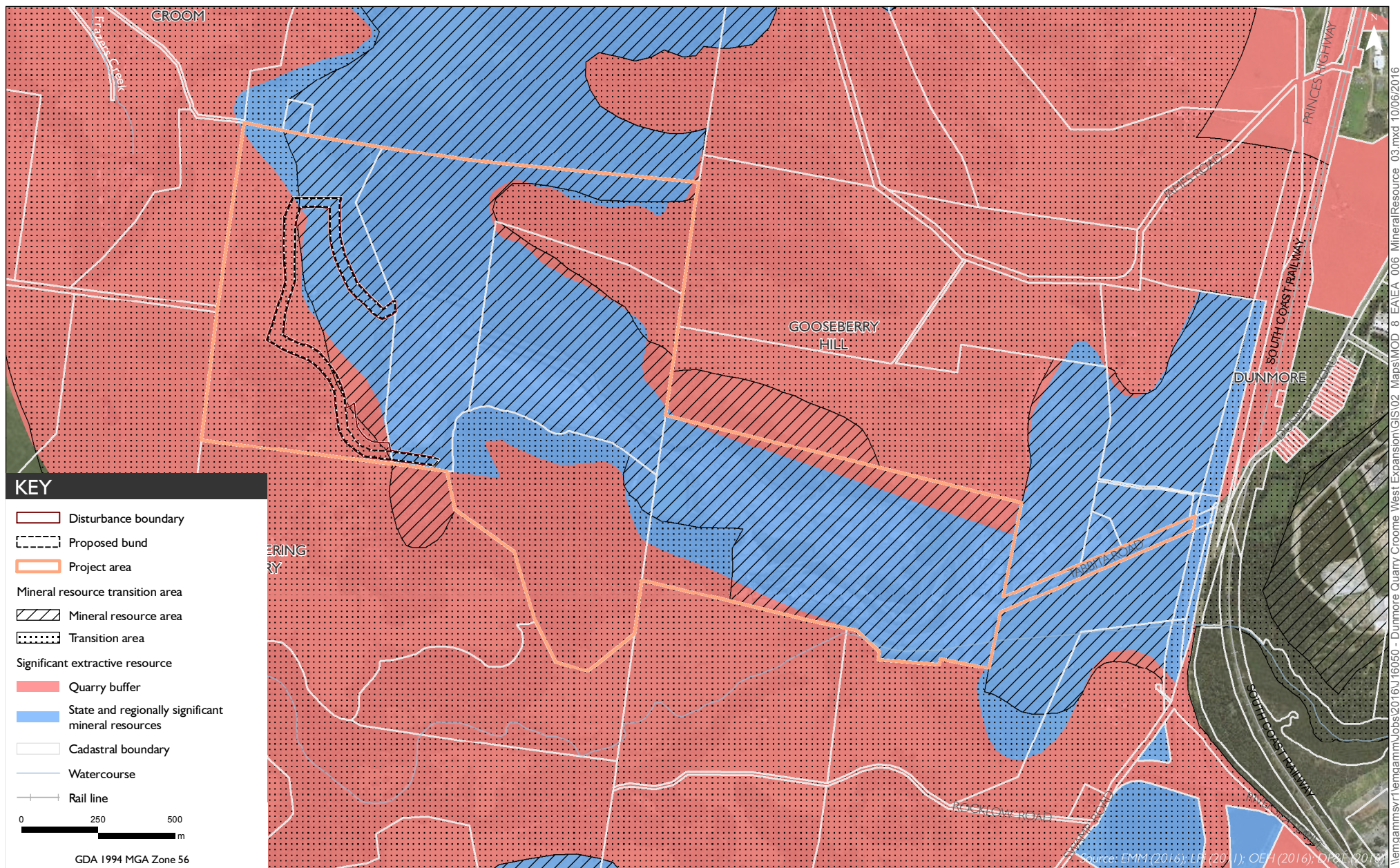
In deciding whether or not to approve the carrying out of a project, the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of section 75R) apply to the project if approved.

Consideration has been given below to applicable environmental planning instruments that are relevant to the proposed modification. Whilst the Shellharbour LEP does not apply to the proposed modification, consideration has still been given to relevant provisions.

a. Shellharbour Local Environmental Plan 2013

As previously stated, the proposed modification is permissible with consent under both the RU1 Primary Production and RU2 Rural Landscape zones pursuant to the provisions of both the Shellharbour LEP and the Extractive Industries SEPP.

Clause 6.10 of the Shellharbour LEP identifies the location of significant resources of minerals, petroleum or extractive materials for the purposes of clause 13 of the Extractive Industries SEPP. It is noted that the majority of the proposed bund is within the 'Mineral Resource Area' though a small portion falls within the 'Transition Area'. The inherent purpose of the 'Transition Area' is to minimise development that may be incompatible with an extractive resource operation, which is not relevant to the proposed modification. The location of the bund in relation to the Mineral Resource Area and Transition Area can be seen in Figure 5.2.



Part 6 of the Shellharbour LEP contains additional local provisions for earthworks, stormwater management, and terrestrial biodiversity which have been addressed in this EA.

The quarry project area borders three heritage items listed under the Shellharbour LEP:

- I070 – Croom School site, ruins, gardens and trees;
- I143 – Glenbrook Homestead Group; and
- I223 – “Glenfield”.

The proposed modification would not disturb these heritage items. Potential visual impacts have been considered in Chapter 9.

b. State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

Clause 7 of the Extractive Industries SEPP identifies development permissible without consent and includes:

(3) Extractive industry

Development for any of the following purposes may be carried out with development consent:

- (a) extractive industry on land on which development for the purposes of agriculture or industry may be carried out (with or without development consent),

As previously discussed, by virtue of clause 7(3)(a), the proposed modification is permissible with consent within the RU1 and RU2 zones.

Part 3 of the Extractive Industries SEPP sets out a number of matters the consent authority must consider before determining a development application for the purposes of an extractive industry. Consideration of the proposed modification against the relevant matters is given in Table 5.1.

Table 5.1 Consideration of relevant Mining SEPP, Part 3 matters

Matter	Comment
12 Compatibility of proposed mine, petroleum production or extractive industry with other land uses	
Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:	Impacts to existing and approved land uses in the vicinity of the proposed bund are detailed in Chapters 7-9.
(a) consider:	
(i) the existing uses and approved uses of land in the vicinity of the development, and	
(ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and	
(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and	
(b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and	
(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	

Table 5.1 Consideration of relevant Mining SEPP, Part 3 matters

Matter	Comment
14 Natural resource management and environmental management	
(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure the following: (a) that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable, (b) that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable, (c) that greenhouse gas emissions are minimised to the greatest extent practicable.	The environmental impacts of the proposed modification are considered in Chapters 6-9.
(2) Without limiting subclause (1), in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or national policies, programs or guidelines concerning greenhouse gas emissions.	The proposed modification would not result in an increase in greenhouse gas emissions above those generated by the approved operations.
15 Resource recovery	
(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider the efficiency or otherwise of the development in terms of resource recovery. (2) Before granting consent for the development, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material. (3) The consent authority may refuse to grant consent to development if it is not satisfied that the development will be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.	The proposed modification will provide an efficient means of resource recovery by allowing approved resource to be extracted. Further, placement of the overburden material within the proposed bund will prevent double handling of material associated with the future Croome Farm West Pit.
16 Transport	
(1) Before granting consent for development for the purposes of mining or extractive industry that involves the transport of materials, the consent authority must consider whether or not the consent should be issued subject to conditions that do any one or more of the following: (a) require that some or all of the transport of materials in connection with the development is not to be by public road, (b) limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools, and (c) require the preparation and implementation, in relation to the development, of a code of conduct relating to the transport of materials on public roads.	There will be no change to transport of materials under the proposed modification.
17 Rehabilitation	
(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at ensuring the rehabilitation of land that will be affected by the development.	The proposed bund will be rehabilitated immediately following construction. Details of proposed rehabilitation is provided in Section 6.2.
(2) In particular, the consent authority must consider whether conditions of the consent should:	This is a matter for the DP&E when assessing the proposed modification,

Table 5.1 **Consideration of relevant Mining SEPP, Part 3 matters**

Matter	Comment
(a) require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated, or	including consideration of this EA.
(b) require waste generated by the development or the rehabilitation to be dealt with appropriately, or	
(c) require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under section 145C of the Act and the <i>Contaminated Land Management Act 1997</i>), or	
(d) require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.	

c. State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) applies to the State of NSW, including the Shellharbour LGA. It requires the consent authority to consider a project's potential to cause hazards or be offensive, including consideration of the location of the development and the way in which it is to be carried out. The *Applying SEPP 33* guideline (DoP 2011) provides advice on the application of SEPP 33 and includes a checklist and risk screening procedure to determine whether a development is potentially hazardous or offensive.

SEPP 33 requires a preliminary hazard assessment (PHA), prepared in accordance with the current circulars or guidelines, to be submitted with a DA for a potentially hazardous development. Determination of potentially hazardous development requires a screening assessment of the quantities, types and locations of dangerous goods proposed to be stored and/or transported. The proposed modification will not change the types or quantities stored or transported by the quarry. Therefore, it is not considered to be a potentially hazardous development and a PHA is not required.

Determination of whether a development is potentially offensive requires consideration of the impacts of polluting discharges from the project (such as noise, and dust). Consideration of these impacts has been given in Chapters 7 and 8. The assessments concluded there were no significant impacts and, therefore, the proposed modification is not an offensive industry.

d. State Environmental Planning Policy No. 55 – Remediation of Land

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) applies to the State of NSW, including Shellharbour LGA. It requires that a consent authority not grant consent to the carrying out of development on land unless it has considered any potential contamination issues. Clause 7(1) of SEPP 55 states:

A consent authority must not consent to the carrying out of any development on land unless:

- (a) it has considered whether the land is contaminated, and
- (b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

- (c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

There is no evidence to suggest potential contamination at the site. The site has been primarily used for agricultural purposes; there has been no development on the land, or animal dips or stockyards, waste dumps or fuel storage. There is no history at the site of other land-use such as industrial and chemical works or storages; or land filling activities which are activities commonly associated with contamination.

Historical aerial photographs showing the quarry in 1948, 1970, 1984 and 2006 can be seen in Figures 5.2 – 5.5. The location of the proposed bund is shown on each historic aerial photograph.

e. [State Environmental Planning Policy No 71—Coastal Protection](#)

State Environmental Planning Policy No 71—Coastal Protection (SEPP 71) applies to land the whole or any part of which is within the coastal zone. Lot 3 DP 1030504 on which the eastern part of the quarry is located, namely the office buildings, processing and stockpiling areas, is partly within the coastal zone. Lots 1 and 2 DP 224597, within which the existing Croome Farm Pit and proposed bund are located, are not within the coastal zone. Therefore, SEPP 71 does not apply to the proposed modification.

5.3.2 [NSW Protection of the Environment Operations Act 1997](#)

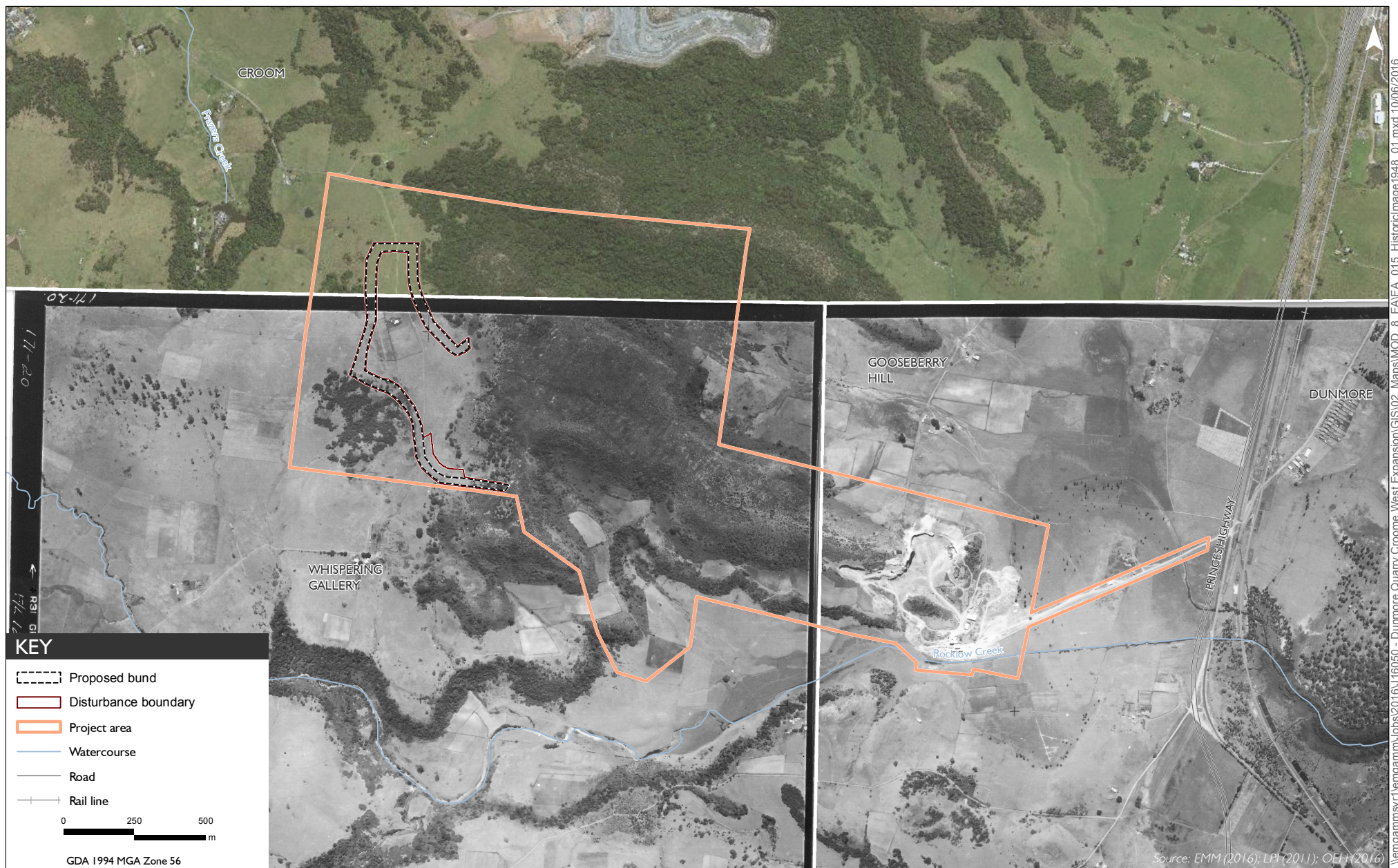
The NSW *Protection of the Environment Operations Act 1997* (POEO Act) aims to protect restore and enhance the quality of the environment, having regard for the need to maintain ecologically sustainable development. This is achieved through installing mechanisms to reduce risks to human health and prevent the degradation of the environment by regulating pollution to the land, air and waters.

An environment protection licence (EPL) is required to be obtained and held by entities that undertake activities listed under Schedule 1 of the POEO Act. An EPL (No. 77) is currently held by Boral for the quarry. The EPL allows for land-based extractive activities and crushing graining or separating for up to 2 Mtpa. A variation to the EPL will not be required for the proposed modification.

5.3.3 [National Parks and Wildlife Act 1974](#)

The NSW *National Parks and Wildlife Act 1974* (NP&W Act), administered by OEH, aims to conserve nature and objects, places or features of cultural value. An Aboriginal heritage impact permit (AHIP) is required under section 90 of the NP&W Act to knowingly destroy, deface or damage, or knowingly cause or permit the destruction or defacement of, or damage to, a relic or Aboriginal place. In accordance with Section 75U of the EP&A Act (now repealed), an AHIP is not required for an approved Part 3A project.

A review of background information indicates that there are no known Aboriginal archaeological sites located within the site of the proposed bund. A number of Aboriginal archaeological surveys and assessments have been undertaken at the quarry including surveys in 1992 and 2008 for the Croome Farm Pit extension. These assessments identified one open artefact scatter (site DQ1; AHIMS # 52-2-1791) and one scarred tree (site DQ2; AHIMS # 52-5-0300) (Navin Officer 1992). No other Aboriginal archaeological sites have been recorded on the property and previous assessments have concluded there is limited archaeological potential in the areas covered by previous investigations. Therefore, it is unlikely that any Aboriginal relics or site would be impacted by the proposed modification.



Note: Historical imagery does not cover complete map extent



Historical imagery - 1948
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Figure 5.3







5.3.4 Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) aims to conserve biological diversity in NSW through the protection of threatened and endangered flora and fauna species and endangered ecological communities (EECs).

The proposed modification's impact on threatened and endangered flora and fauna species and EECs is discussed in Chapter 6. It concludes that there would be no significant impact on any threatened and endangered flora and fauna species and EECs listed under either the TSC Act or EPBC Act as a result of the proposed modification.

5.3.5 Water Act 1912 and Water Management Act 2000

The NSW *Water Act 1912* and *Water Management Act 2000* (WM Act) regulate the use and interference with surface water (streams, creeks, rivers etc) and groundwater in NSW.

The proposed modification does not require any works to be undertaken on the site to increase production which may require additional water. The proposal will not use or interfere with any surface or groundwater sources.

6 Ecology

6.1 Introduction

Potential ecological impacts from construction of the proposed bund and associated clearing were assessed by EMM. The assessment report is in Appendix A and summarised in this chapter.

6.2 Method

The study area comprised areas proposed to be disturbed for construction of the bund and surrounding areas, which were considered for characterisation of the existing environment.

6.2.1 Desktop review

The assessment commenced with a desktop study of previous local studies and database searches. Although there have been a number of ecological assessments of the quarry, none concentrated on the study area apart from flora survey of the eastern section of the study area. Regional vegetation and biodiversity studies were reviewed.

The databases in Table 6.1 were searched for the assessment.

Table 6.1 Database searches

Source	Date	Search radius around the study area
Atlas of NSW Wildlife www.environment.nsw.gov.au/atlasapp	02 June 2016	10 km
PlantNET spatial search plantnet.rbgsyd.nsw.gov.au/search/spatial.htm	25 June 2015	10 km
Protected Matters Search Tool www.environment.gov.au/webgis-framework-apps/pmst/pmst.jsf	02 June 2016	10 km
Critical habitat register www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm	02 June 2016	Not applicable, as individual sites are listed as critical habitat in NSW

6.2.2 Field survey

Ecologists surveyed the study area on 29 June 2015 and 28 April 2016. Nineteen rapid vegetation assessments were completed, which comprised identification of main canopy, mid and understorey species to characterise the vegetation communities in the study area. Planted vegetation in the east of the study area was surveyed using a plot and a transect to characterise it using the BioBanking method. The vegetation communities were classified into plant community types (PCTs).

6.2.3 Targeted searches and habitat assessment

Specific threatened flora species which had been identified during previous studies and the database were targeted during surveys. The likelihood that threatened and migratory fauna species identified during the database search was assessed by comparing habitat in the study area to the habitat preferences of the fauna.

6.2.4 Ecosystems that potentially rely on groundwater

The locations of springs were recorded using a handheld GPS. The type and condition of vegetation adjacent to the springs was considered to identify whether the ecosystems potentially rely on groundwater.

6.3 Existing environment

6.3.1 Results of desktop searches

The previous study of vegetation in the eastern section of the study area identified the communities in Table 6.2. Planted individuals of the threatened Illawarra Zieria (*Zieria granulata*) were recorded in the eastern part of the study area, and 40 naturally occurring individuals were recorded in the western part of the survey area.

Table 6.2 Vegetation communities in eastern part of study area

Community	Key species	Distribution
Subtropical rainforest	Moreton Bay Fig (<i>Ficus macrophylla</i>) Red Ash (<i>Alphitonia excelsa</i>)	Occurs as remnant trees in the valley south of the quarry and as good quality stands in the nearby gorge
Blue Gum White Box woodland/forest	Bangalay x Blue Gum (<i>Eucalyptus botryoides</i> x <i>saligna</i>) Coastal White Box (<i>E. quadrangulata</i>) Forest Red Gum (<i>E. tereticornis</i>)	In a shallow gully in the south-western corner of the quarry western section
Planted Eucalypt forest	Spotted Gum (<i>Corymbia maculata</i>) Forest Red Gum Black Wattle (<i>Acacia mearnsii</i>)	Occurs on bund walls and adjacent slopes in the eastern section of the quarry
Paperbark shrubland	Bracelet Honey-myrtle (<i>Melaleuca armillaris</i>) Prickly Beard Heath (<i>Leucopogon juniperinus</i>) Rock Fern (<i>Cheilanthes sieberi</i>) Narrow-leaved Mint Bush (<i>Prostanthera linearis</i>)	Occurs in the southwest and eastern parts of the quarry and extensively on adjoining ridges
Lantana shrubland	Lantana (<i>Lantana camara</i>) Black Wattle	Occurs over much of the eastern part of the site in highly disturbed areas

The *Forest Ecosystem Classification and Mapping for the Southern CRA Region Volume II* (Thomas, Gellie and Harrison 2000) predicts that Rainforest Ecosystem 177: Illawarra Lowland Subtropical Rainforest occurs across the study area. Illawarra Lowland Sub-Tropical Rainforest is a forest up to 20 m in height, with a diverse range of subtropical rainforest overstorey species, vines and ferns.

The Atlas of NSW Wildlife listed the following amounts of threatened species and populations within 10 km of the study area:

- flora populations – three;
- flora – 18;
- frogs – two;
- birds – 29; and
- mammals – 13.

The Protected Matters Search Tool predicted the following threatened amounts of species and communities listed under the EPBC Act:

- ecological communities – three;
- flora – 18;
- freshwater fish – two;
- frogs – four;
- reptiles – one;
- birds – 14;
- mammals – nine; and
- migratory terrestrial bird species – eight.

Migratory marine and migratory wetland species were excluded from further assessment, given that there is no marine or wetland habitat in the study area.

6.3.2 Vegetation communities

The field survey demonstrated that much of the study area is in a highly disturbed condition, with the majority cleared for grazing. There are small patches of remnant, regenerating and rehabilitated vegetation in the study area, and large tracts of remnant rainforest and shrubland directly adjacent to the study area.

The vegetation communities in Table 6.3 and Figure 6.1 were observed.

6.3.3 Threatened flora

No threatened flora species were recorded other than Illawarra Zieria (*Zieria granulata*), recorded at twenty eight different locations within the study area. The vast majority were recorded within the planted Eucalypt forest on the eastern boundary of the study area (Figure 3.4), with one individual recorded on the periphery of the rainforest community and another individual in the acacia shrubland.

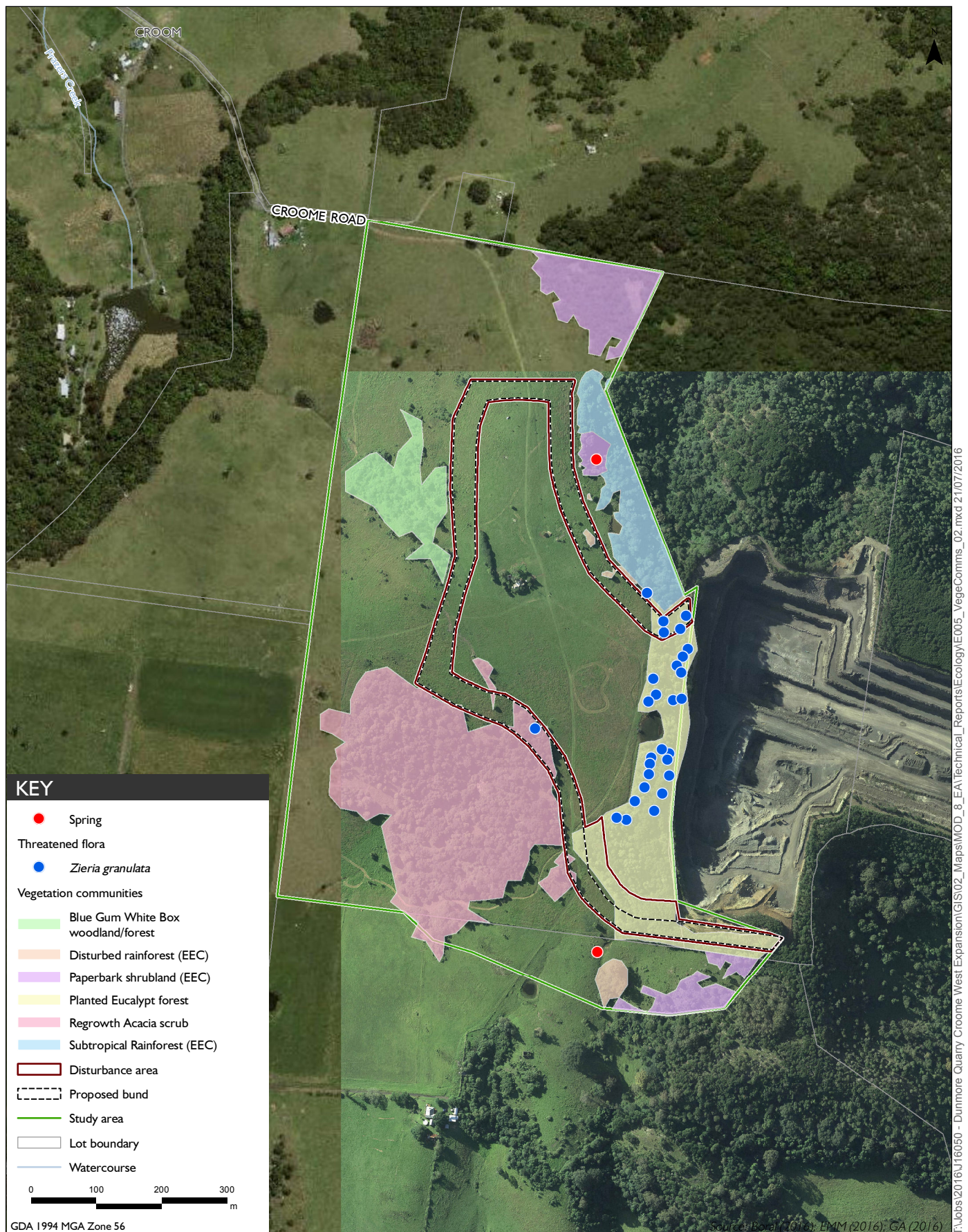
A total of 210 Illawarra Zieria individuals were recorded within the planted Eucalypt forest. Approximately 75% of these were planted, given their large size and the presence of degraded tree guards. The remaining 25% consisted of seedlings and small shrubs, likely to have germinated from seeds from the planted individuals. The species is also predicted to occur in the paperbark shrubland to the south of the disturbance area.

Table 6.3 **Fauna recorded during the field surveys**

Community name	Description	Location
Cleared land	Comprises exotic grasses and forbs. Windrows have been planted around an old residence in the cleared land and were dominated by Small-leaved Privet. The cleared land does not contain any native vegetation.	Dominates the study area.
Planted eucalypt forest	Planted by Boral and contains a variety of native trees and shrubs Planted Eucalypt forest contains a mix of native vegetation species that occur in the local area, and does not conform to any native vegetation type. The northern and southern sections of the planted Eucalypt forest will be disturbed by the proposed modification.	Eastern boundary of study area.
Disturbed rainforest	Two small patches of rainforest trees occur in the north-east of the study area. A larger patch of disturbed rainforest is located in the south-eastern part of the study area. These patches of disturbed rainforest share affinities with PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion. However, the vegetation in these small patches is in a highly disturbed state and only contains a small number of characteristic species of this PCT. The patches of disturbed rainforest area are likely to meet the description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC listed under the TSC Act given the presence of characteristic plant species. The two small patches of disturbed rainforest in the north-eastern part of the study area will be disturbed by the proposed modification. The larger patch in the south-eastern part of the study area will not be impacted by the proposed modification.	North-east and south-east of study area.
Subtropical rainforest	Subtropical rainforest occurs in steep gullies adjacent to the study area. It is dominated by large trees, with the edges of the community invaded by the introduced Lantana. This vegetation is likely to meet the description of PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion given the presence of characteristic plant species. This community meets the description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC listed under the TSC act given the presence of characteristic plant species. The Subtropical rainforest is outside of the disturbance boundary and therefore will not be impacted by the proposed modification.	Steep gullies adjacent to the study area.
Paperbark shrubland	There are two patches of Paperbark shrubland in the study area which meet the description of PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion given the presence of characteristic plant species and are likely to meet the description of <i>Melaleuca armillaris</i> Tall Shrubland in the Sydney Basin Bioregion EEC listed under the TSC Act. Aerial photography suggests that a patch of Paperbark shrubland occurs in the south-east corner of the study area, which could not be accessed during surveys. This patch of Paperbark shrubland is likely to meet the description of PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion given the presence of characteristic plant species. It is also likely to meet the description of <i>Melaleuca armillaris</i> Tall Shrubland in the Sydney Basin Bioregion EEC listed under the TSC Act. All patches of Paperbark shrubland are outside of the disturbance boundary and therefore will not be impacted by the proposed modification.	North-eastern section of the study area.

Table 6.3 Fauna recorded during the field surveys

Community name	Description	Location
Blue Gum White Box woodland/forest	A patch of scattered Blue Gum White Box woodland/forest occurs in the study area. Blue Gum White Box Woodland/Forest shares affinities with PCT 1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion. However, the vegetation in these small patches is in a highly disturbed state and only contains a small number of characteristic species of this PCT. The Blue Gum White Box woodland/forest may be indicative of Illawarra Lowlands Grassy Woodland, listed as an EEC under the TSC Act. The patch of scattered Blue Gum White Box woodland/forest is outside of the disturbance boundary and therefore will not be impacted by the proposed modification.	Western section of study area.
Regrowth Acacia scrub	A large patch of regrowth Acacia scrub was recorded in the study area. This patch is likely to have regenerated from previous rainforest clearing due to the indicative species and its location on a basalt outcrop. This patch shares affinities with PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion. However, the vegetation in this patch is in a highly disturbed state and only contains a small number of characteristic species of this PCT. The regrowth Acacia scrub does not form part of an EEC listed under the TSC or EPBC acts. The eastern fringe of the regrowth Acacia scrub is contained within the disturbance area and therefore will be impacted by the proposed modification.	South-west section of study area.
Groundwater springs	Groundwater springs were observed on basalt caps above Illawarra Lowland Subtropical Rainforest in gullies of the north east and southern boundary of the disturbance area. Given their location in the landscape, these springs may provide some of the surface water required to sustain the Illawarra Lowland Subtropical Rainforest. Based on the water quality results, these springs are unlikely to be from the deep local groundwater, rather derived from shallow, slow moving through flow that seeps along the interface between the weathered profile and competent rock, discharging at the surface at low points.	Above gullies in the north-east and southern boundary of the disturbance area.



Vegetation communities and threatened species

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Figure 6.1

6.3.4 Threatened fauna

No threatened fauna were observed during the surveys. As described in Table 6.4, vegetation in the study area may provide habitat for threatened species.

Table 6.4 Fauna recorded during the field surveys

Vegetation community	Habitat description
Cleared land	Poor habitat for fauna, with only the most disturbance tolerant species likely to occur. No threatened fauna species are dependent on this habitat type, however wide ranging species may occasionally occur, such as the Spotted Harrier (<i>Circus assimilis</i>).
Regrowth Acacia scrub and planted Eucalypt forest	Likely to provide fauna habitat for a range of common species. Dense mid-story shrubs are likely to provide shelter and foraging resources for insectivorous birds. Eucalypts are likely to provide foraging resources for nectivores when in flower.
Disturbed rainforest	Very degraded and small in size, vegetation will no longer function as a rainforest habitat type. Flowering or fruiting trees may provide seasonal foraging resources for species such as the Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>).

The threatened species in Table 6.5 could occur in the study area based on the presence of suitable habitat.

Table 6.5 Threatened and migratory species with potential to be impacted

Common Name	Scientific Name	TSC Act Status ¹	EPBC Act Status ²	Occurrence
Flora				
Illawarra Zieria	<i>Zieria granulata</i>	E	E	Recorded
Birds				
Fork-tailed Swift	<i>Apus pacificus</i>		Mi	Potential
Spotted Harrier	<i>Circus assimilis</i>	V	-	Potential
Rainbow Bee-eater	<i>Merops ornatus</i>	-	Mi	Potential
Turquoise Parrot	<i>Neophema pulchella</i>	V	-	Potential
Flame Robin	<i>Petroica phoenicia</i>	V	-	Potential
Mammals				
Eastern Bentwing Bat	<i>Miniopterus schreibersii oceanensis</i>	V	-	Potential
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Potential
Little Bentwing Bat	<i>Miniopterus australis</i>	V	-	Potential
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	-	Potential

Notes: 1. TSC Act Status: V – Vulnerable; E – Endangered.

2. EPBC Act Status: V – Vulnerable; E – Endangered; Mi – Migratory.

6.4 Impact assessment

6.4.1 Vegetation clearance

The amount of vegetation in Table 6.6 will be cleared for construction of the bund, the 3 m light vehicle and sediment and erosion control setback and the access road between the Croome Farm Pit and the bund.

Table 6.6 **Impact area for each vegetation community**

Community type	Area to be cleared (ha)	Area currently existing within the study area (ha)	Percentage which will be cleared (of that present within the study area)
Exotic grassland	5.14	37.79	14
Planted Eucalypt forest	1.50	4.81	31
Regrowth Acacia scrub	0.39	9.59	4
Disturbed rainforest	0.05	0.32	15
Total impact area	7.08		

6.4.2 Endangered ecological communities, threatened ecological communities and native vegetation

None of the vegetation communities to be disturbed by the proposal meet the description of any threatened ecological communities under the EPBC Act.

The disturbed rainforest in the disturbance area meets the TSC Act description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC. An assessment of significance concluded that the proposed clearing of 0.05 ha of this community will not significantly impact the survival of the community in the region due to the small area impacted, the poor functionality of the community and the presence of large tracks of rainforest communities adjacent to the disturbance area.

The total amount of native vegetation proposed to be cleared is 1.94 ha, which is 9% of the vegetation in the study area. The bund will be revegetated with native species endemic to the local area, resulting in a net gain in amount of native vegetation present.

6.4.3 Threatened flora

Of the 210 Illawarra Zieria individuals recorded within the planted Eucalypt forest, 48 individuals will be removed as a result of the proposed modification. The assessments of significance under both TSC Act and the EPBC Act concluded that there would be no significant impact on the species.

This species will be planted in future regeneration works, resulting in a net gain in abundance for this species.

6.4.4 Threatened fauna

No threatened fauna were recorded in the study area. Three threatened birds and four threatened bats could occur. The disturbance area does not contain any restricted habitat for any of these species, nor are the species dependant on the habitats present within the disturbance area.

It is likely that any threatened species occurrence in the regrowth Acacia scrub, planted Eucalyptus forest and the disturbed rainforest habitat types is intermittent and they are unlikely to rely on the habitat.

The assessments of significance under both TSC Act and the EPBC Act concluded that there would be no significant impact on any of the threatened fauna species.

6.4.5 Migratory fauna

No migratory species listed under the EPBC Act were recorded in the study area. However, the Fork-tailed Swift (*Apus pacificus*) and Rainbow Bee-eater (*Merops ornatus*) could occur, based on their wide distribution and broad habitat preferences. The disturbance area does not contain any restricted habitat for any of these species, nor are the species dependant on the habitats present within the disturbance area.

An assessment of significance under the EPBC Act concluded that there would be no significant impact on either of these migratory species as a result of the proposed modification.

6.4.6 Indirect impacts

A spring in the eastern part of the study area may provide surface water to the Illawarra Subtropical Rainforest EEC adjacent to the proposed disturbance area. This spring will not be impacted as it is outside the proposed disturbance area.

The proposed vegetation clearing and ground disturbance may provide opportunities for the spread of weeds. Management measures will be incorporated into the site's existing Weed Management Plan to prevent the spread of weeds.

6.4.7 Biodiversity corridors and fragmentation

Vegetation in the study area is part of the Dunmore Hills Biodiversity Corridor, identified in the Illawarra Biodiversity Strategy. Clearing of the planted eucalypt forest in the north and south of the study area will impact this corridor as it will impede fauna movement through the corridor. This impact will be temporary as the bund will be vegetated once constructed. Further, the assessed threatened species are highly mobile and are able to move throughout the landscape.

6.5 Management and mitigation

6.5.1 Avoidance

A preliminary ecological assessment of the study area in 2015 recommended that intact areas of vegetation including the subtropical rainforest, paperbark shrubland and blue gum white box woodland/forest be avoided by the bund. These have been avoided during detailed design of the bund.

6.5.2 Minimisation and mitigation

The following measures are recommended to minimise and/or mitigate impacts to ecological constraints:

- clearly mark the outer boundary of disturbance area so that adjacent EECs are not impacted;
- control of weeds through active monitoring and management of rehabilitated areas and responsible disposal of cleared exotic vegetation;
- control of noxious weeds in accordance with the Illawarra District Noxious Weeds Authority (2006);
- the *Flora and Fauna Management and Rehabilitation Plan* (Cumberland Ecology 2009) should be updated to include re-establishment of north/south connectivity for wildlife through the Dunmore Hills biodiversity corridor on completion of the project; and

- the bund area is to be revegetated with indigenous species to provide habitat for local flora and fauna and improve connectivity of habitat;
- include Illawarra Zieria as part of the revegetation program, which will offset the loss of individual plants at a ratio, to ensure net species gain; and
- produce an offset management plan, in negotiation with OEH, within one year from the start of the project.

6.6 Conclusions

One planted threatened flora species and a small area of disturbed EEC were recorded in the disturbance area. Assessments of significance completed for threatened species and EECs concluded that there would be no significant impact on any matter listed under either the TSC Act or EPBC Act as a result of the proposed modification.

The bund has been designed to avoid key ecological features and will be vegetated once it has been constructed. This will include the threatened Illawarra Zieria, resulting in an increase in the total number of individuals within the extension area.

7 Air quality

7.1 Introduction

An air quality assessment was undertaken for the proposed modification by Ramboll Environ Pty Limited in accordance with the *Approved Methods for Modelling* (EPA 2005). The assessment is provided in Appendix B.

7.2 Method

The primary pollutants generated by the proposed modification are expected to be particulate matter, including total suspended particulates (TSP), particulate matter less than 10 microns in aerodynamic diameter (PM₁₀) and particulate matter less than 2.5 microns in aerodynamic diameter (PM_{2.5}). Gaseous pollutants, including oxides of nitrogen (NO_x), sulphur dioxide (SO₂), carbon monoxide (CO) and volatile organic compounds (VOCs), associated with onsite diesel consumption would also be generated, though it is expected that these emissions would be minor.

With regards to air quality compliance, impacts from PM₁₀ are considered the most relevant pollutant for the proposed modification. The specific goals for PM₁₀ that would be applicable at surrounding receptors are those specified by the *Approved Methods for Modelling* (EPA 2005) and are as follows:

- 24-hour maximum of 50 µg/m³.
- annual average of 30 µg/m³.

A qualitative approach to the assessment was undertaken due to the minor nature of the activities. While no specific methodology for such an assessment is available in Australia, the United Kingdom-based Institute of Air Quality Management (IAQM) has prepared the *Guidance on the Assessment of Dust from Demolition and Construction* (GADDC, IAQM 2014). The GADDC has been applied for construction projects in NSW. The most notable recent example of use was for the construction phase of the WestConnex M4 East Project, a construction project of much greater significance than the proposed modification, both with regard to the proximity and density of sensitive receptors to construction areas and the intensity of proposed construction activities. Consultation with the EPA has also confirmed that the use of this method is appropriate for the proposed modification (see Section 4.2.5).

The GADDC provides a progressive 5-step approach to assessing the particulate matter impact risk, returning a risk analysis for potential air quality impacts from a construction project. The approach takes into consideration a range of site specific conditions, including the magnitude of dust generating activities, the number and proximity of receptors to activities and existing air quality levels. In applying classification ratings through the IAQM, worst case options were selected wherever possible to ensure the assessment was conservative. Meteorological data obtained from BoM and detailed in Section 2.2 was used in the assessment.

7.3 Existing environment

Sources of air pollution emissions in the area surrounding the quarry include the industrial operations detailed in Section 2.1. Other sources include vehicle movements on public roads, household and bush fires, exposed areas, and sea breezes.

Data recorded by Boral and OEH monitoring stations was examined to characterise existing PM₁₀ concentrations at the quarry and surrounds. Between 2010 and 2015, recorded 24-hour average PM₁₀ concentrations fluctuated with a defined increased period during the months between October and March. Exceedances of the NSW EPA criteria for 24-hour PM₁₀ occurred only on three days in 2011 and 2013 at the OEH Albion Park South station dataset which were attributable to regional bushfire events. No exceedances were recorded at the quarry. The average concentration was 13.1 µg/m³ which is less than half of the NSW EPA criterion of 30 µg/m³.

7.4 Impact assessment

The GADDC identifies that the risk category for dust impacts from construction and demolition activities should be allocated based on the following factors:

- the scale and nature of works; and
- the sensitivity of the area to dust impacts.

These factors are then combined to determine the risk of impacts from the works.

Section 7.2 of the GADDC requires that in allocating dust impact risk, the scale and nature of the work components are classified against the prescribed criteria as either Large, Medium or Small. Based on the proposed activities at site, earthworks and truck movements were classified as Large and demolition and construction were classified as Small.

The sensitivity of the surrounding environment was categorised by combining receptor sensitivity classifications with the number of receptors, background PM₁₀ concentration (with regard to human health), and distance from source to classify the sensitivity of the surrounding environment. These were then compared with the relevant rating tables in the GADDC (Table 2, Table 3 and Table 4). In accordance with Section 7.3 of the GADDC details, the sensitivity classification of the surrounding environment is as follows:

- sensitivity of area to dust soiling effects on people and property – Low;
- sensitivity of area to human health effects – Low; and
- sensitivity of area to ecological effects – Low.

To determine the risk of impacts with no mitigation applied, Section 7.4 of the GADDC requires that the dust magnitude rating is combined with the sensitivity of the surrounding area for each of the four activity categories. Table 7.1 presents the risk rating for the proposed bund construction activities.

Table 7.1 Dust impact risk rating

Potential impact (sensitivity to impact)	Construction activity (impact risk magnitude)			
	Demolition (Small)	Earthworks (Large)	Construction (Small)	Truck movements (Large)
Dust soiling (Low)	Negligible	Low	Negligible	Low
Human health (Low)	Negligible	Low	Negligible	Low
Ecological (Low)	Negligible	Low	Negligible	Low

It can be seen from the results presented in Table 7.1 that uncontrolled dust emissions from the proposed bund construction are negligible to low for all activity classifications.

7.5 Management and mitigation

Boral proposes to manage potential dust emissions through the proposed bund construction period through the implementation of water sprays to unpaved transport routes and exposed surfaces wherever practicable. In addition, the following measures would be implemented to mitigate the potential impacts and reduce the Dust Impact Risk Rating for earthworks and truck movements from low to negligible:

- record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken;
- record any exceptional incidents that cause dust and/or air emissions, either on or off site, and the action taken to resolve the situation in the log book;
- carry out regular site inspections, record inspection results, and make an inspection log available to the local authority when asked;
- impose a maximum-speed-limit of 20 kilometres per hour (km/h) on all internal roads and work areas;
- minimise idling vehicles onsite, wherever practicable;
- ensure proper maintenance and tuning of all equipment engines;
- provide an adequate water supply on the construction site for effective dust/particulate matter suppression/mitigation; and
- minimise drop heights from loading or handling equipment.

7.6 Conclusions

The air quality impact assessment for the proposed modification assigned a low dust impact risk rating for the closest sensitive receptors from uncontrolled emissions related to earthwork activities and truck movements. Further, the risk ratings for construction and demolition activities were negligible. With the implementation of a number of recommended dust mitigation and management measures, the risk rating of emissions from earthworks and truck movements can be effectively minimised.

8 Noise and vibration

8.1 Introduction

Potential noise impacts from the proposed modification on nearby sensitive receivers (assessment locations) were assessed by EMM. The assessment report is in Appendix C and summarised in this chapter.

8.2 Existing environment

8.2.1 Assessment locations

A list of assessment locations is in Table 2.1 and shown in Figure 2.3. The closest privately owned residential properties are approximately 800 m to the west and 900 m to the south of the quarry. The closest surrounding land uses are industrial and rural. Other than the CBP and DSS, assessment locations to the east of the quarry are closer to the Princes Highway and are residential.

8.2.2 Ambient and background noise

Ambient and background noise at assessment locations potentially affected by the proposed modification was taken to be 30 decibels - A weighted (dB(A)), which is the minimum noise level in *NSW Industrial Noise Policy* (EPA 2000) (INP) which can be adopted for rural areas when representative background noise data is not available. EMM conducted attended noise monitoring at assessment locations near the proposed bund location in May 2016, which demonstrated that these residences receive little to no noise from existing operations at the quarry.

8.2.3 Meteorology

The INP requires consideration of temperature inversions and prevailing winds as these can significantly affect noise propagation over distance.

The INP requires consideration of winds if they are a 'feature' of the area, that is, they have a source to receiver direction, occur for more than 30% of an assessment period and season and have the highest wind speed at or below 3 metres per second (m/s). According to data from the BoM's Kiama weather station, a large proportion of winds are above 3 m/s between standard construction hours and are, therefore, not a feature of this area. Notwithstanding, winds up to 3 m/s were used in the noise model.

Standard weekday construction hours are 7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday and no work on Sundays and public holidays.

According to the INP, the assessment of temperature inversions can be confined to the standard INP night time hours (10 pm to 6 am). Therefore, the assessment did not consider temperature inversions as the proposed modification will be constructed during standard construction hours.

8.3 Method

8.3.1 Assessment criteria

The *Interim Construction Noise Guideline* (EPA 2009) (ICNG) do not necessarily need to be applied to the assessment of construction noise associated with modifications of existing quarry operations as the noise profile of construction and quarrying is similar. Notwithstanding, the ICNG were used for assessment of potential noise impacts from the proposed modification as the bund will be removed from the quarry and construction will be short term.

The ICNG sets out noise management levels (NML) (the point above which there may be some community reaction to noise) for noise at assessment locations and how they are to be applied. The noise management level ($L_{eq(15min)}$) during standard construction hours is the rating background level (30 dB) plus 10 dB; that is, 40 dB.

The highly affected NML, which represents the point above which there may be strong community reaction to noise, is 75 dB(A).

Assessment locations K and O have existing noise limits in Development Consent 470-11-2003 of $L_{Aeq(15 min)}$ 49 dB during INP daytime hours.

8.3.2 Modelling

Brüel and Kjær Predictor Version 11.00 (Predictor) noise prediction software was used to quantitatively calculate total noise levels at assessment locations from the concurrent operation of multiple noise sources based on worst case wind conditions (3 m/s in all directions) during standard construction hours. Topography at the quarry including processing areas and the bund was used in the model. However, noise from processing operations was not used as the processing area is far away from relevant assessment locations and would not increase noise levels from the proposal.

Construction of the bund is expected to take up to eight weeks and was separated into the following scenarios, comprising the noise sources in Table 8.1 in worst case locations, for modelling purposes:

- Scenario 1: stripping and initial construction of bund;
- Scenario 2: construction of western portion of bund; and
- Scenario 3: construction of northern portion of bund.

Table 8.1 Plant and equipment quantities and sound power levels

Item	LW, $L_{Aeq(15 min)}$, dB	Quantity
Bund construction		
Excavator	110	1
Dozer	114	1
Articulated dump truck	110	3
Water cart	110	1
Existing quarry operations		
Crusher and Screen	118	1
Front end loader (FEL)	114	1
Excavator	110	1

Noise levels were predicted at the assessment locations to the west, south-west and north-west of the proposed bund. Noise levels were also predicted for assessment locations K and O, which are east of the proposed bund, to demonstrate that this area will not be affected by noise from bund construction.

8.3.3 Impact assessment

The predicted noise levels at potentially affected assessment locations are in Table 8.2. As the bund will be an item of linear infrastructure, the worksites will move across the area as time progresses, which is demonstrated in Figure 8.2, showing noise levels at assessment locations over the construction period.

The results demonstrate that:

- NMLs are predicted to be satisfied at all assessment locations during the stripping and initial bund construction stage (Scenario 1);
- NMLs are predicted to be exceeded at assessment locations D, G, Z and AA during the construction of the bund west of the quarry (Scenario 2). This exceedance is expected to last for two to four weeks;
- NMLs are predicted to be exceeded at assessment locations D, F, G, Z and AA during the construction of the bund north of the quarry (Scenario 3). This exceedance is expected to last for two to four weeks;
- the largest exceedances are 6-9 dB above NML's for both assessment locations G and Z, and are during the construction of the bund north of the quarry and adverse weather conditions; and
- none of the predicted worst case maximum noise levels exceed the ICNG highly affected noise criterion of 75 dB.

The calm weather results are a more realistic estimate of noise at assessment locations as it is unlikely that adverse winds would prevail for any considerable amount of time.

The construction of the bund is primarily a noise mitigation measure and to complete it requires plant to be operating in areas that are relatively exposed to residences. The exceedances of NMLs at five receivers are limited to noise bund construction, with the exposure of residences to this activity expected to last between two to four weeks for works associated with construction of the section of the bund to the west of the quarry (ie Scenario 2). At all times the ICNG's highly noise affected criteria is satisfied.

The ICNG's primary objective is to firstly limit construction works to standard hours only, which has been committed to under the proposed modification. The noise benefits of further management measures (including those described in Section 8.4) can be described as follows:

- working behind sections of bund already completed where possible will reduce predicted levels by 8-10 dB;
- fit for purpose plant and equipment will be used and will include appropriate mufflers and operator behaviour practices conducive to working in sensitive areas; and
- the other measures are good practice measures that would normally be expected to avoid any additional nuisances to residences. These noise benefits are not quantifiable.

Table 8.2 Predicted noise levels

Assessment location ¹	Criteria, dB		Predicted L _{Aeq} (15 min), dB noise levels								
	(NML)	Highly noise affected	Scenario 1			Scenario 2			Scenario 3		
			Initial bund construction south			Bund construction west			Bund construction north		
			Calm	Adverse ²	Exceedance ³	Calm	Adverse ²	Exceedance ³	Calm	Adverse ²	Exceedance ³
D	40	75	35	38	0	41	44	1-4³	40	43	0-3
F	40	75	32	35	0	37	40	0	40	43	0-3
G	40	75	35	38	0	45	48	5-8	46	49	6-9
K	49	75	28	31	0	27	30	0	28	30	0
O	49	75	26	28	0	25	27	0	25	27	0
S	40	75	38	40	0	33	36	0	33	36	0
T	40	75	37	40	0	33	35	0	33	36	0
Z	40	75	35	38	0	41	44	1-4	46	49	6-9
AA	40	75	30	33	0	38	41	0-1	40	43	0-3
AB	40	75	28	31	0	31	34	0	32	35	0
AC	40	75	27	30	0	27	30	0	28	31	0
AD	40	75	35	37	0	30	33	0	32	35	0

Notes: 1. All assessment locations are privately owned.
2. 'Adverse' constitutes 3 m/s winds source to receiver, consistent with the INP's default parameters. They occur less than 30% of the time.
3. Exceedances have been highlighted bold.

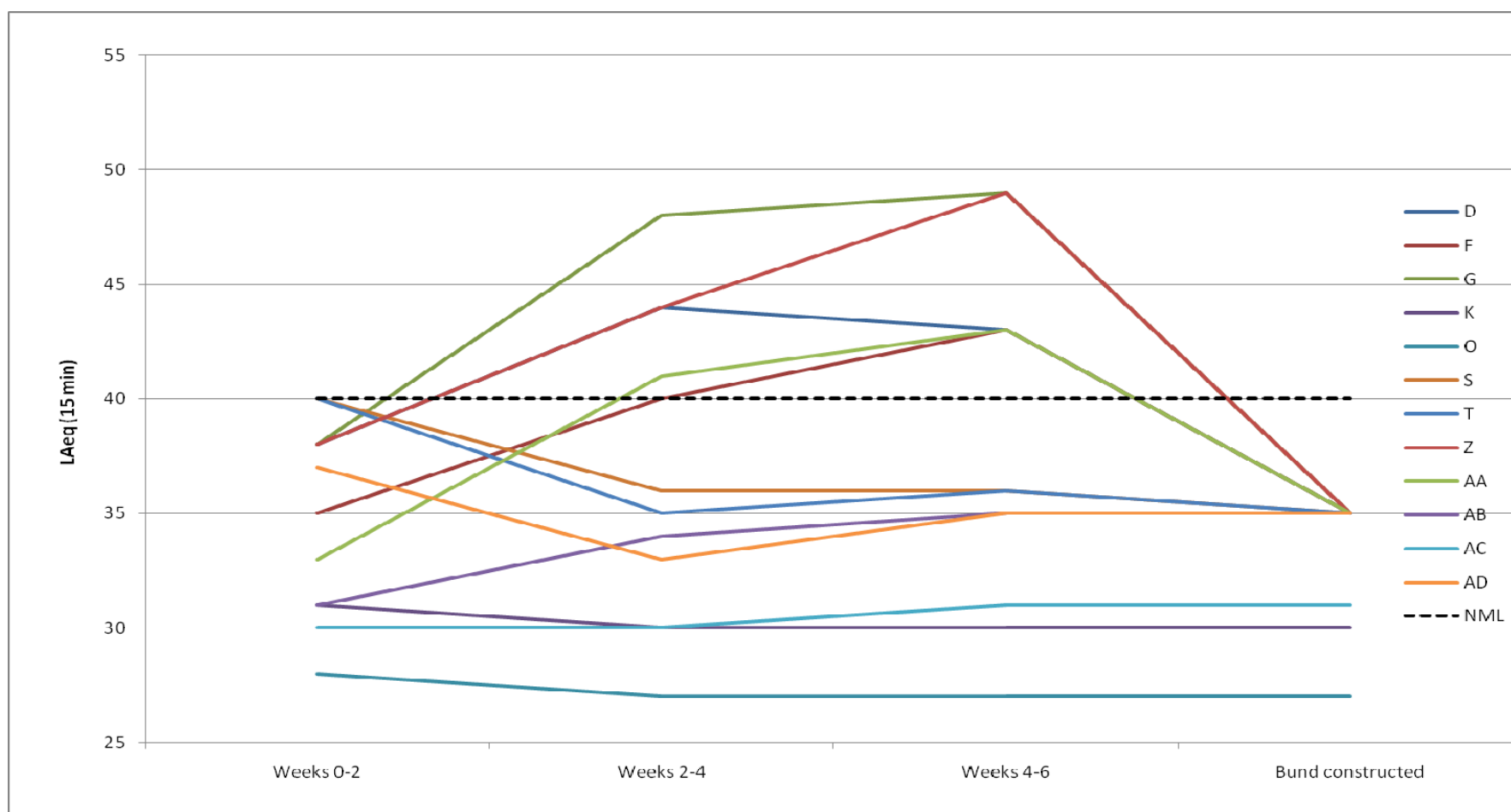


Figure 8.1 Construction time vs predicted noise level

8.4 Management and mitigation

Construction noise levels can be managed by working behind parts of the noise bund that are already constructed. This would generate much lower noise levels than the predicted noise levels provided in Table 8.1, as they represent worst case operations that are unprotected by the noise bund.

The following management measures will be implemented:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- developing routes for the delivery of materials and parking of vehicles to minimise noise;
- minimising the need for excessive vehicle reversing for example, by arranging for one-way site traffic routes;
- use of broadband audible reverse alarms on vehicles;
- minimising the movement of materials and plant and unnecessary metal-on-metal contact;
- minimising truck movements; and
- where practical, managing activities during adverse weather conditions (ie source to receiver winds).

8.5 Conclusions

Noise impacts at assessment locations west, south-west and north-west of the proposed bund were assessed by EMM for three bund construction scenarios. Noise levels at some of these assessment locations are predicted to exceed the NMLs during scenarios 2 and 3. Management measures will be implemented to reduce noise impacts on potentially affected assessment locations, including carrying out activities where possible behind constructed sections of the bund.

9 Visual

9.1 Introduction

This chapter describes the existing visual landscape, the predicted changes and resulting visual amenity impacts associated with the proposed modification.

9.2 Existing environment

The quarry is located on Locking Hill, which is in a low and partially vegetated north-south aligned range (the vegetated range). Topography rises from coastal flats in the east to the range then descends to a shallow and broad valley at the foot of a larger rise to the Southern Highlands region of the Great Dividing Range in the west.

The area has mixed visual characteristics, comprising:

- agricultural land generally to the east and immediately to the west;
- native vegetation to the immediate north and south, and further to the east and west;
- transport infrastructure (Princes Highway and Illawarra Railway) to the east;
- sand and hard rock quarrying to the immediate east and further north and east;
- landfill operations to the east associated with previous sand quarrying;
- residential development to the south-east (Minnamurra and Kiama Downs), north-east (Shell Cove), south-west (Jamberoo) and north-west (Albion Park), interspersed with residences associated with agricultural land; and
- higher vegetated ranges to the west.

9.3 Assessment method

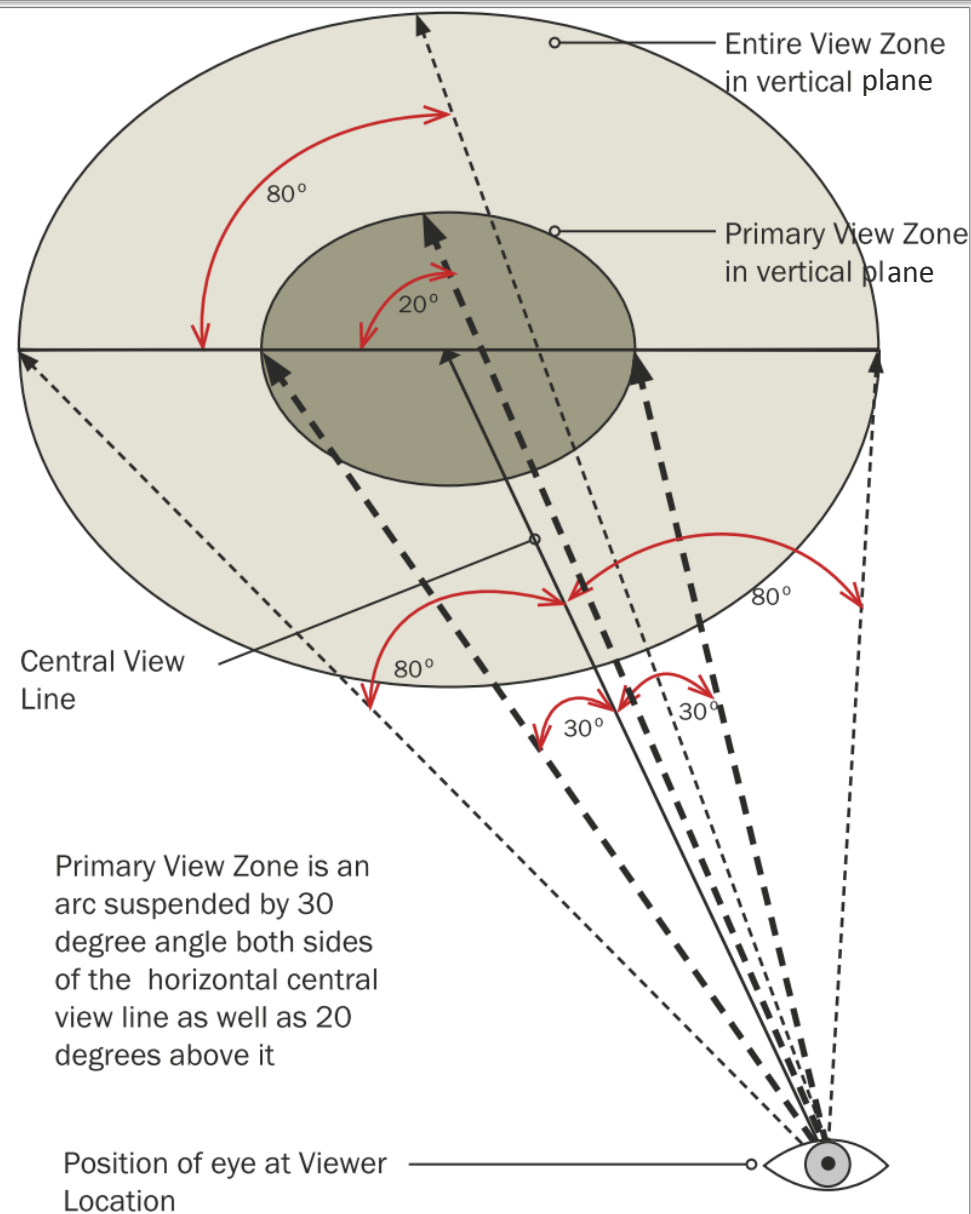
9.3.1 Visual effect and sensitivity

The potential visual impacts of the proposed modification were determined by considering the visual effect and visual sensitivity of the existing environment.

Visual effect is determined by comparing the level of contrast between a development and its surrounding environment. The magnitude of a development's visual effect is determined by considering the level of contrast or integration with its surroundings and the proportion of the view that includes the proposed development for the given level of contrast or integration.

The proportion of the view is the occupied percentage of the primary view zone (PVZ), the area occupied by an arc created by sight lines radiating vertically and horizontally at angles of 30 degrees around the centre view line from the eye (refer to Figure 9.1). The factors that determine visual effect are described in Table 9.1.

Distance from Project Site	Area of Primary View Zone
1 km	0.60 km ²
2 km	2.4 km ²
3 km	5.43 km ²
4 km	9.66 km ²
5 km	15.09 km ²
6 km	21.73 km ²
7 km	29.57 km ²
8 km	38.62 km ²
9 km	48.88 km ²
10 km	60.35 km ²
11 km	73.02 km ²
12 km	86.9 km ²
13 km	101.99 km ²
14 km	118.29 km ²
15 km	135.79 km ²



Source: JVP (2015)

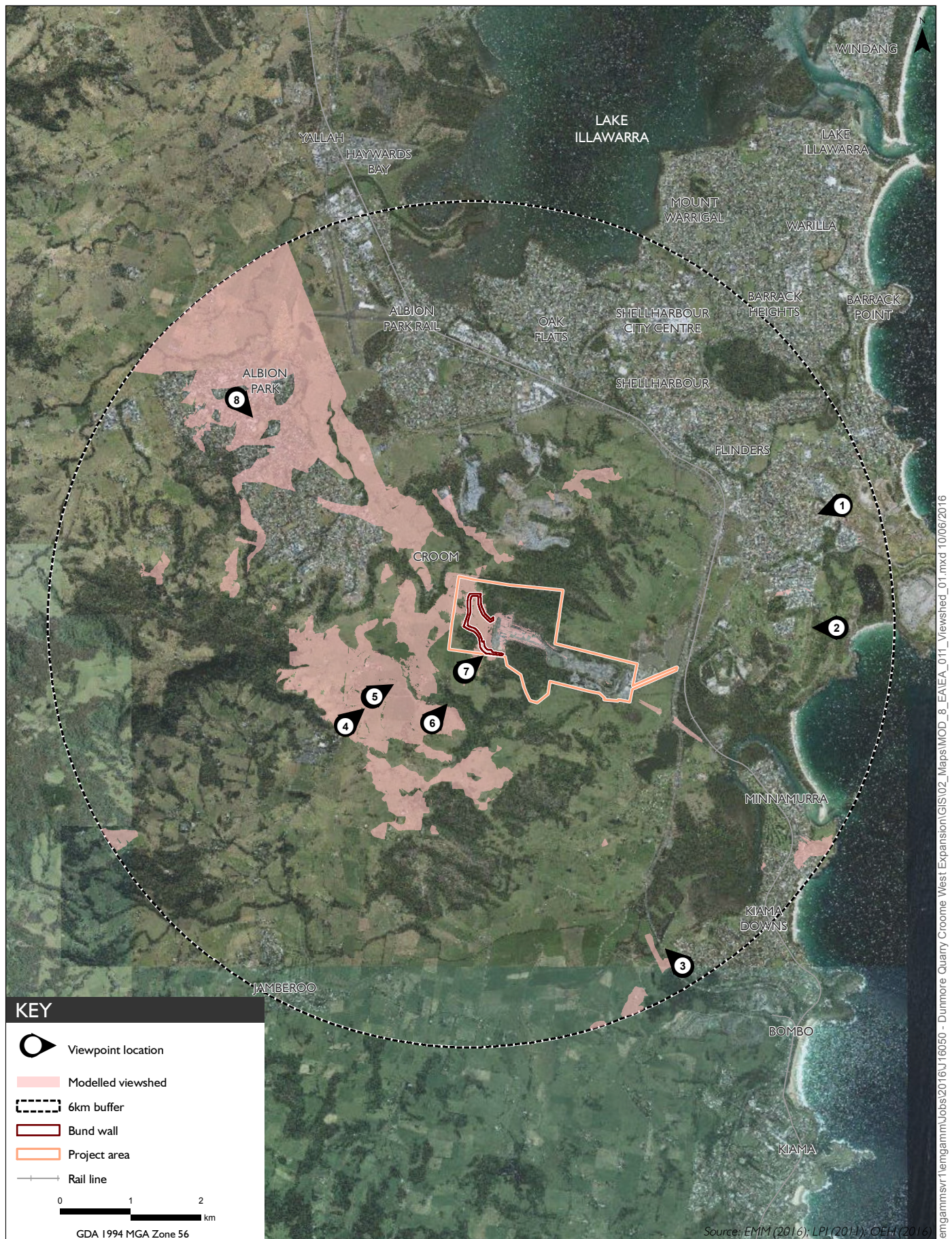
Table 9.1 Visual effect

Visual properties		Visual effect			
Contrast levels with elements in primary view zone	Visual integration with elements in primary view zone		High visual effect	Moderate visual effect	Low visual effect
High Project elements do not borrow, form, shape, line, colour or texture or scale from existing features of the visual setting and contrast levels are high with exiting landscape.	Low The project lacks integration with visual setting because of scale totally dominating the ability of site or surrounding features, vegetation and or topographic features to integrate the development.	Category 1	Visible element occupies more than 2.5% of the primary view zone.	Visible element occupies between 1 - 2.5% of the primary view zone.	Visible element occupies less than 1% of the primary view zone.
Moderate Project elements borrow from some features of the visual setting in terms of form, shape, line, pattern and/or colour and scale, reducing visual contrast with existing setting.	Moderate The project has some degree of visual integration with setting from other features, vegetation, and/or topography, achieving some level of integration.		Category 2	Visible element occupies more than 10% of the primary view zone, generally when in a foreground location.	Visible element occupies between 10 - 20% of the primary view zone.
Low Project elements borrow extensively from features in visual setting in terms of form, shape, line, pattern, colour and scale, minimizing contrast with the existing setting.	High Visual integration is high due to other features, vegetation and/or topography, achieving dominance and screening or filtering.	Category 3	Visible element occupies more than 40% of the primary view zone.	Visible element occupies between 30 - 40% of the primary view zone.	Visible element occupies less than 30% of the primary view zone.

In order to assess visual effect, GIS modelling software was used to analyse the viewshed, which determined the visibility of the proposed modification in the primary view zone. Inputs into the GIS model included topographical contours, the height of the surrounding vegetation and the proposed final landform of the bund.

The modelled viewshed of the bund can be seen in Figure 9.2.

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed by people from different land use areas in the vicinity of a development. Levels of visual sensitivity are shown in Table 9.2.



Modelled viewshed
Dunmore Quarry Modification 8
Environmental Assessment
Figure 9.2

Table 9.2 **Levels of visual sensitivity**

Visual sensitivity	Distance from development (km)
High	<2.5
High to moderate	2.5 – 7.5
Moderate	7.5 – 12.5
Low	>12.5

Visual impacts are determined through the consideration of visual effect in conjunction with visual sensitivity, as shown in Table 9.3.

Table 9.3 **Visual impact**

Visual effect	Visual sensitivity		
	High	Moderate	Low
High	High visual impact	High/moderate visual impact	Moderate/low visual impact
Moderate	High/moderate visual impact	Moderate visual impact	Moderate/low visual impact
Low	Moderate/low visual impact	Moderate/low visual impact	Low visual impact

9.3.2 Viewpoints

Viewpoints were selected based on the following criteria:

- current landownership status of residences surrounding the quarry;
- feedback regarding visual amenity as a result of ongoing stakeholder consultation;
- a review of heritage listings under the Shellharbour LEP;
- a review of the proposed final landform, with a 3D viewshed analysis undertaken to confirm areas where the proposed modification was visible; and
- a site inspection, which confirmed the outputs of the viewshed analysis.

Eight viewpoints were selected for the visual assessment. These viewpoints, their respective distances from the bund (ie the element of visual change due to the proposed modification), and the existing view from each location are described in Table 9.4. These viewpoints are also shown in Figure 9.2.

Table 9.4 Existing views

Viewpoint		Description	Distance to bund	Existing viewscape including views to the bund area
1	Shell Cove	Public road in residential area, close to private residences.	4.6 km	The quarry is south-west of this viewpoint, with views to the bund area obscured by intervening topography and vegetation. Views in the direction of the quarry comprise residential development in the foreground, transport infrastructure and agricultural land in the mid-ground and the vegetated range in the background.
2	Killalea State Park (Photograph 9.1)	Public reserve comprising cleared and vegetated areas.	5 km	The quarry is west-south-west of this viewpoint, with views to the bund area obscured by intervening topography and vegetation. Views in the direction of the quarry comprise cleared and vegetated areas of the park in the foreground, residential areas of Shell Cove in the mid-ground and transport infrastructure, agricultural land, Dunmore Soil and Sand Quarry and the vegetated range in the background.
3	Kiama Downs	Public road in residential area, close to private residences.	5.3 km	The quarry is north-north-west of this viewpoint, with views to the bund area obscured by intervening topography and vegetation. Views in the direction of the quarry comprise residential areas of Kiama Downs and acoustic walls associated with the Princes Highway in the foreground, riparian vegetation along the Minnamurra River in the mid-ground and transport infrastructure, agricultural land, processing facilities associated with the quarry and the vegetated range in the background.
4	Jamberoo Road (Photograph 9.2)	Public road in an area of small rural residential lots.	2 km	The quarry is east-north-east of this viewpoint, with views of the bund area in the background. Views in the direction of the quarry comprise agricultural land in the fore and mid-ground, and the vegetated range in the background.
5	28 Croome Vale Road (Photograph 9.3)	Public road in an area of small rural residential lots.	1.6 km	The quarry is east-north-east of this viewpoint, with views of the bund area in the background. Views in the direction of the quarry comprise agricultural land in the fore and mid-ground, and the vegetated range in the background.
6	86 Croome Vale Road (Photograph 9.4)	Public road in an area of small rural residential lots.	1.2 km	The quarry is north-east of this viewpoint, with views of the bund area in the background. Views in the direction of the quarry comprise agricultural land in the foreground, riparian vegetation in the mid-ground, and the vegetated range in the background.
7	180 Croome Vale Road (Glenbrook Homestead Group) (Photograph 9.5)	At homestead	0.5 km	The quarry is north-east of this viewpoint, with views of the bund area obscured by intervening topography and vegetation. Views in the direction of the quarry comprise agricultural land and trees in the foreground and mid-ground.
8	Albion Park (Photograph 9.6)	Park in residential area, close to private residences.	4.7 km	The quarry is south-east of this viewpoint, with views of the bund area completely obscured by intervening vegetation and urban development. Views in the direction of the quarry comprise a park and residential areas of Albion Park in the fore and mid-ground, and the vegetated range on the background.



Photograph 9.1 View from Killalea State Park towards the quarry



Photograph 9.2 View from Jamberoo Road towards quarry



Photograph 9.3 View from 28 Croome Vale Road towards the bund and quarry



Photograph 9.4 View from 86 Croome Vale Road towards quarry and bund



Photograph 9.5 View from 180 Croome Vale Road (Glenbrook Homestead Group) towards the quarry and bund



Photograph 9.6 View from Albion Park towards quarry

9.4 Impact assessment

According to the viewshed analysis the bund may be visible from viewpoints 1, 2, 3, 7 and 8. However, views to the proposed bund area west of the quarry during inspections of these viewpoints were obscured or blocked by intervening vegetation, topography and urban development, including views from Viewpoint 7 (180 Croome Vale Road - Glenbrook Homestead Group) which is the nearest viewpoint to the bund and quarry. Therefore, these viewpoints are unlikely to be visually impacted by the bund and have not been assessed further.

According to the viewshed analysis the bund may be visible from viewpoints 4, 5 and 6, which was confirmed during inspections of these viewpoints. Visual impacts at these viewpoints are assessed in Table 9.5 and potential views (photomontages) of the bund prior to and after it is vegetated are in Figures 9.3 to 9.5.

It is noted that, despite the moderate/low impact ratings in Table 9.5, impacts will be low as these ratings take into account the proximity of these viewpoints to the bund. Inspection of the photomontages shows that, once vegetated, the bund will have low contrast and high integration with the surrounding landscape.

Properties at 86 Croome Vale Road (Viewpoint 6) and 180 Croome Vale Road - Glenbrook Homestead Group (Viewpoint 7) are listed as heritage items under Schedule 5 of the Shellharbour LEP. As demonstrated in Table 9.5, visual impacts on Viewpoints 6 from the bund will be low.

The bund will be north-east of 180 Croome Vale Road and, as demonstrated in Photograph 9.5, is unlikely to be visible from the homestead due to the topography and intervening vegetation. The bund will be visible from other areas of the property. However, visual impacts will be low because the bund, once vegetated, will have low contrast and high integration as it will provide a continuous vegetated hill consistent with the surrounding landscape. Therefore, visual impacts to the mix of rural and vegetated outlooks from this property will be low.

Visual impact management measures are not required for the bund as it is a proposed management measure in and of itself, that is, the bund will be constructed to manage potential visual impacts from the proposed expansion of the Croome Farm Pit. The bund will be vegetated to increase its visual integration with surrounding areas of native vegetation.

Table 9.5 **Visual impact**

View point		Visual effect			Sensitivity	Impact	
		Contrast	Integration	Effect			
4	Jamberoo Road	Low – the bund will have moderate contrast with the surrounds in the background during construction. However, once it is vegetated it will have low contrast as it will provide a continuous vegetated hill consistent with the surrounding landscape.	High – the bund will have moderate integration with the surrounds in the background during construction. However, once it is vegetated it will have high integration as it will comprise a vegetated hill consistent with the surrounding vegetation.	Low – the bund will have moderate contrast and integration during construction. However, these will become low once the bund is vegetated. The effect will be low as the bund will occupy less than 10% of the viewscape during construction and less than 30% after it has been vegetated.	3	High to Moderate	Moderate /low
5	28 Croome Vale Road	Low – the bund will have moderate contrast with the surrounds in the background during construction. However, once it is vegetated it will have low contrast as it will provide a continuous vegetated hill consistent with the surrounding landscape.	High – the bund will have moderate integration with the surrounds in the background during construction. However, once it is vegetated it will have high integration as it will comprise a vegetated hill consistent with the surrounding vegetation.	Low – the bund will have moderate contrast and integration during construction. However, these will become low once the bund is vegetated. The effect will be low as the bund will occupy less than 10% of the viewscape during construction and less than 30% after it has been vegetated.	3	High to Moderate	Moderate /low
6	86 Croome Vale Road	Low – the bund will have moderate contrast with the surrounds in the background during construction. However, once it is vegetated it will have low contrast as it will provide a continuous vegetated hill consistent with the surrounding landscape.	High – the bund will have moderate integration with the surrounds in the background during construction. However, once it is vegetated it will have high integration as it will comprise a vegetated hill consistent with the surrounding vegetation.	Low – the bund will have moderate contrast and integration during construction. However, these will become low once the bund is vegetated. The effect will be low as the bund will occupy less than 10% of the viewscape during construction and less than 30% after it has been vegetated.	3	High to Moderate	Moderate /low



EXISTING



WORST CASE



REHABILITATED

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EXISTING



WORST CASE



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EXISTING



WORST CASE



REHABILITATED

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9.5 Conclusions

The bund is unlikely to be visible from viewpoints 1 (Shell Cove), 2 (Killalea State Park), 3 (Kiama Downs), 9 (180 Croome Vale Road - Glenbrook Homestead Group) or 8 (Albion Park) as the bund will not be visible from these viewpoints.

The bund will likely be visible in the background from viewpoints 4 (Jamberoo Road), 5 (28 Croome Vale Road) and 6 (86 Croome Vale Road). Visual impacts will be low as, once it is vegetated, it will have low contrast and high integration as it will comprise a vegetated hill consistent with the surrounding vegetation.

The bund will be promptly vegetated after it has been constructed and will integrate with the surrounding landscape. Therefore, no visual impact management measures will be required.

10 Conclusion

10.1 Objects of the EP&A Act

The proposed modification is relevant to four objects of the EP&A Act, comprising:

- the proper management of resources – the proposed modification allows for the efficient extraction of an approved resource by the removal and use of overburden. The proposed modification also removes the double handling of this material;
- the orderly economic use and development of land – the proposed modification allows for orderly economic use and development of the approved extraction area by the removal and use of overburden;
- protection of the environment – the proposed modification has minor environmental impacts which are not considered significant given the short timeframe of works (ie 6 weeks). Environmental impacts would be minimised through the implementation of mitigation measures identified in this EA. Further, the proposed modification would operate in a manner that reasonably and feasibly avoids or minimises impacts to the environment; and
- ecologically sustainable development (ESD) – the proposed modification complies with the four ESD principles described in the EP&A Regulation. This is discussed further in Table 10.1.

Schedule 2 of the EP&A Regulation describes four principles that must be complied with to achieve ESD (Table 10.1).

Table 10.1 Compliance with ESD principles

Principle	Application	Compliance
The precautionary principle	Proposals need to be carefully evaluated to ensure they avoid serious or irreversible environmental damage.	The proposed modification avoids serious and irreversible environmental damage through its design and location. Further, all reasonable and feasible measures that would minimise and mitigate potential environmental impacts from the proposed modification are to be implemented.
Inter-generational equity	The proposed modification needs to consider the health, diversity and productivity of the environment for future generations.	The proposed modification has been designed to ensure compliance with the relevant guidelines and assessment criteria for relevant environmental matters. This will ensure that the health, diversity and productivity of the environment will be maintained for future generations.
Conservation of biological diversity and ecological integrity	The conservation of biodiversity and ecological integrity needs to be considered in the proposed modification.	An ecological assessment has been undertaken of the proposed modification. It concludes that assessments of significance completed for threatened species and EECs concluded that there would be no significant impact on any matter listed under either the TSC Act or EPBC Act as a result of the proposed modification. It also concludes that the bund has been designed to avoid key ecological features and will be vegetated once it has been constructed. This will include the threatened Illawarra Zieria, resulting in an increase in the total number of individuals within the extension area.
Improved valuation, pricing and incentive mechanisms	The proposed modification needs to consider environmental factors in the valuation of assets and services.	The proposed modification has implemented all reasonable and feasible measures to mitigate impacts related to noise and visual impacts.

10.2 Summary of impacts

The proposed modification is required to enable the quarry operations to continue until the application for extension of the Croome Farm Pit (ie Modification 9) can be prepared and assessed. The proposed modification will also avoid double handling and provides pre-emptive noise and visual management.

The proposed modification has been designed to take into account the outcomes of stakeholder engagement. Technical assessments have been prepared in accordance with relevant guidelines and assessment criteria and to address DP&E's specific environmental assessments.

In conclusion, it is recommended that the proposed modification should proceed as it will:

- enable the continuation of an existing quarry that supports the local and regional economies;
- have minor environmental impacts which would be of short duration and will be mitigated through the implementation of all reasonable and feasible measures;
- accord with relevant legislation and state environmental planning policies; and
- accord with the objects of the EP&A Act including compliance with the principles of ESD.

Appendix A

Ecology Assessment

Ecological Assessment

Dunmore Hard Rock Quarry Modification 8

Prepared for Boral Resources (NSW) Pty Limited | 21 July 2016



Ecological Assessment

Dunmore Hard Rock Quarry

Modification 8

Prepared for Boral Resources (NSW) Pty Limited | 21 July 2016

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Ecological Assessment

Final

Report J16050ARP3 | Prepared for Boral Resources (NSW) Pty Limited | 21 July 2016

Prepared by **Eugene Dodd**

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Position Senior Ecologist

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Signature



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Date 21 July 2016

Date 21 July 2016

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

1.1 Background

Dunmore Hard Rock Quarry (the quarry) is located at the end of Tabbita Road, Dunmore, in the Shellharbour local government area (LGA). It is owned and operated by Boral Resources (NSW) Pty Ltd (Boral). This ecological assessment has been prepared to accompany an application to modify (Modification 8) the existing development consent for the quarry (Development Consent 470-11-2003) under Section 75W of the NSW *Environmental Planning and Assessment Act 1979* (the proposed modification).

It is estimated that approved rock reserves at the quarry will be exhausted by February 2017. Boral will be seeking to lodge a further application to modify the development consent – Modification 9 – in mid to late 2016 for an extension to the existing Croome Farm Pit (Croome Farm West Pit). To enable continuation of the current operations until Modification 9 is approved, it is proposed to extract an area of approved resource within the southern corner of the Croome Farm Pit extraction area. Approximately 130,000 m³ of overburden (64,800 m³ free dig material and 62,200 m³ of weathered hard rock) is located in this area. To avoid double handling and to provide pre-emptive noise and visual management, the extracted overburden will be used to construct a bund along the proposed boundary of the future Croome Farm West Pit (Figure 2.1).

The bund will be constructed on Boral owned land to the west of the Croome Farm Pit. The bund will be 1,800 m long with a height of around 5 m. The bund base width will vary between 24 m and 41 m. A further 3 m wide buffer will be maintained around the perimeter of the bund for the provision of sediment and erosion control measures and light vehicle access. Approximately 1.94 ha of predominantly planted native vegetation will be cleared for construction of the bund and for a 30 m wide truck and machinery construction access route from the pit to the bund. The bund will be rehabilitated with a range of locally sourced and propagated native species, including Illawarra Zieria (*Zieria granulata*). It is estimated it will take six weeks to construct the bund during normal construction hours.

The proposed modification also includes some minor administrative amendments to the conditions of consent to remove redundant conditions and to reflect contemporary management practices at the quarry.

1.2 Purpose of this report

An ecological assessment was undertaken by EMM Consulting Pty Limited (EMM) to consider the impacts of a proposed modification of Dunmore Quarry. The aims of this assessment are to identify/assess:

- the characteristics and ecological condition of the vegetation communities and habitats within the area where the bund will be constructed;
- determine the occurrence, or likelihood of occurrence of threatened species, populations and endangered ecological communities listed under the NSW *Environmental Planning and Assessment Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 2000* (EPBC Act);
- describe and quantify impacts on biodiversity resulting from the proposed modification; and

- recommendations to avoid, minimise and mitigate potential impacts of the proposed modification on threatened biodiversity.

1.3 Legislative framework

Legislation and planning policies relevant to the protection of biodiversity or their habitats and this ecological assessment are provided below. These statutory instruments provide conditions, matters for consideration, and requirements to seek authorisation (licences and approvals) to undertake various actions and activities. The list of State and Commonwealth legislation applicable to this assessment are:

- EP&A Act;
- TSC Act;
- *NSW Native Vegetation Act 2003* (NV Act);
- *NSW National Parks and Wildlife Act 1974* (NPW Act);
- *NSW Noxious Weeds Act 1993* (NW Act);
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44);
- *Shellharbour Local Environmental Plan 2013* (Shellharbour LEP); and
- EPBC Act.

i Approvals pathway and environmental assessment requirements

Under Clause 8J(8) of the *NSW Environmental Planning and Assessment Regulations 2000* (EP&A Regulation), a development consent relating to State significant development (SSD) that was granted by the Minister under Part 4 of the EP&A Act before 1 August 2005 is taken to be an approval under Part 3A of the EP&A Act, for the purposes of a modification only, and section 75W of the EP&A Act applies to any modification of such a consent. Under section 75W, the request for the Minister's approval for a modification is to be lodged with the Secretary of the Department of Planning and Environment (DP&E). The Secretary may notify the proponent of formal environmental assessment requirements (SEARs) with respect to the proposed modification that the proponent must comply with before the modification will be considered by the Minister or the Minister's delegate.

Representatives from Boral and EMM met with representatives from DP&E on 13 May 2016 to discuss issues to be assessed in this ecological assessment and the wider EA. Representatives from DP&E stated that while formal SEARs would not be required for the proposed modification, they would provide environmental assessments requirements via email. These were provided by DP&E on 14 May 2016.

The environmental assessments requirements for the ecological assessment are provided below:

- accurate predictions of any vegetation clearing on site;
- a detailed assessment of the potential biodiversity impacts of the development, paying particular attention to threatened species and/or populations (or their habitats) and endangered ecological communities (EECs); and

- a detailed description of the proposed measures to maintain or improve the biodiversity values of the site in the medium to long term, as relevant.

1.3.2 NSW Environmental Planning and Assessment Act 1979

The relevant planning legislation for NSW is the EP&A Act. The EP&A Act institutes a system of environmental planning and assessment in NSW and is administered by the DP&E. Refer to Section 1.3i above regarding the approvals pathway for this project.

1.3.3 State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 commenced on 13 February 1995 and aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reserve the current trend of koala population decline by:

- requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat;
- encouraging the identification of areas of core koala habitat; and
- encouraging the inclusion of areas of core koala habitat in environment protection zones.

This policy only applies to the LGAs listed in Schedule 1 of the policy but does not apply to land dedicated or reserved under the NPW Act or to land dedicated under the NSW *Forestry Act 1916* as a state forest or flora reserve. Shellharbour LGA is not listed within Schedule 1 and therefore does not apply to the proposed modification.

1.3.4 Threatened Species Conservation Act 1995

The TSC Act is administered by NSW Office of Environment and Heritage (OEH) and establishes mechanisms for:

- management and protection of listed threatened species of native flora and fauna (excluding fish and marine vegetation);
- listing of threatened species or key threatening processes;
- development and implementation of recovery and threat abatement plans;
- declaration of critical habitat;
- consideration and assessment of threatened species impacts in development assessment process; and
- management and regulation of actions that may damage critical or other habitat or otherwise significantly affect threatened species, populations and ecological communities.

The TSC Act lists threatened species, populations and ecological communities under Schedules 1 and 2 of the Act, that are priorities for conservation within NSW. Schedule 3 of the TSC Act lists key threatening processes for species, populations and ecological communities within NSW.

Section 5A of the EP&A Act sets out seven factors to be considered during assessments of significance (seven-part test) when determining whether a proposed action will, or is likely to, have a significant effect on a threatened species, endangered populations or EECs listed under the schedules of the TSC Act.

Potential impacts of the proposed modification to threatened species, endangered populations or EECs are considered in Chapter 4. Seven-part tests are provided in Appendix C.

1.3.5 NSW Native Vegetation Act 1997

The NV Act provides for the management of native vegetation in NSW. Generally, approval to clear native vegetation in NSW is required under the NV Act.

Potential impacts of the proposed modification on native vegetation is considered in Chapter 4.

1.3.6 NSW National Parks and Wildlife Act 1974

The NPW Act is administered by OEH and contains provisions that relate to the protection of native terrestrial fauna, flora and EECs.

Under the NPW Act, it is an offence to harm threatened species; buy, sell or possess threatened species; damage critical habitat; or damage the habitat of a threatened species without approval under the Act. Under section 171 of the Act, the Director-General may authorise the harming of threatened and protected flora and fauna species and habitats. It is a defence to prosecution under the Act if the offence is necessary for carrying out a project that has received development consent under the EP&A Act.

1.3.7 Noxious Weeds Act 1993

The NW Act defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds. The NW Act sets up categorisation and control actions for noxious weeds and imposes penalties for various offences. All private landowners, occupiers, public authorities and councils are required to control noxious weeds on their land under Part 3, Division 1 of the NW Act.

1.3.8 Shellharbour Local Environmental Plan 2013

The Shellharbour LEP controls development through land zonings and other planning provisions, and guides planning decisions made by Council. Part of the land subject to the proposed modification has been mapped as environmentally sensitive land due to terrestrial biodiversity. Clause 6.5 of the Shellharbour LEP states:

Before determining a development application for development on land to which this clause applies, the consent authority must consider

- (a) whether the development is likely to have:
 - (i) any adverse impact on the condition, ecological value and significance of the fauna and flora on the land;
 - (ii) any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna;

- (iii) any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land;
- (iv) any adverse impact on the habitat elements providing connectivity on the land; and
- (b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

The above considerations are addressed throughout this ecological assessment.

1.3.9 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES (Matters of National Environmental Significance), as defined under the EPBC Act, include:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have an impact on a MNES is to be referred to Commonwealth Department of the Environment (DoE) for determination as to whether or not it is a controlled action.

The proposed modification will not have a significant impact on any MNES and, therefore, is not required to be referred to DoE and does not require approval from the Commonwealth Minister for the Environment.

1.4 Consultation

A meeting was held at OEH's offices on 27 April 2016 to brief OEH officers on the proposed modification and the environmental assessment (EA) being prepared to accompany the application. Discussions centred around the assessment pathway for ecological matters (ie assessment under the Framework for Biodiversity Assessment (FBA) or alternative approach).

It was acknowledged that the majority of vegetation being cleared under the proposed modification was planted (ie as part of rehabilitation in the mid 2000s) which does not conform with any Plant Community Types (PCTs) under the FBA. However, it was also acknowledged that the rehabilitated vegetation contains several planted individuals of a threatened species, namely Illawarra Zieria (*Zieria granulata*), and the potential removal of these plants for the proposed modification would need to be offset.

It was acknowledged that, given the majority of vegetation being cleared did not conform with any PCTs, it would be difficult to apply the FBA as an assessment tool for the proposed modification. Officers from OEH stated that the clearance of the Illawarra Zieria could be offset using a negotiated outcome which would involve replacing the plants removed as part of the proposed rehabilitation of the bund, but at a higher ratio to ensure a net biodiversity gain.

Notwithstanding the above, it was agreed that EMM would provide OEH with details on the floristics of the vegetation impacted to confirm that the proposed modification would not impact on any additional threatened or endangered flora or fauna.

2 Methods

2.1 Introduction

For the purposes of ecological assessment several spatial scales were considered, including the disturbance area and study area.

The disturbance area is the area which will be directly disturbed by the proposed modification. It includes the footprint of the bund and, the 3 m setback allowed for light vehicle access and sediment and erosion controls, and the area of clearance required for the access road between the Croome Farm Pit and the bund.

The study area surrounds the disturbance area and includes areas which will not be directly impacted by the proposed modification. This provides an appreciation of the vegetation and habitat value of land surrounding the disturbance area and allows relative comparisons to be made regarding ecological value.

The disturbance area and study area can be seen in Figure 2.1.

It is the disturbance area which will be used to calculate the overall impact area of the proposed modification.

2.2 Desktop review

2.2.1 Previous local studies

Several ecological studies have been completed at the quarry. While none of these studies focused on the study area, a flora survey completed by Kevin Mills and Associates in 2003 was completed in the eastern part of the study area.

Local vegetation mapping datasets including the *Forest Ecosystem Classification and Mapping for the Southern CRA Region Volume II* (Thomas, Gellie and Harrison 2000) were also reviewed.

These reports and associated vegetation mapping were reviewed to provide an indication of the native vegetation and threatened biodiversity that may be present in the disturbance area.

The *Illawarra Biodiversity Strategy* (Wollongong, Shellharbour and Kiama Councils 2010) was also reviewed to identify any wildlife corridors present in and surrounding the study area.

2.2.2 Database searches

Table 2.1 summarises the database searches and background research performed to identify threatened species; important habitat for migratory species; and critical habitats in and surrounding the study area.

Table 2.1 Database searches

Source	Date	Search radius around the study area
Atlas of NSW Wildlife www.environment.nsw.gov.au/atlasapp	02 June 2016	10 km
PlantNET spatial search plantnet.rbgsyd.nsw.gov.au/search/spatial.htm	25 June 2015	10 km
Protected Matters Search Tool www.environment.gov.au/webgis-framework-apps/pmst/pmst.jsf refer to Appendix A	02 June 2016	10 km
Critical habitat register www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm	02 June 2016	Not applicable, as individual sites are listed as critical habitat in NSW

2.3 Field survey

Two field surveys were undertaken over two days. The first survey was undertaken by Katie Whiting (EMM) and Roger Lembit of Gingra Ecological Surveys on 29 June 2015. A second survey was undertaken by Dilys Zhang (EMM) on 28 April 2016. Refer to Figure 2.1 for the study area considered and the distribution of survey effort.

2.3.1 Classification of vegetation communities

Vegetation mapping and community descriptions by Kevin Mills and Associates (2003) in the eastern part of the study area were used as a guide to identifying plant communities and plant community types on and surrounding the disturbance area.

Nineteen rapid vegetation assessments were completed to provide a preliminary understanding of vegetation constraints. The main canopy, mid and understorey species were recorded during rapid vegetation assessments to characterise the vegetation present.

One plot and transect was undertaken using BioBanking methodology. This aimed to characterise the planted vegetation, within the eastern part of the study area.

Where possible, vegetation communities identified on and surrounding the proposed extension area were classified into PCTs described by OEH. The vegetation information system (VIS) classification database (OEH 2016) which contains descriptions of all PCTs identified was established as the NSW standard community level vegetation classification for use in site based planning processes and standardised vegetation mapping.

2.3.2 Targeted searches and habitat assessment

Targeted searches were completed for Illawarra Zieria (*Zieria granulata*) in suitable habitat given the previous records of the species in the eastern part of the study area.

Surveys aimed to identify potential habitat for the following threatened flora species and populations recorded or predicted to occur within 10 km of the study area:

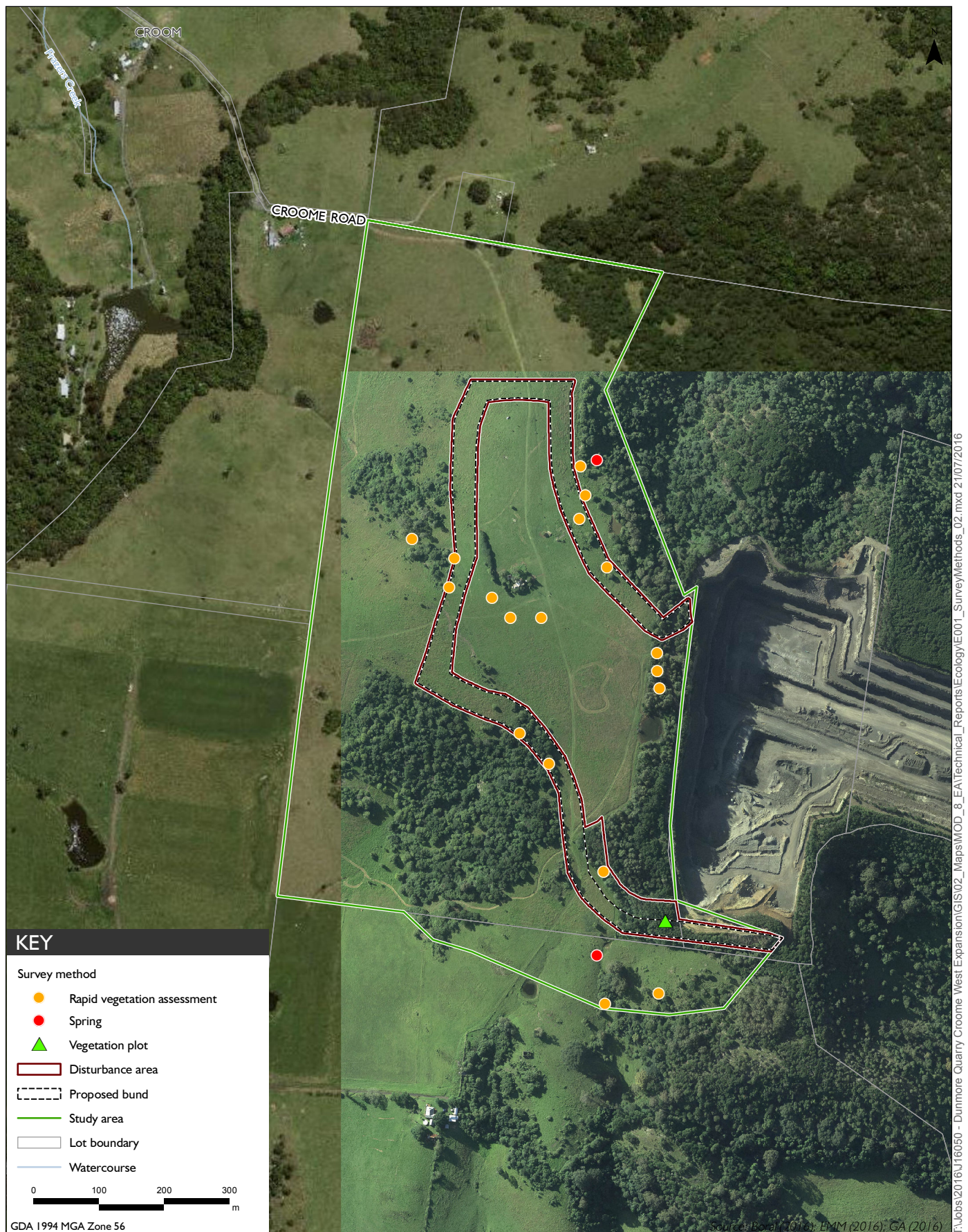
- *Gossia acmenoides* population in the Sydney Basin Bioregion, south of the Georges River;
- Illawarra Irene (*Irenepharsus typherus*);
- Illawarra Socketwood (*Daphnandra johnsonii*);
- Prickly Bush-pea (*Pultenaea aristata*);
- White-flowered Wax Plant (*Cynanchum elegans*);
- *Chorizema parviflorum* population in the Wollongong and Shellharbour LGAs;
- Illawarra Greenhood (*Pterostylis gibbosa*);
- *Pimelea curviflora* var. *curviflora*;
- *Solanum celatum*; and
- Spiked Rice Flower (*Pimelea spicata*).

2.3.3 Fauna habitat assessment

Habitat features were compared to the specific requirements of threatened and migratory fauna species previously recorded within 10 km of the study area. The likelihood that these threatened and migratory species would occur within and adjacent to the disturbance area was assessed (Appendix B).

2.3.4 Ecosystems that potentially rely on groundwater

The locations of springs were recorded using a handheld GPS. The type and condition of vegetation adjacent to the springs was considered to identify ecosystems that potentially rely on groundwater.



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3 Results

3.1 Desktop review

3.1.1 Previous studies

Kevin Mills and Associates (2003) recorded five different vegetation communities in the eastern part of the study area (Table 3.1).

Table 3.1 Vegetation communities in eastern part of study area

Community	Key species	Distribution
Subtropical rainforest	Moreton Bay Fig (<i>Ficus macrophylla</i>) Red Ash (<i>Alphitonia excelsa</i>)	Occurs as remnant trees in the valley south of the quarry and as good quality stands in the nearby gorge
Blue Gum White Box woodland/forest	Bangalay x Blue Gum (<i>Eucalyptus botryoides</i> x <i>saligna</i>) Coastal White Box (<i>E. quadrangulata</i>) Forest Red Gum (<i>E. tereticornis</i>)	In a shallow gully in the south-western corner of the quarry western section
Planted Eucalypt forest	Spotted Gum (<i>Corymbia maculata</i>) Forest Red Gum Black Wattle (<i>Acacia mearnsii</i>)	Occurs on bund walls and adjacent slopes in the eastern section of the quarry
Paperbark shrubland	Bracelet Honey-myrtle (<i>Melaleuca armillaris</i>) Prickly Beard Heath (<i>Leucopogon juniperinus</i>) Rock Fern (<i>Cheilanthes sieberi</i>) Narrow-leaved Mint Bush (<i>Prostanthera linearis</i>)	Occurs in the southwest and eastern parts of the quarry and extensively on adjoining ridges
Lantana shrubland	Lantana (<i>Lantana camara</i>) Black Wattle	Occurs over much of the eastern part of the site in highly disturbed areas

Source: Kevin Mills and Associates (2003)

Kevin Mills and Associates (2003) recorded planted individuals of the threatened Illawarra Zieria (*Zieria granulata*) in the eastern part of the survey area, and 40 naturally occurring individuals in the western part of the survey area.

No threatened fauna species were recorded on the survey area by Kevin Mills and Associates (2003), however they noted that the threatened Grey-headed Flying-fox (*Pteropus poliocephalus*), Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*), Powerful Owl (*Ninox strenua*) and Swift Parrot (*Lathamus discolor*) had potential to occur due to the presence of suitable habitat.

The *Forest Ecosystem Classification and Mapping for the Southern CRA Region Volume II* (Thomas, Gellie and Harrison 2000) covers the study area. However, the mapping is of a coarser scale than Kevin Mills and Associates (2003) and has not been verified by site surveys. This mapping dataset predicts that Rainforest Ecosystem 177: Illawarra Lowland Subtropical Rainforest occurs across the study area.

Thomas, Gellie and Harrison (2000) describe Illawarra Lowland Sub-Tropical Rainforest as a forest up to 20 m in height, with a diverse range of subtropical rainforest overstorey species, including Black Apple (*Planchonella australis*), Brush Bloodwood (*Baloghia inophylla*), Illawarra Flame Tree (*Brachychiton acerifolius*), Giant Stinging Tree (*Dendrocnide exelsa*), Red Cedar (*Toona ciliata*), Native Quince (*Alectryon cinereus*), Myrtle Ebony (*Diospyros pentamera*), Deciduous Fig (*Ficus superba*) and Sandpaper Fig (*F. coronata*). The shrub understorey mainly comprises species from the canopy, together with a lower shrub layer of *Pittosporum spinescens*, *P. revolutum*, and Coffee Bush (*Breynia oblongifolia*). Vines are common and include *Trophis scandens*, Water Vine (*Cissus antartica*), Round-leaf Vine (*Legenephora moorei*), Hairy Milk Vine (*Marsdenia flavescens*), Cockspur Thorn (*Maclura cochinchinensis*), and Giant Pepper Vine (*Piper hederaceum* var. *hederaceum*). Ferns in the ground layer include *Arthropteris tenella* and Prickly Rasp Fern (*Doodia aspera*) and a herb, Pastel Flower (*Pseuderanthemum variabile*).

The study area is part of the Dunmore Hills Biodiversity Corridor, identified in the *Illawarra Biodiversity Strategy* (Wollongong, Shellharbour and Kiama Councils 2010). The Dunmore Hills Biodiversity Corridor commences in Shellharbour in the north and extends south through the Dunmore Hills. It provides a north-south corridor to Minnamurra and provides a western connection through Saddleback Mountain to Barren Grounds and Budderoo National Park. The Dunmore Hills corridor also connects to Tongarra – Stockyard Mountain and provides a western connection to Macquarie Pass National Park.

3.1.2 Database searches

Thirteen EECs are known to occur in the Illawarra Interim Biogeographic Regionalisation for Australia (IBRA) subregion, in which the study area is located.

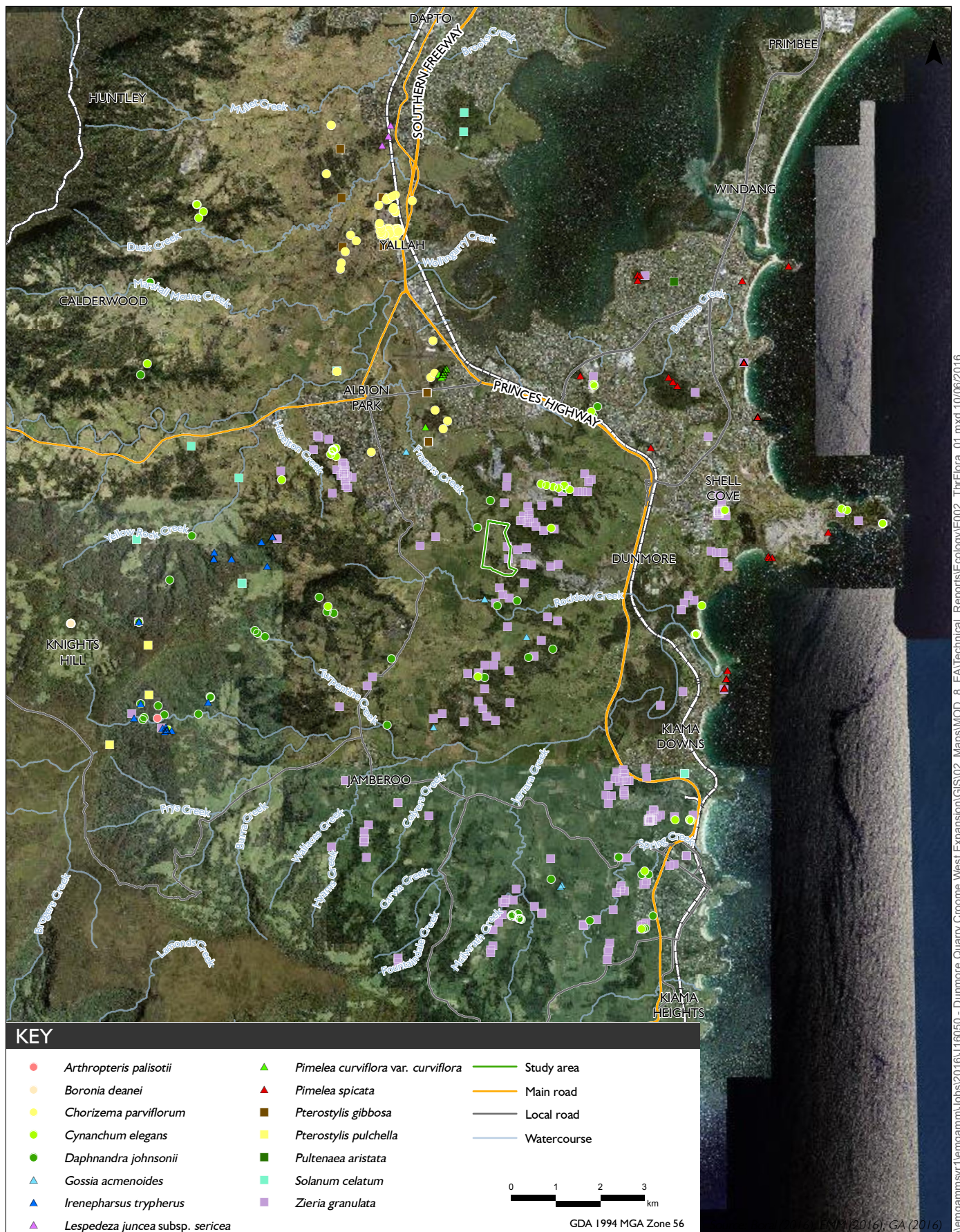
Table 3.2 shows threatened species, populations, and migratory species recorded within a 10 km radius of the study area (Atlas of NSW Wildlife, 2016). The full results are considered in Appendix B, and shown in Figure 3.1, 3.2, and 3.3.

Table 3.2 Threatened species, populations and migratory species recorded within the study area

Entity	Total recorded	Number listed under the TSCA Act	Number listed under the EPBC Act
Flora populations	3	3	-
Flora	12	12	10
Frogs	1	1	1
Birds	29	25	9 (5 threatened and 5 migratory*)
Mammals	13	13	5

Source: Atlas of NSW Wildlife (2016)

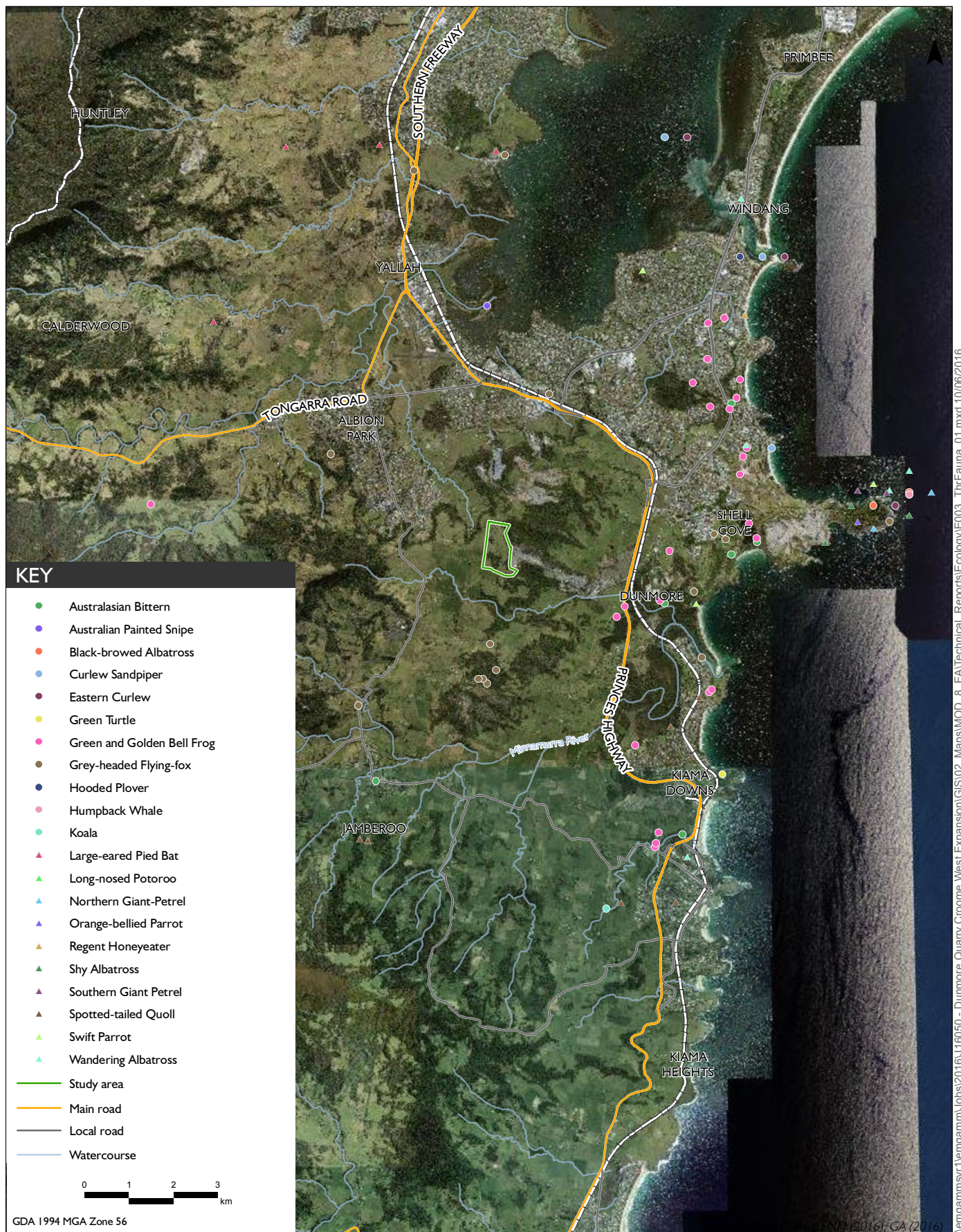
*Note that one species is listed both threatened and migratory.



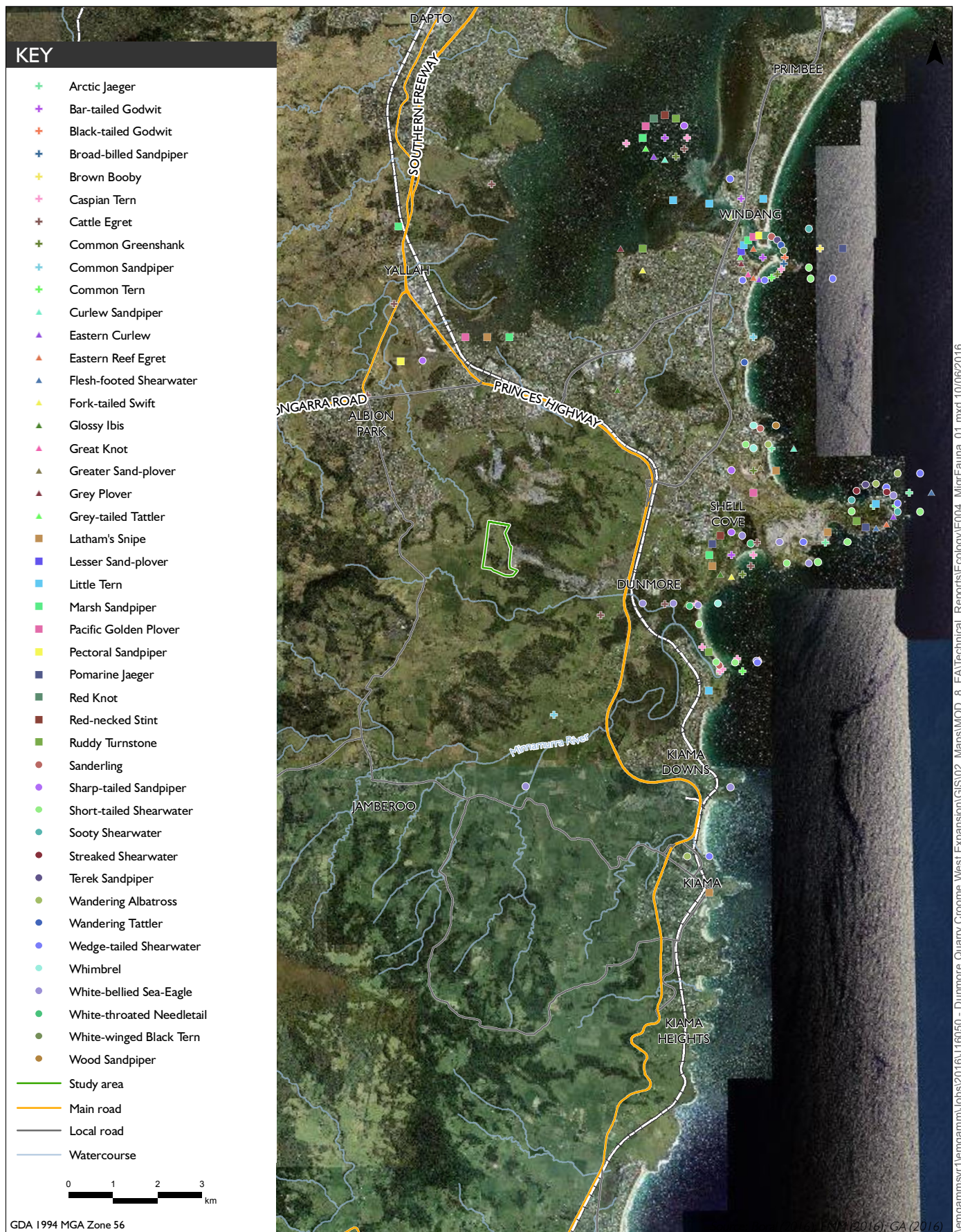
Threatened flora recorded within the locality (10 km buffer)

Dunmore Quarry Modification 8
Ecological Assessment

Figure 3.1



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Migratory species recorded within the locality (10 km buffer)

Dunmore Quarry Modification 8
Ecological Assessment

Figure 3.3

The DoE's Protected Matters Search Tool (PMST) predicts that the following threatened species, populations, and communities listed under the EPBC Act may occur within 10 km of the study area (refer to Appendix A):

- three ecological communities;
- 18 plant species;
- two freshwater fish species;
- four frog species;
- one reptile species;
- 14 birds, and
- nine mammal species.

Marine species predicted to occur within 10 km of the study area were excluded from the assessment given its location inland from the coast.

The PMST also predicts that eight migratory terrestrial bird species listed under the EPBC Act may occur within 10 km of the study area. Migratory marine and migratory wetland species were excluded from further assessment, given that there is no marine or wetland habitat within the study area.

An assessment of the likelihood that these threatened species and populations would occur in the study area is provided in Appendix B.

3.2 Field survey

Much of the study area is in a highly disturbed state. The majority of the study area has been previously cleared for grazing, and is currently grazed by Horses (*Equus caballus*). Small patches of remnant, regenerating and rehabilitated vegetation occur within the study area. Large tracts of remnant rainforest and shrubland occur directly adjacent to the study area.

Preliminary vegetation classifications for the study area are described below.

3.2.1 Vegetation

Where similar vegetation types occur, vegetation community naming has been kept consistent with Kevin Mills and Associates (2003) for ease of reading and assessment.

i Cleared land

Cleared land dominates much of the study area and disturbance area (Photograph 3.1 and Figure 3.4). It comprises the exotic grasses and forbs Kikuyu (*Pennisetum clandestinum*), White Clover (*Trifolium repens*), Paspalum (*Paspalum distichum*) and Fireweed. Windrows have been planted around an old residence in the cleared land and is dominated by Small-leaved Privet.

The cleared land does not contain any native vegetation, therefore does not conform to any native vegetation type.



Photograph 3.1 **Cleared land within the study area**

ii Planted Eucalypt forest

Vegetation on the eastern boundary of the study area (Photograph 3.2 and Figure 3.4) has been planted by Boral. It contains a variety of native trees and shrubs including Forest Red Gum, Coastal White Box, Sydney Blue Gum, Bracelet Honeymyrtle, Sweet Pittosporum (*Pittosporum undulatum*), *Callistemon linearis*, Prickly-leaved Tea Tree (*Melaleuca styphelioides*), Heath-leaved Banksia (*Banksia ericifolia*), Two-veined Hickory (*Acacia binervata*) and Blackwood (*A. melanoxylon*).

This area includes patches of vegetation which have few eucalypt species and dominated by the Parramatta Wattle (*Acacia parramattensis*) and exotic weeds Lantana (*Lantana camera*) and Wild Tobacco (*Solanum mauritianum*). The ground cover is predominately grassy, with native species including Wiry Panic (*Entolasia stricta*) and Bordered Panic (*Entolasia marginata*). Exotic grasses include Pigeon Grass (*Setaria sp.*) and Paspalum (*Paspalum dilatatum*). One threatened species, the Illawarra Zieria (*Zieria granulata*) were recorded in four locations, within this community.

Planted Eucalypt forest contains a mix of native vegetation species that occur in the local area, and does not conform to any native vegetation type.

The northern and southern sections of the planted Eucalypt forest will be disturbed by the proposed modification.



Photograph 3.2 **Planted Eucalypt forest within the study area**

iii Disturbed rainforest

Two small patches of rainforest trees occur in the north east of the study area (Figure 3.4). A larger patch of disturbed rainforest is located in the south-eastern part of the study area. These patches contain trees including Forest Red Gum, Port Jackson Fig (*Ficus rubiginosa*), Guioa (*Guioa semiglauca*), Red Ash and Hairy Clerodendron (*Clerodendron tomentosum*). Shrubs and ferns include Sickie Fern (*Pellaea falcata*), Coffee Bush, Large-leaf Hop Bush (*Dodonaea viscosa* subsp. *viscosa*) and the introduced Blackberry (*Rubus fruticosus* spp.agg).

These patches of disturbed rainforest share affinities with PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion. However, the vegetation in these small patches is in a highly disturbed state and only contains a small number of characteristic species of this PCT.

The patches of disturbed rainforest area are likely to meet the description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC listed under the TSC Act given the presence of characteristic plant species.

The two small patches of disturbed rainforest in the north-eastern part of the study area will be disturbed by the proposed modification. The larger patch in the south-eastern part of the study area will not be impacted by the proposed modification.

iv Subtropical rainforest

Subtropical rainforest occurs in steep gullies adjacent to the disturbance area (Figure 3.4). It is dominated by large trees including Port Jackson Fig (*Ficus rubiginosa*) and Red Ash. Dominant shrubs and vines include Coffee Bush, Cockspur Thorn (*Maclura cochinchinensis*), Blackwood, Two-veined Hickory and Water Vine. The edges of the community are invaded by the introduced Lantana.

This vegetation is likely to meet the description of with PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion given the presence of characteristic plant species.

This community meets the description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC listed under the TSC act given the presence of characteristic plant species.

The Subtropical rainforest is outside of the disturbance boundary and therefore will not be impacted by the proposed modification.

v Paperbark shrubland

There are two patches of Paperbark shrubland within the north-eastern section of the study area. These patches meet the description of PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion given the presence of characteristic plant species and are likely to meet the description of *Melaleuca armillaris* Tall Shrubland in the Sydney Basin Bioregion EEC listed under the TSC Act.

Aerial photography suggests that a patch of Paperbark shrubland occurs in the south-east corner of the study area. This area could not be accessed during surveys. This area is likely to be dominated by Bracelet Honey-myrtle, and also contain Prickly Beard Heath, Rock Fern and Narrow-leaved Mint Bush as recorded by Kevin Mills and Associates (2003).

This patch of Paperbark shrubland is likely to meet the description of PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion given the presence of characteristic plant species. It is also likely to meet the description of *Melaleuca armillaris* Tall Shrubland in the Sydney Basin Bioregion EEC listed under the TSC Act.

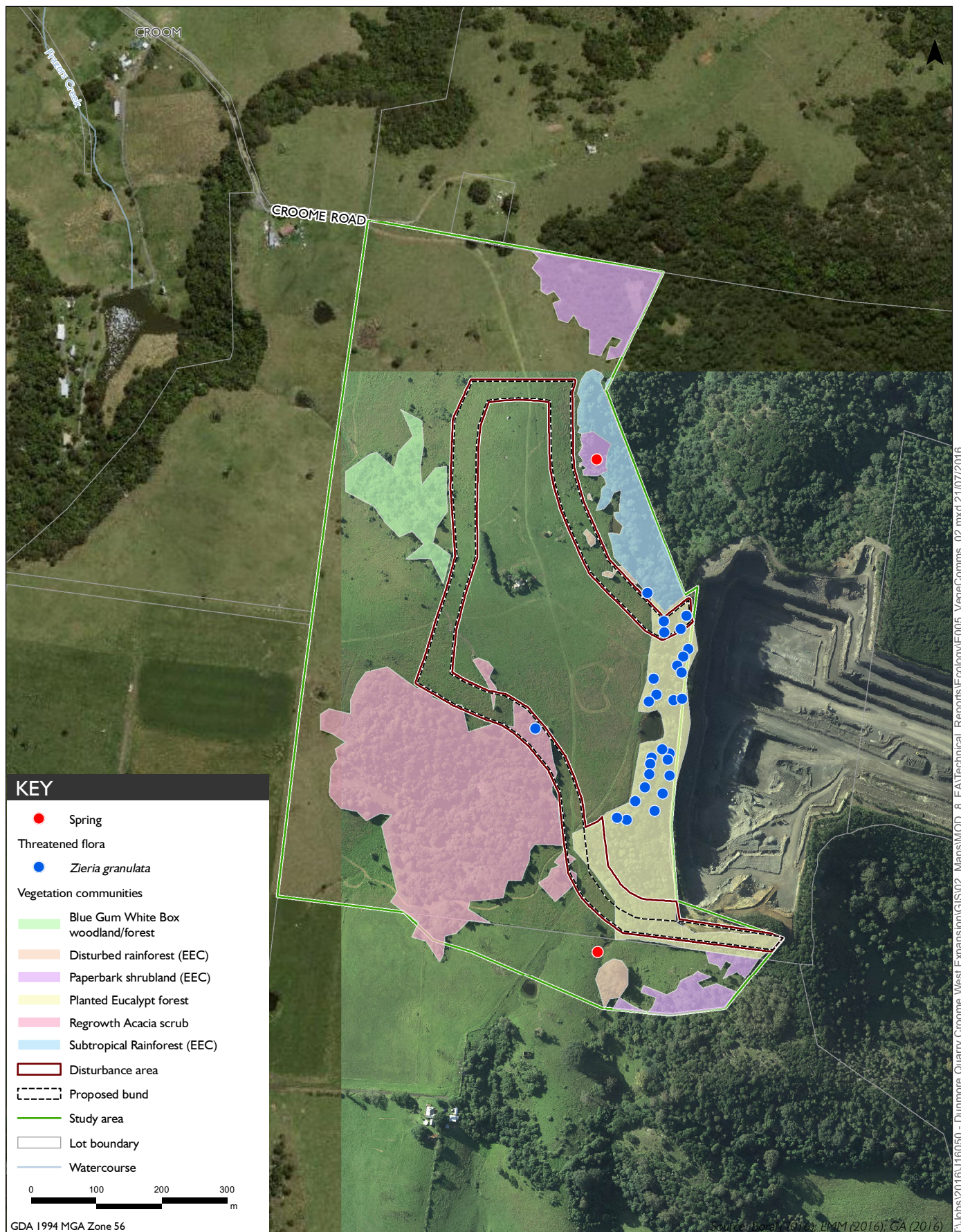
All patches of Paperbark shrubland are located outside of the disturbance boundary and therefore will not be impacted by the proposed modification.

vi Blue Gum White Box woodland/forest

A patch of scattered Blue Gum White Box woodland/forest occurs in the western part of the study area (Figure 3.4). This patch contains scattered Coastal White Box (*E. quadrangulata*), and Forest Red Gums with occasional Bangalay x Sydney Blue Gum (*E. botryoides* x *saligna*) with an exotic understorey, as seen in the cleared land.

Blue Gum White Box Woodland/Forest shares affinities with PCT 1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion. However, the vegetation in these small patches is in a highly disturbed state and only contains a small number of characteristic species of this PCT.

The Blue Gum White Box woodland/forest may be indicative of Illawarra Lowlands Grassy Woodland, listed as an EEC under the TSC Act.



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Vegetation communities and threatened species

Dunmore Quarry Modification 8
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Figure 3.4

The patch of scattered Blue Gum White Box woodland/forest is located outside of the disturbance boundary and therefore will not be impacted by the proposed modification.

vii Regrowth Acacia scrub

A large patch of regrowth Acacia scrub was recorded in the southwest part of the study area (Figure 3.4). It contains some rainforest species, however is dominated by Black Wattle (*Acacia* spp.) and Blackwood (*Acacia melanoxylon*). Other tall shrub species include Foam Bark Tree (*Jagera pseudorhus*), Coffee Bush, Cherry Ballart (*Exocarpos cupressiformis*) and Red Ash. However, the tall shrub layer is dominated by exotic species including Lantana, African Olive (*Olea europaea*), Small-leaved Privet and Large-leaved Privet (*Ligustrum sinense*).

Understorey species in the regrowth Acacia scrub included Wombat Berry (*Eustrephus latifolius*), Sickie Fern, Prickly Beard Heath, *Pittosporum spinescens*, *Geranium homeanum*, *Glycine clandestina*, Monkey Rope (*Parsonsia straminea*), *Rubus parvifolius* and *Hibbertia scandens*.

This patch is likely to have regenerated from previous rainforest clearing due to the indicative species and its location on a basalt outcrop.

This patch shares affinities with PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion. However, the vegetation in this patch is in a highly disturbed state and only contains a small number of characteristic species of this PCT.

The regrowth Acacia scrub does not form part of an EEC listed under the TSC or EPBC acts.

The eastern fringe of the regrowth Acacia scrub is contained within the disturbance area and therefore will be impacted by the proposed modification.

viii Springs

Springs were observed on basalt caps above Illawarra Lowland Subtropical Rainforest in gullies of the north east and southern boundary of the disturbance area. Given their location in the landscape, these springs may provide some of the surface water required to sustain the Illawarra Lowland Subtropical Rainforest. Based on the water quality results, these springs are unlikely to be from the deep local groundwater, rather derived from shallow, slow moving through flow that seeps along the interface between the weathered profile and competent rock, discharging at the surface at low points.

3.2.2 Threatened flora

The threatened shrub, Illawarra Zieria (*Zieria granulata*) was recorded at twenty eight different locations within the study area. The vast majority were recorded within the planted Eucalypt forest on the eastern boundary of the study area (Figure 3.4 and Photograph 3.3), with one individual recorded on the periphery of the rainforest community and another individual in the acacia shrubland.

A total of 210 Illawarra Zieria individuals were recorded within the planted Eucalypt forest. Approximately 75% of these were planted, given their large size and the presence of degraded tree guards. The remaining 25% consisted of seedlings and small shrubs, likely to have germinated from seeds from the planted individuals. The species is also predicted to occur in the paperbark shrubland to the south of the disturbance area.

A total of 48 Illawarra Zieria will be removed as a result of the proposal (refer to Figure 3.4).

No other threatened flora species were recorded during the field surveys, or are expected to occur based on the disturbed nature of the vegetation within the study area.



Photograph 3.3 **Illawarra Zieria, within the planted eucalypt forest**

3.2.3 Weeds

Two noxious weeds were recorded within the study area; Blackberry and Lantana. Both of these species are listed as Class 4 –Locally Controlled Weeds. The NW Act requires that “The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed”.

3.2.4 Fauna

i Species

Fourteen species were recorded during the field survey, including the exotic European Red Fox (*Vulpes vulpes*), Common Eastern Froglet (*Crinia signifera*) and twelve native birds (Table 3.3). Fauna recorded during the field survey were restricted to common species with the ability to persist in disturbed habitats. None of the species are listed under the TSC or EPBC acts.

Table 3.3 Fauna recorded during the field surveys

Common name	Scientific name	TSC Act status	EPBC Act status
Mammals			
Fox*	<i>Vulpes vulpes</i> *	-	-
Frogs			
Common Eastern Froglet	<i>Crinia signifera</i>	-	-
Birds			
White-browed Treecreeper	<i>Climacteris affinis</i>	-	-
White-headed Pigeon	<i>Columba leucomela</i>	-	-
Little Raven	<i>Corvus mellori</i>	-	-
White-eared Honeyeater	<i>Lichenostomus leucotis</i>	-	-
Superb Fairy-wren	<i>Malurus cyaneus</i>	-	-
Lewin's Honeyeater	<i>Meliphaga lewinii</i>	-	-
Red-browed Finch	<i>Neochmia temporalis</i>	-	-
Rufous Whistler	<i>Pachycephala rufiventris</i>	-	-
Crimson Rosella	<i>Platycercus elegans</i>	-	-
Eastern Whipbird	<i>Psophodes olivaceus</i>	-	-
Grey Fantail	<i>Rhipidura albiscapa</i>	-	-
Pied Currawong	<i>Strepera graculina</i>	-	-

Notes: 1. * denotes an exotic species

ii Fauna habitat

The majority of the study area is exotic grassland which provides poor habitat for fauna, with only the most disturbance tolerant species likely to occur. No threatened fauna species are dependent on this habitat type, however wide ranging species may occasionally occur, such as the Spotted Harrier (*Circus assimilis*).

The regrowth Acacia scrub and planted Eucalypt forest is likely to provide fauna habitat for a range of common species. The dense mid-story shrubs are likely to provide shelter and foraging resources for insectivorous birds including the potential to support threatened species such as the Flame Robin (*Petroica phoenicea*). Eucalyptus species within the planted Eucalypt forest are likely to provide foraging resources for nectivores, when in flower. Tree hollows are largely absent in these communities given the lack of remnant trees, reducing the ability to support large numbers of arboreal mammals or provide nesting opportunities for hollow dependant birds.

The disturbed rainforest areas are very degraded and small in size. In its current state vegetation will no longer function as a rainforest habitat type, rather ecological values for threatened species will relate to individual trees present. Flowering or fruiting trees may provide seasonal foraging resources for species such as the Grey-headed Flying-fox (*Pteropus poliocephalus*).

3.3 Likelihood of occurrence assessment

Desktop sources and the field surveys were used to compile a list of threatened subject species and communities, provided in Appendix B. The known habitat preferences and distribution of these threatened entities were considered against the habitat types present within the study area. Species with a moderate or high likelihood to occur and have the potential to be impacted are listed in Table 3.4. These species will be considered further in Chapter 4 and with assessments of significance, under the relevant TSC Act and/or EPBC Act (Appendix C and D).

Table 3.4 Threatened and migratory species with potential to be impacted

Common Name	Scientific Name	TSC Act Status ¹	EPBC Act Status ²	Occurrence
Flora				
Illawarra Zieria	<i>Zieria granulata</i>	E	E	Recorded
Birds				
Fork-tailed Swift	<i>Apus pacificus</i>		Mi	Potential
Spotted Harrier	<i>Circus assimilis</i>	V	-	Potential
Rainbow Bee-eater	<i>Merops ornatus</i>	-	Mi	Potential
Turquoise Parrot	<i>Neophema pulchella</i>	V	-	Potential
Flame Robin	<i>Petroica phoenicia</i>	V	-	Potential
Mammals				
Eastern Bentwing Bat	<i>Miniopterus schreibersii oceanensis</i>	V	-	Potential
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Potential
Little Bentwing Bat	<i>Miniopterus australis</i>	V	-	Potential
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	-	Potential

Notes: 1. TSC Act Status: V – Vulnerable; E – Endangered.

2. EPBC Act Status: V – Vulnerable; E – Endangered; Mi – Migratory.

4 Impact assessment

4.1 Vegetation clearance

The direct impact of the proposed modification is the clearance of vegetation for construction of the bund, the 3 m setback allowed for light vehicle access and sediment and erosion controls, and the area of clearance required for the access road between the Croome Farm Pit and the bund. The total impact footprint is displayed on Figure 3.4 and encompasses an area of 7.08 ha. The majority of this area is exotic grassland with very low or negligible ecological value.

Table 4.1 Impact area for each vegetation community

Community type	Area to be cleared (ha)	Area currently existing within the study area (ha)	Percentage which will be cleared (of that present within the study area)
Exotic grassland	5.14	37.79	14
Planted Eucalypt forest	1.50	4.81	31
Regrowth Acacia scrub	0.39	9.59	4
Disturbed rainforest	0.05	0.32	15
Total Impact Area	7.08		

4.2 Endangered ecological communities, threatened ecological communities and native vegetation

Vegetation communities within the disturbance area do not meet the description of any threatened ecological community (TEC) listed under the EPBC Act.

4.2.1 Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC

The disturbed rainforest in the north-eastern section of the disturbance area meets the TSC Act description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC, given the presence of characteristic tree and plant species. The listing does not specifically exclude disturbed remnants of this community or include a minimum patch size for the community. Therefore, despite being severely degraded and occurring in very small fragments, the vegetation meets the community listing.

A total area of 0.05 ha will be removed for this project. An assessment of significance (Appendix D), concluded no significant impact will result from the clearance. This takes into account, the small area impacted, the poor functionality of the community and the presence of large tracks of rainforest communities adjacent to the disturbance area.

4.2.2 Other vegetation communities

In contrast to the disturbed rainforest vegetation, the regrowth Acacia scrub does not meet the description of the listed community, Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC, because it contains very few characteristic tree species and is instead dominated by Wattles and exotic shrubs.

The total amount of native vegetation which requires clearance is for the extension is 1.94 ha. This is 9% of the vegetation within the study area and much larger areas of native vegetation exist in the locality. Furthermore the bund will be revegetated with native species endemic to the local area, resulting in a net gain in amount of native vegetation present.

4.3 Threatened flora

Forty two Illawarra Zieria would be removed from the planted Eucalypt woodland on the north eastern edge of the proposed extension area (Figure 3.4). The majority of the individuals were planted as part of revegetation works, with several seedlings a result of successful regeneration from the planted specimens. Recruitment of seedlings occurred in areas where there was reduced competition from weeds such as Lantana.

Naturally occurring Illawarra Zieria may also occur in the Paperbark shrubland (its preferred habitat) to the south of the disturbance area. The assessments of significance under both TSC Act and the EPBC Act, concluded that there would be no significant impact on the species. This species will be planted in future regeneration works, resulting in a net gain in abundance for this species.

No other threatened flora species were recorded within the disturbance area or are considered likely to occur.

4.4 Threatened fauna

No threatened fauna were recorded within the study area. Three threatened birds and four threatened bats are considered to have the potential to occur however, given that they are wide ranging and highly mobile (Table 3.4). The disturbance area does not contain any restricted habitat for any of these species, nor are the species dependant on the habitats present within the disturbance area.

The potential for the regrowth Acacia scrub, planted Eucalyptus forest and the disturbed rainforest to support threatened species, is likely to be augmented by the presence of higher quality intact vegetation adjacent to the disturbance area. Species which could not persist within the disturbed vegetation areas, owing to the small patch size and full ecosystem functionality, may be able to do so, because of this adjacent habitat. It is likely that any threatened species occurrence within the disturbed habitat types is intermittent and they are unlikely to rely on the habitat.

The assessments of significance under both TSC Act and the EPBC Act, concluded that there would be no significant impact on any of the threatened fauna species.

4.5 Migratory fauna

No migratory species listed under the EPBC Act were recorded within the study area, however two species are considered as having the potential to occur, based on their wide distribution and broad habitat preferences; Fork-tailed Swift (*Apus pacificus*) and Rainbow Bee-eater (*Merops ornatus*).

The disturbance area does not contain any restricted habitat for any of these species, nor are the species dependant on the habitats present within the disturbance area. There is no breeding habitat for these species within the disturbance area, furthermore there are no habitat attributes which would encourage large aggregations of a population to occur.

An assessment of significance under the EPBC Act concluded that there would be no significant impact on either of these migratory species as a result of the proposed modification.

4.6 Indirect impacts

4.6.1 Groundwater dependant ecosystems

The presence of a bund will restrict the overland flow of water. It is considered a negligible impact however as it would only occur during heavy rainfall events, where water is not likely to be a scarce resource.

A spring in the eastern part of the study area may provide surface water to the Illawarra Subtropical Rainforest EEC adjacent to the proposed disturbance area. Given that the springs are located outside of the proposed disturbance area, there are not considered to be any impacts to this resource and therefore no impacts to ecosystems that potentially rely on the surface expression of shallow through flow.

4.6.2 Introduced species

Without management, ground clearing and disturbance may result in increased weed invasion given the existing occurrence of some noxious and invasive weeds. Ongoing weed maintenance should be undertaken to minimise the risk of further weed invasion into native vegetation areas.

4.7 Biodiversity corridors and fragmentation

Vegetation in the study area is part of the Dunmore Hills Biodiversity Corridor, identified in the Illawarra Biodiversity Strategy (Wollongong, Shellharbour and Kiama Councils 2010), shown on Figure 4.1. The planted Eucalypt forest within the study area currently provides a vegetated link between remnant native vegetation north and south of the quarry. The proposed modification will result in two cleared areas within this corridor, approximately 60 m in width in the south and 25 m in the north. This may impact species with an inability to cross open areas, however the impact is temporary, given that the bund area will be revegetated once constructed. All of the threatened fauna considered with the potential to occur within the planted Eucalypt forest are highly mobile species and the clearance would not result in any impact to movement throughout the landscape for these species.

Clearance of a small part of the regrowth Acacia scrub and disturbed rainforest would not impact the biodiversity corridor given they are currently isolated patches and any clearance will affect the edges rather than bisecting any vegetation.

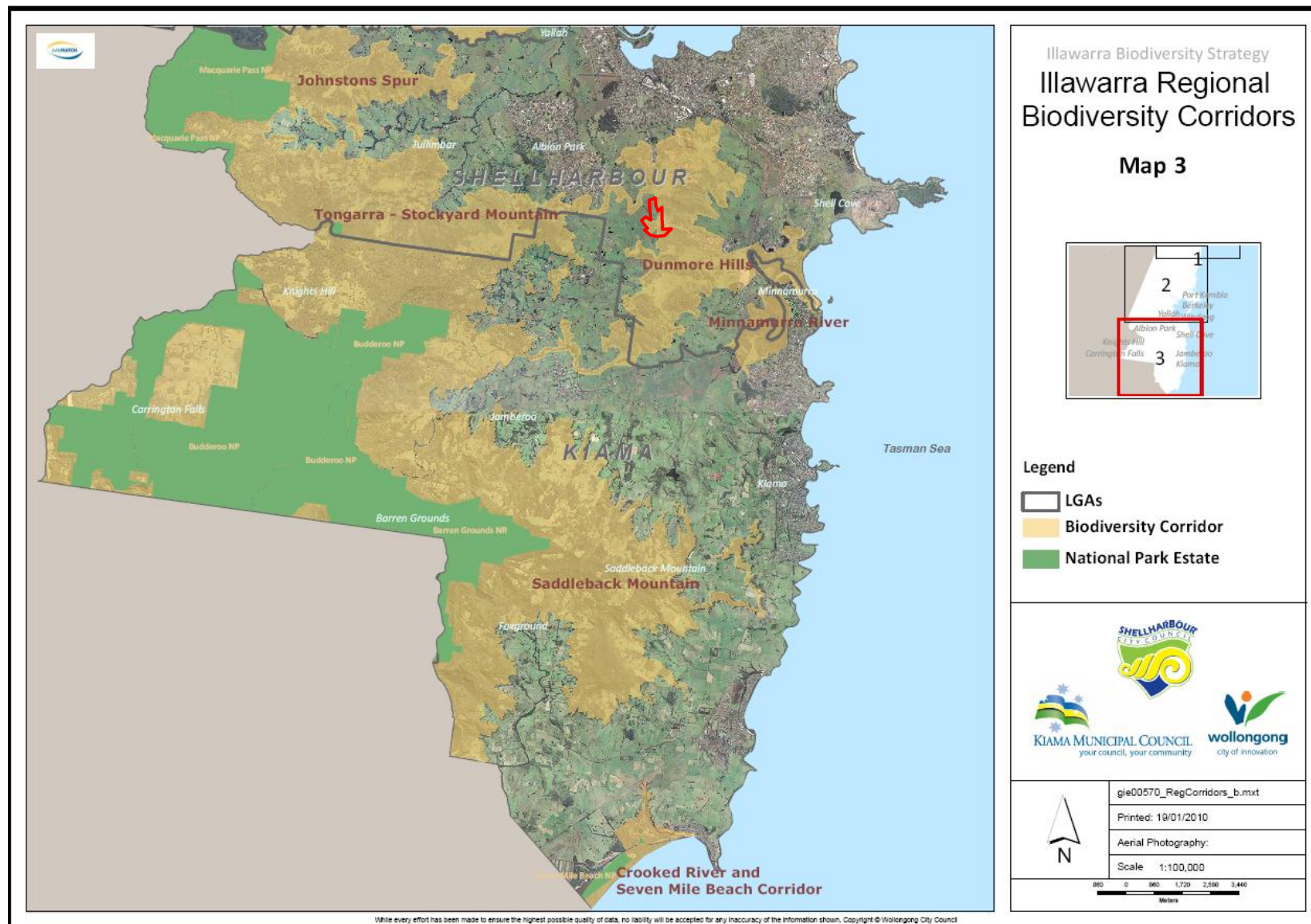


Figure 4.1 The proposed extension (shown in red) and the Dunmore Hills Biodiversity Corridor (source: Wollongong, Kiama and Shellharbour Councils 2000)

5 Recommendations for avoidance, mitigation and offsets

5.1 Avoidance

A preliminary ecological assessment (PEA) of the study area was undertaken in 2015. This PEA made several recommendations including the avoidance of the following intact vegetation communities and corresponding EECs (listed under the TSC Act):

- Subtropical rainforest which meets the description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC;
- paperbark shrubland which is likely to meet the description of *Melaleuca armillaris* Tall Shrubland in the Sydney Basin Bioregion EEC, listed under the TSC Act; and
- Blue Gum White Box woodland/forest which may be indicative of Illawarra Lowlands Grassy Woodland EEC, listed under the TSC Act.

All of these areas have been excluded during detailed design of the bund and associated disturbance area and therefore impact to key ecological values have been avoided.

Given the design requirements of the proposed modification and the low residual ecological impact, further avoidance is not required or recommended.

5.2 Minimisation and mitigation

The following measures are recommended to minimise and/or mitigate impacts to ecological constraints:

- clearly mark the outer boundary of disturbance area so that adjacent EECs are not impacted;
- control of weeds through active monitoring and management of rehabilitated areas and correct disposal of cleared exotic vegetation;
- control of noxious weeds in accordance with the Illawarra District Noxious Weeds Authority (2006);
- the *Flora and Fauna Management and Rehabilitation Plan* (Cumberland Ecology 2009) should be updated to include re-establishment of north/south connectivity for wildlife through the Dunmore Hills biodiversity corridor on completion of the project;
- the bund area is to be revegetated with indigenous species to provide habitat for local flora and fauna and improve connectivity of habitat; and
- include Illawarra *Zieria* as part of the revegetation program, which will offset the loss of individual plants at a ratio to ensure net species gain.

5.3 Offsetting

The majority of the vegetation impacted by the proposal is planted and therefore does not align with PCTs. For this reason the residual impacts of the project will be offset by a negotiated outcome with OEH, as discussed on Section 3.1. It is proposed that an offset management plan will be produced in negotiation with OEH, within one year from the start of the project.

The key features of the plan will include the requirement to plant Eucalypt forest in order to offset the clearance of this vegetation type. The planted Eucalypt offset area will also provide suitable habitat for planting the threatened Illawarra Zieria in order to offset the loss of 42 individuals as a result of this project. The Illawarra will be planted at a ratio greater than 1:1 to ensure a net gain in the number of individuals. It has been demonstrated that the planted Eucalypt forest provides suitable habitat for the Illawarra Zieria due to continued presence of the species several decades after planting and the presence of regenerating individuals from planted parent seeding. It is recommended that weed management is also included within the offset management plan as control of weeds such as Lantana and exotic grasses will help to ensure the continued persistence of the Illawarra Zieria and improve recruitment of seedlings.

6 Conclusion

One planted threatened flora species and a small area of disturbed EEC were recorded within the disturbance area. Assessments of significance completed for threatened species and EECs concluded that there would be no significant impact on any matter listed under either the TSC Act or EPBC Act as a result of the proposed modification.

The disturbance area, which includes the bund, the 3 m buffer for light vehicle access and sediment and erosion controls and the construction access road, has been designed to avoid key ecological values, including three intact EECs. The avoidance of these communities ensures preservation of high quality habitat, outside of the disturbance area, for a range of flora and fauna including threatened species. The disturbance area is situated in an area of low ecological value, with the majority of the area cleared comprising exotic grassland. Small quantities of disturbed rainforest, regrowth Acacia scrub and planted Eucalypt forest exist within the disturbance footprint. These are all highly modified and, whilst provide some habitat for flora and fauna, they are not likely to be important for any threatened fauna species.

Adoption of the mitigation measures and recommendations outline in this report will result in a net gain of native vegetation and habitat, given that the entire bund area will be revegetated with native species. This will include the threatened Illawarra Zieria, resulting in an increase in the total number of individuals within the extension area.

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Appendix A

Protected matters search results



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/06/16 10:15:54

[Summary](#)

[Details](#)

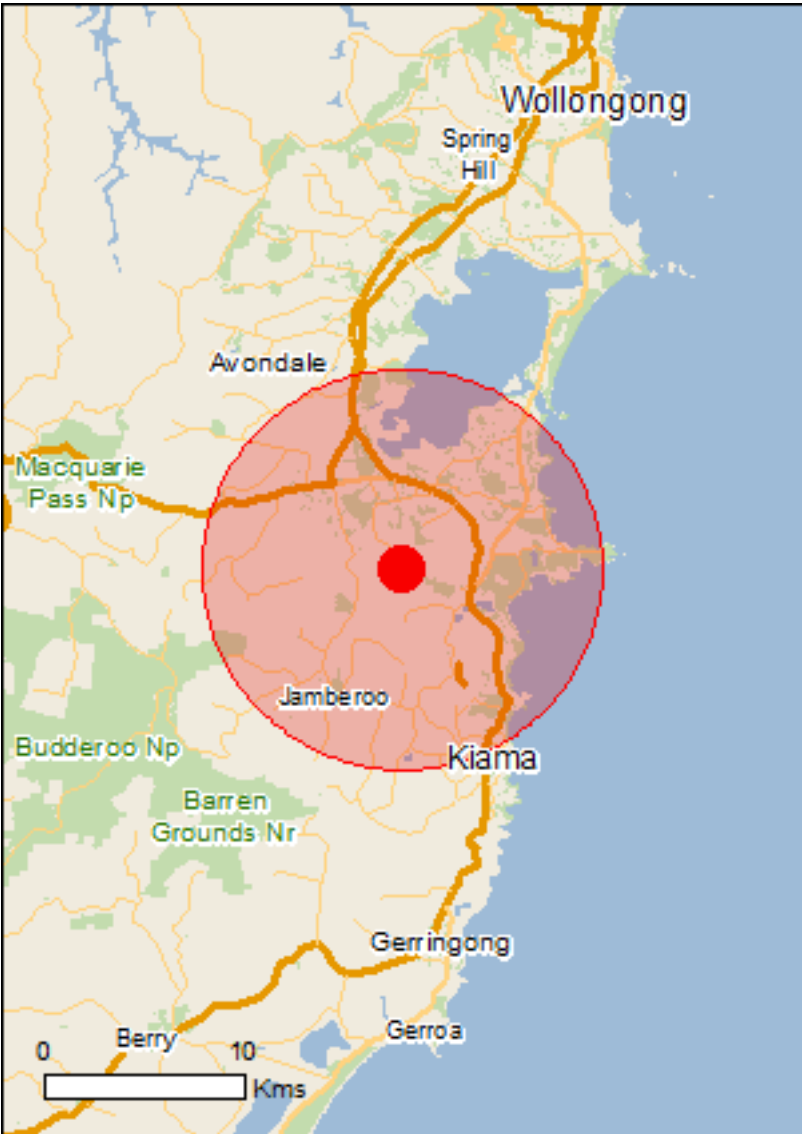
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

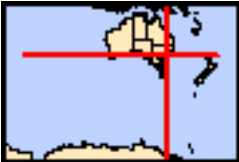
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	80
Listed Migratory Species:	70

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	7
Commonwealth Heritage Places:	1
Listed Marine Species:	96
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	51
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area

Listed Threatened Species

[Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Bar-tailed Godwit (menzbieri), Northern Siberian Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Roosting known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
to occur within area		
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fish		
Epinephelus daemeli Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (Eastern) [68050]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Boronia deanei Deane's Boronia [8397]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Daphnandra johnsonii Illawarra Socketwood [67186]	Endangered	Species or species habitat likely to occur within area
Genoplesium baueri Yellow Gnat-orchid [7528]	Endangered	Species or species habitat likely to occur within area
Gentiana wingecarribiensis Wingecarribee Gentian [18033]	Endangered	Species or species habitat may occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Irenepharsus trypherus Delicate Cress, Illawarra Irene [14664]	Endangered	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area
Prasophyllum affine Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid [2210]	Endangered	Species or species habitat likely to occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat known to occur within area
Pterostylis pulchella Pretty Greenhood [6448]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Zieria granulata Hill Zieria, Hilly Zieria, Illawarra Zieria [17147]	Endangered	Species or species habitat likely to occur within area

Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Sharks		
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat known to occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species	[<u>Resource Information</u>]	
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		

Name	Threatened	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area

Name	Threatened	Type of Presence
Gallinago stenura Pin-tailed Snipe [841]	Critically Endangered	Roosting likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew [847]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land	[Resource Information]
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The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Academy of Science
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited

Commonwealth Heritage Places	[Resource Information]
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Name	State	Status
Historic		
Kiama Post Office	NSW	Listed place

Listed Marine Species	[Resource Information]
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* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Critically Endangered	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]	Critically Endangered	Species or species habitat known to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area

Name	Threatened	Type of Presence
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Cosmocampus howensis Lord Howe Pipefish [66208]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area

Name	Status	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]		Species or species habitat known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves		[Resource Information]
Name	State	
Budderoo	NSW	
Regional Forest Agreements		[Resource Information]
Note that all areas with completed RFAs have been included.		
Name	State	
Southern RFA	New South Wales	
Invasive Species		[Resource Information]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.		
Name	Status	Type of Presence
Birds		

Name	Status	Type of Presence
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large- leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Killalea Lagoon		NSW
Lake Illawarra		NSW
Minnamurra River Estuary		NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.60233 150.80724

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Parks and Wildlife Commission NT, Northern Territory Government](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix B

Likelihood of occurrence for threatened biodiversity

B.1 Threatened species habitat assessment criteria

The likelihood of occurrence for each threatened species previously recorded within 10 km of the proposed extension area was assessed against the criteria in Table A.1.

Note that the PMST and Atlas of NSW Wildlife records were screened to exclude marine species. This removed a large number of species which would not be impacted given the site is inland. Examples of species groups removed include shorebirds, cetaceans, and marine turtles. Any freshwater aquatic species were retained and considered in the likelihood of occurrence table.

Table B.1 **Assessment criteria**

Likelihood	Description	Further assessment required?
Recorded	The species was observed in the proposed extension area during the current survey.	Yes
High	It is highly likely that a species inhabits the site due to the presence of suitable habitat, and has been recorded recently in the surrounding area.	Yes
Moderate	Potential habitat is present in the proposed extension area, although it has not been recorded recently in the proposed extension area and surrounds. The species is unlikely to be dependent (ie. for breeding) on habitat within the proposed extension area.	Yes
Low	It is unlikely that the species inhabits the proposed extension area, and may be an occasional visitor. Habitat similar to the site is widely distributed in the local area, meaning that the species is not dependent (ie for breeding) on it.	No
None	Suitable habitat is absent from the proposed extension area.	No

B.2 Likelihood of occurrence for threatened species

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Threatened Ecological Communities					
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia		CE	A complex of rainforest and coastal vine thickets on the east coast of Australia influenced by its proximity to the sea.	PMST	None. This community must be within 2 km of the coast to qualify for the listed community; the proposed extension area is > 4.6 km.
Subtropical and Temperate Coastal Saltmarsh		V	Occurs in coastal areas under regular or intermittent tidal influence.	PMST	None. The proposed extension area is not tidally influenced.
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion		E	A tall open eucalypt forests found on igneous rock in, or adjacent to, the Sydney Basin Bioregion. The ecological community occurs in areas of high rainfall, generally ranging from 950 to 1600 mm/year (NSW Scientific Committee, 2001). The ecological community typically occurs at elevations between 650 and 1050 m above sea level, although it has been recorded at elevations as low as 350 m (DoE, 2016).	PMST	None. The elevation of the proposed extension area is approximately 150 m and no tall open forests, dominated by eucalypts exist, within the extension area.
Flora					
Austral Toadflax <i>Thesium australe</i>	V	V	Not known from the proposed extension area or surrounds. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass.	Species or habitat likely to occur within area SPRAT	None. Kangaroo Grass is absent from the proposed extension area.
Biconvex paperbark <i>Melaleuca biconvexa</i>	V	V	Occurs in coastal districts and adjacent tablelands in NSW, from Jervis Bay to Port Macquarie. The species distribution is not continuous however, with no records in the locality of the project. The species Biconvex Paperbark occurs in damp areas, often near watercourses, on alluvium soils over shale. The species may form a dense stand in a narrow strip adjacent to a watercourse.	Species or habitat likely to occur within area	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Bynoes's Wattle <i>Acacia bynoeana</i>	V		Bynoe's wattle is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Occurs in heath or dry sclerophyll forest on sandy soils.	Species or habitat likely to occur within area	None. Suitable habitat does not exist within the proposed extension area.
<i>Chorizema parviflorum</i> population in the Wollongong and Shellharbour Local Government Areas	E	-	This endangered population has been recorded from between Austinmer and Albion Park in the LGAs of Wollongong and Shellharbour. All known sites (excluding the site at Austinmer) occupy woodland or forest dominated by Forest Red Gum (<i>Eucalyptus tereticornis</i>) and/or Woollybutt (<i>E. longifolia</i>). At Austinmer, the species is recorded from a coastal headland. Flowering period is August to January, with seeds maturing from November (OEH 2015).	Recorded within 10 km (117 records) NSW Wildlife Atlas	None. Grassy woodland is absent from the proposed extension area.
Deane's Boronia <i>Boronia deanei</i>	V	V	Not known from the project area or surrounds. Grows in wet heath, often at the margins of open forest adjoining swamps or along streams. Also found in drier open forest on poorly drained peat soils over granite or sandstone.	Recorded within 10 km (6 records) Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent.
<i>Gossia acmenoides</i> population in the Sydney Basin Bioregion south of the Georges River	E	-	Grows in subtropical rainforest, but more commonly in dry rainforest; chiefly north from the Hunter Valley but as far south as the Illawarra region.	Recorded within 10 km (6 records) NSW Wildlife Atlas	None, not recorded and not anticipated to occur within the proposed extension area. Moderate potential to occur in subtropical rainforest adjacent to the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Illawarra Greenhood <i>Pterostylis gibbosa</i>	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum (<i>Eucalyptus tereticornis</i>), Woollybutt (<i>E. longifolia</i>) and White Feather Honey-myrtle (<i>Melaleuca decora</i>). Near Nowra, the species grows in an open forest of Spotted Gum (<i>Corymbia maculata</i>), Forest Red Gum and Grey Ironbark (<i>E. paniculata</i>). In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (<i>E. crebra</i>), Forest Red Gum and Black Cypress Pine (<i>Callitris endlicheri</i>). Flowers from August to November.	Recorded within 10 km (26 records) NSW Wildlife Atlas PlantNET spatial search Species or habitat likely to occur within area SPRAT	None. Grassy woodland is absent from the proposed extension area.
Illawarra Irene <i>Irenepharsus trypherus</i>	E	E	Typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines. The vast majority of sites are recorded from the upper slopes of the ridge systems that extend south and east of the Illawarra escarpment, although the species has also been recorded from the deep sandstone gorges of the Shoalhaven River. Associated vegetation includes moist sclerophyll forest, Ironwood - <i>Backhousia myrtifolia</i> thicket, and rainforest.	PlantNET spatial search Recorded within 10 km (21 records) Species or habitat likely to occur within area SPRAT	None. Not anticipated to occur within the proposed extension area. Moderate potential to occur in subtropical rainforest adjacent to the proposed extension area.
Illawarra Socketwood <i>Daphnandra johnsonii</i>	E	E	Restricted to the Illawarra region where it has been recorded from the local government areas of Shoalhaven, Kiama, Shellharbour and Wollongong. Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Associated vegetation includes rainforest and moist eucalypt forest. Associated soils are loams and clay loams derived from volcanic and fertile sedimentary rocks (OEH 2015).	Recorded within 10 km (56 records) NSW Wildlife Atlas PlantNET spatial search Species or habitat likely to occur within area SPRAT	None. Not anticipated to occur within the proposed extension area. Moderate potential to occur in subtropical rainforest adjacent to the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Illawarra Zieria <i>Zieria granulata</i>	E	E	The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils, usually on Bumbo Latite. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments. Associated vegetation includes Bracelet Honey-myrtle <i>Melaleuca armillaris</i> scrub, Forest Red Gum <i>Eucalyptus tereticornis</i> woodland and rainforest margins, although the species has been recorded from a number of other vegetation types. Most vegetation types are also listed as Endangered Ecological Communities. Much of the natural habitat for the species has been removed and many sites now occupy road verges and paddock edges.	Recorded within 10 km (225 records) NSW Wildlife Atlas PlantNET spatial search Species or habitat likely to occur within area SPRAT	Recorded. This species has been recorded in the planted area adjacent to the proposed extension area but will not be impacted. One individual plant will be removed, with nine other individual remaining.
Jervis Bay Leek Orchid <i>Prasophyllum affine</i>	E	E	Not known from the proposed extension area or surrounds. Jervis Bay Leek Orchid is currently known from three areas south-east of Nowra on South Coast. These are Kinghorne Point, Wowly Gully near the town of Callala Bay, and near the township of Vincentia. Grows on poorly drained clay soils that support low heathland and sedgeland communities. Flowers are followed by a fleshy seed capsule. Plants retreat into subterranean tubers after fruiting, so are not visible above-ground.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Kangaloon Sun Orchid <i>Thelymitra kangaloonica</i>	CE	CE	Not known from the proposed extension area or surrounds. The Kangaloon Sun-orchid is found in swamps in sedgelands over grey silty grey loam soils. It is thought to be a short-lived perennial, flowering in late October and early November.	Species or habitat likely to occur within area SPRAT	None. The species is only known from Kangaloon.
Leafless Tongue Orchid <i>Cryptostylis hunteriana</i>	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community.	Species or habitat likely to occur within area	None. Preferred habitat is absent from the proposed extension area and no records exist within 10 km.
<i>Lespedeza juncea</i> subsp. <i>Sericea</i> in the Wollongong Local Government Area	E		Known from just one roadside population of approximately 200 plants. Located in a small strip of open forest dominated by <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. longifolia</i> (Woollybutt), and <i>Melaleuca decora</i> (White Feather Honey Myrtle), on Budgong Sandstone.	Recorded within 10 km (3 records)	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Lesser Creeping Fern <i>Arthropteris palisotii</i>	E		Epiphytic fern mainly growing on tree trunks, occurring in rainforest, mainly on tree trunks. Isolated records occur in the Illawarra Escarpment, North-eastern NSW and more frequently in Queensland.	Recorded approximately 8.5 km to the NE. A single record exists within the Illawarra region.	None. Not anticipated to occur within the proposed extension area. Low potential to occur in subtropical rainforest adjacent to the proposed extension area.
Omeo Stork's-bill <i>Pelargonium sp. Striatellum</i>	E	E	Not known from the project area or surrounds. The Omeo Stork's-bill is known from only three locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain. It flowers from October to May. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots.	Recorded within 10 km (13 records) NSW Wildlife Atlas PlantNET spatial search	None. Suitable grassy woodland habitat is absent from the proposed extension area.
Pretty Greenhood <i>Pterostylis pulchella</i>	V	V	The Waterfall Greenhood is found only at Fitzroy Falls, Belmore Falls, upper Bundanoon Creek (Meryla) and Minnamurra Falls. The Waterfall Greenhood is found on cliff faces close to waterfalls and creek banks and mossy rocks alongside running water.	Recorded within 10 km (3 records) Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Prickly Bush-pea <i>Pultenaea aristata</i>	V	V	Prickly Bush-pea is restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong. The species occurs in either dry sclerophyll woodland or wet heath on sandstone. Flowering has been recorded in winter and spring (OEH 2015).	Recorded within 10 km (1 record) PlantNET spatial search	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Siah's Backbone <i>Streblus pendulinus</i>	-	E	Not recorded in the study area or nearby surrounds. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area. Moderate potential to occur in subtropical rainforest adjacent to the proposed extension area.
<i>Solanum celatum</i>	E	-	Grows on hills and slopes in eucalypt woodland; commonly found after fire or disturbance.	Recorded within 10 km (11 records) PlantNET spatial search	None. Suitable habitat is absent from the proposed extension area.
Spiked Rice-flower <i>Pimelea spicata</i>	E	E	In the coastal Illawarra, it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey. Coastal headlands and hilltops are the favoured sites. The Illawarra populations usually occur in one of two communities - woodland or coastal grassland. Woodland sites are dominated by Forest Red Gum (<i>E. tereticornis</i>) and Narrow-leaved Stringybark (<i>E. eugenioides</i>), with a groundcover dominated by Kangaroo Grass (<i>Themeda australis</i>) and Spiny-headed Mat-rush (<i>Lomandra longifolia</i>). The grassland sites are dominated by Kangaroo Grass and Spiny-headed Mat-rush, with Blady Grass (<i>Imperata cylindrica</i>). A shrubby layer, where present, is dominated by Coastal Wattle (<i>Acacia sophorae</i>) and Coast Rosemary (<i>Westringia fruticosa</i>) with Coast Banksia (<i>Banksia integrifolia</i>).	Recorded within 10 km (31 records) NSW Wildlife Atlas Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Thick-lipped Spider-orchid <i>Caladenia tessellata</i>	E	V	Not known from the proposed extension area or surrounds. The Thick Lip Spider Orchid is generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
White-flowered Wax Plant <i>Cynanchum elegans</i>	E	E	Recorded in Picton (1987). The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (<i>Leptospermum laevigatum</i>) – Coastal Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>) coastal scrub; Forest Red Gum (<i>Eucalyptus tereticornis</i>) aligned open forest and woodland; Spotted Gum (<i>Corymbia maculata</i>) aligned open forest and woodland; and Bracelet Honey myrtle (<i>Melaleuca armillaris</i>) scrub to open scrub.	Recorded within 10 km (46 records) Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area. High potential to occur at the margin of subtropical rainforest and <i>Melaleuca armillaris</i> shrubland adjacent to the proposed extension area.
Wingecarribee Gentian <i>Gentiana wingecarribeensis</i>	CE	E	Wingecarribee Gentian is known only from Hanging Rock Swamp and Wingecarribee Swamp on the Southern Highlands. Wingecarribee Gentian grows in bogs, in Sphagnum Moss humps and in sedge communities.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Wingless Raspwort, Square Raspwort <i>Haloragis exalata</i> subsp. <i>exalata</i>	V	V	Populations are known from the areas of western Sydney, Kosciuszko National Park, the Bega Valley, Bungonia Gorge east of Goulburn on the Central Tablelands, the Shoalhaven River and Lake Illawarra on the Central Coast, the North Coast and the Northern Tablelands. It appears to be a post-disturbance coloniser, based on observations of large numbers of plants on disturbed roadsides, cleared power-line easements, and recently burnt or flooded areas. Square Raspwort appears to require protected and shaded damp situations in riparian habitats.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Yellow Gnat-orchid <i>Genoplesium baueri</i>	E	E	Not known from the proposed extension area or surrounds. The Yellow Gnat-orchid has been recorded from locations between Ulladulla and Port Stephens. Grows in dry sclerophyll forest and moss gardens over sandstone.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Fish					
Maquarie Perch <i>Macquaria australasica</i>	E	E	A riparian species found in the Murray-Darling Basin and parts of south-eastern coastal NSW, including the Hawkesbury/Nepean and Shoalhaven catchments.	Species or habitat likely to occur within area. SPRAT	None. No rivers are present.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Australian Grayling <i>Prototroctes maraena</i>	E	V	Streams and rivers on the eastern and southern flanks of the Great Dividing Range.	Species or habitat likely to occur within area. SPRAT	None. No rivers are present.
Frogs					
Giant Burrowing Frog <i>Heleioporus australiacus</i>	V	V	Not known from the proposed extension area or surrounds. The Giant Burrowing Frog is distributed in south-eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Green and Golden Bell Frog <i>Litoria aurea</i>	E	V	Inhabits marshes, dams and stream-sides, particularly those containing Bullrushes (<i>Typha</i> spp.) or Spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available (OEH 2015).	Recorded within 10 km (25 records) NSW Wildlife Atlas Species or habitat may occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Littlejohn's Tree Frog <i>Litoria littlejohni</i>	V	V	Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria, typically occurring in sandstone woodland and heath communities at mid to high altitude (OEH 2015).	Species or habitat may occur within area SPRAT NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Stuttering Frog <i>Mixophyes balbus</i>	E	V	Not known from the proposed extension area or surrounds. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Feed on insects and smaller frogs. Breed in streams during summer after heavy rain. Eggs are laid on rock shelves or shallow riffles in small, flowing streams. As the tadpoles grow they move to deep permanent pools and take approximately 12 months to metamorphose.	Species or habitat may occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area. Potential to occur in subtropical rainforest adjacent to the proposed extension area.
Reptiles					
Broad-headed Snake <i>Hoplocephalus bungaroides</i>	V	V	Not known from the proposed extension area or surrounds. The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer (OEH 2015).	Species or habitat may occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.
Birds					
Australasian Bittern <i>Botaurus poiciloptilus</i>	E	E	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. They favour permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spikerushes (<i>Eleocharis</i> spp.). They hide during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails (OEH 2015).	Recorded within 10 km (7 records) Species or habitat may occur SPRAT Recorded within 10 km (5 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Australian Painted Snipe <i>Rostratula australis</i>	E	E, Mi	The Australian Painted Snipe prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. The Australian Painted Snipe nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (OEH 2015).	Recorded within 10 km (1 record) Species or habitat may occur SPRAT	None. Although some dams are present at the proposed extension area, they do not offer suitable cover to support the species.
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>	E		Floodplain wetlands of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	Recorded within 10 km (1 record) OEH, 2016	None. Suitable habitat is absent from the proposed extension area.
Barking Owl <i>Ninox connivens</i>	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 hectares, with 2,000 hectares being more typical in NSW habitats.	Recorded within 10 km (2 records) NSW Wildlife Atlas	Low. May occasionally fly over the proposed extension area. Moderate potential to occur adjacent to the proposed extension area.
Black Bittern <i>Ixobrychus flavicollis</i>	V		Inhabits the dense vegetation growing at the margins of various types of wetlands, where it forages at the edge of the water.	Recorded within 10 km (2 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Black-faced Monarch <i>Monarcha melanopsis</i>	-	Mi	The Black-faced Monarch occurs mainly in rainforest ecosystems but sometimes is found in nearby open eucalypt forests in gullies with a dense, shrubby, or patchy understorey.	Species or habitat may occur SPRAT	Low potential to occur within the proposed extension area while migrating. Moderate potential to occur within the adjacent rainforest habitats.
Blue-billed Duck <i>Oxyura australis</i>	V	-	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.	Recorded within 10 km (3 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Bush Stone-curlew <i>Burhinus grallarius</i>	E	-	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes.	Recorded within 10 km (1 record) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Comb-crested Jacana <i>Irediparra gallinacean</i>	V	-	Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation. Forage on floating vegetation, walking with a characteristic bob and flick. They feed primarily on insects and other invertebrates, as well as some seeds and other vegetation.	Recorded within 10 km (2 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Eastern Bristlebird <i>Dasyornis brachypterus</i>	E	E	Not known from the proposed extension area or surrounds. Known from Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula. Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone (OEH 2015).	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Eastern Osprey <i>Pandion cristatus</i>	V	-	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Recorded within 10 km (7 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Flame Robin <i>Petroica phoenicia</i>	V	-	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	Recorded within 10 km (2 records) NSW Wildlife Atlas	Medium potential to occur within and adjacent to the proposed extension area.
Fork-tailed Swift <i>Apus pacificus</i>		Mi	Occur over inland plains but sometimes above foothills or in coastal areas. They have very broad foraging habitat requirements catching flying invertebrates on the wing, although seem to prefer dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh.	Recorded within 10 km (4 records) NSW Wildlife Atlas	Medium potential to occur within and adjacent to the proposed extension area.
Freckled Duck <i>Stictonetta naevosa</i>	V	-	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates.	Recorded within 10 km (9 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	V		In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas (OEH 2016). The species nests in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water.	Recorded within 10 km (2 records) NSW Wildlife Atlas	Low potential to occur within the proposed extension area, may fly over the site. Moderate potential to occur within the adjacent rainforest habitats.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Glossy Black-Cockatoo <i>Calyptorhynchus lathamii</i>	V		Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of She-oak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods (OEH 2015).	Recorded within 10 km (1 record) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Latham's Snipe <i>Gallinago hardwickii</i>		Mi	Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.	Recorded within 10 km (7 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Little Eagle <i>Hieraaetus morphnoides</i>	V	-	Occupies open eucalypt forest, woodland or open woodland. Sheoak or <i>Acacia</i> woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (OEH 2015).	Recorded within 10 km (8 records) NSW Wildlife Atlas	Low potential to occur within the proposed extension area, may fly over. Moderate potential to occur within the adjacent habitats.
Orange-bellied Parrot <i>Neophema chrysogaster</i>	CE	CE	The Orange-bellied Parrot breeds in the south-west of Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern South Australia and southern Victoria. There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. It is expected that NSW habitats may be being more frequently utilised than observations suggest. Typical winter habitat is saltmarsh and strandline/foredune vegetation communities either on coastlines or coastal lagoons. Spits and islands are favoured but they will turn up anywhere within these coastal regions. The species can be found foraging in weedy areas associated with these coastal habitats or even in totally modified landscapes such as pastures, seed crops and golf courses.	Recorded within 10 km (1 record) Species or habitat may occur SPRAT	None. Suitable habitat is absent from the proposed extension area.
Pink Robin <i>Petroica rodinogaster</i>	V		Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	Recorded within 10 km (1 record) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area. Moderate potential to occur within the adjacent habitats.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Powerful Owl <i>Ninox strenua</i>	V		This species is widely distributed throughout the eastern forests from the coast inland to the tablelands with scattered, historical records from the western slopes and plains. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Nest in large tree hollows (at least 0.5 m deep), in large eucalypts (DBH of 80-240 cm) that are at least 150 years old.	Recorded within 10 km (1 record) NSW Wildlife Atlas OEH 2016	Low potential to occur within the proposed extension area, may fly over. Moderate potential to occur within the adjacent habitats.
Rainbow Bee-eater <i>Merops ornatus</i>	-	Mi	The Rainbow Bee-eater is distributed across much of mainland Australia, and occurs on several near-shore islands where it breeds. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. The Rainbow Bee-eater is also common in cleared and semi-cleared habitats ie farmland.	Species or habitat may occur SPRAT	Moderate potential to occur in the proposed extension area.
Regent Honeyeater <i>Anthochaera phrygia</i>	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast.	Recorded within 10 km (1 record) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Rose-crowned Fruit-Dove <i>Ptilinopus regina</i>	V		Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Typically found within the coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria.	Recorded within 10 km (5 records) NSW Wildlife Atlas OEH, 2016	None. Suitable habitat is absent from the proposed extension area. Moderate potential to occur in the rainforest adjacent to the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Rufous Fantail <i>Rhipidura rufifrons</i>	-	Mi	The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>) or Red Mahogany (<i>E. resinifera</i>); usually with a dense shrubby understorey often including ferns.	Species or habitat may occur SPRAT	None. Suitable habitat is absent from the proposed extension area.
Satin Flycatcher <i>Myiagra cyanoleuca</i>	-	Mi	The Satin Flycatcher is widespread in eastern Australia and vagrant to New Zealand. Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	Species or habitat may occur SPRAT	None. Suitable habitat is absent from the proposed extension area.
Spectacled Monarch <i>Monarcha trivirgatus</i>	-	Mi	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Species or habitat may occur SPRAT	None. Suitable habitat is absent from the proposed extension area. Moderate potential to occur in subtropical rainforest adjacent to the proposed extension area.
Spotted Harrier <i>Circus assimilis</i>	V	-	Occurs in grassy open woodland including <i>Acacia</i> and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months.	Recorded within 10 km (11 records) NSW Wildlife Atlas	Moderate potential to occur in the proposed extension area.
Square-tailed Kite <i>Lophoictinia isura</i>	V		Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Appears to occupy large hunting ranges of more than 100km ² .	Recorded within 10 km (1 record) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Swift Parrot <i>Lathamus discolor</i>	E	E	The Swift Parrot migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. They return to Tasmania to breed between September and December.	Recorded within 10 km (6 records) Species or habitat may occur SPRAT NSW Wildlife Atlas	None. Favoured food trees are absent from the proposed extension area.
Turquoise Parrot <i>Neophema pulchella</i>	V		Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Recorded within 10 km (1 record) NSW Wildlife Atlas	Moderate potential to occur in the proposed extension area.
Varied Sittella <i>Daphoenositta chrysoptera</i>	V		The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. The Varied Sittella inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and <i>Acacia</i> woodland. Feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	Recorded within 10 km (1 record) NSW Wildlife Atlas	Low. This species does not persist well in fragmented areas, such as the proposed extension area.
White-bellied Sea Eagle <i>Hieraeetus leucogaster</i>	-	Mi	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes and the sea).	Species or habitat may occur SPRAT	None. Suitable habitat is absent from the proposed extension area.
White-fronted Chat <i>Ephianura albifrons</i>	V	-	Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground).	Recorded within 10 km (7 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
White-throated Needletail <i>Hirundapus caudacutus</i>	-	Mi	The White-throated Needletail occurs in open forest, rainforest, heathland, grassland and swamps. The species breeds in wooded lowlands and sparsely vegetated hills, as well as mountains covered with coniferous forests. This species is almost exclusively aerial, rarely coming to the ground.	Recorded within 10 km (2 records) Species or habitat may occur SPRAT	Low. This species is almost exclusively aerial, and may fly over the site, but is unlikely to be reliant on the habitats present.
Wood Sandpiper <i>Tringa glareola</i>		Mi	Wood Sandpipers are seen in small flocks or singly on inland shallow freshwater wetlands, often with other waders. They prefer ponds and pools with emergent reeds and grass, surrounded by tall plants or dead trees and fallen timber.	Recorded within 10 km (2 records)	None. Suitable habitat is absent from the proposed extension area.
Mammals					
Brush-tailed Phascogale <i>Phascogale tapoatafa</i>	V		Dry sclerophyll forests and open woodlands that contain hollow-bearing trees. It occurs more rarely in wetter forests.	Recorded within 10 km (1 record) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i>	E	V	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent.
Eastern Bentwing Bat <i>Miniopterus schreibersii oceanensis</i>	V	-	Hunt in forested areas, catching moths and other flying insects above the tree tops. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	Recorded within 10 km (18 records) NSW Wildlife Atlas	Moderate potential for species to forage in and adjacent to the proposed extension area. Breeding habitat is absent.
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Recorded within 10 km (5 records) NSW Wildlife Atlas	None. Suitable habitat is absent from the proposed extension area.
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	V	-	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	Recorded within 10 km (8 records) NSW Wildlife Atlas	Low. The species may occur in habitat adjacent to the proposed extension area and occasionally fly over.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	V	V	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Species or habitat likely to occur in area SPRAT Recorded within 10 km (20 records) NSW Wildlife Atlas	High potential for species to forage in and adjacent to the proposed extension area. Breeding habitat is absent.
Koala <i>Phascolarctos cinereus</i>	V	V	This species inhabits eucalypt woodlands and forests and feeds on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (OEH 2016). Primary feed trees for this species listed within the Central Coast Koala Management Area, include Parramatta red gum (<i>E. parramattensis</i>), Swamp mahogany (<i>E. robusta</i>), Forest red gum (<i>E. tereticornis</i>), Tallowwood (<i>E. microcorys</i>), Ribbon gum (<i>E. viminalis</i>) and Cabbage gum (<i>E. amplifolia</i>).	Recorded within 10 km (1 record) Species or habitat known to occur within area SPRAT	Low. Although Forest Red Gum (a favoured feed tree) is present on part of the proposed extension area, it does not comprise greater than 15 % of canopy cover and does not classify as potential Koala habitat in accordance with SEPP 44. There are no records within close proximity to the site.
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	V	V	This species roosts in caves, crevices in cliffs, old mine workings, frequenting low to mid-elevation dry open forest and woodland, especially in gullies. Females have been recorded raising young in maternity roosts in roof domes in sandstone caves and overhangs.	Recorded within 10 km (4 records) Species or habitat known to occur within area SPRAT	None. Suitable habitat is absent.
Little Bentwing Bat <i>Miniopterus australis</i>	V	-	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas.	Recorded within 10 km (12 records) NSW Wildlife Atlas OEH, 2016	Moderate potential for species to forage in and adjacent to the proposed extension area. Breeding habitat is absent.

Table B.2 **Threatened species, populations and communities, with the potential to occur within the locality**

Name	Conservation status		Habitat requirements	No. of records and source	Likelihood of occurrence
	TSC Act	EPBC Act			
Long-nosed Potoroo <i>Potorous tridactylus</i>	V	V	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	Recorded within 10 km (1 record) NSW Wildlife Atlas OEH, 2016	None. Suitable habitat is absent.
New Holland Mouse <i>Pseudomys novaehollandiae</i>	V		Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. It is a social animal, living predominantly in burrows shared with other individuals (OEH 2015).	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent.
Southern Brown Bandicoot (Eastern) <i>Isodon obesulus obesulus</i>	E	E	Southern Brown Bandicoots are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruited) fungi. Their searches for food often create distinctive conical holes in the soil (OEH 2015).	Species or habitat likely to occur within area SPRAT	None. Suitable habitat is absent.
Southern Myotis <i>Myotis macropus</i>	V	-	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Recorded within 10 km (8 records) NSW Wildlife Atlas	None. Suitable habitat is absent.
Spotted-tail Quoll <i>Dasyurus maculatus maculatus</i>	V	E	Spotted-tail Quolls are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Recorded within 10 km (7 records) NSW Wildlife Atlas	Low. Habitat is poor within the proposed extension area. Moderate potential to occur in subtropical rainforest adjacent to the proposed extension area.
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i>	V		Roosts in tree hollows and buildings. The species forages for insects over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Recorded within 10 km (4 records) NSW Wildlife Atlas	Moderate potential for species to forage in and adjacent to the proposed extension area. Breeding habitat is absent from the proposed extension area.

Appendix C

Assessments of significance – EPBC Act

C.1 Significant impact criteria in accordance with the EPBC Act

The following sections provide the criteria that must be considered in the assessment of all threatened species listed under the EPBC Act. There are separate criteria for each listing category under the EPBC Act, in accordance with *'EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance'* (DEH 2006).

C.1.1 Significant impact criteria for critically endangered and endangered species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population;
 - reduce the area of occupancy of the species;
 - fragment an existing population into two or more populations;
 - adversely affect habitat critical to the survival of a species;
 - disrupt the breeding cycle of a population;
 - modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
 - result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
 - introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

C.1.2 Significant impact criteria for vulnerable species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat;

- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

C.1.3 Significant impact criteria for listed migratory species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

C.1.4 Assessments of significance

Assessments of significance have been prepared for species listed under the EPBC Act, in accordance with the criteria above.

i Illawarra Zieria (*Zieria granulata*)

The Illawarra Zieria (*Zieria granulata*) is listed as an endangered species under the EPBC Act. The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils, usually on Bumbo Latite. It is less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments. Associated vegetation includes Bracelet Honey-myrtle (*Melaleuca armillaris*) scrub, Forest Red Gum (*eucalyptus tereticornis*) woodland and rainforest margins, although the species has been recorded from a number of other vegetation types. Much of the natural habitat for the species has been removed and many sites now occupy road verges and paddock edges.

The threatened shrub, Illawarra Zieria (*Zieria granulata*) was recorded at twenty eight different locations within the study area. The vast majority were recorded within the planted Eucalypt forest on the eastern boundary of the study area, with one individual recorded on the periphery of the rainforest community and another individual in the acacia shrubland.

A total of 210 Illawarra Zieria individuals were recorded within the planted Eucalypt forest. Approximately 75% of these were planted, given their large size and the presence of degraded tree guards. The remaining 25% consisted of seedlings and small shrubs, likely to have germinated from seeds from the planted individuals. The species is also predicted to occur in the paperbark shrubland to the south of the disturbance area.

A total of 48 Illawarra Zieria will be removed as a result of the proposal, however these will be offset by planting of individuals.

Table C.1 provides an assessment of significance for the removal of one planted Illawarra Zieria, in accordance with the relevant assessment criteria (Section C.1.1).

Table C.1 Assessment of significance for the Illawarra Zieria

Criteria	Discussion
1: long-term decrease in population size	A total of 48 planted Illawarra Zieria will be impacted by the proposal, with the majority (77%) of the planted individuals avoided by design. The revegetation of the bund area will include planting in excess of 48 individuals to ensure a net gain in the species presence in the long-term. The proposal will not impact any naturally occurring populations of the species. As naturally occurring populations will not be impacted, and the number of planted individuals will increase as a result of the proposal, there will be no long-term decrease in population size.
2: reduce area of occupancy	An area of 1.5 ha of planted eucalypt forest will be removed for the proposal. However, a larger area (5.3 ha) of the planted eucalypt forest will be revegetated on completion of the works (ie a 3.5 to 1 ratio). This will provide a suitable area to plant Illawarra Zieria, therefore increasing the area of occupancy for this species. This species has a strong regenerative capacity and has thrived in the planted eucalyptus forest within the study area. Approximately 25% of the population within the planted Eucalypt forest is self seeded.
3: fragment a population	The planted Eucalypt forest will be cleared at its northernmost and southernmost extent, with the remaining planted individuals, all connected to one another through continuous vegetation. Any fragmentation effects will not be significant.
4: adversely affect critical habitat	No critical habitat is listed for this species within recovery plans (DEC 2005) or the register of critical habitat. According to the National Environmental Significance Guidelines (2013)'critical habitat' should be considered against the following criteria; which are necessary; 1) <i>for activities such as foraging, breeding, roosting, or dispersal</i> 2) <i>for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)</i> 3) <i>to maintain genetic diversity and long term evolutionary development, or</i> 4) <i>for the reintroduction of populations or recovery of the species or ecological community.</i> The habitat which will be removed is unlikely to hold particular importance for this species considering it is planted and unlikely to replicate the naturally occurring vegetation communities in the surrounding area. Natural populations of this species are present in the locality of the study area and are likely to provide a more robust optimum reservoir population, with genetic diversity indigenous to the area and surrounding habitat in which the species may disperse more widely.
5: disrupt the breeding cycle of a population	The species is able to self pollinate and cross pollinate (DEC 2005), neither of which are likely to be compromised by the proposal. Pollination for the species is likely to be from generalist pollinators, such as nectivorous flies which will not be impacted significantly. Seed dispersal is by forcible ejection and planted eucalypt forest habitat will be retained around each of the planted individuals ensuring that there is opportunity for germination and regeneration. There is not anticipated to be any disruption of the breeding cycle for the species.
6: decrease availability or quality of habitat	Approximately 1.5 ha of planted eucalypt forest will be removed for the proposal, and 48 individual plants will be impacted. The revegetated bund area will be larger than the area of planted eucalypt forest removed and will include plantings of this species, ensuring a net gain in the total number of individuals. A net gain in the habitat area for this species is anticipated.
7: result in invasive species	Weed and soil hygiene controls will be implemented during the construction works, reducing the chance of introducing any invasive species. As the understorey of the planted eucalypt forest is dominated by Lantana, the construction works and revegetation present an opportunity to reduce and manage weed prevalence in the disturbance area.
8: introduce disease	This species is not known to be particularly susceptible to disease. The material which will form the bund is sourced on site, therefore reducing the likelihood of introducing any novel pathogens in the soil.

Table C.1 **Assessment of significance for the Illawarra Zieria**

Criteria	Discussion
9: interfere with recovery	The specific recovery objective (DEC 2005), most relevant to this species is 'to conserve <i>Z. granulata</i> using land-use and conservation planning mechanisms'. Although 48 individual Illawarra Zieria will be removed, the proposal will not interfere with recovery of this species as there will be a net gain in the number of individuals due to replanting. Previous planting of this species has been successful owing to the survival of plants within the planted eucalypt forest.
Conclusion	The project is not expected to result in significant impacts on Illawarra Zieria as: - planting on the bund area will result in a net gain in the number of individuals; and - no natural populations of the species or preferred habitat will be impacted.

i **Grey-headed Flying-fox (*Pteropus poliocephalus*)**

The Grey-headed Flying-fox is listed as a vulnerable species under the EPBC Act. Individuals are generally found within 200 km of the eastern coast of Australia, from Bundaberg, Queensland to Melbourne, Victoria. In times of natural resource shortages, they may be found in unusual locations. They occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. The species has not been recorded in the project area; however 20 records exist within 10 km of the extension area, and one camp has been recorded south of the study area, along Flying-fox Creek

Table C.2 provides an assessment of significance potential impacts of the proposal on the Grey-headed Flying-fox, in accordance with the relevant assessment criteria (Section C.1.2).

Table C.2 **Assessment of significance for Grey-headed flying fox**

Criteria	Discussion
1. Long term decrease in population size	Actions that would cause a long-term decrease in Grey-headed Flying-fox population size would be the removal of maternity camps and the substantial removal of foraging habitat. The proposal will not impact any roosts, however requires removal of 1.55 ha of potential foraging habitat. The foraging habitat is considered sub-optimal given that its restricted to planted eucalypt forest (1.5 ha) and a very small area of disturbed rainforest (0.05 ha). The removal this small area is not likely to cause any population level effects. Furthermore, revegetation of the bund area will result in a net gain in potential foraging habitat over the long term.
2. Reduce area of occupancy	The Grey-headed Flying-fox is a highly mobile species with a large area of occupancy along the east coast of Australia. The removal of 1.55 ha of potential foraging habitat is unlikely to reduce this area of occupancy significantly.
3. Fragment a population	The Grey-headed Flying-fox is a highly nomadic species with a wide distribution along the east coast of Australia, which occurs as a single, contiguous population. The removal of 1.55 ha of potential foraging habitat will not fragment the population.
4. Adversely affect critical habitat	Habitat critical to the survival of the species may include foraging habitat which can support 30,000 individuals within a 50 km radius, and productive habitat during seasonal bottlenecks (DECCW 2009). Roosting habitat critical to survival include those used as a camp >50% of years, or has a certain number of females during the final stages of pregnancy. As roosting camps and habitat are absent, the project area does not contain critical habitat for the Grey-headed Flying Fox.
5. Disrupt the breeding cycle of a population	Maternity roosts are absent from the study area, and the highly cleared landscape is unlikely to support any breeding in the future, therefore it will not disrupt the breeding cycle of a population.

Table C.2 Assessment of significance for Grey-headed flying fox

Criteria	Discussion
6. Decrease availability or quality of habitat	Given the small area of clearing and the abundance of suitable habitat in the locality including rainforest; this is not expected to impact the species such that it would decline.
7. Result in invasive species	Weed controls and hygiene protocols will be implemented during the construction works, reducing the chance of introducing any invasive species. As the understorey of the planted eucalypt forest is dominated by Lantana, the construction works and revegetation present an opportunity to reduce and manage weed prevalence in the disturbance area.
8. Introduce disease	This species is subject to Australian Bat Lyssavirus and Hendra virus. These diseases become more prevalent when the species is stressed. As the works are not located in a roosting colony, have a short duration and are minor in nature they are unlikely to cause stress such that a disease outbreak would occur.
9. Interfere with recovery	Recovery actions for this species rely on identifying foraging resources, mapping critical habitat and documenting levels of flying-fox damage so non-invasive mitigation measures can be implemented. The project does not interfere with any of these priority actions.
Conclusion	The project will not have a significant impact on the Grey-headed Flying Fox as: • no roost sites or habitat will be directly impacted; • the project area represents sub-optimal potential foraging habitat only; and • a large area of optimal foraging habitat exists close to the study area, that will be avoided by the proposal.

ii Migratory Species: Rainbow Bee-eater (*Merops ornatus*) and Fork-tailed Swift (*Apus pacificus*)

The Rainbow Bee-eater is distributed across much of mainland Australia. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. The Rainbow Bee-eater is also common in cleared and semi-cleared habitats i.e. farmland. The species constructs their nests in sandy creek banks where a long tunnel is excavated (average length: 89.4 cm) leading to a nesting chamber, which is often lined with grasses.

In NSW, the Fork-tailed Swift is recorded in all regions, however most frequently recorded east of the Great Divide. Habitats preferences are very broad, although mostly recorded over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. The species also occurs on grassland, open farmland, inland and coastal sand-dunes. They are insectivorous, foraging aerially, up to hundreds of metres above ground, but also less than 1 m above open areas or over water. The Fork-tailed Swift does not breed in Australia. Neither species has been recorded in the project area, however four records of the Fork-tailed Swift occur within 10 km of the extension area.

Table C.3 provides an assessment of significance that examines potential impacts of the proposal on the migratory species, in accordance with the relevant assessment criteria (Section C.1.3).

Table C.3 Assessment of significance for migratory species

Criteria	Discussion
1. Substantially modify destroy or isolate an area of important habitat .	The disturbance area does not contain important habitat for the Rainbow Bee-eater or Fork-tailed Swift. While both species have the potential to occur given they are highly mobile and have broad habitat requirements, neither species will breed in the site considering that the Fork-tailed Swift does not breed in Australia and suitable banks for the Rainbow Bee-eater to nest are absent.
2. result in an invasive species becoming established in an area of important habitat.	As stated above, the area does not contain important habitat for either species. Weed controls and hygiene protocols will be included during the construction works, reducing the chance of introducing any invasive species. The understorey of the planted eucalypt forest is dominated by Lantana. Therefore, the construction works and revegetation present an opportunity to reduce and manage weed prevalence in the disturbance area.
3. Disrupt the breeding cycle of a population	If either species occur within the site, is anticipated to be on an intermittent basis only, and not include significant proportions of a population at any given time. There are no attributes of the extension area which would cause large aggregations of individuals to occur. The species will not breed within the study area as suitable habitat is absent, therefore disruptions to the breeding cycle are unlikely.
Conclusion	The project will not have a significant impact on either migratory species: • the area does not contain important habitat; • no breeding habitat will be impacted; • foraging habitat is sub-optimal and considered unimportant within the landscape; and • no large aggregations of either species are likely to occur.

Appendix D

Assessments of significance - TSC Act

D.1 Significant impact criteria in accordance with the TSC Act

Section 5A of the EP&A Act provides the criteria that must be considered in the assessment of the significance of potential impacts on all threatened species listed under the TSC Act. Assessment of Significance (known as the seven-part test) is made up of the following seven questions:

1. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;
2. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;
3. In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
 - a) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction;
 - b) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;
4. In relation to the habitat of a threatened species, population or ecological community:
 - a) the extent to which habitat is likely to be removed or modified as a result of the action proposed;
 - b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action;
 - c) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;
5. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);
6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and
7. Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Assessments of significance are undertaken in accordance with *Threatened Species Assessment Guidelines: The Assessment of Significance* (DEC 2007).

D.1.1 Assessments of significance

Species requiring additional assessment as identified in Appendix B and which are listed as threatened under the TSC Act were assessed using the seven-part test. Seven-part tests have been prepared in accordance with the criteria presented in Section C.1. Assessments have been undertaken for guilds of species which have similar habitat requirements. The results of tests have been tabulated for ease of reading and are presented in the following sections.

i Illawarra Zieria (*Zieria granulata*)

Species information and habitat preferences is provided in Section C i.

Table C.1 provides an assessment of significance for the removal of one planted Illawarra Zieria individual, in accordance with the criteria presented in Section D.1.

Habitat

Table D.1 Assessment of significance for Illawarra Zieria

Criteria	Discussion
1: life cycle of threatened species	A total of 48 planted Illawarra Zieria will be impacted by the proposal, with the majority (77%) of the planted individuals avoided by design. The retained individuals occur within the planted eucalypt forest, and have the ability to regenerate and potentially extend their occurrence within the surrounding vegetation. The species is able to self pollinate and cross pollinate (DEC 2005), neither of which are likely to be compromised by the proposal. Pollination for the species is likely to be from generalist pollinators, such as nectivorous flies which will not be impacted significantly. The proposal is not anticipated to alter any of the key life cycle stages which may affect regeneration.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	Approximately 1.5 ha of planted eucalypt forest will be removed for the proposal. This area does not support a naturally occurring population of Illawarra Zieria as the vegetation is planted. The habitat is not considered important to the local conservation of the species, given that it can be readily replicated elsewhere and does not represent a natural intact habitat type. The removal of 48 individuals will not fragment the planted population as all remaining individuals will remain connected via the planted eucalypt forest. The constructed bund area will be revegetated, which will result in similar habitat to that which is being lost. The revegetated area will be larger than the disturbance area, resulting in a net gain in habitat for the species.
5: critical habitat	Critical habitat has not been declared for Illawarra Zieria.
6: consistency with recovery or threat abatement plans	The key recovery objective (DEC 2005) for the species is 'to conserve <i>Z. granulata</i> using land-use and conservation planning mechanisms'. The proposal does not interfere with recovery of this species as there will be a net gain in the number of individuals due to replanting. Previous planting of this species has been successful, as evidenced by the survival of plants within the planted eucalypt forest. The revegetation of the bund area will include planting the species at a higher ration than those removed, increasing the number of individuals occurring within the area.

Table D.1 **Assessment of significance for Illawarra Zieria**

Criteria	Discussion
7: key threatening processes	The Key Threatening Process (KTP) 'clearing of native vegetation' is most relevant to this species. Vegetation clearance has been avoided where possible, limiting the clearance of planted eucalypt forest to 1.5 ha. The revegetation of the bund area will increase the amount of planted eucalypt forest, resulting in a net gain in native vegetation.
Conclusion	The project is not expected to result in significant impacts on Illawarra Zieria as: - planting on the bund area will result in a net gain in the number of individuals; and - no wild populations of the species or preferred habitat will be impacted.

ii **Turquoise Parrot (*Neophema pulchella*)**

The Turquoise Parrot (*Neophema pulchella*) is listed as a vulnerable species under the TSC Act and is found from south-eastern Queensland, through New South Wales to eastern and north-eastern Victoria. It favours open, grassy woodland with dead trees near permanent water. It also inhabits coastal heaths and pastures with exotic grasses and weeds, along roadsides and in orchards. The species forages mostly on or near the ground for seeds of grasses and shrubs. They also eat flowers, nectar, fruits, leaves and scale-insects. It nests in vertical or near-vertical hollows in living or dead trees. The species was not recorded in the study area, however it has the potential to occur, given its ability occur in cleared areas adjacent to woodlands. One record exists within 10 km of the study area.

Table D.2 provides an assessment of significance that examines potential impacts of the proposal on the Turquoise Parrot, in accordance with the assessment criteria in Section D.1.

Table D.2 **Assessment of significance criteria for the Turquoise Parrot**

Criteria	Discussion
1: life cycle of threatened species	The habitat which will be removed does not contain suitable hollows for nesting, therefore breeding will be unaffected. The habitat within the study area represents sub-optimal foraging habitat given that the grassland is non-native and grazed by horses, which reduces the presence of seed heads. Removal of the potential sub-optimal foraging habitat would not affect the energetic requirements of this species significantly enough to have any bearing on its lifecycle.
2 : life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to EECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	Approximately 5.1 ha of grazed exotic grassland and 1.9 ha of woody vegetation will be impacted as part of the proposal. This habitat is not considered important to the species as foraging resources are sub-optimal and no suitable breeding habitat occurs within the study area. If the study area is utilised it is likely to be on an intermittent basis and by a small number of individuals at any given time. The loss of small woodland areas will not cause any significant fragmentation impacts to the Turquoise Parrot, as it is highly mobile and can cross open areas with ease.
5: critical habitat	No critical habitat or priority sites have been declared for these species. Preservation of breeding habitat (hollows) is important for this species. As breeding hollows are absent, the proposal will not impact important habitat resources for the Turquoise Parrot.

Table D.2 Assessment of significance criteria for the Turquoise Parrot

Criteria	Discussion
6: consistency with recovery or threat abatement plans	This species has been recently added to the landscape species management stream under the Saving our Species program. Key threats to the viability of landscape-managed species are loss, fragmentation and degradation of habitat, and widespread factors including climate change and disease. Although habitat in the disturbance area is not considered important to the continued viability of the Turquoise Parrot, the impacts of potential habitat loss will be ameliorated by the planting of larger areas of native vegetation along the bund wall.
7: key threatening processes	The KTP 'clearing of native vegetation' is most relevant to this species. Vegetation clearance has been avoided where possible, limiting the clearance of woody vegetation types to 1.9 ha. The revegetation of the bund area will increase the amount of planted eucalypt forest, resulting in a net gain in native vegetation.
Conclusion	The project is not expected to result in significant impacts to the Turquoise Parrot: • breeding is unlikely to occur in the project area given the paucity of hollows; • a small area of potential sub-optimal foraging habitat will be cleared; and • revegetation of the bund area will result in a net gain in native vegetation.

iii Spotted Harrier (*Circus asimilis*)

The Spotted Harrier (*Neophema pulchella*) is listed as a vulnerable species under the TSC Act. It occurs throughout mainland Australia, however it is most frequently recorded in the arid and semi-arid zones. Typical habitat types include grassy open woodland including *Acacia* and mallee remnants, inland riparian woodland, grassland and shrub steppe. It may also be found in agricultural land, foraging over open habitats including edges of inland wetlands. The species builds a stick nest in a tree and lays eggs in spring with young remaining in the nest for several months. Prey include ground foraging birds, small mammals and reptiles.

The Spotted Harrier may occur within the extension area given its wide range and ability to hunt within disturbed habitats including agricultural land. Seven records of this species exists within 10 km of the study area.

Table D.2 provides an assessment of significance that examines potential impacts of the proposal on the Spotted Harrier, in accordance with the assessment criteria in Section D.1.

Table D.3 Assessment of significance for the Spotted Harrier

Criteria	Discussion
1: life cycle of threatened species	Any occurrence of the species within the study area is likely to be intermittent, with a very low number of individuals expected to occur. The study area does not contain important foraging habitat for the Spotted harrier as prey densities are likely to be low; the highly grazed grassland is sub-optimal for prey as there is a paucity of shelter. No nests of the Spotted Harrier were recorded, and the study area is outside of the core habitat areas typically used for nesting. There will be no anticipated impact on the lifecycle of the species, and no population wide effects.
2 : life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to EECs, therefore is not relevant to this assessment.

Table D.3 **Assessment of significance for the Spotted Harrier**

Criteria	Discussion
4: habitat removal, fragmentation, isolation and importance	A total of 7 hectares of potential foraging habitat will be removed, which includes exotic grassland and forested areas, as the species has the ability to fly over and forage within both types of habitat. The foraging within the study area is sub-optimal however, as prey densities are likely to be low due to the lack of shelter within the grassland areas. The study area may provide habitat for the species but it does not represent unique or restricted habitat. It does not provide breeding habitat and is likely to be of low importance to the species.
5: critical habitat	No critical habitat or priority sites have been declared for these species.
6: consistency with recovery or threat abatement plans	No recovery or threat abatement plans have been produced for this species.
7: key threatening processes	The KTP 'clearing of native vegetation' is most relevant to this species. Vegetation clearance has been avoided where possible, limiting the clearance of woody vegetation types to 1.9 ha.. The revegetation of the bund area will increase the amount of planted eucalypt forest, resulting in a net gain in native vegetation. Clearance of exotic grassland is not part of the KTP
Conclusion	The project is not expected to result in significant impacts to the Spotted Harrier: • breeding is unlikely to occur in the study area; • a small area of potential foraging habitat will be cleared; and • revegetation of the bund area will result in a net gain in forested area, which in turn may increase prey densities.

iv **Flame Robin (*Petroica phoenicia*)**

The Flame Robin is listed as a vulnerable species under the TSC Act. The species breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. It prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. It occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains). This species was not recorded within the study area; however it has the potential to occur during the winter months. Two records exist within 10 km of the study area.

Table D.4 **Assessment of significance for the Flame Robin**

Criteria	Discussion
1: life cycle of threatened species	The woody vegetation types within the study area may provide overwintering habitat for the species, however these habitats are not considered important or restricted in the locality. Removal of a small proportion of potential foraging habitat would not affect the energetic requirements of this species significantly enough to have any bearing on its lifecycle. This species breeds in upland areas and therefore no impact on breeding would result from the proposal.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to EECs, therefore is not relevant to this assessment.

Table D.4 Assessment of significance for the Flame Robin

Criteria	Discussion
4: habitat removal, fragmentation, isolation and importance	The occurrence of this species is positively associated with larger patch size and higher structural habitat complexity (i.e. high tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter). Given that the study area is already fragmented with small patch sizes of vegetation, the small area of habitat loss is not likely to significantly change the nature of the habitat present. Approximately 1.9 ha of woody vegetation types will be impacted as part of the proposal. This habitat is not considered important for the species as higher quality foraging resources are present in the surrounding locality and no suitable breeding habitat occurs within the study area. If the study area is utilised it is likely to be on an intermittent basis and by a small number of individuals at any given time. The loss of small woodland areas will not cause any significant fragmentation impacts to the species as it is highly mobile and can cross the small cleared areas which will result as part of the proposal.
5: critical habitat	Critical habitat has not been declared for the Flame Robin.
6: consistency with recovery or threat abatement plans	No recovery plans exist for this species.
7: key threatening processes	The KTP 'clearing of native vegetation' is most relevant to this species. Vegetation clearance has been avoided where possible, limiting the clearance of woody vegetation types to 1.9 ha. The revegetation of the bund area will increase the amount of planted eucalypt forest, resulting in a net gain in native vegetation.
Conclusion	The project is not expected to result in significant impacts to the Flame Robin as: • The study area does not contain breeding habitat; • a small area of potential sub-optimal foraging habitat will be cleared; and • revegetation of the bund area will result in a net gain in native vegetation.

v Threatened microbats: Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) Little Bentwing Bat (*Miniopterus australis*), Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)

The Eastern Bentwing Bat is listed as a vulnerable species under the TSC Act. The species typically forages above the canopy of forested areas and also in more open areas such as grasslands. They roost in caves but will also use abandoned mines and road culverts as alternative roosting habitat. This species has been recorded on 18 occasions within 10 km of the study area.

The Little Bentwing Bat is listed as a vulnerable species under the TSC Act. The Little Bentwing Bat roosts in maternity caves in limestone cave systems and disperse to other caves, abandoned mines, tunnels, tree hollows and stormwater drains in winter. They inhabit well-timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. Little Bentwing Bats forage between the shrub and canopy layers of densely wooded areas. This species has been recorded on 12 occasions within 10 km of the study area.

The Yellow-bellied Sheath-tail Bat is listed as a vulnerable species under the TSC Act. It roosts in tree hollows and buildings. The species forages for insects over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees, and appears to defend an aerial territory. This species has been recorded on 4 occasions within 10 km of the study area.

Given the paucity of hollows and absence of suitable caves, the project area does not contain roosting or breeding habitat for these species. Suitable roosting hollows are likely to be present in forested habitats adjacent to the study area. Potential foraging habitat exists within the woodland and shrubland areas of the study area.

Table D.5 Assessment of significance for threatened microbats

Criteria	Discussion
1. Life cycle of threatened species	The project will not remove any potential breeding habitat for threatened microbats due to the absence of suitable structures and therefore is unlikely to impact on the lifecycle of these species. The proposal will remove 1.9 ha of potential foraging habitat for threatened microbats. These species are highly mobile and higher quality area of foraging habitat exists adjacent to the study area. The lifecycle of these species are unlikely to be threatened by the proposal.
2. Life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3. EEC extent and modification	This question refers to EECs, therefore is not relevant to this assessment.
4. Habitat removal, fragmentation, isolation and importance	The intersection upgrade will remove 1.9 ha of potential foraging habitat for threatened microbats. No breeding habitat will be removed as these features are absent from the disturbance area. Habitat removal will not fragment or isolate foraging habitat for the threatened microbat species as a and gaps with the vegetation will be limited to distances in which the species can cross given their highly mobile nature and the ability to move across open areas, furthermore revegetation of the bund area will re-establish vegetation corridors. The habitat to be removed has no significant importance to these species as substantial amounts of foraging and roosting habitat is present in adjacent bushland surrounding the study area. The indirect impacts of the development of the project such as noise disturbance from construction is not expected to interrupt foraging nocturnal bats as the impact will occur during daylight hours only.
5. Critical habitat	Critical habitat has not been listed for these threatened microbats.
6. Consistency with recovery or threat abatement plans	There are currently no recovery or threat abatement plans for these threatened microbats. Priority actions for these species focus on monitoring the breeding success of maternity colonies to determine the viability of regional populations, identifying the types of winter roosts used by species and regular censuses of maternity colonies and other key roosts. Given that only potential foraging habitat will be cleared, the project does not interfere with these actions.
7. Key threatening processes	The KTP 'clearing of native vegetation' is most relevant to this species. Vegetation clearance has been avoided where possible, limiting the clearance of potential foraging areas to 1.9 ha. The revegetation of the bund area will increase the amount of planted eucalypt forest, resulting in a net gain in native vegetation.
Conclusions	The proposed development will not have a significant impact on threatened microbats as: • no roost sites or will be directly impacted; • a relatively small area of potential foraging habitat will be removed, however larger areas of more optimal foraging habitat exists close to the study area which will not be impacted; and • no breeding habitat will be removed.

vi Grey-headed Flying-fox (*Pteropus poliocephalus*)

For species information and habitat preferences refer to Section C ii

Table D.6 Assessment of significance for the Grey-headed Flying-fox

Criteria	Discussion
1. Life cycle of threatened species	Maternity roosts are absent from the extension area, and the highly cleared landscape is unlikely to support any breeding in the future, therefore it will not disrupt the breeding cycle of a population. The potential foraging habitat is considered sub-optimal given that it's restricted to recently planted eucalypt forest (1.5 ha) and a very small area of disturbed rainforest (0.05 ha). The removal of this small area is not likely to cause any impacts to the life cycle of this species, especially when considering that more optimal rainforest areas are found adjacent to the study area, The foraging activities of this nocturnal species are not expected to be impacted from construction noise as construction will occur in the day only.
2. Life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3. EEC extent and modification	This question refers to EECs, therefore is not relevant to this assessment.
4. Habitat removal, fragmentation, isolation and importance	Removal of potential foraging habitat is restricted to planted eucalypt forest (1.5 ha) and a very small area of disturbed rainforest (0.05 ha). The removal of this area is negligible considering the large amount of much more optimal foraging habitat, including rainforest, outside of the study area. The habitat removed is likely to be unimportant for the species as the foraging resources are restricted to individual trees in the case of the disturbed rainforest areas, or flowering of the planted eucalypts. The planted eucalypts are small in size which reduced the magnitude of the foraging resources which are typically more abundant in remnant vegetation. The indirect impacts of the development of the project such as noise disturbance from construction is not expected to interrupt foraging nocturnal bats as the impact will occur during daylight hours only. This species is highly mobile with the ability to fly over cleared areas, as a result there will be no fragmentation impacts.
5. Critical habitat	Habitat critical to the survival of the species may include foraging habitat which can support 30,000 individuals within a 50 km radius, and productive habitat during seasonal bottlenecks (DECCW 2009). Roosting habitat critical to survival include those used as a camp >50% of years, or has a certain number of females during the final stages of pregnancy. As roosting camps and habitat are absent, the project area does not contain critical habitat for the Grey-headed Flying Fox. No winter-flowering eucalypts are present to provide foraging habitat when resources are in short supply (DECCW 2009), further reducing the value of the habitat present.
6. Consistency with recovery or threat abatement plans	Recovery actions in the Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW 2009) focuses on the identification and protection of critical habitat for the species. As critical habitat is absent from the project area and only a small area of potential foraging habitat will be removed, the project does not interfere with the species' recovery.
7. Key threatening processes	The KTP 'clearing of native vegetation' is most relevant to this species. Vegetation clearance has been avoided where possible, limiting the clearance of potential foraging areas to 1.55 ha. The revegetation of the bund area will increase the amount of planted eucalypt forest, resulting in a net gain in native vegetation.
Conclusions	The project will not have a significant impact on the Grey-headed Flying Fox as: • no roost sites or habitat will be directly impacted; • the project area represents sub-optimal potential foraging habitat only; • a large area of more optimal foraging habitat exists close to the study area which will not be impacted, that will be avoided by the proposal.

The disturbed rainforest in the north-eastern section of the disturbance area meets the TSC Act description of Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC, given the presence of characteristic tree and plant species. The listing does not specifically exclude disturbed remnants of this community or include a minimum patch size for the community. Therefore, despite being severely degraded and occurring in very small fragments, the vegetation meets the community listing. A total area of 0.05 ha will be removed for this project.

Table D.7 provides an assessment of significance that examines potential impacts of the proposal on the EEC, in accordance with the assessment criteria in Section D.1.

Table D.7 **Assessment of significance criteria for the Illawarra Subtropical Rainforest in the Sydney Basin Bioregion EEC**

Criteria	Discussion
1: life cycle of threatened species	This question refers to threatened species, therefore is not relevant to this assessment.
2 : life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	Two isolated patches of this community will be removed, totalling an area of 0.05 ha. The impact of this will be negligible, considering much larger areas of less disturbed rainforest exist within close proximity and will not be impacted by the project.
4: habitat removal, fragmentation, isolation and importance	The EEC is already fragmented, occurring in two small patches, surrounded by exotic pasture. The patches do not link any other areas of habitat and therefore connectivity will not be impacted. The EEC is of very low importance given its small size, weedy understory and lack of any recruitment of canopy species. The patches are likely to be unviable within the long term.
5: critical habitat	No critical habitat or priority sites have been declared for this EEC.
6: consistency with recovery or threat abatement plans	There are no recovery or threat abatement plans for this EEC.
7: key threatening processes	The KTP 'clearing of native vegetation' is most relevant to this species. Avoidance of larger areas of rainforest EEC has been undertaken through design, resulting in 0.05 ha of vegetation clearance for this community.
Conclusion	The project is not expected to result in significant impacts to the Illawarra Subtropical Rainforest EEC as: - the area requiring clearance is small in size (0.05 ha); - the condition of the EEC is very poor with larger areas of higher quality rainforest EEC within the locality; and the EEC is not considered viable in the long term given the highly weedy understory, lack of recruitment and surrounding exotic pasture.

D.2 References

Department of Environment and Conservation (DEC) 2007, *Threatened Species Assessment Guidelines: the assessment of significance*, Department of Environment and Conservation NSW, Hurstville

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Appendix B

Air Quality Assessment

Intended for
EMM Consulting Pty Ltd

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DUNMORE QUARRY AIR QUALITY IMPACT ASSESSMENT – MODIFICATION 8

DUNMORE QUARRY
AIR QUALITY IMPACT ASSESSMENT – MODIFICATION
8

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APPENDICES

Appendix 1

Seasonal and Diurnal Wind Roses – Dunmore Quarry

1. INTRODUCTION

Dunmore Hard Rock Quarry ('the quarry') is located at the end of Tabbita Road, Dunmore, in the Shellharbour local government area. It is owned and operated by Boral Resources (NSW) Pty Ltd ('Boral'). This air quality impact assessment has been prepared by Ramboll Environ Australia Pty Ltd (Ramboll Environ) at the request of EMM Consulting Pty Ltd (EMM) to accompany an application to modify (Modification 8) the existing development consent for the quarry (Development Consent 470-11-2003) under Section 75W of the NSW *Environmental Planning and Assessment Act 1979* ('the proposed modification').

1.1 Overview of Modification

It is estimated that approved rock reserves at the quarry will be exhausted by February 2017. Boral will be seeking to lodge a further application to modify the development consent – Modification 9 – in mid to late 2016 for an extension to the existing Croome Farm Pit ('Croome Farm West Pit'). To enable continuation of the current operations until Modification 9 is approved, it is proposed to extract an area of approved resource within the southern corner of the Croome Farm Pit extraction area. Approximately 130,000 m³ of overburden (64,800 m³ free dig material and 62,200 m³ of weathered hard rock) is located in this area. To avoid double handling and to provide pre-emptive noise and visual management, the extracted overburden will be used to construct a bund along the proposed boundary of the future Croome Farm West Pit (see **Figure 1-1**).

The bund will be constructed on Boral owned land to the west of the Croome Farm Pit. The bund will be 1,800m long with a height of around 5 m. The bund base width will vary between 24m and 41m. A further 3 m wide buffer will be maintained around the perimeter of the bund for the provision of sediment and erosion control measures and light vehicle access. Approximately 1.94 hectares of predominantly planted native vegetation will be cleared for construction of the bund and for a 30m wide truck and machinery construction access route from the pit to the bund. The bund will immediately be covered with erosion matting and be rehabilitated with a range of locally sourced and propagated native species, including Illawarra Zieria (*Zieria granulata*). It is estimated it will take six weeks to construct the bund during normal construction hours.

The proposed modification also includes some minor administrative amendments to the conditions of consent to remove redundant conditions and to reflect contemporary management practices at the quarry.



Figure 1-1: Proposed bund construction area

2. SURROUNDING RECEPTOR LOCATIONS

A number of residential receptors exist in the region surrounding the quarry site. The closest of these residential receptors to the quarry are presented in **Table 2-1** and illustrated in **Figure 2-1**.

Table 2-1 Sensitive Receptor Locations Surrounding the Project Site				
Receptor ID	Location (m, MGA56S)		Description	Ownership status
	Easting	Northing		
A	298737	6168168	Boral owned	Tenanted
B	298098	6167942	Boral owned	Tenanted
C	298173	6168084	Boral owned	Tenanted
D	298183	6169201	Privately owned	
E	298513	6169517	Boral owned	Tenanted
F	298285	6169804	Privately owned	
G	298176	6169349	Privately owned	
H	300340	6167584	Boral owned	Tenanted
I	301331	6167096	Boral owned	Dunmore Sand and Soil, tenanted
J	301505	6167630	Privately owned	
K	301395	6167360	Privately owned	
L	300747	6168671	Boral owned	Dunmore Sand and Soil, tenanted
M	300879	6168919	Other quarry owned	Holcim
N	301589	6168870	Boral owned	Dunmore Sand and Soil, tenanted
O	301486	6166699	Privately owned	
P	300905	6166707	Privately owned	
Q	298925	6166759	Boral owned	Tenanted
R	298298	6167363	Boral owned	Tenanted
S	298214	6167335	Privately owned	
T	297519	6168261	Privately owned	
U	302001	6168472	Privately owned	
V	302177	6168691	Privately owned	
W	302224	6169262	Privately owned	
X	301651	6169245	Privately owned	
Y	297557	6167925	Boral owned	Tenanted
Z	298173	6169276	Privately owned	
AA	297979	6169974	Privately owned	

Table 2-1 Sensitive Receptor Locations Surrounding the Project Site				
Receptor ID	Location (m, MGA56S)		Description	Ownership status
	Easting	Northing		
AB	297587	6170062	Privately owned	
AC	297304	6169436	Privately owned	
AD	297401	6167717	Privately owned	

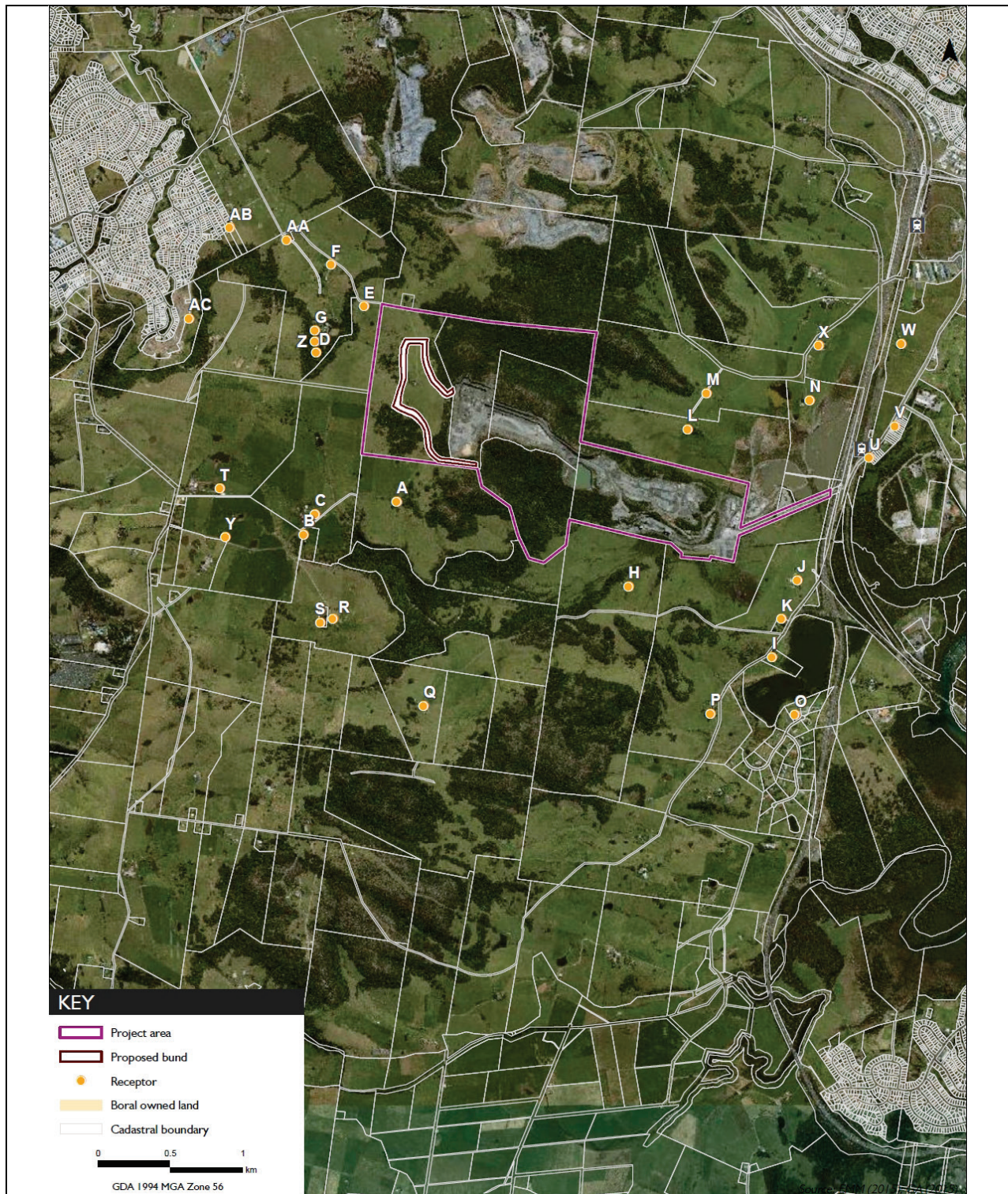


Figure 2-1: Surrounding sensitive receptor locations

3. AIR QUALITY ASSESSMENT CRITERIA

The quarry and bund construction project must demonstrate compliance with the impact assessment criteria specified by the NSW Environment Protection Authority (NSW EPA) within the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2005) (EPA, 2005). The impact assessment criteria are designed to maintain ambient air quality that allows for the adequate protection of human health and well-being.

The primary pollutants generated by the proposed construction activities are expected to be particulate matter, including Total Suspended Particulates (TSP), particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$).

Gaseous pollutants, including oxides of nitrogen (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO) and volatile organic compounds (VOCs), associated with onsite diesel consumption would also be generated by the proposed bund construction activities. It is expected that these emissions would be minor.

With regards to air quality compliance, impacts from PM_{10} is considered the most relevant pollutant from proposed construction activities associated with Modification 8. The specific goals that would be applicable at surrounding receptors are as follows:

- A 24-hour maximum of $50\mu g/m^3$.
- An Annual average of $30\mu g/m^3$.

The assessment of bund construction-related impacts will be undertaken using a qualitative approach (further details in **Section 7**).

4. CLIMATE AND DISPERSION METEOROLOGY

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. Emission generation rates are particularly dependent on wind energy and on the moisture budget, which is a function of rainfall and evaporation rates.

A continuous meteorological monitoring station is located at the quarry site. Data recorded between 2012 and 2015 has been collated and analysed for use in this assessment and presented in the following sections. Long-term records from the Bureau of Meteorology (BoM) climate station at Kiama Bowling Club are also referenced to determine the representativeness of the quarry site data.

4.1 Prevailing Wind Regime

A wind rose showing wind speed and direction data recorded at the quarry site meteorological station between 2012 and 2015 is presented in **Figure 4-1**. The annual recorded wind pattern is dominated by south-westerly airflow. A less frequent north-easterly airflow is also experienced. The strongest wind speeds recorded are most frequently experienced from the north-east. The average recorded wind speed for the analysed period was 2.9 m/s, with a frequency of calm conditions (wind speeds less than 0.5 m/s) occurring in the order of 13% of the time.

Additional inter-annual, seasonal and diurnal wind roses for the quarry site are provided in **Appendix 1**.

Seasonal and diurnal (dividing the day into night and day) wind roses for the meteorological dataset are presented within **Appendix 1**.

Seasonal variation in wind speed and direction is evident in the recorded data from the quarry site meteorological station. The south-westerly airflow is evident in all seasons, with a particular dominance in winter. The north-easterly airflow is most common in the spring and summer months. Wind speeds are typically lowest during the autumn and winter months, with the lowest average wind speed and highest occurrence of calm conditions at this time.

Diurnal variation is also notable in the quarry site monitoring dataset. Wind speeds are higher during the daylight hours than at night. Daylight hours experience a mixture of north-east and south-west airflow. Night time hours are dominated by airflow from the south-west quadrant.

4.2 Ambient Temperature

Monthly mean minimum temperatures are in the range of 9°C to 18°C, with mean maxima of 17°C to 25°C, based on the long-term average record from the BoM Kiama Bowling Club climate station. Peaks occur during summer months with the highest temperatures typically being recorded between December and February. The lowest temperatures are usually experienced between June and August.

Figure 4-2 presents the monthly variation in recorded temperature recorded at the quarry site between 2012 and 2015 compared with the mean, minimum and maximum temperatures from the long term climate station at Kiama Bowling Club. There is good agreement between temperatures recorded at the quarry site and the recorded historical trends, indicating that the dataset is representative of conditions likely to be experienced in the region.

4.3 Rainfall

Precipitation is important to air pollution studies since it impacts on dust generation potential and represents a removal mechanism for atmospheric pollutants.

Based on historical data recorded at Kiama Bowling Club, the area is characterised by high rainfall, with a mean annual rainfall of approximately 1,250 mm, and an annual rainfall range between 600 mm and 2,715 mm. Rainfall is most pronounced in late summer to early winter months, peaking in March. According to the long term records, an average of 125 rain days occur per year.

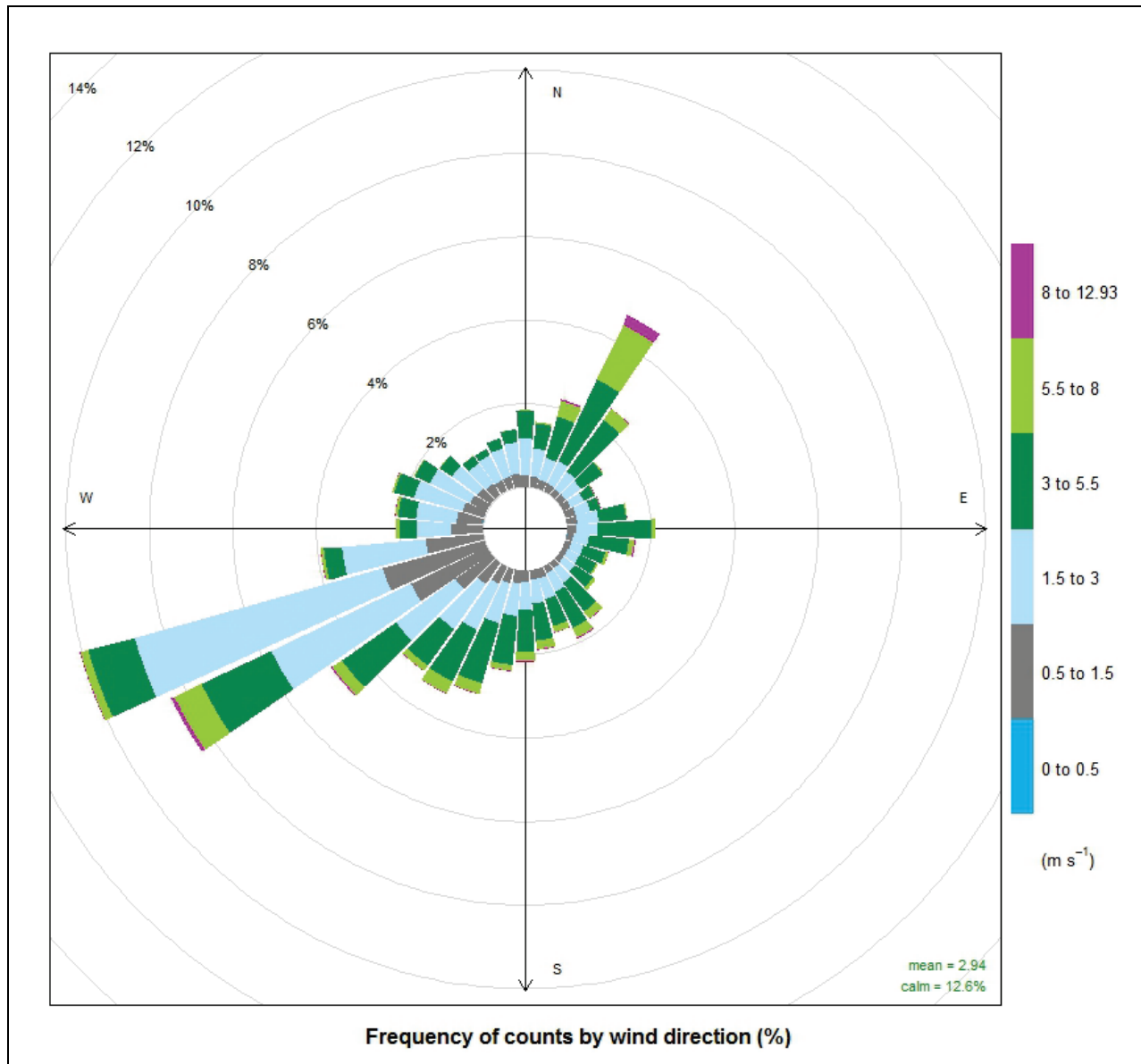


Figure 4-1: Annual average wind rose – Dunmore Quarry – 2012 to 2015

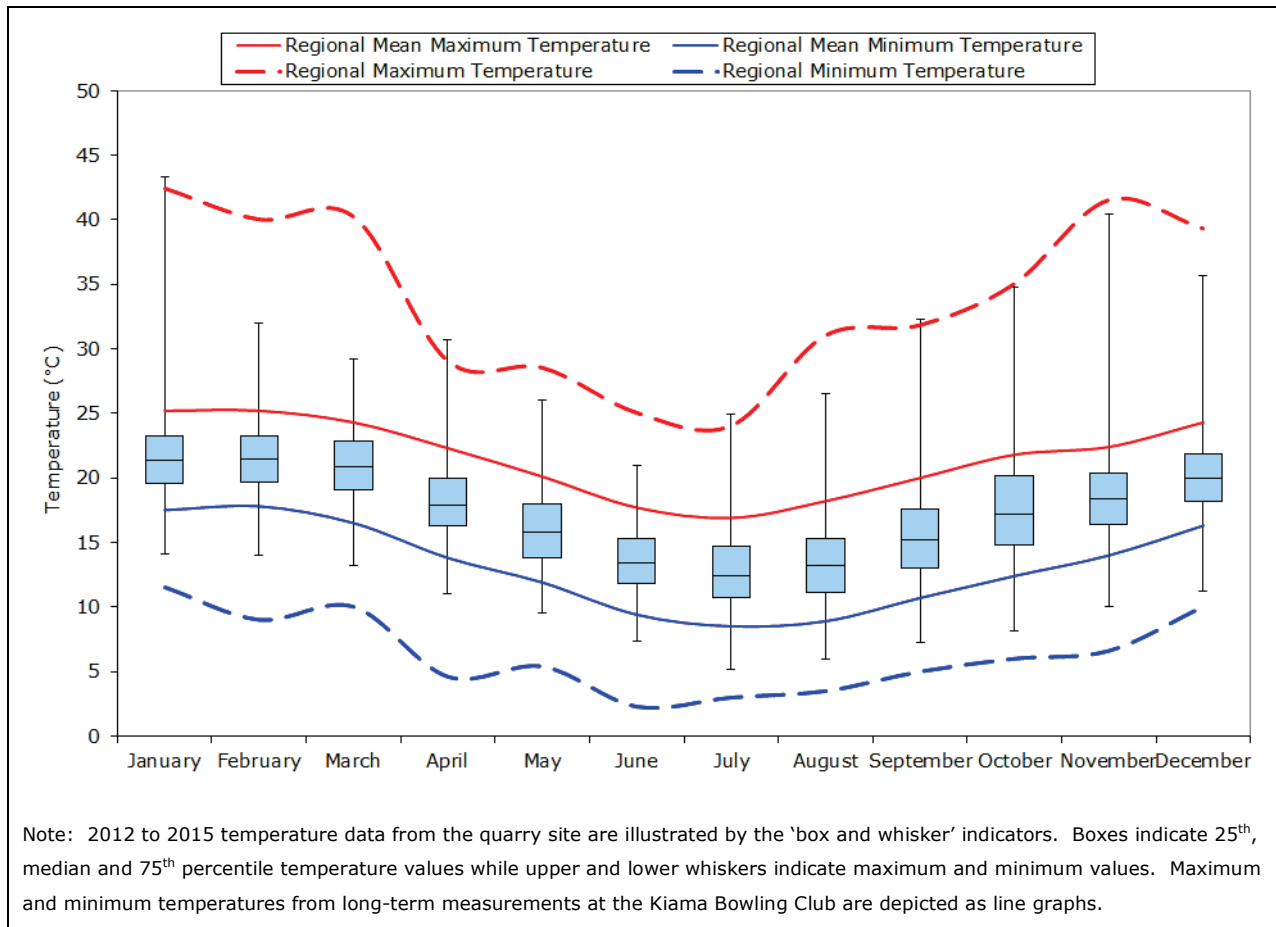


Figure 4-2: Temperature Comparison between Quarry Site 2012 to 2015 dataset and historical averages (1981 -2002) – Kiama Bowling Club BoM

5. EXISTING AIR QUALITY ENVIRONMENT

The quantification of cumulative air pollution concentrations and the assessment of compliance with ambient air quality limits necessitate the characterisation of baseline air quality. Given that particulate matter emissions represent the primary pollutant of concern generated by the proposed construction of the bund, it is pertinent that existing sources and ambient air pollutant concentrations of these pollutants are considered.

5.1 Existing Local Sources of Atmospheric Emissions

The National Pollutant Inventory (NPI) database identifies nine reporting sources of air pollution emissions in the surrounding 10km from the quarry site, in addition to the quarry, with the industrial activities listed in **Table 5-1** reported to contribute emissions of particulate matter to the local environment.

Table 5-1 Neighbouring air pollution emission sources – NPI database		
Industry Name	Location	Activities
Albion Park Quarry, Holcim Australia	Albion Park	Extractive Industries - quarrying
Bass Point Quarry, Hanson	Shellharbour	Extractive Industries - quarrying
Tallawarra Power Station, EnergyAustralia	Yallah	Electricity Generation
Shellharbour Sewage Treatment System, Sydney Water	Shellharbour	Secondary biological sewage treatment with chlorine disinfection
Bombo Quarry, Sydney Trains	Bombo	Extractive Industries - quarrying
Albion Park Quarry, Cleary Brothers	Albion Park	Extractive Industries - quarrying

In addition to NPI reporting facilities, a review of the NSW EPA environment protection licence register identifies that, in addition to the sources in **Table 5-1**, the surrounding 10km area also contains the Cleary Bros (Bombo) Albion Park Quarry and several small waste depot/materials recycling facilities.

Other sources that contribute to particulate matter emissions in the vicinity of the quarry site include:

- Dust entrainment and tyre and break wear due to vehicle movements along public roads;
- Petrol and diesel emission from vehicle movements along public roads;
- Regional industrial emission sources to the north in the Port Kembla area;
- Agricultural practices;
- Wind generated dust from exposed areas within the surrounding region;
- Seasonal emissions from household wood burning fires;
- Sea salts contained in sea breezes.

More remote sources which contribute episodically to suspended particulates in the region include dust storms and bushfires. Whereas dust storms predominately contribute primary particulates from mechanical attrition, bushfires are a source of fine particulates including both primary particulates and secondary particulates formed by atmospheric gas to particle conversion processes.

5.2 Ambient PM₁₀ concentrations

Boral records PM₁₀ concentrations by high volume air sampler at the quarry site. Data is collected on a one-in-six day cycle. Data recorded between 2010 and 2015 have been analysed to understand and describe existing baseline PM₁₀ concentrations in the area surrounding the quarry.

In addition to the onsite PM₁₀ monitoring data, PM₁₀ concentrations recorded by the NSW Office of Environment and Heritage (OEH) Albion Park South air quality monitoring station (located 3.5km to the northwest) have been collected and analysed for the period between 2010 and 2015.

The daily varying (24-hour average) PM₁₀ concentrations recorded at the two monitoring stations are between 2010 and 2015 are illustrated in **Figure 5-1**. It can be seen that the recorded 24-hour average PM₁₀ concentrations fluctuate throughout the period presented, with a defined increased period during the months between October and March evident at both sites across each year of data. It is considered likely that the increase in concentrations between spring and summer is due largely to the influence of sea salt, given the incidence of north-easterly airflow during those months (see **Section 4.1**).

Exceedances of the NSW EPA criteria for 24-hour PM₁₀ occurred only on three days in 2011 and 2013 at the OEH Albion Park South station dataset. These exceedances are attributable to regional bushfire events. No exceedances were recorded at the quarry site, although it is noted that the HVAS only samples every sixth day.

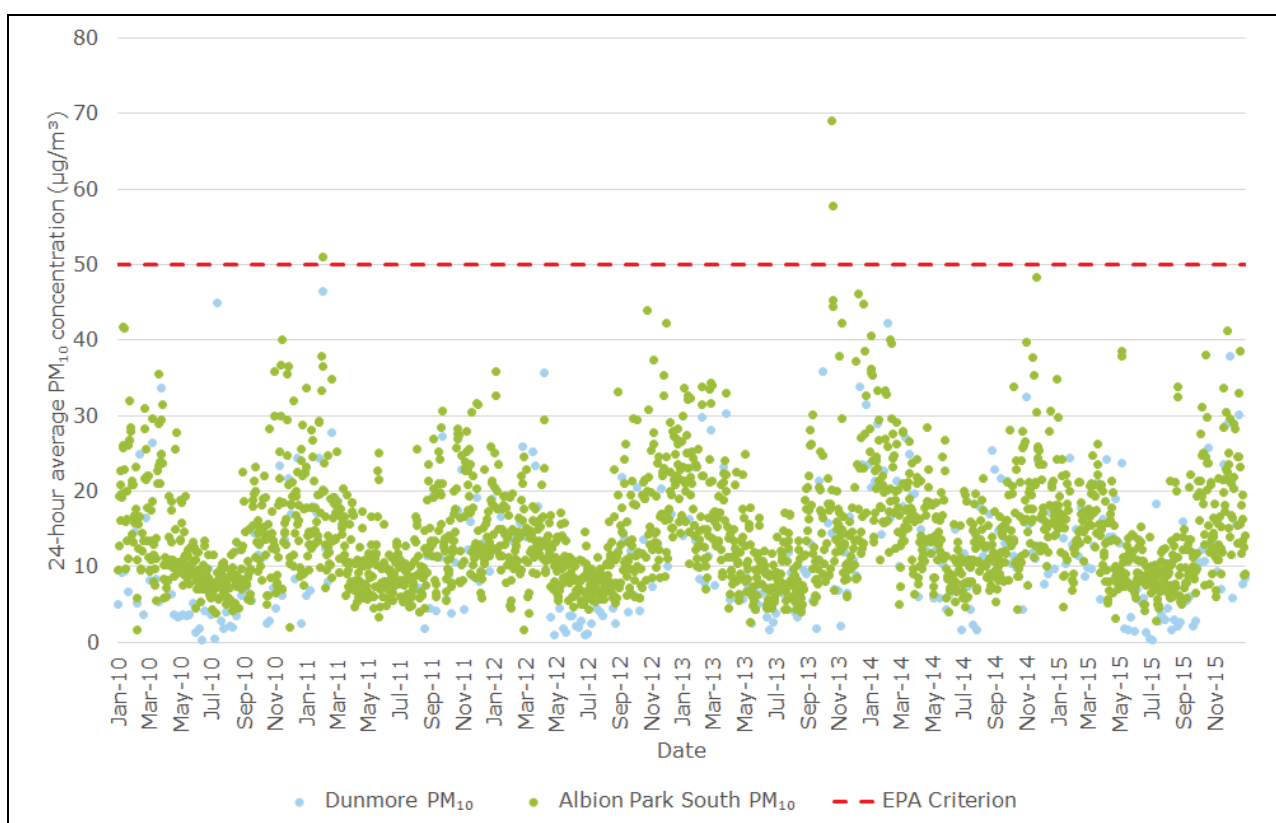


Figure 5-1: Time-series of 24-hour average PM₁₀ concentrations – Quarry Site and OEH Albion Park South – 2010 to 2015

Annual average PM₁₀ concentrations recorded at the quarry site and OEH Albion Park South locations are presented in **Figure 5-2**. It can be seen that the OEH station typically records higher concentrations than the quarry site station, likely attributable to the siting of that station in an urban developed area. Annual average concentrations at both locations are below the NSW EPA criterion for all years between 2010 and 2015. The average concentration across all years at

the two locations between 2010 and 2015 was $13.1 \mu\text{g}/\text{m}^3$ which is less than half of the NSW EPA criterion of $30 \mu\text{g}/\text{m}^3$.

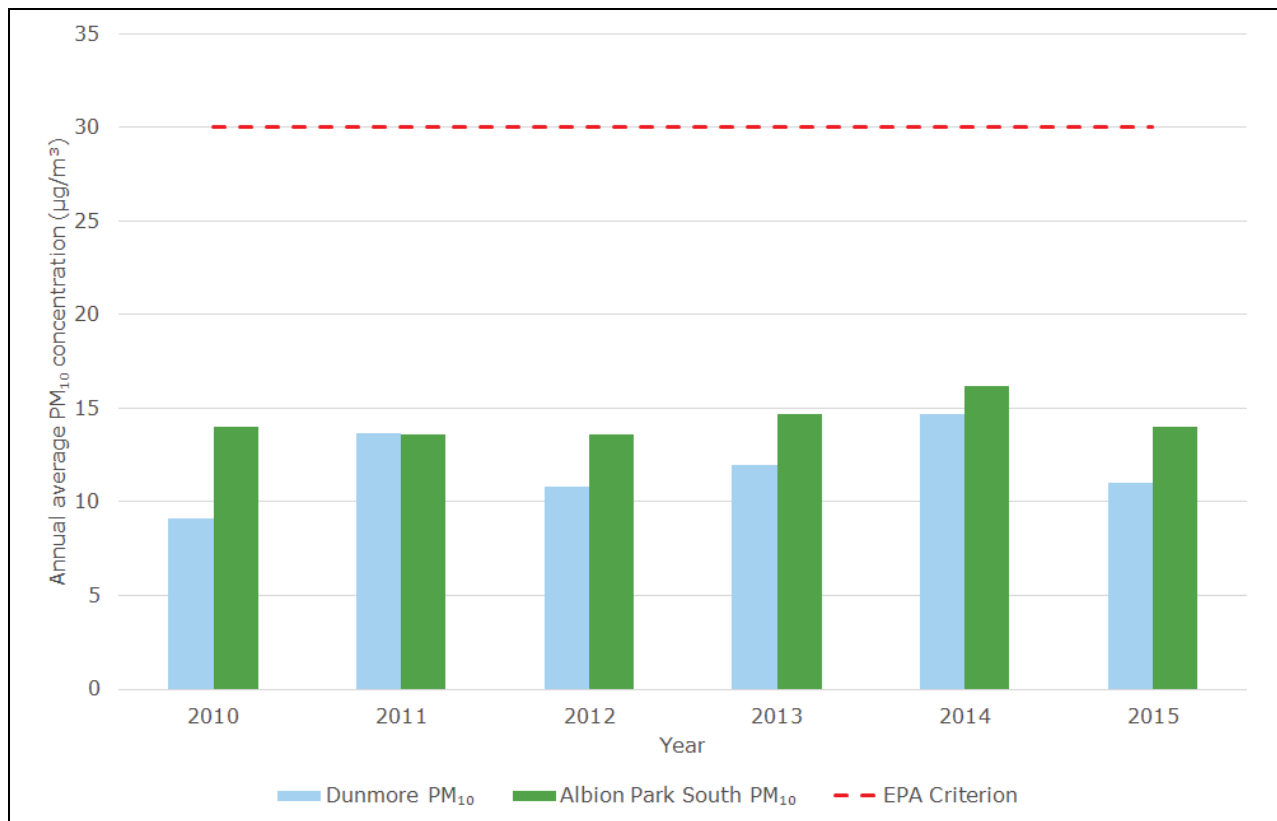


Figure 5-2: Annual average PM₁₀ concentrations – Quarry Site and OEH Albion Park South – 2010 to 2015

6. ASSESSMENT METHODOLOGY

In order to assess the air quality impact potential of the proposed bund construction activities, a qualitative impact assessment has been undertaken. While no specific methodology for such an assessment is available in Australia, the United Kingdom-based Institute of Air Quality Management (IAQM) has prepared the *Guidance on the Assessment of Dust from Demolition and Construction* (hereafter GADDC, IAQM 2014). The GADDC has been applied for construction projects in NSW and provides a progressive approach to assessing the particulate matter impact risk associated with construction and demolition projects.

The key steps to the GADDC approach to assessing air quality risks construction and demolition projects are as follows:

- **STEP 1** – screen requirement for a more detailed assessment based on proximity of surrounding receptors;
- **STEP 2** – assess the risk of dust impacts from demolition, earthworks, construction and truck movements and the sensitivity of surrounding receptors;
- **STEP 3** – determine the site-specific mitigation for each of the four potential activities in STEP 2;
- **STEP 4** – examine the residual effects and determine significance; and
- **STEP 5** – prepare dust assessment report.

It is noted that there will not be any demolition activities associated with the construction of the proposed bund. It is also noted that the GADDC impacts from truck movements also relates to track-out to public roads. Given that truck movements associated with Modification 8 will be restricted to the bund construction area and existing Quarry pit with no off-site haulage of material, this assessment will focus on all relevant truck movements.

7. CONSTRUCTION DUST ASSESSMENT

The following sections document the construction dust assessment, conducted in accordance with the GADDC as described in **Section 6**.

7.1 STEP 1 – Screen the Need for a Detailed Assessment

Screening criteria for a detailed assessment is presented in Box 1 of Section 6 of the GADDC. The IAQM specify that if a human receptor is located within 350m of the boundary of a site, or within 50m of a route used by construction vehicles beyond 500m from site boundary, then a detailed construction dust assessment should be undertaken.

The closest receptors to the north-west (receptor E) and south-west (receptor A) are located within approximately 350m of the proposed bund footprint. Consequently, the proposed construction activities trigger the criteria to undertake a more detailed construction dust assessment. This detailed construction assessment is presented in the following sections.

Notwithstanding the above, it should be noted that receptor E is a Boral owned property and Boral is currently in the process of purchasing receptor A.

7.2 STEP 2 – Assess the Risk of Dust Impacts

The GADDC identifies that the risk category for dust impacts from construction and demolition activities should be allocated based on the following factors:

- The scale and nature of works (STEP 2A); and
- The sensitivity of the area to dust impacts (STEP 2B).

These factors are then combined to determine the risk of impacts from the works (STEP 2C). The risk rating process is addressed in the following sections.

7.2.1 STEP 2A – Scale and Nature of Works

Section 7.2 of the GADDC requires that in allocating dust impact risk, the scale and nature of the following components are to be determined:

- Demolition;
- Earthworks;
- Construction; and
- Truck movements.

The GADDC prescribes a range of criteria that classify the magnitude of each activity as either large, medium or small. The GADDC notes that not all criteria need to be satisfied to meet a certain classification. For this assessment, where more than one magnitude rating could be applied, the highest magnitude classification has been selected for conservatism. Based on the proposed activities at site, the following magnitude ratings, and the rationale behind the classification, are applied:

- Demolition – **SMALL** – no demolition activities are proposed for Modification 8 activities;
- Earthworks – **LARGE** – total site area greater than 10,000m², potentially dusty soil type, more than 100,000t of material to be excavated;
- Construction; – **SMALL** – beyond the construction of the bund (addressed in the Earthworks category) no demolition activities are proposed for Modification 8 activities;
- Truck movements – **LARGE** – approximately 50 haul truck loads movements in a single day, unpaved road length greater than 100m, potentially dusty surface material.

7.2.2 STEP 2B – Sensitivity of the Surrounding Environment

Section 7.3 of the GADDC details approach to categorise the sensitivity of the surrounding environment reviewing the following factors:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- Local ambient PM₁₀ concentrations and likelihood of impact to human health; and

- Site specific factors to reduce wind-blown dust.

Based on the classification definitions presented within Section 7.3 of the GADDC, the following sensitivity ratings have been applied:

- Sensitivity of people to dust soiling effects - **HIGH**;
- Sensitivity of people to health effects of PM₁₀ – **HIGH**; and
- Sensitivity of surrounding flora and fauna communities – **LOW**.

The above receptor sensitivity classifications are then combined with the number of receptors, background PM₁₀ concentration (with regard to human health) and distance from source to classify the sensitivity of the surrounding environment. The specific influencing factors are as follows:

- The number of receptors within the surrounding environment is within the 10-100 category of the GADDC;
- As detailed in **Section 7.1**, two receptors are located within 350m of the proposed bund footprint; and
- As detailed in **Section 5.2**, the annual mean PM₁₀ concentration for the area is taken to be 13.1 µg/m³.

After combining the above receptor sensitivity classifications with these influencing factors and comparing with the relevant rating tables in the GADDC (Table 2, Table 3 and Table 4), the sensitivity classification of the surrounding environment is as follows:

- Sensitivity of area to dust soiling effects on people and property - **LOW**;
- Sensitivity of area to human health effects – **LOW**;
- Sensitivity of area to ecological effects – **LOW**.

7.2.3 STEP 2C – Define the Risk of Dust Impacts

To determine the risk of impacts with no mitigation applied, Section 7.4 of the GADDC requires that the dust magnitude rating (**Section 7.2.1**) is combined with the sensitivity of the surrounding area (**Section 7.2.2**) for each of the four activity categories (demolition, earthworks, construction and truck movements).

Table 7-1 presents the risk rating for the proposed bund construction activities.

Table 7-1 Dust Impact Risk Rating				
Potential impact (sensitivity to impact)	Construction activity (impact risk magnitude)			
	Demolition (Small)	Earthworks (Large)	Construction (Small)	Truck movements (Large)
Dust Soiling (Low)	Negligible	Low	Negligible	Low
Human Health (Low)	Negligible	Low	Negligible	Low
Ecological (Low)	Negligible	Low	Negligible	Low

It can be seen from the results presented in **Table 7-1** that uncontrolled dust emissions from the proposed bund construction are negligible to low for all activity classifications.

The GADDC presents a range of recommended mitigation measures based on the risk rating derived from the dust impact risk assessment approach. These measures are listed in **Section 8**.

8. MITIGATION MEASURES

Boral propose to manage potential dust emissions through the proposed bund construction period through the implementation of water sprays to unpaved transport routes and exposed surfaces wherever practicable. Completed parts of the bund construction will immediately be covered with erosion matting and be rehabilitated with a range of locally sourced and propagated native species, including Illawarra Zieria (*Zieria granulata*).

In addition, it is recommended that the following measures should be implemented to mitigate the potential impacts identified in **Section 7**.

The implementation of these measures would result in the dust impact risk rating for earthworks and truck movements (as described in **Section 7.2.3**) to reduce from **low** to **negligible**.

- Maintain a log book during construction
- Record all dust and air quality complaints in the log book, identifying cause(s) and appropriate measures taken to reduce emissions;
- Record any exceptional incidents that cause dust and/or air emissions, either on or off site, and the action taken to resolve the situation in the log book;
- Carry out regular site inspections, record inspection results, and make the log book available to the local authority when asked;
- Impose a maximum-speed-limit of 20 km/h on all internal roads and work areas;
- Ensure proper maintenance and tuning of all equipment engines;
- Provide an adequate water supply on the construction site for effective dust/particulate matter suppression/mitigation; and
- Minimise drop heights from loading or handling equipment.

9. CONCLUSION

This air quality impact assessment has been prepared by Ramboll Environ to support the application for the proposed modification (Modification 8) to the existing development consent for the quarry to allow for the construction of a bund around the perimeter of the proposed Croome Farm West Pit which will be the subject of Modification 9.

The air quality assessment approach is a qualitative approach that allocates a dust impact risk rating for demolition, earthworks, construction and truck movement emissions based on the likely magnitude of proposed activities, proximity of surrounding receptors and sensitivity of the surrounding environment to dust impacts.

The risk rating completed for the proposed modification assigned a low risk rating for dust impacts from uncontrolled emissions from related earthwork activities and truck movements for the closest sensitive receptors. The proposed modification will not involve construction (other than the bund construction) and demolition activities and therefore the risk rating was negligible.

Following the risk rating analysis of uncontrolled emissions, it is considered that through the implementation of a number of recommended dust mitigation and management measures, the risk rating of emissions from earthworks and truck movements can be effectively minimised.

Analysis of locally collected air quality monitoring data shows that concentrations of PM_{10} , considered the critical compliance pollutant for the proposed construction activities, are well below the applicable NSW EPA assessment criteria for 24-hour and annual averaging periods. The risk rating derived for the construction activities (negligible to low) indicates that the proposed activities would not likely result in a significant change to ambient particulate matter concentrations.

10. GLOSSARY OF KEY ACRONYMS AND SYMBOLS

Approved Methods for Modelling of Air Pollutants in NSW	Approved Methods for the Modelling and Assessment
BoM	Australian Bureau of Meteorology
Boral	Boral Resources (NSW) Pty Ltd
CO	Carbon monoxide
DEC	NSW Department of the Environment and Conservation
EMM	EMM Consulting
GADDC	Guidance on the Assessment of Dust from Demolition and Construction
IAQM	Institute of Air Quality Management
µg	Microgram (g x 10 ⁻⁶)
µm	Micrometre or micron (metre x 10 ⁻⁶)
m ³	Cubic metre
NO _x	Oxides of nitrogen
NPI	National Pollutant Inventory
NSW EPA	NSW Environment Protection Authority
OEH	Office of Environment and Heritage
PM ₁₀	Particulate matter less than 10 microns in aerodynamic diameter
PM _{2.5}	Particulate matter less than 2.5 microns in aerodynamic diameter
The quarry	Dunmore Hard Rock Quarry
Ramboll Environ	Ramboll Environ Australia Pty Ltd
SO ₂	Sulphur dioxide
tpa	Tonnes per annum
TSP	Total Suspended Particulate
VOC	Volatile Organic Compounds

11. REFERENCES

Boral (2016). Air quality and meteorological monitoring data from the Dunmore Quarry monitoring equipment.

Bureau of Meteorology (2016). Climate statistics from the Kiama Bowling Club climate station.

IAQM (2014). Guidance on the assessment of dust from demolition and construction.

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

NSW OEH (2016), Air quality monitoring data from the Albion Park South monitoring station.

APPENDIX1

SEASONAL AND DIURNAL WIND ROSES – DUNMORE QUARRY

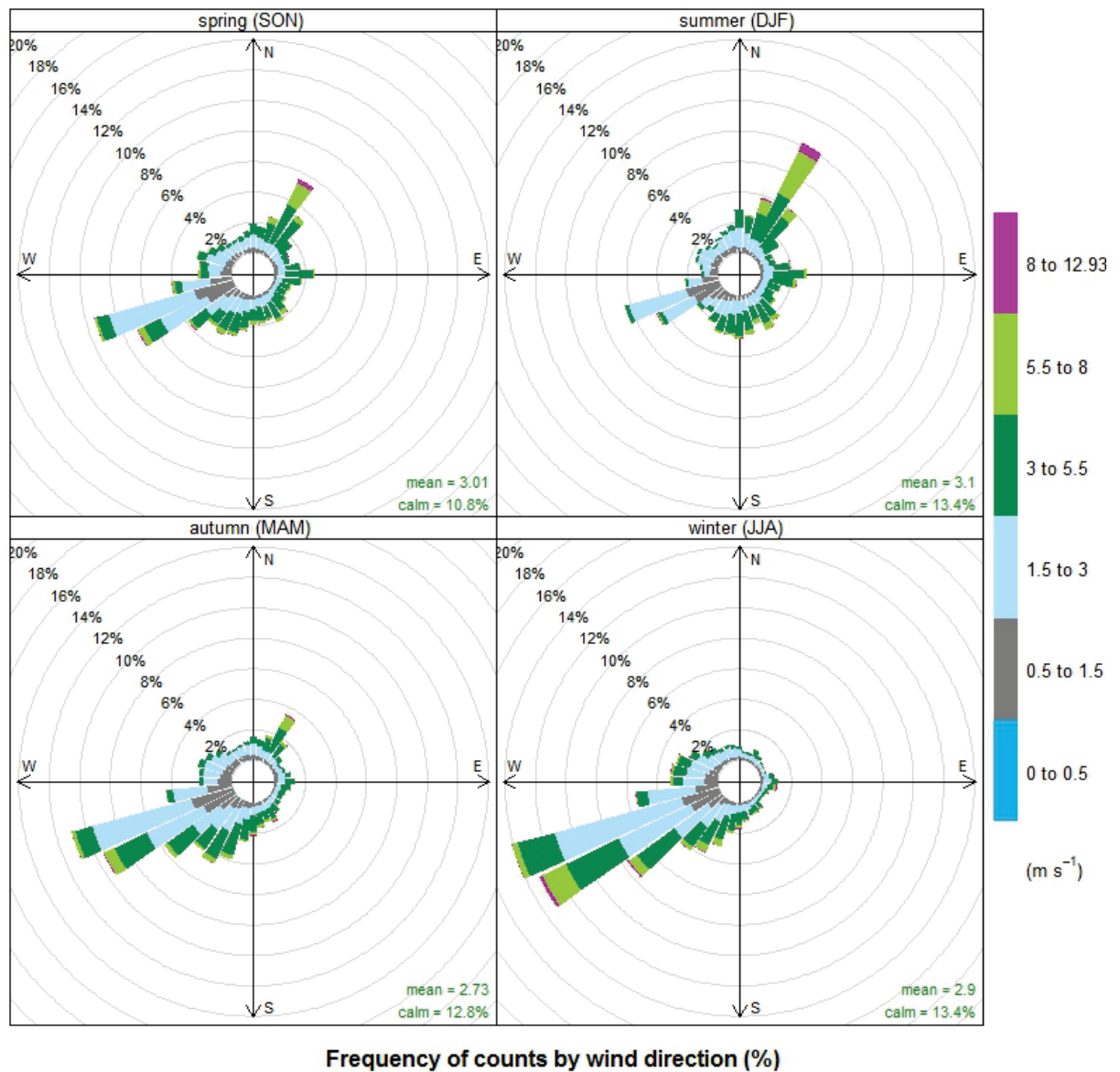


Figure A1-1: Seasonal wind roses – Dunmore Quarry–2012 to 2015

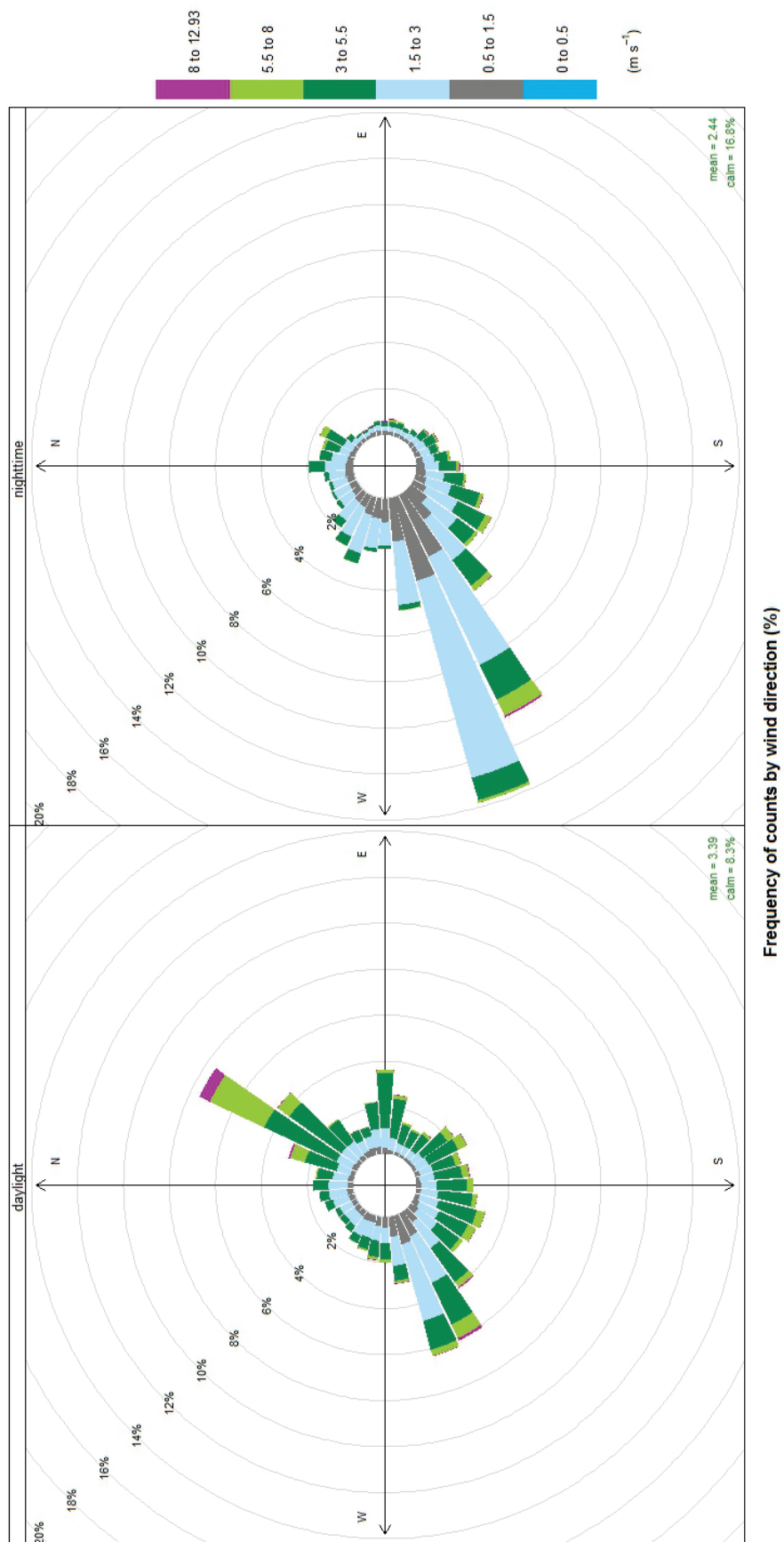


Figure A1-2: Diurnal wind roses – Dunmore Quarry–2012 to 2015

Appendix C

Noise Assessment

Noise Assessment

Dunmore Hard Rock Quarry Modification 8

Prepared for Boral Resources (NSW) Pty Limited | 19 July 2016



Noise Assessment

Dunmore Hard Rock Quarry
Modification 8

Prepared for Boral Resources (NSW) Pty Limited | 19 July 2016

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Noise Assessment

Final

Report J16050RP1 | Prepared for Boral Resources (NSW) Pty Limited | 19 July 2016

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Signature



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Date 19 July 2016

Date 19 July 2016

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1 Introduction

Dunmore Hard Rock Quarry (the quarry) is at 38 Tabbita Road, Dunmore in Shellharbour local government area and is owned and operated by Boral Resources (NSW) Pty Limited (Boral).

This noise assessment has been prepared as part of an environmental assessment (EA) that will accompany a modification application to the existing development consent for the quarry (Development Consent 470-11-2003) originally approved in September 2004 and subsequently modified seven times. This modification application is Modification 8 and is referred to in this noise assessment as 'the proposed modification'.

It is proposed to extract overburden in a section of the approved Croome Farm Pit extraction area to enable extraction of approved resource under the overburden. The extracted overburden will be used to construct a noise and visual bund around part of the future Croome Farm Pit extension area ('Croome Farm West Pit'), which will be subject to a subsequent modification application, namely Modification 9.

This noise assessment has been completed with reference to the following guidelines and policies:

- the *NSW Industrial Noise Policy* (EPA 2000) (INP); and
- the *Interim Construction Noise Guideline* (EPA 2009) (ICNG).

1.1 Glossary of acoustics terms

A number of technical terms are required for the discussion of noise. These are explained in Table 1.1.

Table 1.1 Glossary of acoustic terms

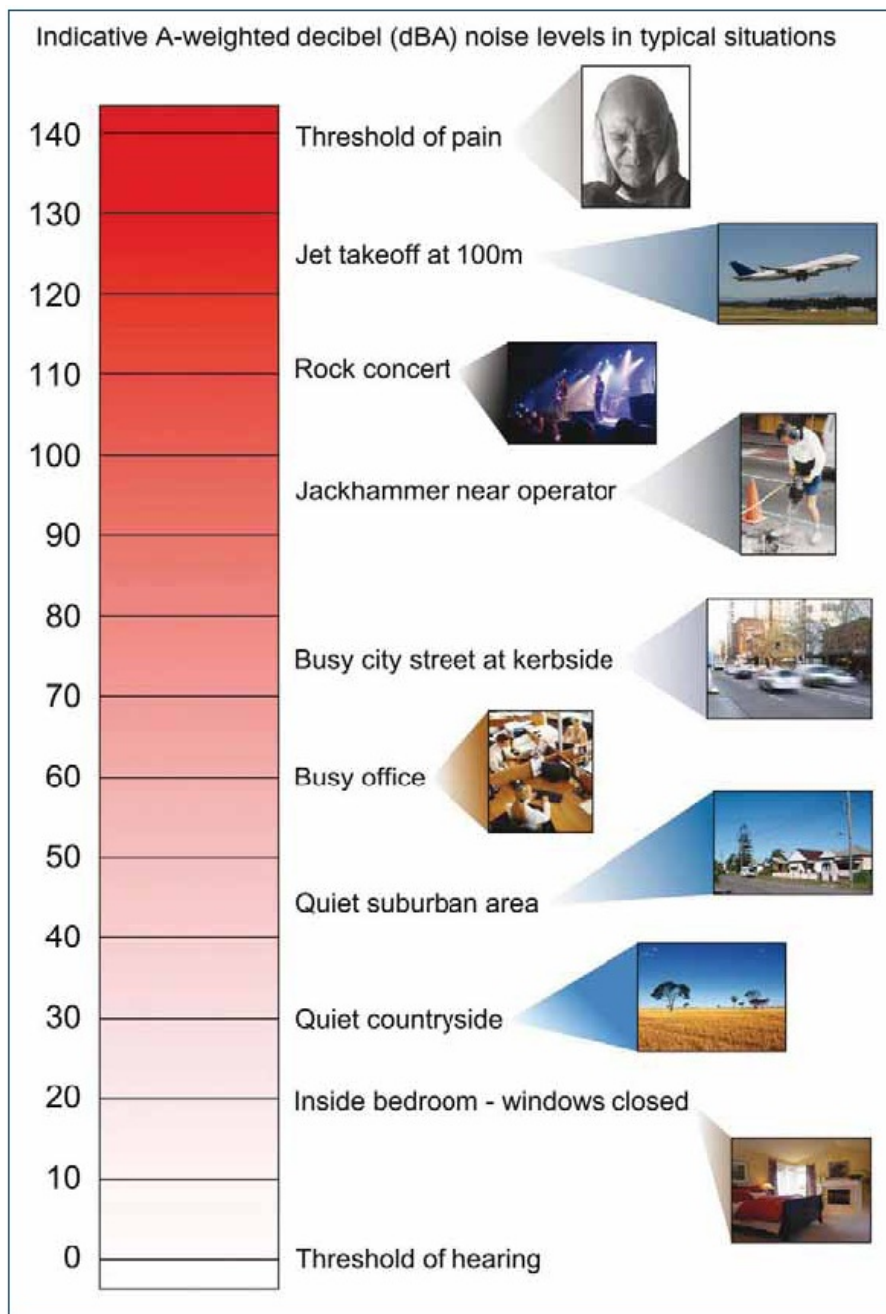
Term	Description
dB	Noise is measured in units called decibels (dB).
A-weighting	There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L_{A1}	The A-weighted noise level exceeded for 1% of a measurement period.
L_{A10}	The A-weighted noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise levels.
L_{A90}	Commonly referred to as the background noise, this is the A-weighted level exceeded 90% of the time.
L_{Aeq}	The A-weighted energy average noise from a source, and is the equivalent continuous sound pressure level over a given period. The $L_{eq(15min)}$ descriptor refers to an L_{eq} noise level measured over a 15-minute period.
L_{Amax}	The maximum root mean squared A-weighted sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period.
Sound power level	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A positive temperature gradient. A meteorological condition where atmospheric temperature increases with altitude.

It is useful to have an appreciation of decibels, the unit of noise measurement. Table 1.2 gives an indication as to what an average person perceives about changes in noise levels:

Table 1.2 **Perceived change in noise**

Change in sound level (dB)	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud

Examples of common noise levels are provided in Figure 1.1.



Source: NSW Road Noise Policy (DECCW 2011).

Figure 1.1 Common sources of noise with levels

2 Project overview

It is estimated that approved rock reserves at the quarry will be exhausted by February 2017. Boral will be seeking to lodge a further application to modify the development consent – Modification 9 – in mid to late 2016 for an extension to the existing Croome Farm Pit ('Croome Farm West Pit'). To enable continuation of the current operations until Modification 9 is approved, it is proposed to extract an area of approved resource within the southern corner of the Croome Farm Pit extraction area. Approximately 130,000 m³ of overburden (64,800 m³ free dig material and 62,200 m³ of weathered hard rock) is located in this area. To avoid double handling and to provide pre-emptive noise and visual management, the extracted overburden will be used to construct a bund along the proposed boundary of the future Croome Farm West Pit (see Figure 3.1).

The bund will be constructed on Boral owned land to the west of the Croome Farm Pit. The bund will be 1,800 m long with a height of around 5 m. The bund base width will vary between 24 m and 41 m. A further 3 m wide buffer will be maintained around the perimeter of the bund for the provision of sediment and erosion control measures and light vehicle access. Approximately 1.94 hectares of predominantly planted native vegetation will be cleared for construction of the bund and for a 30 m wide truck and machinery construction access route from the pit to the bund. The bund will be immediately be covered with erosion matting and rehabilitated with a range of locally sourced and propagated native species, including Illawarra Zieria (*Zieria granulata*). It is estimated it will take up to eight weeks to construct the bund during normal construction hours.

The proposed modification also includes some minor administrative amendments to the conditions of consent to remove redundant conditions and to reflect contemporary management practices at the quarry.

3 Existing environment

3.1 Assessment locations

The closest privately owned residential properties are approximately 800 m to the west and 900 m to the south of the quarry. The closest surrounding land uses are industrial and rural. There are a number of other quarrying operations in the local area including Holcim's Albion Park Quarry, Cleary Brothers' Albion Park Quarry, and Hanson's Bass Point Quarry. Other industrial land uses proximate to the quarry include Dunmore Sand and Soil (owned and operated by Boral), Dunmore Resources and Recycling, Integral energy, and Dunmore Waste Depot.

Assessment locations to the east of the quarry are closer to the Princes Highway and are more residential. The nearest assessment locations to the proposed modification area of the quarry are provided in Table 3.1. They are also shown in Figure 3.1.

Table 3.1 **Assessment locations**

Reference ID	Description	Ownership status	Easting	Northing
A	Boral owned	Tenanted	298737	6168168
B	Boral owned	Tenanted	298098	6167942
C	Boral owned	Tenanted	298173	6168084
D	Privately owned		298183	6169201
E	Boral owned	Tenanted	298513	6169517
F	Privately owned		298285	6169804
G	Privately owned		298176	6169349
H	Boral owned	Tenanted	300340	6167584
I	Boral owned	Dunmore Sand and Soil, tenanted	301331	6167096
J	Privately owned		301505	6167630
K	Privately owned		301395	6167360
L	Boral owned	Dunmore Sand and Soil, tenanted	300747	6168671
M	Other quarry owned	Holcim	300879	6168919
N	Boral owned	Dunmore Sand and Soil, tenanted	301589	6168870
O	Privately owned		301486	6166699
P	Privately owned		300905	6166707
Q	Boral owned	Tenanted	298925	6166759
R	Boral owned	Tenanted	298298	6167363
S	Privately owned		298214	6167335
T	Privately owned		297519	6168261
U	Privately owned		302001	6168472
V	Privately owned		302177	6168691
W	Privately owned		302224	6169262
X	Privately owned		301651	6169245
Y	Boral owned	Tenanted	297557	6167925
Z	Privately owned		298173	6169276
AA	Privately owned		297979	6169974
AB	Privately owned		297587	6170062
AC	Privately owned		297304	6169436
AD	Privately owned		297401	6167717

3.2 Existing ambient and background noise levels

Based on historic assessments and the rural residential nature of the nearest assessment locations, the INP's minimum background noise level of 30 dB(A) was used to represent the ambient and background noise environment for properties potentially affected by the proposed modification. These are properties located to the west, north-west, and south-west of the proposed bund. These properties currently receive little to no noise from the current approved operations. This observation is based on EMM's site visit and attended noise monitoring completed in May 2016.

3.3 Meteorology

3.3.1 INP

Noise propagation over distance can be significantly affected by the prevailing weather conditions. Of most interest are source to receiver winds, the presence of temperature inversions and drainage flow effects, as these conditions can enhance received noise levels. To account for these phenomena, the INP specifies meteorological analysis procedures to determine the prevalent weather conditions.

3.3.2 Prevailing winds

The INP recommends consideration of wind effects if they are a "feature" of the area. The INP defines "feature" as the presence of source to receiver wind direction (measured at 10 m above ground level) occurring for 30% of the time in any assessment period and season.

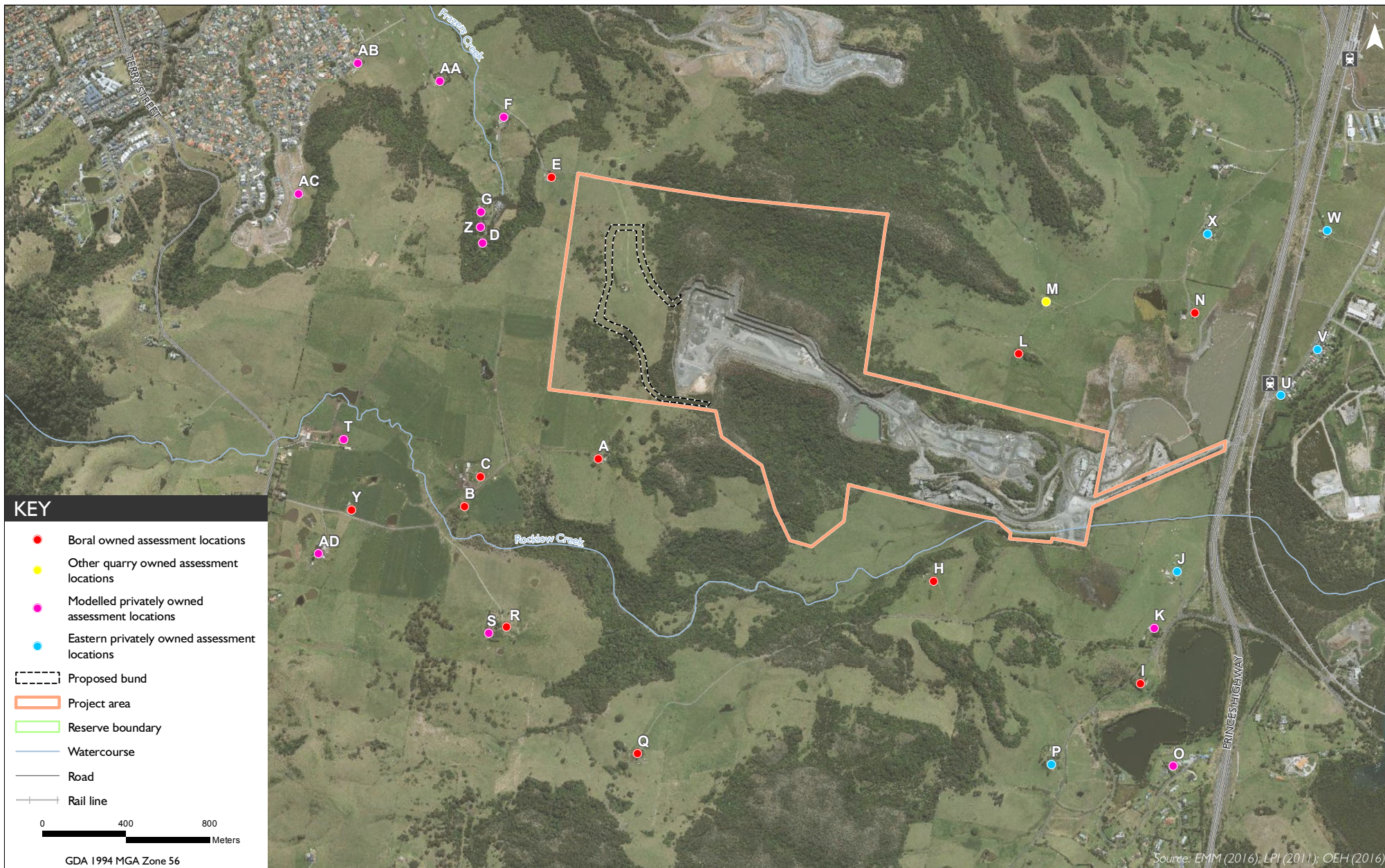
This is further clarified by defining source to receiver wind direction as being the directional component of wind. The INP states that where wind is identified to be a feature of the area then the assessment of noise impacts should consider the highest wind speed at or below 3 m/s, for 'feature' directions.

Meteorological data for the area was obtained from the Bureau of Meteorology automatic weather station (AWS ID 068242) for April 2014 to April 2015 and analysed in accordance with INP methodologies.

It is understood that the construction of the proposed bund would generally occur during standard daytime hours (7 am-6 pm). The analysis showed that, during standard daytime hours, winds of 3 m/s or less are not a 'feature' of the area. The reason for this is a large portion of the wind data was generally above 3 m/s and was, therefore, discarded in accordance with the INP. Nonetheless, for assessment purposes, both calm and worst case winds of up to 3 m/s were modelled.

3.3.3 Temperature inversions

The INP states that the assessment of the impact of temperature inversions be confined to the standard INP night time hours (10 pm-6 am) where temperature inversions are most prevalent. They have not been included in this assessment as it is understood that the construction of the bund would occur during standard daytime hours only.



Assessment locations and proposed bund
Dunmore Quarry Modification 8
Noise Assessment
Figure 3.1

4 Assessment criteria

4.1 Construction noise

4.1.1 Assessment approach

The current government position is to not consider 'construction' scenarios for existing extractive sites on the basis that such activities are similar in character to their operations. However, where it can be justified, construction noise limits may be adopted. For the proposed modification, the construction of the bund is well removed from existing operations and potentially affected assessment locations are generally unaffected by existing operations. Vibration impacts generated by the proposed modification are not considered to be an issue as no additional blasting activities are proposed and existing blasting activities will remain in accordance with current approvals. Ground vibration emitted by plant and machinery are not considered to affect nearby assessment locations given the separation distances between the proponent and these locations. Furthermore, the construction of the bund is primarily for noise mitigation, and activities are limited in duration (ie they are expected to last eight weeks). For these reasons, the ICNG is considered appropriate for the assessment of predicted noise levels from the proposed modification.

4.1.2 Interim Construction Noise Guideline

The ICNG has been jointly developed by NSW Government agencies including the EPA and DP&E. The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (ie assessment locations) as follows:

- Monday to Friday 7 am-6 pm;
- Saturday 8 am-1 pm; and
- no construction work is to take place on Sundays or public holidays.

The proposed modification will adopt the above construction hours and will, therefore, satisfy the ICNG's primary objective. The ICNG's secondary objective is to assess noise against noise management levels to guide feasible and reasonable management and mitigation.

The ICNG provides two methodologies to assess construction noise emissions. The first is a quantitative approach, which is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise management levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

This assessment has adopted a quantitative approach. The qualitative aspects of the assessment include identification of assessment locations, description of works involved and proposed management measures that include a complaints handling procedure.

4.1.3 Noise management level methodology

Table 4.1 is a reproduction of Table 2 from the ICNG. It sets out management levels for noise at assessment locations and how they are to be applied. This process has been adopted for the quantitative construction noise assessment.

Table 4.1 Noise at assessment locations using quantitative assessment

Time of day	Noise management level $L_{eq(15min)}$	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, No work on Sundays or public holidays	Noise-affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. - Where the predicted or measured $L_{eq(15min)}$ is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level; and - The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise-affected level represents the point above which there may be strong community reaction to noise. - Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); and - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise-affected RBL + 5 dB	- A strong justification would typically be required for works outside the recommended standard hours; - The proponent should apply all feasible and reasonable work practices to meet the noise affected level; - Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise-affected level, the proponent should negotiate with the community; and - For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Source: ICNG (EPA, 2009).

4.2 Noise management levels

It is understood that construction of the proposed modification is to be during standard ICNG daytime hours only (7 am–6 pm). Based on Table 4.1 and Section 3.2, the noise management level (NML) that will apply to the potentially most affected assessment locations is a $L_{Aeq(15 min)}$ of 40 dB.

For assessment locations K and O, which both have an existing noise limit (Development Consent Mod 7 2015) of $L_{Aeq(15 min)}$ 49 dB during INP daytime hours, this will be maintained.

5 Noise assessment methodology

5.1 Overview

This section presents the methods and parameters used to model noise emissions from construction of the proposed bund.

Noise modelling was based on three-dimensional digitised ground contours of the surrounding land and the site.

Noise predictions were carried out using Brüel and Kjær Predictor Version 11.00 (Predictor) noise prediction software. Predictor calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. The model considers factors such as:

- the lateral and vertical location of plant;
- source to assessment location distances;
- ground effects;
- atmospheric absorption;
- topography of the quarry and surrounding area; and
- meteorological conditions.

5.2 Assessed meteorological conditions

Table 5.1 provides a summary of the meteorological conditions used in the noise model. All conditions are for standard daytime hours. As noted earlier, the adverse wind does not prevail in the area for more than 30% of the time, but has nonetheless been included in the assessment.

Table 5.1 Modelled meteorological conditions

Meteorological condition	Air temperature °C	Relative humidity (%)	Wind speed (m/s)	Direction degrees from north
Calm	15	70	0	n/a
Adverse (<30%)	15	70	3	All

5.3 Modelled scenarios

The proposed modification plans used for modelling were supplied by Boral. They represent the current topography of the site, including the processing areas and the proposed bund. The noise generated by the existing operations at the processing area was not included in the noise model. This was because assessment locations that were most likely to be impacted by the proposed activities are well removed from the existing operations and it is considered that noise from existing operations would not increase predicted noise levels from the proposed modification.

The construction of the proposed bund is expected to take eight weeks. Stripping and clearing of vegetation will occur at the south-west of the site to create access for the construction of the bund. It is understood that the bund will be built starting from its most south-eastern point and construction will continue until it reaches its most north-eastern point (refer to Figure 3.1). Therefore, the following construction scenarios were modelled:

- Scenario 1: stripping and initial construction of bund, south.
- Scenario 2: construction of bund, west.
- Scenario 3: construction of bund, north.

Noise sources were in the most exposed positions for all scenarios and, therefore, represent worst case noise conditions. Refer to Appendix A for model graphics of each scenario.

5.4 Noise sources

Table 5.2 summarises the noise sources and associated sound power levels that were used in the noise model. The plant sound emission data is based on a combination of Boral supplied data and measurements by EMM at similar operations.

Table 5.2 Plant and equipment quantities and sound power levels

Item	Lw, L _{Aeq} (15 min), dB	Quantity
Bund construction		
Excavator	110	1
Dozer	114	1
Articulated dump truck	110	3
Water cart	110	1
Existing Croome operations		
Crusher and Screen	118	1
FEL	114	1
Excavator	110	1

5.5 Modelled assessment locations

The potentially most affected privately owned assessment locations were modelled, which are those located to the west, south-west and north-west of the site. Other private residences are well east of the proposed modification, and it was considered that noise from the proposed modification would be insignificant compared to the existing site noise at these assessment locations. Assessment locations K and O, which are to the east of the proposed modification, were included in the noise model to demonstrate this. The modelled assessment locations can be seen in Figure 3.1.

6 Noise assessment results

Table 6.1 summarises the predicted noise levels for each of the assessment locations. The scenarios adopt worst case plant locations and, therefore, provide the highest noise levels expected. During other times plant will be located in areas less exposed or further removed from assessment locations. A time versus noise level graph is also presented in Figure 6.1 to demonstrate the expected changes in worst case noise levels for each scenario by assessment location.

The results demonstrate that:

- NML's are predicted to be satisfied at all assessment locations during the stripping and initial bund construction stage (Scenario 1);
- NML's are predicted to be exceeded at assessment locations D, G, Z and AA during the construction of the bund west of the quarry (Scenario 2). This exceedance is expected to last for two to four weeks;
- NML's are predicted to be exceeded at assessment locations D, F, G, Z and AA during the construction of the bund north of the quarry (Scenario 3). This exceedance is expected to last for two to four weeks;
- the largest exceedances are 6-9 dB above NML's for both assessment locations G and Z, and are during the construction of the bund north of the quarry and adverse weather conditions; and
- none of the predicted worst case maximum noise levels exceed the ICNG highly affected noise criterion of 75 dB.

Although NML's are predicted to be exceeded for Scenarios 2 and 3, it is accepted that construction noise levels are constantly varying and impacts are temporary. It is likely that if noise levels exceed the NML at an assessment location it will be for a short period of time (eg two to four weeks). This is emphasised by the fact that predicted noise levels represent worst case scenarios. Further, given the limited duration it is unlikely that assessable adverse winds would prevail for any considerable amount of time. Hence, the presented calm weather results are a more realistic estimate of noise at receivers.

Boral will manage and minimise the potential for construction noise impacts from the site, as discussed in Section 7.

Table 6.1 Predicted noise levels

Assessment location ¹	Criteria, dB		Predicted L _{Aeq} (15 min), dB noise levels								
	(NML)	Highly noise affected	Scenario 1			Scenario 2			Scenario 3		
			Initial bund construction south			Bund construction west			Bund construction north		
			Calm	Adverse ²	Exceedance	Calm	Adverse	Exceedance	Calm	Adverse	Exceedance
D	40	75	35	38	0	41	44	1-4³	40	43	0-3
F	40	75	32	35	0	37	40	0	40	43	0-3
G	40	75	35	38	0	45	48	5-8	46	49	6-9
K	49	75	28	31	0	27	30	0	28	30	0
O	49	75	26	28	0	25	27	0	25	27	0
S	40	75	38	40	0	33	36	0	33	36	0
T	40	75	37	40	0	33	35	0	33	36	0
Z	40	75	35	38	0	41	44	1-4	46	49	6-9
AA	40	75	30	33	0	38	41	0-1	40	43	0-3
AB	40	75	28	31	0	31	34	0	32	35	0
AC	40	75	27	30	0	27	30	0	28	31	0
AD	40	75	35	37	0	30	33	0	32	35	0

Notes: 1. All assessment locations are privately owned.

2. 'Adverse' constitutes 3 m/s winds source to receiver, consistent with the INP's default parameters. They occur less than 30% of the time.

3. Exceedances have been highlighted bold.

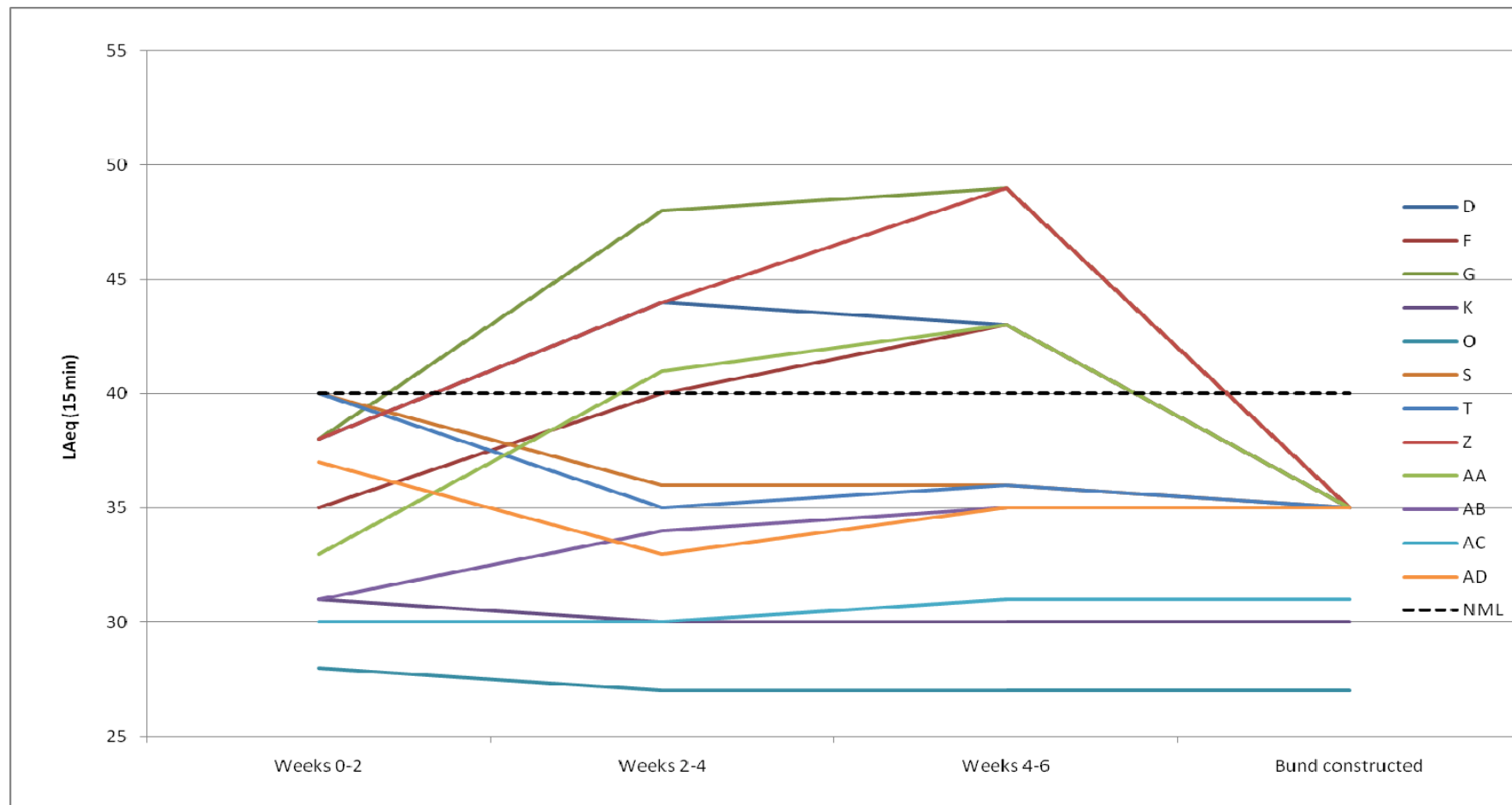


Figure 6.1 Time versus noise level graph

7 Management and mitigation

Construction noise levels can be managed by working behind parts of the noise bund that are already constructed. This would generate much lower noise levels than the predicted noise levels provided in Section 6, as they represent worst case operations that are unprotected by the noise bund. Boral will also manage construction noise from the proposed modification by adopting universal work practices such as:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- developing routes for the delivery of materials and parking of vehicles to minimise noise;
- minimising the need for vehicle reversing for example, by arranging for one-way site traffic routes;
- use of broadband audible reverse alarms on vehicles;
- minimising the movement of materials and plant and unnecessary metal-on-metal contact;
- minimising truck movements; and
- where practical, managing activities during adverse weather conditions (ie source to receiver winds).

8 Conclusion

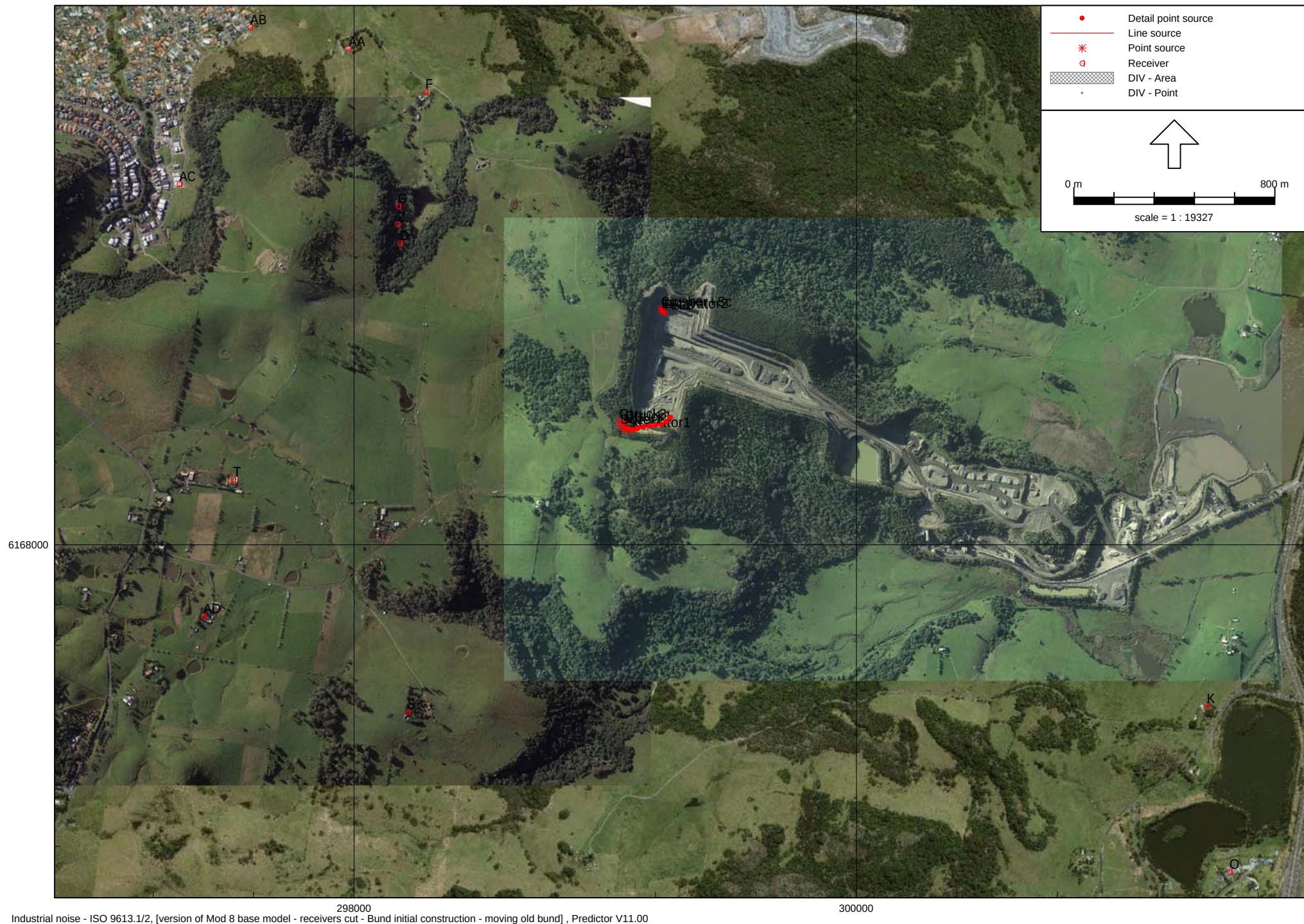
The noise assessment for the proposed modification predicted that NML's at all assessment locations will be satisfied for the initial stages of stripping and constructing the bund (scenario 1).

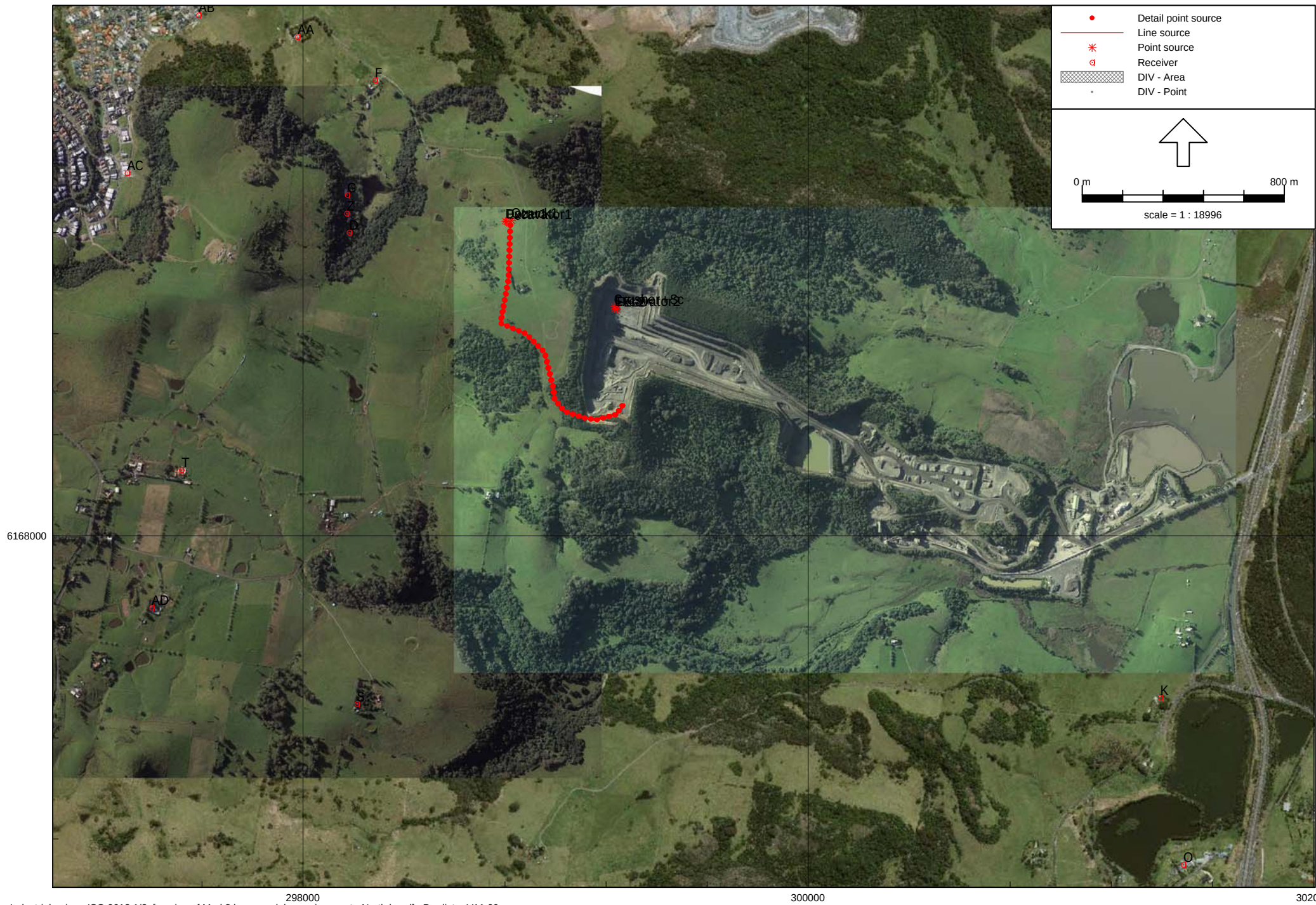
For the construction of the bund towards the west and north (scenarios 2 and 3), NML's were predicted to be exceeded at four and five assessment locations, respectively during adverse weather conditions. None of the maximum noise levels predicted in the noise model exceed the ICNG highly affected noise criterion of 75 dB.

Noise level predictions represent worst case scenarios and impacts are expected to be relatively short-term. Nonetheless, Boral will manage and minimise the potential for construction noise impacts from site, as outlined in Chapter 7.

Appendix A

Noise model prints









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