Australian Government

BUILDING OUR FUTURE

NSW NOW The new state of business

Hornsby Quarry

Road Construction Spoil Management project

Environmental Impact Statement

Volume 3: Appendices G to N

August 2015

Volume 3 – Appendices G to N

(blank page)

Appendix G

Technical working paper: Biodiversity

Hornsby Quarry: Road Construction Spoil Management Project

Technical Working Paper: Biodiversity Assessment Report

Prepared for
Roads and Maritime Services of NSW

28 July 2015

DOCUMENT TRACKING

Item	Detail
Project Name	Hornsby Quarry: Road Construction Spoil management Project - Biodiversity Assessment
Project Number	14SYD_401
Project Manager	Meredith Henderson 02 8536 8671 299 Sussex Street Sydney, NSW 2000
Prepared by	Matthew Dowle, Meredith Henderson, Danielle Adams-Bennett, Lachlan Copeland
Reviewed by	Steven Ward
Approved by	Steven Ward
Status	Final
Version Number	6
Last saved on	28 July 2015

This report should be cited as 'Eco Logical Australia 2015. *Hornsby Quarry: Road Construction Spoil Management Project - Biodiversity Assessment Report*. Prepared for Roads and Maritime Services of NSW.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Roads and Maritime Services of NSW and AECOM.

Contents

List of figures

List of tables

Abbreviations

Abbreviation	Description
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority
DotE	Commonwealth Department of the Environment (formerly SEWPaC)
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DotE)
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FBA	Framework for Biodiversity Assessment
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystem
I&I NSW	Industry and Investment NSW
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPWS	NSW National Parks and Wildlife Service (part of OEH)
NSW Department of Planning and Environment	NSW Department of Planning and Environment, formerly the Department of Planning and Infrastructure
NW Act	*Noxious Weeds Act 1993*
OEH	NSW Office of Environment and Heritage (formerly Department of Environment Climate Change and Water, DECCW)
SEARs	Secretary's Environmental Assessment Requirements
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995*
VIS	Vegetation Information System

Key terminology

Terminology	Description
BioBanking	A methodology developed by Office of Environment and Heritage (OEH) which provides a transparent, consistent and scientifically-based set of rules to assess biodiversity values. The BioBanking Assessment Methodology provides rules for the number and type of credits that can be created from undertaking conservation management at a biobank site. The methodology also provides rules for the number and type of credits that a development site will require in order to offset its impacts and thus improve or maintain biodiversity values. This project has used the Major Projects Offset Policy and Framework for Biodiversity Assessment (FBA) to assess the number and type of biodiversity credits required (see below).
Clearing	The removal of vegetation or other obstacles at or above ground level.
Project footprint	The area directly impacted upon by the project. ‘Project footprint’ is used in this technical working paper as an alternative to ‘subject site’ as defined by DEC (2004). The project footprint includes all components relating to the project including (but not limited to): • All excavations/construction, including ancillary equipment. • All stormwater/sediment control measures. • All access requirements. • All spoil and material storage areas.
Direct impacts	Those that directly affect species, populations or ecological communities and their associated habitats. Direct impacts include, but are not limited to, loss of individuals or ecological communities and removal of suitable habitat.
Earthworks	All works involved in loosening, excavating, placing, shaping and compacting soil or rock.
Framework for Biodiversity Assessment	The Framework for Biodiversity Assessment (FBA) is a tool that is applied by accredited ecological consultants. It provides a step by step method to identify and assess impacts on biodiversity. The FBA provides clear guidance on avoiding and minimising the biodiversity impacts of a project. It also provides an objective and repeatable method for determining offset requirements before a development application is submitted.
Hornsby Quarry	The former Hornsby Quarry at Lot 1 DP 926103 and Lots A, B, C, D and E DP 318676, located around one kilometre north-west of Hornsby central business district. The site that may be used as a site for spoil management for spoil generated from the NorthConnex project. Site infrastructure to support spoil management at the quarry would include a conveyor, truck loading area, spoil disposition mound, access and internal roads.

Terminology	Description
Indirect impacts	Those which occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, hydrological changes, increased soil salinity, erosion, weed invasion, increased noise and/or light, or increased human activity within or directly adjacent to sensitive habitat areas which include sites of known threatened species, endangered ecological communities or features that are potential habitat for threatened species e.g. culverts.
Locality	The locality is defined by a 10 kilometre radius around the study area for the purposes of conducting database search.
M1 Pacific Motorway interchange	The current interchange between the Pacific Highway and the M1 Pacific Motorway at Wahroonga.
Primary habitat	For the purposes of this technical working paper primary habitat for threatened species are those areas or resources that may be used or required by threatened species for breeding or roosting purposes.
SEARs	Secretary's Environmental Assessment Requirements. Requirements and specifications for an environmental assessment prepared by the Secretary of the NSW Department of Planning and Environment under the *Environmental Planning and Assessment Act 1979.*
Secondary habitat	For the purposes of this technical working paper secondary habitat for threatened species are those areas or resources that may be used by threatened species for foraging purposes.
Site establishment works	Preliminary works carried out prior to carrying out of the project, including: • Installation of environmental controls. • Vegetation clearing. • Establishment of construction facilities. • Road works to Bridge Road and internal access tracks. • Initial dewatering of the quarry void. • Construction of the conveyer.
Spoil	Surplus excavated material. which is either Excavated Natural Material (ENM) or Virgin Excavated Natural Material (VENM)
Stockpile	Temporarily stored materials such as soil, sand, gravel and spoil/waste.
Study area	The area of ecological survey investigation for this technical working paper. The study area can be seen in **Figure 1**.
The project	The spoil management facility project, as described in **Section 1.1**.

Executive summary

Roads and Maritime is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project), from the NorthConnex motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney.

The majority of the project takes advantage of previously cleared areas and the Quarry void. Opportunities to further avoid impacts in the design have also been explored, and as a result of investigations for this assessment, the following ecological values have been avoided:

- The majority of Blue Gum High Forest present at the site, which is listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) as a critically endangered ecological community (CEEC)
- Habitat for Varied Sittella, which is listed as vulnerable under the TSC Act

The assessed project footprint covers all the areas required for the project, including excavation, spoil stockpiling and placement, machinery and access roads (where road works are proposed). The assessment utilised both desktop analysis and field assessment, using the Framework for Biodiversity Assessment methodology to assess habitat and condition of ecological communities. Targeted survey was conducted for one threatened flora species. Potential indirect impacts that have been considered include disruptions to ecological connectivity, injury and mortality to flora and fauna, weeds, pathogens, hydrological changes, noise, vibration and light.

The project design and project footprint of the project, as assessed in this technical working paper, represents the preferred design for the project. Sufficient flexibility has been provided in the design to allow for refinement during detailed design, or to minimise environmental impacts, or in response to submissions received during the exhibition of the environmental impact statement. As such, the ecological impacts assessed as part of this technical working paper represent a worst case scenario.

A total of 1.64 hectares of direct impacts on native vegetation associated with the proposed project footprint have been identified (see **Table 11**) comprising:

- 0.06 hectares of Blue Gum High Forest (CEEC TSC Act).
- 0.84 hectares of Sandstone Blackbutt Woodland.
- 0.74 hectares of native regeneration.

Blue Gum High Forest has been identified in the study area. Although these stands satisfy the definition for the CEEC under the TSC Act, none of the patches that would be impacted by the project met the EPBC Act definition which has a narrower definition for condition. The Blue Gum High Forest impacted was in “poor” condition due to exotic species, such as privet and lantana.

A total of 21 hollow bearing trees were present, supporting a total of 44 hollows. No trees had very large hollows of a sufficient size to support breeding and roosting for large forest owls. Up to eight trees with hollows would be removed or lopped, accounting for 12 hollows of a range of sizes that provide potential habitat for threatened microbats and other hollow dependent fauna.

The project has substantially avoided biodiversity impacts by utilising, as much as possible, already disturbed sites and taking advantage of existing tracks. A number of mitigation measures to minimise ecological impacts would be implemented as part of the project in line with Roads and Maritime Biodiversity Guidelines – *Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority 2011). These measures would be detailed in the flora and fauna management plan for the project which includes: site-specific environmental induction; identification of clearing limits and protective fencing; vegetation clearance procedure; pre-clearing surveys; reuse of topsoil and habitat elements; erosion and sediment control; weed management; pathogen management and monitoring.

This Biodiversity Assessment Report assessed the type and quantum of credits as a result of the project using the Framework for Biodiversity Assessment (FBA) methodology to quantify the impacts of the proposal. Due to the small area of Blue Gum High Forest to be impacted, there is a requirement to merge the vegetation zone with the other native vegetation impacted by the project. Therefore these calculations identified the following quantum of offsets for the project:

- Total of 30 ecosystem credits consisting of Sandstone Blackbutt Woodland (PCT 1181 or HN586)
- 33 credits for the endangered population of the Gang-gang Cockatoo in the Hornsby and Ku-ring-gai local government areas.

It is anticipated that where possible offsets would be delivered via BioBanking Agreement(s), which provide for 'in perpetuity' ecological management of the offsets. Other options for delivery of some offsets may be pursued where BioBanking credits cannot be obtained or are not practicable to meet project or conservation objectives. There is a clear commitment to undertake an offset strategy consistent with the offset strategy for the NorthConnex project. This would be prepared to compensate for the loss of native vegetation, endangered ecological communities and threatened species habitat which cannot be avoided or mitigated.

An assessment of the potential impacts on groundwater dependent ecosystems and aquatic habitats concluded there would be no significant impact as a result of filling the quarry void and removing some vegetation. This is because the ground water levels in the void are far lower than the root zone of any of the vegetation to be removed. The water in the void has little value as a 'lake' and is largely disconnected from natural watercourses. There is likely to be no significant impact to aquatic fauna listed under the *Fisheries Management Act 1994*.

Native vegetation, in particular Blue Gum High Forest, that would be potentially impacted by the project does not meet EPBC Act condition criteria. Habitat for some threatened flora and fauna species listed under the EPBC Act would be impacted, but these impacts are expected to be minor in nature and not considered likely to be significant and it is therefore considered that a referral to the Commonwealth Department of the Environment (DotE) is not required.

1 Introduction

1.1 Project background

Roads and Maritime Services (RMS) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project) from the NorthConnex project.

On 13 January 2015 RMS received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for the NorthConnex project identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage. Following design development, the Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during road construction from late 2015.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's Environmental Assessment Requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on biodiversity values. This Biodiversity Assessment Report has been prepared to inform the EIS being prepared for the Hornsby Quarry Road Construction Spoil Management Project.

The SEARS outlined the requirements to assess impacts to biodiversity and specifically stated that:

- an assessment in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995*.(TSC Act)
- This includes a requirement for a Biodiversity Assessment Report and a Biodiversity Offset Strategy.

This report satisfies the requirement to produce a Biodiversity Assessment Report in accordance with the TSC Act. It is noted that Appendix J provides details of how this report meets the layout and requirements of a Biodiversity Assessment Report, as specified in Table 20 (stage 1) and 21 (stage 2) of the Framework for Biodiversity Assessment. The accredited assessor was Dr Steven Ward (accreditation number 0039).

Although not included at this stage, there is a clear commitment from Roads and Maritime to develop an offset strategy consistent with that being implemented for the NorthConnex project.

No additional matters for further consideration were recommended by the NSW Office of Environment and Heritage.

1.2 The project

The Hornsby Quarry site would receive up to1.5 million cubic metres of excavated natural material (ENM) and/ or virgin excavated natural material (VENM) from tunnelling and excavation activities at the approved NorthConnex construction sites. Only ENM and/ or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road and track) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the project area.
- Dewatering of the quarry void (to be undertaken by Hornsby Shire Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.
- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil within the Hornsby Quarry site using dozers and wheel loaders.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.
- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor to a condition resembling pre-commencement condition, as agreed to with Hornsby Shire Council.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete.

1.3 Study area

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The quarry site covers approximately 35 hectares and is owned by Hornsby Shire Council (**Figure 1**). The quarry site comprises a quarry void, internal access roads and a cleared area to the east which is likely to have been used as processing areas when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the quarry site is zoned for public recreation (RE1) under the Hornsby Local Environmental Plan 2013, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for public safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible. The quarry site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and an area to the east which are likely to have been used as processing areas when the quarry was operational. Dense bushland comprising the Berowra Valley National Park occurs directly to the west.

The quarry site is bounded by a Crown Reserve to the south, vegetated area of the Hornsby Rifle Range and the Berowra Valley National Park to the west, residential dwellings to the north and a TAFE campus to the east. The quarry site also includes vegetated areas to the east abutting the urban interface as well as a square pocket which falls inside urban extent. The vegetation surrounding the quarry site would potentially be at the eastern end of a wildlife corridor given its connectedness to the Berowra Valley National Park.

The designated "study area" is a portion or subset of the quarry site (**Figure 1**). It is noted that some ecological investigation works were undertaken within the broader quarry site prior to the study area being nominated. Plot and transect data collected from the broader quarry site which was collected previously has been utilised as it helps to inform the ecological assessment of the works. This data is still relevant to the nominated study area as the vegetation was mapped in a consistent manner.

The project footprint is a portion or subset of the study area (**Figure 2**).. The project footprint has the same meaning as 'development site' in accordance with the FBA.

1.4 Context of Biodiversity Assessment Report

The NSW Government has developed a NSW Biodiversity Offsets Policy for Major Projects, including State Significant Development (SSD) and SSI. As part of an application for a Major Project under the EP&A Act, a proponent must prepare an EIS that addresses the SEARs provided by the NSW Department of Planning and Environment (DP&E).

Under the NSW Biodiversity Offsets Policy for Major Projects, the SEARs require the Framework for Biodiversity Assessment (FBA) to be applied to assess impacts on biodiversity. The FBA outlines the assessment methodology to quantify and describe the biodiversity values on the development site, and the biodiversity offsets required for any unavoidable impacts.

The FBA negates the need to conduct Assessments of Significance (7-part tests) under the NSW *Threatened Species Conservation Act 1995* (TSC Act). However, the FBA requires proponents to identify and assess the impacts on all *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed threatened species and ecological communities that may be on the development site. These have been assessed in **Appendix I** according to EPBC Act impact assessment processes.

The FBA applies only to terrestrial impacts. Section 115ZG of the EP&A Act states that permits under section 201, 205 or 219 of the *Fisheries Management Act 1994* do not apply to State significant infrastructure. These permits relate to dredging work, harm to marine vegetation and blocking of fish passage. However, potential impacts on freshwater aquatic environments and Groundwater Dependent Ecosystems (GDEs) have been considered in this assessment. Hornsby Shire Council also has a licence to extract water from the quarry void, and thus these works would be carried out under that licence.

Figure 1: Location map

Figure 2: Site map

(blank)

2 Methodology

2.1 Background information

A number of database searches, aerial photograph, previous reports and studies were used in this assessment, including:

2.1.1 Assessment Guidelines

The assessment presented in this technical working paper was undertaken in accordance with the survey guidelines specified by the SEARs. Updated versions of the guidelines were used if available and were confirmed with Department of Planning and Environment. These include:

- Policy and guidelines for fish habitat conservation and management (update 2013). This guideline supersedes the Guidelines for Aquatic Habitat Management and Fish Conservation (DPI 2013).
- NSW offset policy for major projects (State significant development and State significant infrastructure) (OEH 2014a).
- NSW Framework for Biodiversity Assessment (OEH 2014b).

2.1.2 Database searches

ELA reviewed aerial photography as well as the following vegetation and soil datasets which overlap within the study area:

- Hornsby Shire Council vegetation mapping (Smith and Smith 2008).
- Western Sydney vegetation mapping (NSW National Parks and Wildlife Service (NPWS 2002).
- Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy 1989).

Mapping for Hornsby local government area (Smith and Smith 2008) provides detailed and recently validated vegetation mapping. However this mapping is primarily limited to areas of intact native vegetation and does not attempt to map fragmented vegetation located within urban areas, such as that which occurs within parts of the study area. Smith and Smith (2008) mapping was used as a primary data set, supplemented by NSW NPWS 2002 mapping. Both of these data sets were combined and then validated and refined in the field.

The following threatened species and predicted species databases were reviewed for the locality:

- OEH Atlas of NSW Wildlife (10 kilometre radius search), accessed 19 March 2015.
- EPBC Act Protected Matters Search Tool (10 kilometre radius search) (DotE 19 March 2015).
- NSW DPI Fisheries threatened and protected species records viewer (Hornsby LGA) (FM Act), accessed 19 March 2015
- NSW DPI Fisheries Key Fish Habitat Map (Hornsby LGA), accessed 19 March 2015

2.1.3 Previous reports

- Former CSR Quarry Hornsby & associated lands (PSM 2007).
- Hornsby Quarry and Environs Land Capability Study and Master Plan, Master Plan Report (Parsons Brinckerhoff 2004).
- Review of Options for Filling Hornsby Quarry, Discussion Paper (GHD 2009).
- Hornsby Quarry Land Filling Preliminary Impact Assessment (Cardno 2013)
- Review of Environmental Factors Old Mans Valley and Hornsby Park Proposed Mountain Bike Trail (Dragonfly Environmental 2011)

- Targeted Surveys for the Varied Sittella and Supplementary s5A Assessments, Proposed Mountain Bike Trail Sire, Old Mans Valley, Hornsby (Aquila Ecological Surveys 2011).

Former CSR quarry Hornsby & associated lands (PSM 2007)

Pells Sullivan Meynink Pty Ltd undertook a geotechnical and hydrogeological constraints analysis to inform development of the Hornsby Quarry.

The findings of the study have identified that the quarry sidewalls are susceptible to instability and therefore limit the development potential of the quarry. Remedial options were proposed to remove the risk posed by the quarry walls, namely:

- Backfilling the quarry with natural material.
- A combination of backfilling the quarry and cutting back (flattening) the upper quarry walls.
- Supporting the walls with a combination of drainage holes, rock bolts, shotcrete, mesh and scaling.

Hornsby Quarry and Environs Land Capability Study (Parsons Brinckerhoff 2004)

Council engaged Parsons Brinckerhoff (PB) to undertake a land capability study and master plan to identify the study area's opportunities and constraints and define its future landuse and management needs.

The study concluded that the area has the capacity to accommodate a mix of land uses that relate sensitively to its context in an urban environment within a natural setting. As the study area is visually and physically disconnected from its adjoining urban environment, new land uses must integrate with its context and provide appropriate access to encourage traffic and pedestrian circulation both to and within the study area.

The study noted that there were a range of constraints including ecological constraints which were confined largely to the Blue Gum High Forest (defined as Glen Forest in the PB report). The Parsons Brinckerhoff (2004) report included a map of ecological constraints and did not provide a vegetation map.

Review of Options for Filling Hornsby Quarry, Discussion Paper (GHD 2009)

GHD undertook a review of two options for the rehabilitation and utilisation of Hornsby Quarry:

- Filling the quarry with non-putrescible solid waste.
- Filling the quarry with Virgin Excavated Natural Material (VENM).

The GHD report did not make a recommendation of either options. However they noted the higher cost of approvals, site preparation, site operation, post closure management and carbon pollution for the non-putrescible solid waste option than the VENM option. The report noted a higher royalty to be paid to the Council with the non-putrescible waste than the VENM option. The royalty figures were redacted in the report reviewed.

Hornsby Quarry Land Filling Preliminary Impact Assessment (Cardno 2013)

Cardno was appointed by Hornsby Shire Council to secure approvals for the filling of Hornsby Quarry. Council requested that Cardno provide a preliminary evaluation of the environmental, social and economic impacts that can be expected during quarry filling.

The report determined that the best way to achieve this outcome is for the site to receive VENM spoil and use this spoil to fill the quarry to approximately reduced level (RL) 90metres Australian Height Datum (AHD).

A flora and fauna evaluation was undertaken which identified Blue Gum Diatreme Forest as being present within the study area. Blue Gum Diatreme Forest is a component of Blue Gum High Forest under the TSC Act.

Review of Environmental Factors Old Mans Valley and Hornsby Park Proposed Mountain Bike Trail (Dragonfly Environmental 2011)

Dragonfly Environmental were engaged by Council to determine whether the proposed construction and use of a mountain bike trail network would significantly impact biodiversity values within the quarry site. Dragonfly relied on the previous ecological constraints mapping conducted by Parsons Brinkerhoff (2004) and the mapping for the Hornsby local government area (Smith and Smith 2008). They concluded no significant impact to the Blue Gum High Forest as a result of the trail construction. They concluded no significant impact for five threatened flora, none of which they found at the site.

Dragonfly conducted assessments for nine threatened fauna. They concluded no significant impact for all of these fauna. One species, Varied Sittella was listed as being present in an area between Quarry Road and the void. This conclusion was based on targeted survey and impact assessment for the Varied Sittella by Aquila Ecological Surveys (2011), which is briefly reviewed below.

Targeted Surveys for the Varied Sittella and Supplementary s5A Assessments, Proposed Mountain Bike Trail Sire, Old Mans Valley, Hornsby (Aquila Ecological Surveys 2011)

Aquila Ecological Surveys was engaged by Council to conduct a targeted survey for the Varied Sittella to determine if it was present in the quarry site. The survey and assessment were carried out to determine if there was a significant impact likely due to the mountain bike trail construction.

Aquila detected the Varied Sittella on one occasion. They found that habitat for this species was limited at the quarry due to the presence of the Noisy Miner. The Noisy Miner is an aggressive species that can outcompete other native forest and woodland birds. They concluded no significant impact was likely as a result of the track construction.

The report found that much of site was suitable foraging habitat for a range of large forest owls. They did not detect any threatened owl species during their surveys. They did not carry out targeted surveys for the range of large forest owls potentially occurring in the study area. Rather Aquila assumed presence based on knowledge of habitat requirements. Aquila noted that the large forest owl species were likely to use the site as part of their foraging territories. They assumed the foraging territory was likely to be in the range of 1000 hectares or more.

2.2 Assessment methodology

The assessment presented in this report paper was undertaken in accordance with the survey guidelines specified by the SEARs, which is outlined in **Section 2.1.1**. In addition, the number of vegetation plot/transects utilised in this assessment meets or exceeds the FBA minimum number of plots required (OEH 2014b).

2.2.1 Field surveys

ELA employed a series of field survey methods to undertake the field assessment of the biodiversity values of the study area. The surveys conducted considered the relevant survey guidelines for various threatened species. In a number of instances data from previous surveys was utilised to build on ecological information to inform this assessment. These are identified in **Section 2.1.3**. If information was not available on whether or not threatened species occurred within the study area, then a precautionary approach was adopted, whereby the presence of the species was assumed. This approach is consistent with the SEARs, FBA, and relevant impact assessment guidelines.

The methods used and rationale behind their selection is described below, with field survey locations shown in **Figure 3**. Assessment of vegetation mapping: verification of vegetation communities occurring within the study area to confirm the presence of natural vegetation communities including presence of threatened ecological communities. Where the study site was not covered by the Smith and Smith (2008) vegetation mapping, other mapping sources were used (NPWS 2002). Once vegetation communities were identified from a combination of floristic surveys and transect traverses, plant community types (PCT) were assigned to vegetation mapping units from the published PCTs for the Hawkesbury Nepean Catchment Management Authority (CMA). This was done by comparing the dominant canopy species recorded through the traverses or floristic surveys, the general description of location, soil type and other attributes as described in the profiles (OEH 2015a) and OEH online VIS classification database (OEH 2015b).

- Vegetation polygons assigned to the 'moderate-good' condition category were also assigned to a sub-condition class of poor, moderate or good:
  - Poor condition vegetation had predominantly exotic species in the mid storey and ground cover layers, with very few native species in any stratum.
  - Moderate condition vegetation had predominantly native species in the mid storey and ground cover layers but had some exotic incursions.
  - Good condition vegetation had very few exotic species in any stratum and were predominantly native and species diverse.
- Biometric plots using the methodology described in the FBA. These plots were undertaken in accordance with the FBA. These plot / transect plots include a 20 metre by 20 metre full floristic plot (described below) and a 20 metre by 50 metre plot identifying number of hollow bearing trees and length of fallen wood. They also include 50 metre transect to collect data on canopy cover, midstorey cover, and ground cover for native and exotic species.
- Floristic surveys as part of the plot / transect survey plots (20 metre by 20 metre quadrats) Where a 20 metre by 20 metre quadrat could not fit into a patch of vegetation, e.g. adjacent to a track, 40 metres by 10 metres quadrats were used. Quadrats of these dimensions were required in poor condition vegetation adjacent to Bridge Road.
- Random meander survey technique (Cropper 1993) for threatened flora species: targeted searches for threatened species potentially occurring in the study area. This technique is used in preference to systematic, plot based surveys when attempting to detect threatened plants. Random meander in suitable habitat is more likely to detect threatened species than plot or transect based survey used in floristic surveys. This technique is considered preferable in terms of searching large areas of potential habitat and generally allows for greater area coverage than a plot based survey.
- Targeted threatened flora survey for *Genoplesium baueri*: Prior to the targeted survey in the study area, *G. baueri* was examined at two known reference sites in the northern Sydney region to confirm their flowering status and to also gain further familiarity with their microhabitat. The two reference sites were approximately ten kilometres from the study area. At both reference sites the plants observed consisted of a combination of plants in full flower, plants that had finished flowering but were still clearly visible, as well as numerous plants in early bud that were 1-2 weeks off flowering. The presence of numerous plants at all flowering stages confirmed that it was an ideal time to be targeting the species in northern Sydney. The species requires about six weeks to flower following heavy rainfall. There were several rainfall events in early to mid-December 2014 that provided suitable rainfall. It is thought that this rain triggered the flowering events at the two nearby reference sites.

On Monday 2 February 2015, Dr Lachlan Copeland and Dr Meredith Henderson spent approximately 12 hours targeting *Genoplesium baueri* at the study area. All areas that were considered potential habitat were searched. Areas that were more likely to contain the orchid were noted on a map for later targeted survey. Areas were ruled out on the basis of presence of dense woody weeds, slope, or incorrect soil type. Areas retained for targeted searches were deemed potential habitat. In the area classified as potential habitat, the two botanists walked a series of parallel transects approximately five metres apart carrying a handheld GPS which recorded the approximate location of the tracks walked. Even within the potential habitat there were still considerable areas that were highly unlikely to support the orchid on a fine-scale. These areas of poor habitat were typically areas with a high concentration of weeds or had a dense ground layer of ferns such as *Calochlaena dubia* (Rainbow Fern). These areas were generally searched more quickly so as to allow a more thorough search effort in the more open areas with suitable microhabitat. All areas thought to have any chance at all to support plants of *Genoplesium baueri* were searched thoroughly at a slow pace to as to allow any plants to be detected. The orchid survey was completed in accordance with the EPBC Act *Draft Threatened Orchid Survey Guidelines* (DotE 2013).

- Opportunistic sightings of fauna: identification of faunal species occurring within the study area. The fauna surveys undertaken by ELA consisted of opportunistic sightings whilst conducting other surveys i.e. targeted flora surveys, random meanders and transects. Evidence of fauna usage was noted, for example diggings, chewed plant cones, scats. No targeted fauna surveys were undertaken.
- Fauna habitat assessments identifying potential habitat for threatened fauna species, including marking of habitat features i.e. rock habitats and foraging substrates, presence of termite mounds. Presence of hollow bearing trees and coarse woody debris were recorded as part of the biometric plots. In the absence of fauna surveys, habitat assessments identify important habitat features that may provide potential habitat for threatened fauna. A hollow bearing tree survey was conducted by AECOM (2014) and additional hollow bearing tree survey was undertaken by ELA as part of surveys performed in 2015.
- Microchiropteran bat survey was performed by two ELA ecologists, Dr Meredith Henderson and Danielle Adams-Bennett, on the 15 and 17 December 2014. The survey involved performing a habitat search which involved traversing the site taking notes on vegetation types, presence of flyways, hollow-bearing trees and any other roosting habitats including any man-made structures that represent potential microchiropteran roosting habitat. Following the habitat survey two Anabat detectors were placed in four separate locations (**Figure 3**) over two separate nights on the 15 and 17 December 2014. Each Anabat device was programmed to begin recording prior to dusk at 1800hr and turn off the following morning at 0600hr. Bat calls were analysed by Danielle Adams-Bennett and reviewed by Alicia Scanlon of ELA who has seven years' experience in the identification of ultrasonic echolocation recordings, using the program AnalookW (Version 3.8 25 October 2012, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW. Available: (http://www.forest.nsw.gov.au/research/bats/default.asp).
- Aquatic assessment was limited to freshwater fish (finfish and aquatic invertebrates) as defined in the FM Act. It did not assess the potential impacts to downstream environments due to discharging of water during dewatering (which commenced in 2013), which occurs under Council's existing licence. The databases and published material (**Section 2.1**) were reviewed to identify important habitat and threatened aquatic fauna that may occur in the greater catchment.

2.2.2 Survey effort

The survey effort was focused according to the vegetation communities and potential habitat for threatened flora and fauna species within the study area. A summary of the field survey effort for each survey method is provided in **Table 1**.

All surveys were diurnal surveys, except for the Anabat survey, and were conducted over five days, two days in December 2013, two days in December 2014 and one day in February 2015. The AECOM HBT survey was conducted in December 2013,over two days.. Weather conditions were warm to hot for all survey periods. No significant rainfall was experienced during the survey period but significant rainfall fell prior to the December 2014 and February 2015 surveys.

Table 1: Summary of survey effort

Method	Person hours	Dates	Time of day	Weather
Floristic surveys	16	13 and 20 December 2013 15 and 17 December 2014	Morning and afternoon	Warm to hot and humid Warm to hot and humid
Biometric plots	20	20 December 2013 15 and 17 December 2014	Morning and afternoon	Warm to hot and humid Warm to hot and humid
Fauna habitat assessment	4*	13 and 20 December 2013 15 December 2014	Morning and afternoon	Warm to hot and humid Warm to hot and humid
Targeted flora survey for *G. baueri*	12	2 February 2015	Morning to early afternoon	Warm and humid
Anabat surveys – detectors set up, left overnight and collected the following morning	N/A	15 and 17 December 2014	Evening	Cool to mild
Hollow bearing tree survey	2 days	AECOM 17 and 20 December 2013	Day	Warm to hot
	20	15 and 17 December 2014	Morning to early afternoon	Warm to hot and humid
Aquatic surveys	16	December 2013 (for Old Mans Valley). Noted that access was not available to water in quarry void	Morning and afternoon	Warm to very hot

*Note: conducted concurrently with Biometric plots

2.2.3 Field study personnel

This assessment was carried out by appropriately qualified and experienced ecologists and environmental professionals as demonstrated in **Table 2**.

Table 2: Personnel and qualifications

Name	Role	Qualifications
Dr Steven Ward	Project Director	Ph.D., University of Western Sydney, 2002 Honours, University of Wollongong, 1999 BSc (Botany / Zoology), University of Western Australia, 1987 Accredited Biobanking and major projects assessor
Dr Meredith Henderson	Ecology assessment	PhD, Victoria University, Melbourne, 2003 BSc (Hons), University of Wollongong, 1991 Accredited Biobanking and major projects assessor
Dr. Lachlan Copeland	Targeted threatened flora survey and advice	PhD in plant systematics, University of New England , 2005 Bachelor of Natural Resources (Hons), University of New England, 1995
Ian Dixon	Aquatic Assessment	AUSRIVAS Accreditation (Australian River Assessment System), 2011 Master of Tropical Environmental Management, Charles Darwin University, 2006 Graduate Diploma of Tropical Environmental Management, Charles Darwin University, 2001 Bachelor of Landscape Architecture, 1999
Danielle Bennett-Adams	Ecology assessment	Bachelor of Animal Science- Major in Wildlife Studies, University Of Western Sydney, 2007
Ashlee Clarke	GIS Analysis and Mapping	Bachelor of Environmental Science, University of Wollongong

2.2.4 Limitations

Following significant rainfall events, access within the inner void fence, which includes both the quarry void and walls, is not permitted due to potentially unstable quarry walls. In December 2014 and February 2015, when the survey was undertaken, there had been significant rainfall events and thus access within the inner void fence was not available. This meant that the void walls could not be surveyed, and survey of the water in the void was not possible. Thus, these areas were subject to visual inspections due to site access restrictions. Species were noted where they could be identified and a qualitative assessment of condition was made by noting disturbance or presence of exotic species.

For flora species, surveys occurred during the time of year in which the potentially occurring threatened flora species are detectable.

A hollow bearing tree survey was conducted for the study area by AECOM (2014) to determine the number and extent of hollow bearing trees that may be important for hollow dependent fauna. Additional survey for hollow bearing trees was conducted by ELA in December 2014 to supplement the AECOM survey. All hollow bearing tree survey data referred to in this report is subject to the limitations stated in both AECOM (2014) and this report.

Locations of hollow bearing trees and plot locations were recorded with hand-held GPS units, which can have errors in the locations of up to 20 metres. Furthermore, traces of paths walked recorded using the handheld GPS units can often be sporadic or have greater errors in accuracy as the units can lose satellite reception due to not being in an optimal position, particularly in areas where foliage cover is high.

Survey effort for most fauna (excluding Anabat survey) consisted of incidental observations and habitat assessment. In the absence of targeted surveys for most threatened fauna species with the potential to occur within the proposed footprint, this technical working paper assumes the presence of the species and potential impacts are addressed in the mitigation section. On the basis that threatened species are present, the assessment and offset calculations adopt a worst case scenario.

Figure 3: Field survey locations

(blank)

3 Landscape features

The study area is located within the Sydney Basin Bioregion which extends north to the Hunter Valley, west to Mudgee and south to Batemans Bay. The study area occurs within a highly urbanised setting surrounded by extensive areas of established urban development to the east, north and south. However, remnant vegetation occurs to the west within Berowra Valley National Park and Regional Park, and in close proximity to the study area itself.

The landscape features of the study area are shown in **Figure 4**.

3.1 IBRA bioregions and subregions

The area for assessment is contained wholly within the Sydney Basin Bioregion. The project footprint crosses two IBRA subregions, Pittwater and Cumberland. According to the FBA, '*the distribution of the species includes the IBRA subregion in which the development site… is, in the opinion of the assessor, mostly located*'. More of the project footprint occurs within the Cumberland IBRA subregion. This subregion was used for the 1000 hectare assessment circle (**Figure 4**).

3.2 Mitchell Landscapes

The project footprint is covered by three separate Mitchell Landscapes. The majority of the site is covered by Pennant Hills Ridges, with the remainder covered by Sydney Basin Hornsby and Sydney Basin Volcanics (Mitchell 2002) (**Figure 5**). The Pennant Hills Ridges Mitchell Landscape was entered into the calculator.

3.3 Rivers, stream and estuaries

The quarry pit is characterised by deep open water, steep walls (banks) and rocky substrate. It lacks natural ecosystem processes that occur in flowing streams, such as nutrient cycling and transport, depositional zones and material exchange with the floodplain. When compared to a natural lake, the quarry pit is devoid of a shallow littoral zone that would accumulate organic matter and provide soft substrate for macrophyte growth. As such, life forms in the pond would be dominated by microorganisms creating a biofilm on hard substrate, and free floating algae (phytoplankton) in open water.

Biofilms are a source of food for larger grazing invertebrates such as aquatic snails and mayfly nymphs; and phytoplankton is the primary food for filter-feeding zooplankton. This primary (plant) and secondary (animal) production forms the lower order of an aquatic food web. But without the habitat structure typical in lakes, wetlands and rivers (e.g. shallow zones for macrophytes, and woody debris for shelter), larger fauna would be limited to hardy, common species.

Presence of larger aquatic species is also restricted by the quarry's disconnection from natural watercourses, although it does not exclude them completely. Certain fish that are known to travel overland or up/around vertical structures (e.g. eels, gudgeons and galaxiids) would find it difficult to access the quarry due to its steep and high perimeter wall. Presence of fish, therefore, is likely limited to human stocking and/or aerial transfer of eggs/newborn via wetland birds (attached to feet/underbelly). This aerial dispersal mechanism is well known for eggs of invasive carp, which often inhabit isolated farm dams. If native fish have managed to colonise the pond, their foraging and shelter habitat is very limited and unlikely to favour a breeding population.

3.4 Wetlands

There were no important or local wetlands relevant to the study area. There were no SEPP 14 wetlands in the study area and no SEPP 14 wetlands are to be impacted.

3.5 Groundwater dependent ecosystems

Groundwater Dependant Ecosystems (GDEs) are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function. Groundwater use by an ecological community or individual species does not necessarily imply groundwater dependence.

In Australia, the majority of ecosystems have little to no dependence on groundwater, although the full understanding of the role of groundwater in maintaining ecosystems is generally poor. The exception to this is wetland communities, for which it is thought that most have some level of dependence on groundwater resources.

GDEs are generally classified into six categories:

- Terrestrial vegetation – forests and woodland which develop a permanent or seasonal dependence on groundwater, often by extending roots into the water table.
- Base Flow in streams – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow.
- Aquifer and cave systems – aquatic ecosystems that occupy caves or aquifers.
- Wetlands – aquatic communities and fringing vegetation that depend on groundwater fed lakes and wetlands.
- Estuarine and near shore marine ecosystems – various ecosystems including mangroves, salt marsh and seagrass, whose ecological function has some dependence on groundwater discharge.
- Terrestrial fauna – fauna species assemblages reliant on groundwater for drinking water.

A final category is also recognised ‘not apparently dependant’. This category acknowledges that some ecosystems, particularly wetland and riparian vegetation, might superficially appear to be groundwater dependent while in fact they are dependent entirely on surface flows and or rainfall.

Groundwater in the Hornsby Quarry study area has a water level of 28.5 metres AHD by PSM 2006 (later quoted in Cardno 2013). A piezometer was drilled by PSM in 2006 (BH HQ1) to the southwest of the quarry void. Analysis of groundwater data from BH HQ1 for the period 20 November 2006 to 2 July 2010 indicated GW levels between 80 metres and just under 120 metres AHD in the area immediately surrounding the quarry void. Current water levels in the void have been estimated by Council to be 19 m AHD (pers. comms. Craig Clendenning, Hornsby Shire Council). Land surrounding the quarry rim is between 60 and 180 metres AHD, making the water table between 41 and 161 metres below ground level. This is likely to be beyond the rooting depth of most plant species in the vegetation types present at the site.

3.6 Ecological corridors

No formal state or regional biodiversity links are present within the study area. Areas of potential impact are also in proximity to existing peri-urban development. For example, roads and residences bound the Quarry site to the north, east and south.

Local wildlife corridors do exist at a smaller scale. At a local scale there are riparian corridors linked to regional parks, namely vegetation adjacent to the Quarry extending to Cowan Reserve. However, these linkages do not meet the definition of state or regional biodiversity links, and therefore linkage impacts were assessed for site based developments as defined under the FBA (OEH 2014b).

The links from within the study area to the adjacent vegetation will not be severed by the proposed works. The proposed works make use of already cleared or degraded areas of vegetation and will not introduce new access points through any local corridor.

3.7 Landscape value score

The assessment method was chosen in accordance with the site based assessment outlined in the FBA.

Assessment circles with a radius of 1,784 metres (1,000 hectares) and 564 metres (100 hectares) are used to assess the impact of proposals on the surrounding vegetation cover at a landscape and local scale (respectively) (**Figure 6**).

The amount of vegetation within the 100 hectare and 1,000 hectare assessment circles before the development was calculated using ArcGIS using the Native Vegetation of the NSW NPWS GIS layer (NPWS 2002) (excluding the non-native categories). Where this layer did not cover the whole circle, the gaps were filled in manually. To determine the native vegetation cover after development in the 1,000 hectare circle, the total amount of clearing was subtracted from the average. The development footprint was then used to calculate the amount of vegetation loss for 100 hectare each circle. **Table 3** outlines the vegetation in each circle, before and after development, and the average and associated Native Vegetation Cover Class (per cent) to be entered into the Credit Calculator.

Table 3: Area of vegetation in each assessment circle

Circle	Native Vegetation Cover (Before Development)	Native Vegetation Cover (After Development)
1 000 ha circle	401 ha (rounded down to 40%) (36-40%)	398.5 ha (36-40%)
100 ha circle	51 ha (51-55%)	49 ha (46-50%)

A connectivity assessment was conducted using the FBA technique for site based developments (OEH 2014b). The site did not contain either state or regionally significant biodiversity links due to not being in biodiversity link plans approved by the Chief Executive of OEH or in a riparian buffer for a 4th or higher order stream. Thus the following aspects were considered:

- The width of the current and future connecting link (**Table 4**)
- The condition of the current and future connecting link (overstorey and mid-storey/ground cover) (**Table 5**).

The project footprint is surrounding by connected vegetation on three sides and does not form a significant linkage between any vegetation zones. As such, the connectivity has not been affected by this development.

Connectivity width assessment

The current most limiting width within the corridor is approximately 30 metres, thus falling into the 30-100 metre linkage width class (**Figure 7**). As the area of minimum width does not occur within the proposed development it does not reduce the minimum width of this link. Professional judgement was used to ascertain that the proposed development will not result in a change in the minimum linkage width class, remaining unchanged at less than 30-100 metres after development, as the study area is connected to both the north and south to vegetation, and these linkages will be retained (**Table 4**).

Table 4: Linkage width classes before and after development

	Linkage Width Class (Before Development)	Linkage Width Class (After Development)
Connectivity Value (Width)	>30-100m	>30-100m

Connectivity condition assessment

The connectivity condition assessment was undertaken on woody vegetation as woody vegetation types dominate the project footprint. Two measures were used to assess the condition of the connection:

- The condition of over-storey vegetation before and after development.
- The condition of ground cover vegetation before and after development.

The vegetation within the link is connected to Ku-ring-gai Chase National Park and so the condition of the overstorey is high. Over-storey vegetation before development has therefore been assessed as Projected Foliage Cover (PFC) at Benchmark. The impact of the proposed development on the average overstorey condition across the entire connection is minimal, as the area within the linkage to be cleared is very small. It is therefore expected that the average overstorey condition after development will remain the same at PFC at Benchmark.

While it is difficult to estimate the condition of the mid-storey and ground cover through the entire connection, from the field visit and analysis of aerial photos, it is likely that some exotic vegetation would be present due observations made on site. However, the average condition of the mid-storey/ground cover vegetation before development has been assessed to also be at benchmark (PFC at Benchmark). As previously described, the impact of the proposed development would be minimal on the condition of the connectivity, and the ground cover after development will remain at PFC at Benchmark (**Table 5**).

Table 5: Condition of vegetation within the assessment circle before and after development

	Width Class (Before Development)	Width Class (After Development)
Connectivity Value (Overstorey Condition)	PFC at Benchmark	PFC at Benchmark
Connectivity Value (Mid-storey/Ground Cover Condition)	PFC at Benchmark	PFC at Benchmark

Patch size

Threatened species sub-zones, which form the base units of vegetation zones, were mapped for the impact area. The threatened species sub-zones allow the entry of data such as adjacent remnant area and patch size for individual vegetation zones.

The majority of the vegetation impacted is adjacent to large patches of vegetation with an area of greater than 501 hectares, and thus the adjacent remnant area and patch size for all threatened species sub-zones was entered as the maximum 501 hectares.

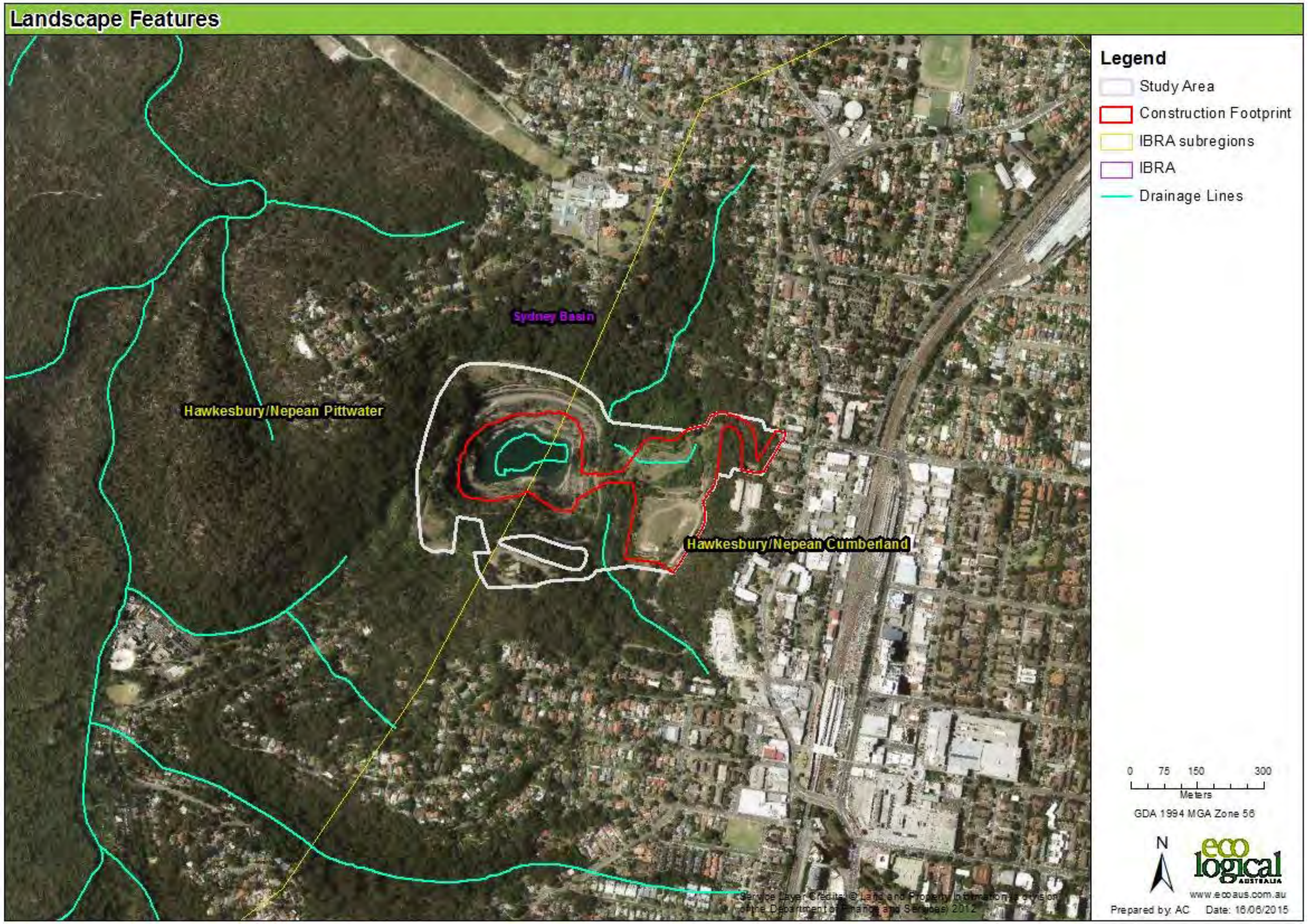

Figure 4: IBRA regions and subregions and drainage lines

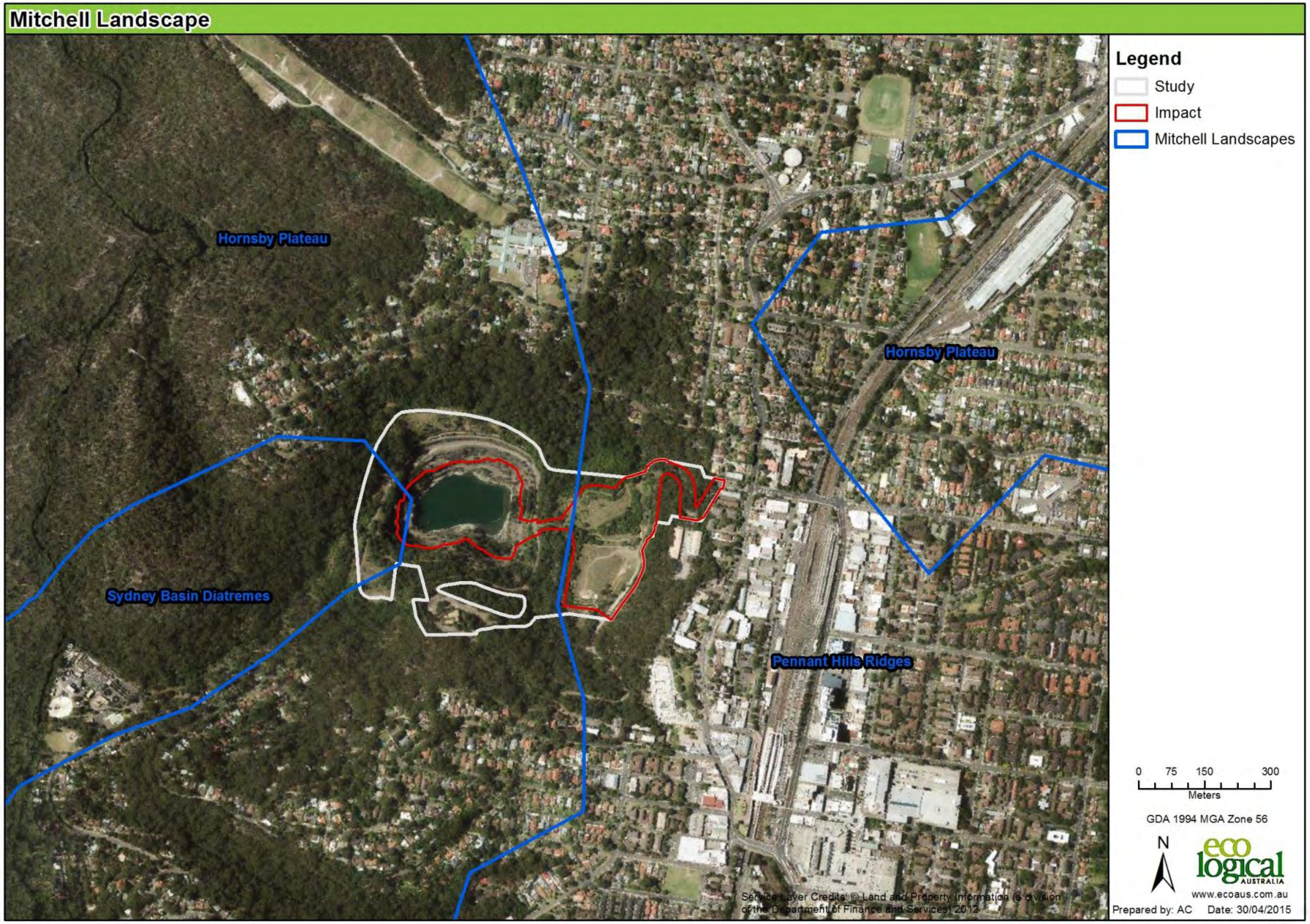

Figure 5: Mitchell Landscapes

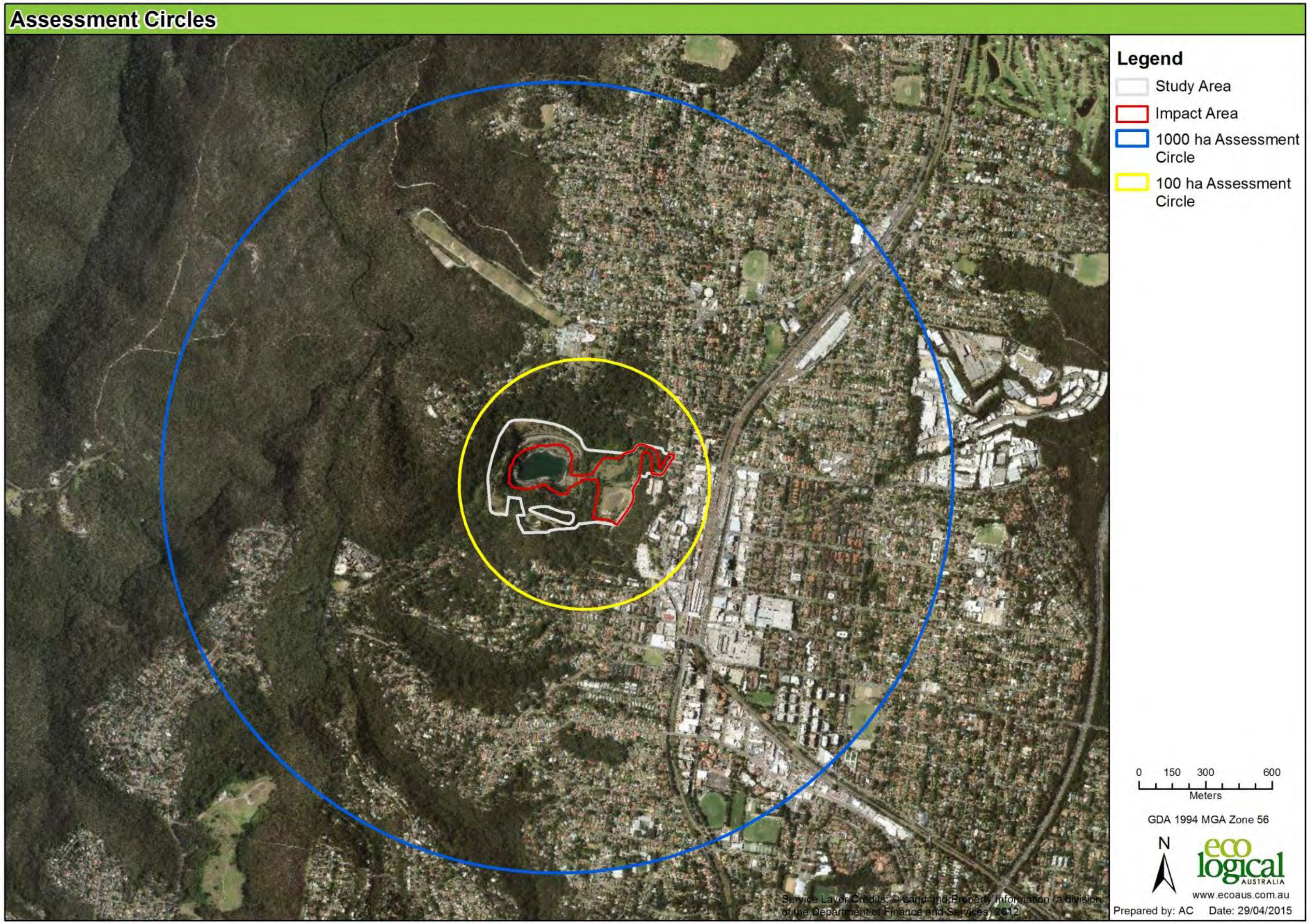

Figure 6: Assessment circles

Figure 7: Connectivity assessment

(blank)

4 Native vegetation

4.1 Plant Community Types (PCTs)

There were two PCTs mapped and assessed in the study area. PCTs within the development site are outlined in **Table 6** and shown in **Figure 8**.

4.1.1 Sydney Blue Gum – Blackbutt – Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin (PCT 1237)

This PCT is also known as Blue Gum High Forest and is in the North Coast Wet Sclerophyll Forest class. It is a critically endangered ecological community (CEEC). It is 90 percent cleared in the CMA.

The Blue Gum High Forest in the study area did not meet EPBC Act criteria. The EPBC Act Blue Gum High Forest community definition is narrower than the TSC Act definition, in that EPBC Act Blue Gum High Forest:

- Occurs only on sandstone derived soils.
- Requires minimum canopy coverage of 10 per cent.
- Must be part of a patch greater than one hectare.
- Must be dominated by native plants in all structural layers of the community.

Although Blue Gum High Forest was identified in the study area, none of the patches meet the EPBC Act definition. This is because the Blue Gum High Forest occurs on soils not derived from sandstone and often had a canopy cover of less than 10 percent. However the most critical element was that in the main, the areas of Blue Gum High Forest were not dominated by native plants in all structural layers. In general the understorey was typically dominated by woody weeds and the ground cover often dominated by seedlings of these weeds.

The vegetation was identified using previous mapping by Smith and Smith (2008), conducting vegetation validation, comparison of species present with the VIS dataset and the final determination for the CEEC, and conducting a number of floristic and biometric plots in accordance with the FBA method. ELA is cognisant of NSW Land and Environment Court decisions in protecting very small patches of Blue Gum High Forest and individual *Eucalyptus saligna* trees and as such has adopted a precautionary approach to the classification of this community under the TSC Act in including areas dominated by *E. saligna* as part of this CEEC, even when in highly disturbed condition. There were a few small patches that were classified as ‘Blue Gum individuals’. These patches were ostensibly a small group of adult *Eucalyptus saligna* in a matrix of woody weeds. Given that individual Blue Gum trees can be considered the CEEC, these patches were included in this PCT.

Canopy species were primarily used to identify this community from the other PCT present. Where the canopy was dominated by *Eucalyptus saligna* and the vegetation was on more fertile loamy rather than sandy soils, the PCT was identified as being present. In most locations where this community was sampled, the vegetation was usually dominated by weeds in the understorey. A precautionary approach was taken when identifying this PCT at the development site. In general, the dominant canopy species were *Eucalyptus saligna* (averaging six trees per 20 metre by 20 metre plot), *Angophora floribunda* (ten per plot) and *Pittosporum undulatum* (12 per plot).

The understorey was typically dominated by woody weeds such as *Ligustrum lucidum* and *L. sinense*. In most areas, the native shrub layer was absent and very few native species were present in the ground layer. Species encountered included *Lomandra longifolia*, *Poa labillardieri*, *Oplismenus aemulus* and *Dichondra repens.*

The project would remove areas of TSC Act listed Blue Gum High Forest located within the eastern portion of the Quarry. Areas to be removed are quantified in **Table 7**.

4.1.2 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (PCT 1181 or HN586)

This PCT is also known as Sandstone Blackbutt Woodland (Smith and Smith 2008). It is in the Sydney Coastal Dry Sclerophyll Forest class and is not an EEC or CEEC. However, Sandstone Blackbutt Woodland is a tall open forest recognised as a locally significant community in the Hornsby Shire 2006 Biodiversity Conservation Strategy (Cardno 2013; Smith and Smith 2012). It is 20 percent cleared in the CMA. For clarity, this PCT will be referred to as Sandstone Blackbutt Woodland.

Typical species that occur within the community include *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Sydney Red Gum) and *Syncarpia glomulifera* (Turpentine).

Mapping from previous studies (e.g. Smith and Smith 2008) was used to identify where this community potentially occurs in the study area. Validation of mapping, comparison of descriptions from the VIS data set with floristic plots was all used to identify and assign this PCT. Canopy species, presence of sandstone outcrops, sandy soil and an absence of more fertile soils were used to help confirm the presence of this PCT within the study area.

The PCT was present in two condition states. Both condition states met the definition of “moderate-good” under the methodology, but these were further separated into ‘moderate’ and ‘poor’ condition. In general the canopy was dominated by the following species: *Eucalyptus pilularis*, *Angophora costata*, *Corymbia gummifera*, *Syncarpia glomulifera*. A smaller tree layer comprised *Allocasuarina littoralis*, *A. torulosa*, *Banksia serrata* and *Elaeocarpus reticulatus*. The understorey was dominated by sclerophyllous shrubs, herbs and grasses including *Imperata cylindrica*, *Breynia oblongifolia*, *Lomandra longifolia*, *Pteridium esculentum*, *Dianella longifolia*, *Xanthorrhoea* sp., *Hibbertia empetrifolia* and *Lomandra obliqua*.

Where the PCT was in poor condition, there were more woody weeds including *Ligustrum lucidum, L. sinense, Ochna serrulata* and *Lantana camara*. The patches of poor condition forest were adjacent to the road or track edges and appeared to have had a modified soil profile, possibly from earlier road construction.

4.2 Other vegetation

4.2.1 Regeneration native

There were some areas of vegetation that were largely comprised of regenerating native plants, including Allocasuarina littoralis. These areas were mostly contained within the quarry void, where access was limited or prohibited due to steepness and unstable walls. No plot/transects were able to be conducted in these areas and it was also difficult to assign the community to a PCT due to not having direct access. It is also noted that this vegetation has regenerated from previous past disturbance and is therefore a highly disturbed community.

For the areas inside the project footprint, this vegetation type was assigned to the closest PCT available. This was deemed to be Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin. This was because it was an open forest with more shrubby sclerophyllous plants than the Blue Gum High Forest PCT. The vegetation condition was considered ‘poor’.

4.2.2 Regeneration exotic, weeds and exotics, cleared

Areas that were exclusively or dominated by weeds were assigned to this vegetation type. Large areas within the study area were dominated by weed species such as *Ligustrum lucidum*, *L. sinense, Lantana camara* and herbaceous weeds. These areas were usually close to track edges or where the soil profile had been extensively modified. This vegetation type also included two large flat areas east of the void that were dominated by exotic grasses, with no shrubs or trees present. These vegetation types were excluded from the calculations.

Table 6: Vegetation in the study area

Vegetation types			Vegetation Zones for analysis purposes				
Vegetation community	Ancillary	Total in study area (ha)	Veg Zone No.	Plant Community Type (PCT)	Ancillary code	Total impacted (ha)	Justification
Blue Gum High Forest	Poor	3.62	1	Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin	Poor	0.06	Merged with Sandstone Blackbutt Woodland in poor condition for calculations because of the small size of the vegetation being impacted. Zones smaller than 0.25 hectares are required to be merged to provide the calculations.
Sandstone Blackbutt Woodland	Moderate	1.40	2	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	Moderate	0.58	No change
	Poor	0.44	3		Poor	0.26	No change
Regeneration - Native		3.23				0.74	Merged with Sandstone Blackbutt Woodland in poor condition for calculations This vegetation most closely aligns with the PCT above. Due to access restrictions, no plots/transects were able to be done in this vegetation type because the majority occurred within the inner quarry fence.
Blue Gum Individuals		0.06				0	None of this vegetation is impacted
Regeneration - Exotic		0.46	Excluded from impact assessment as it is not native vegetation			0	Non-native vegetation and other cleared areas do not need to be included in calculations
Weeds and Exotics		10.14				4.02	
Cleared		4.57				3.19	
Water		2.32				2.32	
Total		26.23				11.18	

4.3 Vegetation zone

Vegetation zones and their extent within the project footprint are outlined in **Table 7**.

The vegetation zones outlined in **Table 7** are assessed for impacts in **section 7**.

Table 7: Vegetation zones and plot requirements

Vegetation zone	Vegetation Community	Plant community type	Ancillary Code	Area impacted (ha)	Plots required	Plots collected	Description of plots used
1	Blue Gum High Forest	Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin	Poor	0.06	1	2	Plot collected in the Blue Gum High Forest ‘poor’ zone. Due to the small size of this vegetation was merged with vegetation zone 3.
2	Sandstone Blackbutt Woodland (Moderate)	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	Moderate	0.58	1	3	All plots collected in the Smooth-barked Apple Forest 'moderate' zone
3	Sandstone Blackbutt Woodland (Poor) and Regeneration – Native combined	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	Poor	1.00	1	2	All plots collected in the Smooth-barked Apple Forest 'poor' zone. This vegetation zone is a combination of Sandstone Blackbutt Woodland Poor and Regeneration – Native.
Total				1.64	3	7	

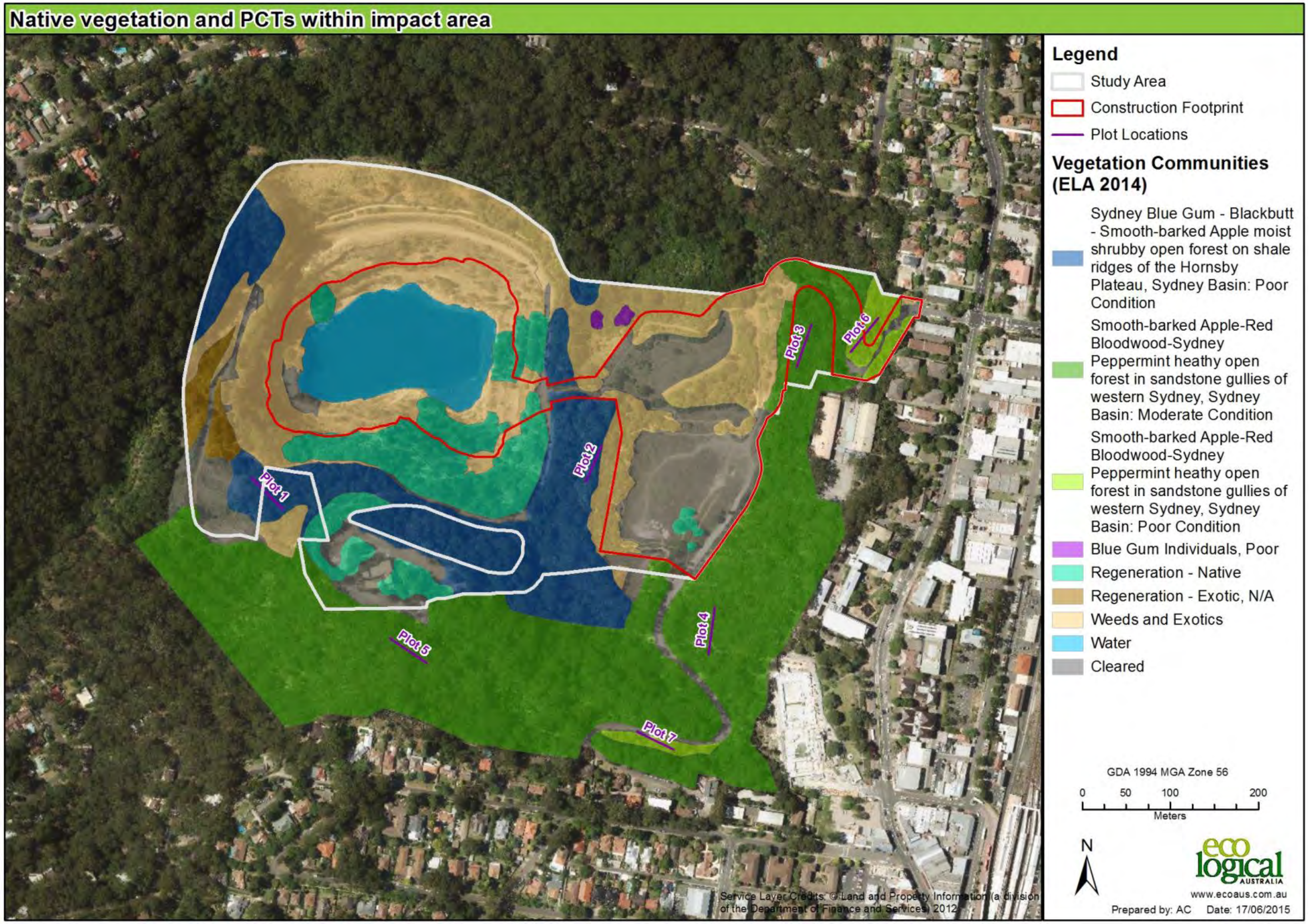

Figure 8: Native vegetation and PCTs within study area

5 Threatened species

5.1 Ecosystem credit species

A number of threatened species have been recorded or may occur within the study area. Ecosystem credit species associated with PCTs in the project footprint are outlined below in **Table 8**.

Table 8: Ecosystem credit species on development site

Species	Inclusion / exclusion	Justification for exclusion
Glossy Black-Cockatoo	Include	N/A
Gang-gang Cockatoo (Endangered Population has a separate species credit listing)	Include	N/A
Little Eagle	Include	N/A
Little Lorikeet	Include	N/A
Masked Owl.	Include	N/A
New Holland Mouse	Include	N/A
Powerful Owl.	Include	N/A
Barking Owl	Include	N/A
Scarlet Robin.	Include	N/A
Sooty Owl	Include	N/A
Square-tailed Kite	Include	N/A
Swift Parrot	Include	N/A
Varied Sittella	Include	N/A
Eastern False Pipistrelle	Exclude	Survey conducted – not present
Eastern Freetail Bat	Exclude	Survey conducted – not present
Golden-tipped Bat	Exclude	Survey conducted – not present
Greater Broad-nosed Bat	Exclude	Survey conducted – not present
Spotted-tail Quoll	Exclude	No suitable habitat in impact area
Superb Fruit Dove	Exclude	No rainforest present and limited most eucalypt forest present in impact area
Yellow Bellied Glider	Exclude	Forest is present but it is not nutrient rich or with abundant hollows in the impact area
Yellow Sheath-tailed Bat	Exclude	Survey conducted – not present

5.1.1 Glossy Black-Cockatoo

The Glossy Black-Cockatoo is listed as vulnerable under the TSC Act. The Glossy Black Cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 metres in which there are stands of she-oak species providing foraging habitat, particularly where *Allocasuarina littoralis* (Black She-oak) and *A. torulosa* (Forest She-oak) occur (OEH, 2013b).

In the Sydney metropolitan region important breeding habitat has been defined as tree hollows with a minimum diameter greater than 15 centimetres (OEH, 2013b). There are 23 records of the species within the ten kilometre radius Wildlife Atlas search area. There is potential habitat for this species in the project footprint with patches of regenerating *Allocasuarina* species growing on the quarry void walls and benches. There were a small number of hollow bearing trees, which are potential breeding habitat. No Glossy Black Cockatoos were observed during the field survey and no evidence of the species utilising the habitat, such as crushed cones of sheoak, were observed where this tree species was present.

There was some foraging habitat present but there was no evidence of the species utilising this habitat. However it was retained as an ecosystem credit species.

5.1.2 Gang-gang Cockatoo (Endangered Population has a separate species credit listing)

Gang-gang Cockatoo is listed as vulnerable under the TSC Act.

In summer they occur in dense, tall, wet forests of mountains and gullies, as well as alpine woodlands (NSW Scientific Committee, 2008). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome, 1992). They can often be found in urban areas in autumn/winter (Simpson & Day, 2004). The population size is small and estimated to be between 18 to 40 pairs, yet individuals of this population are likely to move outside the 'defined' population boundary in the general area and should still be considered of this population (OEH, 2013c).

Important breeding habitat in the Sydney metropolitan region has been defined as a tree hollow with a minimum diameter of 10 centimetres (OEH, 2013c) and typically occurs in live trees close to water (NSW Scientific Committee, 2008). There are eight records of the endangered population of Gang-gang and eight of the species within the ten kilometre radius Wildlife Atlas search. No Gang-gang Cockatoos were recorded during the field survey. There is some potential foraging habitat and potential breeding habitat in the study area. There are hollow bearing trees suitable for this species (AECOM, 2014 and ELA 2014).

5.1.3 Little Eagle

Hieraaetus morphnoides (Little Eagle) is a medium-sized bird of prey. It is listed as vulnerable under the TSC Act.

It occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. The species nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. It lays two or three eggs during spring, and young fledge in early summer. It preys on birds, reptiles and mammals, occasionally adding large insects and carrion.

The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. There was foraging habitat in the project footprint.

5.1.4 Little Lorikeet

Glossopsitta pusilla (Little Lorikeet) is listed as vulnerable under the TSC Act.

In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri.

Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box *Eucalyptus albens* and Yellow Box *E. melliodora* are particularly important food sources for pollen and nectar respectively.

There was potential foraging habitat in the project footprint.

5.1.5 Masked Owl

Tyto novaehollandiae (Masked Owl) is listed as vulnerable under the TSC Act. It is associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland (DECC 2007) and especially the ecotone between wet and dry forest, and non-forest habitat (DotE 2015). The Masked Owl is known to utilise forest margins and isolated stands of trees within agricultural land and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained. This species is very sparse in the region and there are no known breeding records south of the Hawkesbury River (Kavanagh 2004).

The number of pairs in the locality is unknown. However, there are seven records for Masked Owl on the Wildlife Atlas within ten kilometres of the study area. There is a lack of breeding records of this species south of the Hawkesbury River and there are sparse records of this species in the northern Sydney region in general. This means that this species is unlikely to be breeding in the project footprint. This project may impact on foraging habitat but is unlikely to impact on breeding habitat.

5.1.6 New Holland Mouse

Pseudomys novaehollandiae (New Holland Mouse) is not listed under the TSC Act. It is listed under the EPBC Act. It was not surveyed for, and thus it is not possible to discount the presence of this species. The species utilises open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. The number of individuals present at a site can fluctuate widely, and populations will tend to irrupt in the early to mid vegetation succession stage induced by fire. It is considered that habitat for this species in the study area would be limited, particularly given the close proximity to urban interface. However, it is not possible to completely discount its potential presence and thus it has been retained as an ecosystem credit species.

5.1.7 Powerful Owl

Ninox strenua (Powerful Owl) is listed as vulnerable under the TSC Act. They require large tracts of forest or woodland but can also occur in fragmented landscapes. As most prey species require hollows and a shrub layer, these are important habitat components for the owl. Large trees with hollows at least 0.5 metres deep (DotE 2015) and diameter at breast height of 80 to 240 centimetres that are at least 150 years old are required for nesting.

The project could impact on the lifecycle of the Powerful Owl by reducing the amount of potential foraging habitat. Tree hollows with a diameter greater than 300 millimetres constitute potential primary (breeding) habitat for the Powerful Owl. Removal of such habitat may impact the lifecycle of the species by reducing the availability of breeding habitat, which would impact on species fecundity (being the ability to reproduce) in the local area. No hollows of a suitable size were found within the study area.

If Powerful Owl nesting sites occur within the study area, the species may be indirectly impacted through noise and vibration during the project. It is recommended that a buffer of at least 200 metres of native vegetation should be retained around nesting trees of Powerful Owl. The species is known to be extremely sensitive to disturbance around the nest site, particularly during pre-laying, laying and downy chick stages.

During the field survey, there was no evidence of nesting by Powerful Owls but field surveys were primarily conducted in summer when Powerful Owl are not breeding. However, there are 105 records for Powerful Owl on the Wildlife Atlas within ten kilometres of the study area.

Loss of foraging habitat has the potential to reduce the availability of prey species within a mating pair's territory, which may force individuals to travel greater distances during hunting.

A previous study by Aquila Ecological Surveys (2011) suggested that the quarry site would provide for foraging habitat, but that the size of a pair's foraging territory may extend to 1000 hectares. They did not survey for this species, but assumed that foraging habitat would be present (see **section 2.1.3**).

While the project would result in the removal of potential foraging habitat for the Powerful Owl, the project would retain trees containing smaller hollows and areas of high quality foraging habitat. The hollow bearing tree surveys performed (AECOM 2014) did not identify any hollows large enough to provide breeding habitat for Powerful Owl, but there were hollows suitable for prey species of the Powerful Owl.

5.1.8 Barking Owl

Ninox connivens (Barking Owl) is listed as vulnerable under the TSC Act. The Barking Owl inhabits a variety of habitats such as savannah woodland, open eucalypt forests, wetland and riverine forest, including fragmented remnants and partly cleared farmland. This species is flexible in its habitat use and hunting can extend into closed forest and more open areas. The habitat is typically dominated by eucalypts (often Redgum species) (DECC 2007).

The Barking Owl usually roosts in dense foliage in large trees. It usually nests near watercourses or wetlands in large tree hollows with entrances averaging two to 29 metres above ground, depending on the forest or woodland structure and the canopy height (NSW NPWS 2003).

The project could impact on the lifecycle of the Barking Owl by reducing the amount of potential foraging habitat. Loss of foraging habitat has the potential to reduce the availability of prey species within a mating pair's territory, which may force individuals to travel greater distances during hunting. The sizes of home ranges are generally unknown for Barking Owl, but like Powerful Owl are likely to be variable and dependent upon quality of habitat. Tree hollows with a diameter greater than 300 millimetres constitute potential primary (breeding) habitat for the Barking Owl. Removal of such habitat may impact the lifecycle of the species by reducing the availability of breeding habitat, which will impact on species fecundity in the local area. No hollows of suitable size were recorded within the project footprint.

If a Barking Owl nesting site occurs within the study area or 200 metres from the study area, it may be indirectly impacted through noise, vibration and artificial light during the carrying out of the project.

During the field survey there was no evidence of nesting by Barking Owls. It is unlikely that the species would breed within the study area, given the landscape is highly fragmented and disturbed and that the range of the species has contracted considerably in NSW, so that it is rarely found east of the Great Divide. However, there are three records for Barking Owl on the Wildlife Atlas within ten kilometres of the study area. It has been suggested that Barking Owls are itinerant and sporadic inhabitants of the forests east of the Great Dividing Range (David Coombes, Senior Ecologist, pers comm January 2014).

While the project would result in the removal of potential foraging habitat for the Barking Owl, the project will not impact on any hollow bearing trees large enough to provide potential breeding habitat for the Barking Owl. In addition the works have avoided the majority of the existing hollow bearing trees and areas of high quality foraging habitat.

5.1.9 Scarlet Robin

Petroica boodang (Scarlet Robin) is listed as vulnerable under the TSC Act. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It may also occur in mallee or wet forest communities, or in wetlands and tea-tree swamps.

The Scarlet Robin was not recorded within the project area. However there are two records of the species within the ten kilometre Wildlife Atlas search area.

There was some foraging habitat present but there was no evidence of the species utilising this habitat. The area of potential habitat to be cleared was small relative to the potential habitat remaining in vegetation adjacent to the impact areas at the Hornsby Quarry.

5.1.10 Sooty Owl

Tyto tenebricosa (Sooty Owl) is listed as vulnerable under the TSC Act.

Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall *Eucalyptus* species (Environment Australia 2000, Debus and Chafer 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus and Chafer 1994, Garnett 1993).

The Sooty Owl was not recorded in the study area and there was no evidence (i.e. whitewash) of it being present. There was only one record of this species occurring in the ten kilometre radius search. It is likely that this species has been filtered in based on the association with the two PCT present on this site. There were no hollows present that were large enough to support a breeding pair.

There is likely to be potential foraging habitat both within the study area and in the area to be impacted by this project.

5.1.11 Square-tailed Kite

Lophoictinia isura (Square-tailed Kite) is listed as Vulnerable under the TSC Act. The Square-tailed Kite is a reddish, medium-sized, long-winged raptor, about the size of a Little Eagle or harrier.

The Square-tailed Kite ranges along coastal and sub-coastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.

It hunts for small forest birds and nests in twig and stick nests in the forest canopy. While no nests were observed in the study area or project footprint, the presence of suitable foraging habitat warranted the inclusion of this species.

5.1.12 Swift Parrot

Lathamus discolor (Swift Parrot) is listed as endangered under the TSC Act.

It breeds in Tasmania between September and January. The Swift Parrot feeds mostly on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), White Box (*E. albens*) and Forest Red Gum (*E. tereticornis*) (DECC 2007). Box-ironbark habitat in drainage lines and coastal forest in NSW is thought to provide critical food resources during periods of drought or low food abundance elsewhere (Mac Nally et al. 2000).

There were no records of this species from within the ten kilometre radius Atlas search. It may be an occasional visitor to the area utilising the winter flowering eucalypts that are present in the Sandstone Blackbutt Woodland.

5.1.13 Varied Sittella

Daphoenositta chrysoptera (Varied Sittella) is listed as vulnerable under the TSC Act.

The species inhabits eucalypt forests and woodlands, especially with rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland (DECC 2005) and has a widespread range across mainland Australia,

The Varied Sittella was not recorded within the study area. However there is one record of the species within the ten kilometre Wildlife Atlas search area. There was a sighting of this species at the Quarry in 2014 by Dragonfly (2014). This record occurred in an area that will be retained and not impacted directly by the project.

5.2 Species credit species

The following questions were asked in the calculator to determine what species would be filtered into the assessment for consideration (**Table 9**). The answers were obtained from the site visit, and in any cases of ambiguity the default answer of 'Yes' was used, as directed by the methodology. It should be noted that an answer of 'yes' does not mean that the threatened species or its habitat is present, merely that the species is retained in the assessment by the tool (an answer of 'no' results in the threatened species being excluded).

Table 9: Geographic and habitat questions and answers

Question: Does any part of the development impact on	Answer
Heath or eucalypt forest on sandstone with a build-up of litter or other debris and containing, or within 40 metres of, ephemeral or intermittent drainage lines	Yes
Land within 40 metres of heath, woodland or forest	Yes
Land situated in damp, disturbed sites	Yes
Lateritic to shaley ridgetops	Yes
Land within 100 metres of emergent aquatic or riparian vegetation	Yes

Species generated by the tool were used. From review of previous reports, no additional threatened species were added to the list (refer **section 2.1.3**). However, from review of database records (**section 2.1.2**) one additional species, *Genoplesium baueri*, was identified as potentially occurring and targeted survey for this species was conducted. This list was utilised in step 2 (**Table 10**). The list of candidate species was compared against the habitat features at the site following habitat assessment to determine whether the species is considered present. The resulting list of species is compared against the features in the impact area to determine if there is a requirement for survey. A candidate species is not considered present in the development site where:

- the habitat is substantially degraded
- an expert report states that the species is unlikely to be present
- the species is a vagrant and is unlikely to use habitat on the development site
- records of the species are at least 20 years old or have doubtful authenticity.

Table 10: List of candidate species credit species and second filtering step

Species	Inclusion / exclusion	Rationale
Acacia bynoeana	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
Acacia gordonii	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
Acacia pubescens	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
Anthochaera phrygia	exclude	Species is likely to be vagrant and unlikely to use habitat in the project footprint

Species	Inclusion / exclusion	Rationale
Callocephalon fimbriatum population in the Hornsby and Ku-ring-gai Local Government Areas	include	Forest present; areas of *Allocasuarina* will be removed from within the void
Cercartetus nanus	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
Chalinolobus dwyeri	include	Forests, potentially crevices in cliff around void – requirement to survey
Darwinia biflora	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Darwinia peduncularis	exclude	areas of dry sclerophyll forest to be impacted are restricted to road edges and tend to be degraded
Epacris purpurascens subsp. *purpurascens*	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Eucalyptus sp. Cattai	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Genoplesium baueri	This species was not generated by the tool, but was included for consideration from review of Atlas records and because of potential habitat on site	Targeted survey of potential habitat was conducted. Prior to the targeted survey two known reference sites in the northern Sydney region were inspected, and at both sites flowering was in progress (section 2.2.1). The species was not detected during the targeted survey..
Grevillea parviflora subsp. *supplicans*	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals

Species	Inclusion / exclusion	Rationale
Gyrostemon thesioides	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Haloragodendron lucasii	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Heleioporus australiacus	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Leucopogon exolasius	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Leucopogon fletcheri subsp. *fletcheri*	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Melaleuca deanei	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Persoonia bargoensis	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Persoonia hirsuta	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals

Species	Inclusion / exclusion	Rationale
Persoonia mollis subsp. *maxima*	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
Petaurus norfolcensis	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded.
Phascolarctos cinereus	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded.
Pomaderris brunnea	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
Pseudophryne australis	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded.
Pterostylis saxicola	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
Tetratheca glandulosa	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
Zieria involucrata	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.

From this second filtering step (**Table 10**), only two species were considered as potentially occurring on the site. These were the endangered population of *Callocephalon fimbriatum* (Gang-gang Cockatoo) and *Chalinolobus dwyeri* (Large-eared Pied bat). These are discussed in the sections below.

5.2.1 *Callocephalon fimbriatum* population in the Hornsby and Ku-ring-gai Local Government Areas

The endangered population was assumed present within the development site. It is not a species that cannot withstand further loss. The TSPD (OEH 2015c) suggested that loss was limited to up to 5 percent of the foraging habitat only within the CMA. This species is associated with both of the PCT recorded in the development site. It was therefore assumed that both PCT form the species polygon for this species. The total area impacted of suitable habitat for this species is 1.64 hectares (**Table 7**). This is a species for which an offset is to be determined.

5.2.2 *Chalinolobus dwyeri* (Large-eared pied Bat)

Chalinolobus dwyeri (Large-eared Pied Bat) is listed as vulnerable under the TSC Act. The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

Large-eared Pied Bat is found in well-timbered areas containing gullies. It frequents low to mid-elevation dry open forest and woodland close to caves, crevices in cliffs, old mine workings and disused mud nests of *Hirundo ariel* (Fairy Martin). The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years (OEH 2015c).

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

The Large-eared Pied Bat has been recorded three times within the ten kilometre Wildlife Atlas search, scattered through the study area.

Cave-like crevices could possibly occur in the constriction footprint in the quarry void walls. Their presence cannot be confirmed due to access restriction and lack of detailed inspection of the quarry walls. Areas of potential foraging habitat include both woodlands and forests. Therefore there was a requirement to survey for this species. The survey was conducted in accordance with the draft OEH Threatened Species Survey Guidelines (2004) – see **section 2.2.1**. **Appendix F** contains details of the survey results.

The survey revealed that there were no Large-eared Pied Bats present. Survey was conducted during the correct season and echolocation units were placed in areas suitable for flyways and as close as possible to the area where potential void wall crevices could potentially occur. No access was able to be gained to the void to place any recording devices within the void.

The species was not detected and there is unlikely to be breeding habitat present. Therefore this species is excluded from further assessment and an offset is not required.

(blank)

6 Avoidance and mitigation measures

6.1 Avoidance of impacts

Avoidance measures incorporated into the project are characterised by:

- Examining alternate locations
- Utilising existing access tracks
- Stockpiling location
- Conveyor location.

The proposed design of the project has allowed utilisation of currently disturbed locations within the Quarry site. This therefore reduces the project overall footprint and impacts to biodiversity values of the site by limiting the vegetation clearance.

6.1.1 Alternate location

The Environmental Impact Statement (EIS) exhibited for NorthConnex identified a number of spoil management location options, with the final option(s) to be determined at construction stage.

The options identified in the EIS included the ADI site at St Marys, Gosford Quarry, Hornsby Quarry, the CSR Quarry, the Defence precinct Schofields (HMAS Nirimba) and the Great Southern Rock Quarry Sandy Point.

The management of spoil at Hornsby Quarry represents an opportunity to deposit of a large volume of spoil generated by the NorthConnex project. Additional benefits of the Hornsby Quarry site is that it provides the advantage of a site in relatively close proximity to the NorthConnex works (in comparison to other sites further to the north or west) with easy access via the M1 Pacific Motorway, Pennant Hills Road and the Pacific Highway.

With regards to alternate locations within the study area, the location of the project footprint has predominantly been located to utilise areas that are already cleared. The main area that will be cleared is associated with the access track on the eastern side of the site. This access track requires works to improve the access so that the trucks carrying the spoil will be able to safely enter.

6.1.2 Utilising access tracks

The project would utilise existing access roads and internal access tracks as far as possible to avoid the need to construct new roads and associated vegetation disturbance. However, the widening and sealing of Bridge Road is proposed to allow for safe traffic movements, which would involve some vegetation disturbance and clearing.

6.1.3 Stockpiling location

The location of the proposed stockpile will utilise a currently disturbed / cleared area that is currently utilised as part of the Mountain Bike Trail. No native vegetation has been mapped in this location and is currently dominated by exotic species, including pasture grasses and broadleaf exotic species.

6.1.4 Conveyor location

Alternative locations were proposed for the conveyor which would have required clearing through more intact native vegetation. However, following initial ecological constraints advice, the location of the conveyor has shifted to avoid the greater area of Blue Gum High Forest. The new location takes advantage of an area previously cleared for access to the void. The new location will therefore mostly avoid the CEEC and not result in the need to further fragment the CEEC.

6.2 Mitigation measures

Mitigation measures aim to reduce the ecological impacts of the Major Project to the greatest extent practicable. The relevant ecological impacts and associated mitigation measures and protocols (standard and project specific) are identified in **Table 11** and described in detail below. It is anticipated that the standard control measures (i.e. inductions etc.) would be incorporated in a flora and fauna management plan.

6.2.1 Standard mitigation measures

The mitigation and management measures would be detailed within a flora and fauna management plan, which would be prepared with consideration to the Roads and Maritime Biodiversity Guidelines – Protecting and managing biodiversity on Roads and Maritime projects (the Biodiversity Guidelines) (Roads and Traffic Authority 2011). The measures would include, but are not limited, to the following:

- The disturbance and clearance of established vegetation would be minimised as far as reasonable and feasible.
- Pre-clearing surveys would be undertaken prior to the commencement of site establishment by a suitably qualified ecologist to identify the presence of hollow bearing trees and other habitat features, and threatened flora and fauna. This would be undertaken in accordance with Guide 1 of the Biodiversity Guidelines.
- Exclusion zones would be identified to protect against accidental vegetation damage. This would be undertaken in accordance with Guide 2 of the Biodiversity Guidelines.
- Clearing of vegetation and the removal of bushrock, if required, would be undertaken in accordance with Guide 4 of the Biodiversity Guidelines to manage risks to fauna during vegetation clearing activities.
- Where reasonable and feasible habitat elements (such as woody debris and bushrock) would be stored and reused on site, or in adjacent bushland in accordance with Guide 5 of the Biodiversity Guidelines.
- Rehabilitation efforts will be as per the landowner requirements, with the aim of not precluding future land use (i.e. application of a sterile cover crop to achieve a stabilised groundcover, as per the Blue Book (Landcom 2004)).
- Any handling of fauna would be carried out by appropriately licenced or experienced person and undertaken in accordance with Guide 9 of the Biodiversity Guidelines.
- Works within aquatic habitats or riparian zones would be undertaken to limit impacts on aquatic flora and fauna, and their habitats, and impacts on riparian areas. This would be undertaken in accordance with Guide 10 of the Biodiversity Guidelines.

6.2.2 Project specific measures

Project specific measures are recommended for species where impacts would remain after the implementation of measures detailed in **Section 6.2.1**, or where additional mitigation measures would further reduce the ecological impact. The project specific mitigation measures are controls or protocols which would seek to further reduce impact on threatened species, native vegetation, or riparian and aquatic habitats

Native vegetation management

Rehabilitation efforts will be as per the landowner requirements, with the aim of not precluding future land use (i.e. application of a sterile cover crop to achieve a stabilised groundcover, as per the Blue Book (Landcom 2004)).

Sediment and erosion management

The flora and fauna management plan would include measures to minimise the impacts on all the adjoining vegetation by measures such as:

- Potential chemical pollutants (e.g. fuels, oils, lubricants, paints etc.) would be stored in appropriate containers within bunded areas within construction compounds to minimise the risk of the pollution of aquatic environments.
- Water quality would be protected through the implementation of suitable erosion and sediment control measures in accordance with Managing Urban Stormwater – Soils and Construction, Volume 2D, Main Road Construction (Department of Environment and Climate Change, 2008).

Fauna Protection Measures

A fauna protection protocol should be prepared to mitigate against impacts to aquatic fauna during the void dewatering. This protocol is intended to provide protection for any aquatic fauna that may be stranded as a result of dewatering of the void. No threatened species are expected to be present, however the protocol should also include procedures to manage unexpected finds.

The final project footprint is identified and assessed in the next chapter.

Table 11: Avoidance and mitigation measures

Impact	Flora and fauna management plan / standard mitigation measures	Project Specific	Responsibility	Timing*
Vegetation				
Clearing of native vegetation	• Inductions • Pre-clearing process • Exclusion zones • Clearing of vegetation and removal of bushrock • Re-use of woody debris and bushrock • Weed management • Nest boxes - installation of 12 nest boxes to offset the loss of the hollows that need to be removed • Fauna handling • Pathogen management	• Native vegetation management measures	Environmental representative and project contractor	Pre-commencement, site establishment, Carrying out of the project
Run off	• Erosion and sedimentation controls • Stabilisation of disturbed land in accordance with the requirements of the Blue Book.	• Sediment and erosion management and mitigation measures	Project contractor	Pre-commencement, Site establishment, Carrying out of the project
Spread of weeds	• Weed management • Re-establishment of native vegetation where possible to limit weed spread	• Sediment and erosion management and mitigation measures	Environmental representative and project contractor	Site establishment, Carrying out of the project
Spread of pathogens	• Pathogen management		Project contractor	Site establishment,

Impact	Flora and fauna management plan / standard mitigation measures	Project Specific	Responsibility	Timing*
Threatened fauna				
Loss of native fauna from clearance	• Clearing vegetation and removal of bushrock • Fauna handling	N/A	Environmental representative and fauna handlers	Site establishment,
Loss of habitat for fauna	• Re-use of woody debris and bushrock	• Native vegetation management measures	Environmental representative, project contractor and nest box installers	Pre-commencement Site establishment, Carrying out of the project
Loss of hollow bearing trees	• Pre-clearing process • Clearing vegetation and removal of bushrock • Re-use of woody debris and bushrock • Installation of 12 nest boxes prior to offset the loss of hollow bearing trees that need to be removed	N/A	Environmental representative, project contractor and nest box installers	Site establishment, Carrying out of the project

(blank)

7 Assessment of impacts

The potential impacts on biodiversity are discussed in this chapter. Impacts have been identified as both direct, such as direct clearing of vegetation, and indirect such as increases in noise, lighting and downstream riparian impacts.

The use of existing access tracks along with making the most of the disturbed/cleared area of the mountain bike site east of the void and the proposed conveyor location has avoided many of the potential impacts within the study area (**Table 9**). The project would have both direct and indirect impacts on a range of biodiversity values during the carrying out of the project. Impacts are mainly associated with the project footprint. The level of indirect impacts is considered to be minimal given the mitigation measures to be implemented (**section 6.2**).

The impact assessment has considered impacts during site establishment and the carrying out of the project and includes:

- Access Road construction / widening – site establishment impact
- Storage of spoil – carrying out of project impact
- Construction of conveyor belt – site establishment impact
- Spoil transport to the quarry void via conveyor belt – carrying out of project impact
- Deposition of spoil in quarry void – carrying out of project impact
- Haulage of spoil – carrying out of project impact
- Truck movements – site establishment and carrying out of project impact.

The direct impacts (**Section 7.1**) of the project relate to:

- Loss of vegetation/habitat.
- Weed spread.
- Changed hydrology.

Indirect impacts (**Section 7.2**) of the project relate to:

- Pathogens and animal pests.
- Impact on relevant Key Threatening Processes.
- Wildlife connectivity and habitat fragmentation.
- Injury and mortality.

Negligible impacts (**Section 7.3**) relate to:

- Bushfire
- Noise, vibration and light
- Groundwater dependent ecosystems
- Aquatic impacts.

Figure 9: Final project footprint

7.1 Direct impacts

7.1.1 Loss of vegetation and/or habitat

Loss of vegetation and fauna and flora habitat is a necessary consequence of the project. The field survey validated the type and extent of vegetation and various habitats present throughout the study area:

- One critically endangered ecological community (Blue Gum High Forest) has been recorded within the study area.
- One endangered population has potential to occur within the study area, none were recorded within the study area:
    - Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas
- One PCT associated with threatened species habitat was recorded in the study area. This PCT was Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin.

No critical habitat was identified within the study area for any species, communities or populations.

The amount of project footprint is 11.2 hectares, with a total of 1.64 hectares of native vegetation to be cleared, 4.02 ha of weeds and exotics, and the remainder cleared or water in the quarry void.

There were eight hollow bearing trees likely to be impacted by the project. None of the hollows to be impacted were large enough to be roosting or breeding habitat for large forest owls or large cockatoos. A total of 12 hollows will be impacted by the works. As a result of design alterations, the project would avoid the majority of the large hollow bearing trees present within the Quarry site.

7.1.2 Weeds

Weeds were abundant within the study area with some areas containing prolific weed infestations.

Noxious weeds encountered across the study area are shown in **Table 12**.

Table 12: Noxious weed species encountered in study area

Weed species	Noxious in LGA	Class	Weed of National Significance
Araujia sericifera (Moth vine)	Hornsby	4	×
Asparagus aethiopicus (Asparagus Fern)	Hornsby	4	✓
Cinnamomum camphora (Camphor Laurel)	Hornsby	4	×
Ipomoea indica (Morning Glory)	Hornsby	4	×
Genista monspessulana (Cape Broom)	Hornsby	3	✓
Lantana camara (Lantana)	Hornsby	4	✓
Ligustrum lucidum (Large-leaved Privet).	Hornsby	4	×
Ligustrum sinense (Small-leaved Privet).	Hornsby	4	×
Ochna serrulata (Mickey Mouse Plant)	Hornsby	4	×
Rubus fruticosus aggregate species (Blackberry)	Hornsby	4	×
Senecio madagascariensis (Fireweed)	Hornsby	4	✓

Class3: The plant must be fully and continuously suppressed and destroyed.

Class 4: The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.

The comprehensive list of weeds can be found in **Appendix D**. A total of 59 weeds species were recorded across the study area.

Given the high presence of weeds in the study area it is very likely that any vegetation disturbance could potentially create conditions where weeds are likely to invade or intensify. This would have a flow on effect on native flora and fauna by reducing quality of habitat, competition for resources and altering the structure and composition of vegetation communities.

Mitigation measures listed in **Section 6.2** would need to be implemented to contain the spread of weeds during the project.

7.1.3 Changes to hydrology

The development may result in impacts to the hydrology and aquatic ecology of creeks in the project area, via piping of stormwater runoff from newly sealed access roads into waterways east of the Quarry. There are some stormwater outlets that are currently discharging from Bridge Road into the study area. Changes to or upgrades of these outlets may increase surface flow across the Sandstone Blackbutt Woodland community. However it is noted that where the outlets currently discharge, there is already minor erosion and weed plumes. The area of discharge flows into an already diverted creek, which ultimately joins Old Man's Creek to the west of the Quarry.

It is noted that discharge of water from the quarry void is already covered under a current licence held by Hornsby Shire Council, and as such this is not included as part of this development.

7.2 Indirect impacts

7.2.1 Pathogens and animal pests

Pathogens

A number of pathogens are of concern in NSW that have the potential to impact on native flora and fauna. Activities that involve movement of equipment over large areas are of particular concern given the high potential for pathogen spread over large areas.

Although no sign of pathogen infection was identified during the field survey or literature search it is important to assess the potential impacts of these pathogens and mitigate against their spread. The main pathogens of concern are:

- Myrtle Rust (*Uredo rangelli*)
- Chytrid Fungus (*Batrachochytrium dendrobatidis*).

A pathogen of lesser concern is Phytophthora (*Phytophthora cinnamomi*).

Myrtle Rust is an air-borne plant fungus that attacks the young leaves, shoot tips and stems of Myrtaceous plants eventually causing plant death. It is spread by movement of contaminated material such as clothing, infected plants, vehicles and equipment etc. The 'introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae' is a listed Key Threatening Process under the TSC Act (OEH 2014c).

Chytrid fungus is a water-borne fungus that affects amphibians. It is spread by cross contamination of water bodies and improper handling of frogs. Chytridiomycosis is the infection that causes lethargy, emaciation, skin sloughing and a range of other symptoms that eventually result in death. The infection of frogs by amphibian chytrid fungus causing the disease Chytridiomycosis' is a listed Key Threatening Process under both the EPBC Act and the TSC Act (OEH 2014d).

Chytrid fungus is of particular concern in areas where the threatened Red-crowned Toadlet habitat occurs in the northern extents of the northern interchange study area. There is a potential that the fungus may be introduced into the species' habitat.

Phytophthora is a soil-borne fungus capable of causing tree death (dieback) by attacking the roots of native plants. Spores can be spread over large areas by water, vehicle and machinery movement as well as human and animal movement. 'Dieback caused by Phytophthora' is a listed Key Threatening Process under both the EPBC Act and the TSC Act (OEH 2014e).

Given that no pathogens have been identified or are likely to occur within the study area it is unlikely that pathogens would have a significant impact on flora and fauna as part of this project, provided the mitigation measures listed in **Section 6.2** are adopted to limit the introduction of pathogens.

Animal Pests

Given the study area is disturbed and within a highly urbanised setting it is likely that animal pests would be present within the study area. Most likely pests are:

- European Red Fox (*Vulpes vulpes*)
- European Rabbit (*Oryctolagus cuniculus*)
- Feral Cat (*Felis catus*).

The European Red Fox can be found in a range of habitats. They prey on medium-sized ground-dwelling and semi-arboreal mammals and ground-nesting birds. 'Predation by the European Red Fox *Vulpes vulpes*' is a Key Threatening Process listed under both the EPBC Act and the TSC Act. Animal scats likely to belong to the European Red Fox were noted within the study area. The project is not likely to increase the presence of introduced foxes or increase predation of native fauna because no additional tracks will be created which facilitate movement of predators into otherwise uncleared or undisturbed vegetation.

The European Rabbit causes a number of environmental problems in the Australian landscape. The rabbit can increase the likelihood of soil erosion by creating numerous burrows, threaten the survival of a number of native animal species by altering habitat, reducing native food sources, displacing small animals from burrows and attracting introduced predators such as foxes. 'Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)' is a listed Key Threatening Process under both the EPBC Act and the TSC Act. Evidence of Rabbits was identified within the study area particularly in the open/disturbed areas of the mountain bike track. The project is not likely to increase the presence of the European Rabbit within the study area because the project is removing only small areas of native vegetation and will clear some areas that are heavily weed invaded which are utilised by the European Rabbit.

Cats can be found in almost all terrestrial environments in Australia. Predation by feral cats is a particular problem that affects native fauna such as small mammals (such as rodents, dasyurids, and burramyids) and ground-nesting birds. 'Predation by the feral cat (*Felis catus*)' is a listed Key Threatening Process under both the EPBC Act and the TSC Act. No evidence of feral cats was identified during the field survey however feral and domesticated cats are likely to forage throughout the study area given the extensive areas of surrounding urban development. Given the likely abundance of cats in the locality, and the nature of the impacts associated with the project, the project is unlikely to increase the abundance of cats, introduce them into new areas, or increase predation pressure on native fauna.

7.2.2 Impact on relevant Key Threatening Processes

A number of Key Threatening Processes have been identified as being relevant. The activities associated with the project would either contribute to the Key Threatening Processes (known) or may potentially contribute to the Key Threatening Processes (potential). These are listed in **Table 13**.

Table 13: Known and potential Key Threatening Processes and impacts on biodiversity

Key Threatening Process	Relevance to the project	Potential or known
Clearing of native vegetation (TSC Act) Land clearance (EPBC Act)	Clearing of vegetation including native vegetation would be undertaken as part of the project. There would be a need to offset the loss of native vegetation in accordance to the Guideline for Biodiversity Offsets (Roads and Maritime Services 2011). This is discussed in **section 8**.	Known
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act) Infection of amphibians with chytrid fungus resulting in chytridiomycosis (EPBC Act)	Potential habitat for frogs within the study area within the ephemeral drainage line located within the mountain bike track. Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of the chytrid fungus in these habitats with potential to impact on frog species. With the implementation of appropriate mitigation measures listed in **section 6.2** the risk is considered to be low.	Potential
Infection of native plants by *Phytophthora cinnamomi* (TSC Act)	Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of the plant pathogen *Phytophthora cinnamomi.* Presence of the plant pathogen within the study area is unknown. With the implementation of appropriate mitigation measures listed in **section 6.2** the risk is considered to be low.	Potential
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (TSC Act)	Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of 'Myrtle Rust'. Presence of Myrtle Rust within the study area is unknown. With the implementation of appropriate mitigation measures listed in **section 6.2** the risk is considered to be low.	Potential
Invasion and establishment of exotic vines and scramblers (TSC Act)	Exotic vines and scramblers are present within the study area including areas along road and track edges within the study area. Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of these exotic vines and scramblers and well as disturbing intact vegetation can increase the risk of weed infestations. Appropriate mitigation measures are to be implemented to limit the spread of weeds and reduce the risk of weed infestations of areas.	Potential
Invasion, establishment and spread of *Lantana camara* (TSC Act)	*L. camara* is present within the study area including within the disturbed/cleared section of the mountain bike track. Movement of vehicles, equipment and people carries a risk of introduction and spread of *L. camara* into unaffected areas. Appropriate mitigation measures are to be implemented to limit the spread of weeds and reduce the risk of weed infestations of areas.	Potential

Key Threatening Process	Relevance to the project	Potential or known
Loss of Hollow-bearing Trees (TSC Act)	The project would result in permanent removal or lopping of up to eight hollow bearing trees, containing 12 hollows (AECOM 2014). There would be a need to offset the loss of hollow-bearing trees through the installation of nest boxes in accordance to the Guideline for Biodiversity Offsets (Roads and Maritime, 2011). This is discussed further in **section 6.2.2**.	Known

7.2.3 Wildlife connectivity and habitat fragmentation

Fragmentation of habitat would be minimal across the study area given that the project footprint is generally following the alignment of the existing track infrastructure. The Hornsby Quarry site abuts and is connected to the vegetation of the Berowra Valley Regional Park to the west. There is likely to be an increase in the gaps between patches of native vegetation resulting from the widening of the access road into the quarry from Bridge Road. The project is not expected to significantly fragment this vegetation given that the project area is already partially cleared and the activities within the Hornsby Quarry study area are temporary.

Wildlife connectivity would not be significantly affected due to the project footprint generally following the existing access track. No new access tracks are proposed and areas where there is existing connectivity will remain.

The edge effect is likely to impact on native vegetation through the increased presence of weeds, particularly around the edges of the project footprint. No threatened species are expected to be affected by increases in weeds. One endangered ecological community may be affected by increases in weeds. However this community, Blue Gum High Forest, is already degraded by the presence of weeds in the study area. Mitigation measures to manage an increase in weed spread are discussed. Such measures include clearance limits, fencing off areas and specific site induction covering sensitive environmental issues.

7.2.4 Injury and mortality

Fauna injury or mortality could occur as a result of both the site establishment and carrying out of the project. The access roads will experience an increase in traffic via truck haulage. However, truck movements will be speed limited and impacts to fauna are likely to be limited.

During the site establishment of the project, injury or mortality may occur as a result of vegetation clearing or direct collision with vehicles and equipment within the project site. Although some mobile species may be able to move away quickly and easily such as some birds, others may be slower to move away or may not relocate at all such as some reptiles and amphibians, potentially resulting in injury or mortality of the individual.

Although the project may potentially result in some injury or mortality of fauna species, the project is unlikely to cause a significant increase in fauna injury or mortality incidents. This is because truck movements along the access roads will be speed limited due to the steep and winding nature of the access roads, allowing fauna to move off the road.

7.3 Negligible impacts

7.3.1 Bushfire

It is understood there are no permanent built or inhabited structures within areas surrounded by bush, other than road and drainage infrastructure, therefore no hazard reduction would be required within the study area. The project would not result in impediments to the implementation of bushfire protection measures within the study area. It is possible that activities during site establishment (e.g. welding) or final use of the above ground part of the assets may result in bushfire igniting and spreading from project areas. Under section 63 of the *Rural Fires Act 1997*, the obligation to prevent the occurrence and spread of bushfire needs to be factored in. This can be dealt with by emergency management planning, training and escalation protocols on days of increased bushfire risk.

The project would not result in an increased risk of inappropriate fire regimes which may adversely affect the ecological values of the remnant vegetation and associated habitats within the study area and beyond.

7.3.2 Noise, vibration and light

Indirect impacts on biodiversity caused by noise, vibration and light as part of the site establishment as well as changes in noise or lighting impacts as a result of the carrying out of the project are likely. Certain threatened species are particularly vulnerable to these indirect impacts.

All works associated with spoil management on the Hornsby Quarry site would be confined to standard work hours comprising:

- 7am to 6pm Monday to Friday.
- 8am to 1pm Saturdays.
- No work on Sundays or Public Holidays.

Whilst no works are currently proposed to occur outside of standard work hours there may be circumstances where out-of-hour works are necessary. Works which may be undertaken outside of standard work hours, without further approval, would include any of the following circumstances:

- Works which are determined to comply with the relevant Noise Management Level (NML) at the most affected sensitive receiver.
- The delivery of materials as required by the Police or other authorities for safety reasons.
- Where it is required to avoid the loss of lives, property and / or to prevent environmental harm in an emergency.
- Where agreement is reached with affected receivers.
- Where explicitly approved through an Environment Protection Licence.

Threatened species most at risk from indirect noise and vibration are:

- Nocturnal birds (such as Powerful Owl and Barking Owl) may be impacted by daily noise which could affect their behaviour.
- Bats and nocturnal mammals within the study area could be impacted by increased noise during the site establishment phase of the project and during the carrying out of the project.
- Diurnal birds may be indirectly impacted by noise during the project. Species such as small woodland birds are known to be impacted by noise associated with roads (Reijnen et al, 1995).

Noise and vibration impacts as a result of site establishment and the carrying out of the project are likely to affect fauna species that rely on sound to communicate or are nocturnal and sleep during the day when project activities are at their peak. These may include bats and other nocturnal mammals and diurnal and nocturnal birds.

Changes to the availability of light as a result of vegetation clearance may potentially impact both flora and fauna species. The potential impacts are likely to be a result of:

- Altering light regimes affecting plant growth.
- Changes to micro-climates caused by overshadowing or increased light potentially increasing the likelihood of weed invasion.

In general noise and vibration and light are unlikely to have a significant effect on the diurnal and nocturnal threatened birds and diurnal and nocturnal mammals in the study area, because these areas already receive these types of indirect impacts, and mitigation measures would be enacted by the project. In addition, noise and vibration impacts will be temporary. Works are expected to be conducted over a 33 month period. Haulage of spoil will not be a permanent activity for this site. Similarly these indirect impacts are unlikely to result in significant impacts on the amphibians and reptiles that have the potential to occur in the study area.

7.3.3 Groundwater dependent ecosystems

The main groundwater dependent ecosystems (GDEs) in the study area are Sandstone Blackbutt Woodland. While this vegetation type has a ‘moderate’ chance of being groundwater dependent, the water levels in the void are likely to be significantly lower than the root zone for the plants in this vegetation type.

Water level adjacent to the quarry is between 49 and 161 metres below ground level, and in-filling of the quarry is not expected to alter this. An impact assessment suggested that groundwater flow in the study area would become closer to the pre-quarry flow rates than they currently are (GHD 2009). Provided the material used to fill the quarry is not contaminated or contain sulphuric ores, soils, or other waste, the groundwater chemistry should not be impacted (GHD 2009). The proposed spoil emplacement and management would comprise of ENM and VENM materials and would not comprise waste materials or materials classified as contaminated. This means that even if vegetation communities do draw on groundwater, filling the quarry with appropriate material will not result in any significant impacts.

Widening of access roads to the quarry will be needed during quarry filling, which may require the clearing of some vegetation with potential groundwater dependence. However the ground water levels are likely to be far lower than the lowest root zone for this vegetation.

7.3.4 Aquatic impacts

A lack of ecosystem processes and aquatic habitat (e.g. soft littoral sediments and macrophyte beds) limits the type of aquatic fauna that could survive in the quarry void pond. Macroinvertebrates present would likely be hardy species suited to disturbed conditions, rather than threatened species that are known to inhabit good quality streams (e.g. Adams Emerald Dragonfly in Berowra Creek). Impacts to threatened fish are unlikely, given none are expected to occur in the quarry pond. Full dewatering or infilling of the quarry pond would extinguish the potential for all aquatic habitat, although it has limited value as a ‘lake’ (see **section 3.3**).

Loss of this water body would not affect downstream Key Fish Habitat, migration routes, spawning habitat or refuge habitat for any native fish. This is largely due to its isolation and difficulty for overland fish dispersal.

As the water level drops extremely low during the final stages of dewatering, dissolved oxygen may be quickly consumed by bacteria, decomposing algae and aquatic fauna (if any). This could cause impacts on aquatic fauna (e.g. fish) and semi-aquatic fauna (e.g. waterbirds, turtles, frogs and water dragons). Semi-aquatic fauna are capable of relocating themselves, although the surrounding terrain may be difficult to navigate. These impacts are understood to be covered by Hornsby Council's current water licence which allows for dewatering of the void. A faun protection protocol is recommended to provide protection for any aquatic fauna stranded as a result of dewatering.

8 Impact summary and offsets

Although avoidance and mitigation measures have been considered and implemented during the design of the project, impacts on native vegetation (including Endangered Ecological Communities) have been identified that require offsetting. The areas and credits required for offsets are outlined below.

8.1 Areas not requiring assessment or offsets

Areas not requiring assessment or offset, including for PCTs and species are outlined below and shown in **Figure 8**. The areas not requiring assessment were:

- Cleared areas – associated with tracks and roads, and areas dominated by exotics
- Water in the void
- Areas of site value score <17 (none of the vegetation met this criteria).

8.2 Ecosystem and species credits requiring offsets

Ecosystem credits and species credits that measure the impact of the Major Project on biodiversity values in the project footprint are outlined below in **Table 14** and **Table 15** (respectively) and shown in **Figure 10**. Due to the small area of poor condition Sydney Blue Gum Forest being impacted in the assessment (0.06ha), which was less than the minimum size of 0.25ha, this vegetation zone was combined with the poor quality Smooth-barked Apple vegetation zone.

Table 14: PCTs requiring offset and ecosystem credits

PCT requiring offsets	Area (ha)	Vegetation zone	Future site value score	Loss in site value score	Offset multiplier	Ecosystem credits required
HN586 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (Moderate condition)	0.58	2	0	49.28	2	16
HN586 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (Poor condition)	1.06	Vegetation zones 1 and 3 were merged due to the small size of vegetation zone 1	0	21.01	2	14

Table 15: Species requiring offset and credits required

Species requiring offsets	TS offset multiplier	Required species credits
Gang-gang Cockatoo endangered population in the Hornsby and Ku-ring-gai LGA (1.64ha impacted)	2.0	33

8.3 Impacts requiring further consideration

No matters for further consideration were listed in the SEARS or accompanying agency advice. The project also does not affect:

- A riparian buffer of an important river, stream or estuary
- Important wetland or its buffer
- Impacts on species movements along corridors(state significant biodiversity link)

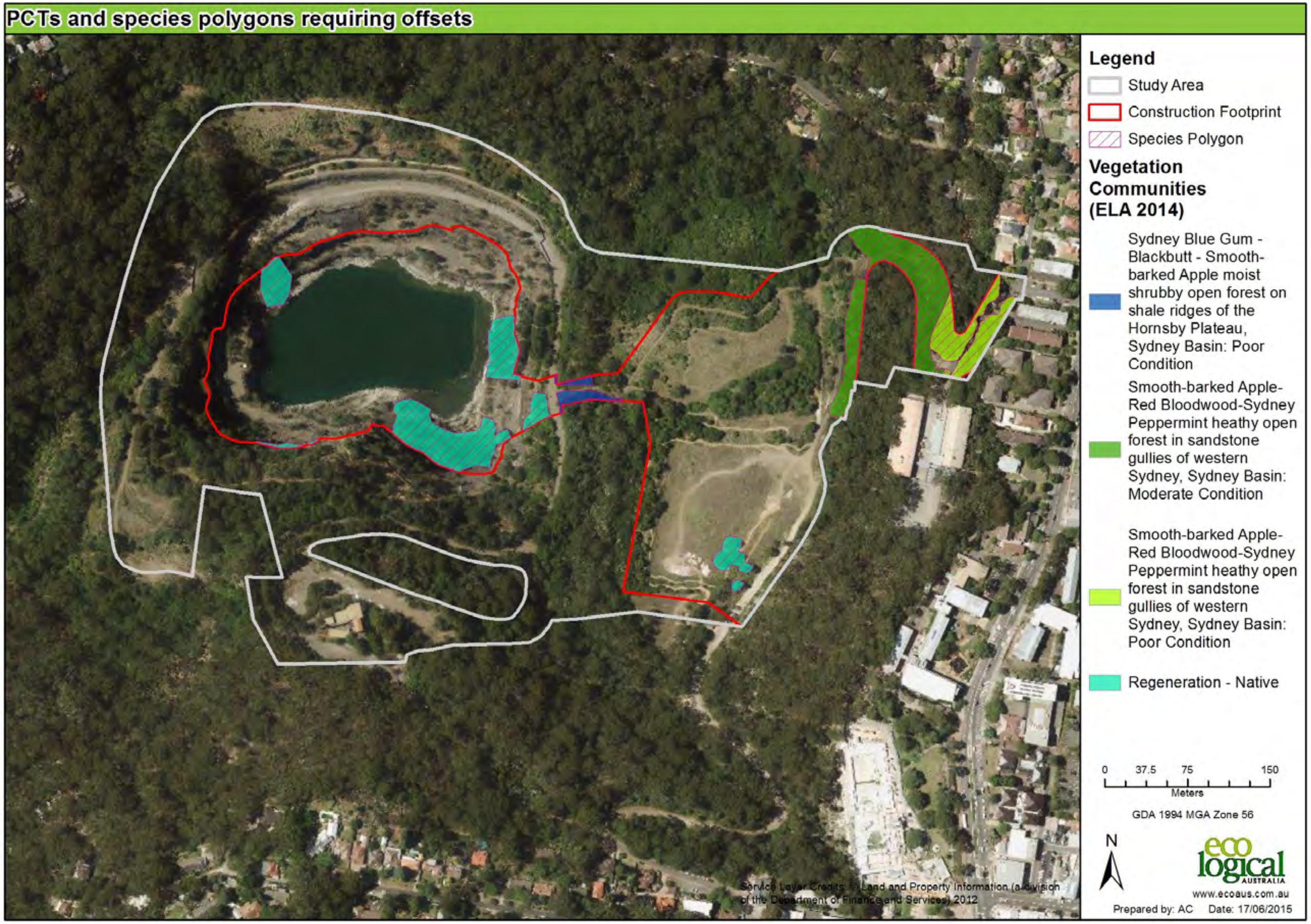

Figure 10: PCTs and species polygons requiring offsets

(blank)

9 Summary and biodiversity credit report

This project was assessed as a Major Project in accordance with the Framework for Biodiversity Assessment. The assessed project footprint covers all the areas required for the project, including excavation, spoil placement, machinery and access roads. ELA approached the assessment by conducting both desktop analysis and field assessment, using the FBA methodology to assess habitat and condition of ecological communities.

One plant community type required offsets. This was:

- Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (Sandstone Blackbutt Woodland) requiring 30 ecosystem credits.

One species credit species required an offset. This was:

- Gang-gang Cockatoo endangered population in the Hornsby and Ku-ring-gai local government areas – requiring 33 credits.

Avoidance of high value ecological matters was achieved through refining the design, especially for the conveyor. The project also avoided native plant communities by taking advantage of previously cleared areas and areas with high dominance of weeds. The spoil stockpiles are to be placed on exotic grasslands, which do not correspond with any PCT.

Mitigation measures have been considered and will be delivered by:

- Delineation of clearance areas
- Management of weed spread
- Conducting the project during standard works hours as described in Section 7.3.2.
- Management of traffic within the site
- Containment of potential pollutants within specific areas to be bunded
- Rehabilitation efforts will be as per landowner requirements, with the aim of not precluding future land use.

An offset strategy consistent with the offset strategy for the NorthConnex project would be prepared to compensate for the loss of native vegetation, endangered ecological communities and threatened species habitat which cannot be avoided or mitigated. A copy of the credit report from the tool is included below.

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 17/06/2015 Time: 9:47:28PM Calculator version: v4.0

Major Project details

Proposal ID:	0039/2015/1830MP
Proposal name:	Hornsby Quarry Version 2
Proposal address:	Quarry Road NSW
Proponent name:	Roads and Maritime
Proponent address:	
Proponent phone:	
Assessor name:	Steven Ward
Assessor address:	Level 6, 299 Sussex Street SYDNEY NSW 2000
Assessor phone:	9993 0566
Assessor accreditation:	0039

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	1.64	30.00
Total	1.64	30

Credit profiles

1. Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion, (HN586)

Number of ecosystem credits created	30
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion, (HN586) Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion, (HN566) Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion, (ME012) Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion, (HU595) Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion, (HU622) Spotted Gum - Grey Ironbark open forest in the Pittwater area, Sydney Basin Bioregion, (HN642) Sydney Peppermint - White Stringybark - Smooth-barked Apple forest on shale outcrops, Sydney Basin Bioregion, (HN644) Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands, (HU833) Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast, (HU850) Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast, (HU856) Red Bloodwood - Smooth-barked Apple - Scribbly Gum - Old Man Banksia heathy woodland on sandstone ranges of the Central Coast, (HU857)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	Callocephalon fimbriatum population in the Hornsby and Ku-ring-gai Local Government Areas	1.64	33

References

AECOM Australia Pty Ltd, 2014. *M1 – M2 Hollow Bearing Trees Report*. Prepared for Roads and Maritime Services.

Allison, F.R. and Hoye, G.A. 1998. 'Eastern Freetail-bat', In: Strahan, R. (Ed.) The Mammals of Australia, pp. 484-485, Australian Museum/ Reed Publications, Sydney.

Aquila Ecological Surveys, 2011. *Targeted Survey for the Varied Sittella and Supplementary s5A Assessments, Proposed Mountain Bike Trail Site, Old Mans Valley, Hornsby*. Prepared for Hornsby Shire Council.

Benson, D. and McDougall, L. 1992. 'Ecology of Sydney plants 2', Cunninghamia, 3(4): 709- 1004.

Benson, D. & McDougall, L. 1998. Ecology of Sydney plant species Part 6: Dicotyledon family Myrtaceae. Cunninghamia 5(4): 808-987.

Blakers, M., Davies, S., and Reilly, P.N 1984. The Atlas of Australian Birds. RAOU Melbourne University Press.

Bureau of Meteorology (BOM), Climate Data Online, Available at: http://www.bom.gov.au/climate/averages/tables/cw_066047.shtml [Accessed 23 March 2015]

Cardno, 2013. Hornsby Quarry Land Filling Preliminary Impact Assessment. Report prepared for Hornsby Council by Cardno.

Catling, P.C., R.J. Burt & R.I. Forrester 1998 Models of the distribution and abundance of ground-dwelling mammals in the eucalypt forests of south-eastern New South Wales. Wildlife Research. 25(5):449-466.

Catling, P.C., R.J. Burt & R.I. Forrester 2000 Models of the distribution and abundance of ground-dwelling mammals in the eucalypt forests of north-eastern New South Wales in relation to habitat variables. Wildlife Research. 27:639-654.

Chapman, GA and Murphy, CL, 1989, Soil Landscapes of the Sydney 1:100 000 sheet Map, Soil Conservation Service of NSW, Sydney.

Churchill, S. 1998. *Australian Bats*, Reed New Holland, Sydney.

Corben C and O'Farrell MJ 2002. *Anabat System Manual* 2nd Edition.

Cropper, SC, 1993. *Management of endangered plants.* CSIRO Australia, Melbourne.

Debus, S.J.S. and Chafer, C.J. 1994. 'The Powerful Owl Ninox strenua in New South Wales', Australian Birds. 28:s21-s38.

Department of Environment and Climate Change NSW (DECC) 2007. Threatened Species Profiles http://www.threatenedspecies.environment.nsw.gov.au/index.aspx

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

Department of Environment and Heritage NSW 2012. Threatened Species Profiles http://www.threatenedspecies.environment.nsw.gov.au/index.aspx Accessed November 2012

Department of Sustainability Environment Water Population and Communities 2012. Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from http://www.environment.gov.au/sprat

Department of the Environment (DotE), 2013. *EPBC Act Draft Threatened Orchid Survey Guidelines*. Commonwealth of Australia, Canberra.

Department of the Environment (DotE), 2015. Protected Matters Search Tool. Available: http://www.environment.gov.au/epbc/protect/index.htm.

Dragonfly Environmental 2011. *Review of Environmental Factors Old Mans Valley and Hornsby Park Proposed Mountain Bike Trail.* Report prepared for Hornsby Shire Council.

Dwyer, P.D. 1995. 'Common Bent-wing Bat (Miniopterus schreibersii)', In: R. Strahan (Ed.) The Australian Museum Complete Book of Australian Mammals, pp494-495, Angus and Robertson Publishers, Sydney.

Eby, P. 1998. 'An analysis of the diet specialisation in frugivorous Pteropus poliocephalus in Australian subtropical rainforest', Austral Ecology, 23:443-456

Eco Logical Australia Pty Ltd 2014. *NorthConnex Technical Working Paper; Biodiversity*. Prepared for AECOM on behalf of Roads and Maritime Services.

Edgar, R. & C. Belcher 2008. Spotted-tailed Quoll, Dasyurus maculatus (Kerr, 1792). In: Strahan, R., ed. The Mammals of Australia. Page(s) 61-62. Carlton, Victoria: Reed New Holland.

Ehmann, E. 1997. *Threatened Frogs of New South Wales: Habitats, status and conservation*, Frog and Tadpole Study Group, Sydney.

Ehmann, H., 1997. (Editor). *Threatened frog species of New South Wales*. Frog and Tadpole Study Group of NSW, Sydney.

Environment Australia 2000. Comprehensive and Regional Assessments for North-East NSW. Report to National Parks and Wildlife Service.

Fairfull, S. 2013. *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update).* NSW Department of Primary Industries.

Forshaw, J.M. and Cooper, W.T. 1981. *Australian Parrots*, (2nd Ed.). Lansdowne Press, Melbourne.

Franklin, D., P. Menkhorst & J. Robinson 1989 Ecology of the Regent Honeyeater Xanthomyza phrygia. Emu. 89:140--154.

Garnett, S. (Ed) 1993. Threatened and extinct birds of Australia. Royal Australian Ornithologists Union and Australian NPWS, Royal Australian Ornithologists Union Report, No. 82.

GHD, 2009. *Review of Options for Filling Hornsby Quarry, Discussion Paper*. Report prepared for Hornsby Quarry by GHD.

Harden, G.J., McDonald, W.J.F. and Williams, J.B. 2006. *Rainforest Trees and Shrubs; A field guide to their identification*. Gwen Harden Publishing.

Higgins, P.J., J.M. Peter & W.K. Steele (Eds) 2001 Handbook of Australian, New Zealand and Antarctic Birds. Volume Five - Tyrant-flycatchers to Chats. Melbourne: Oxford University Press.

Industry and Investment NSW (I&I NSW), 2015. *Fisheries NSW Threatened & Protected Species - Records Viewer.* http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer [Accessed 17/1/2014]

Kavanagh, R. P., 2004. Conserving owls in Sydney's urban bushland: current status and requirements. **In**: D. Lunney and S. Burgin eds. *Urban Wildlife more than meets the eye*. Pages 93-108. Mosman: Royal Zoological Society of NSW.

Ku-ring-gai Council (2013). *Ku-ring-gai Flying-fox Reserve Management Plan*. Ku-ring-gai Council.

Kushlan, J.A. & J. Hancock 2005. *Herons*. Oxford, United Kingdom: Oxford University Press.

Law, B. S., Anderson, J. and Chidel, M. 1999. Bat communities in a fragmented forest landscape on the south-west slopes of New South Wales, Australia. – Biol. Conserv. 88: 333–345.

Ley, A. & M.B. Williams 1992 The conservation status of the Regent Honeyeater near Armidale, New South Wales. Australian Bird Watcher. 14:277--281.

Lloyd A., Law B. & Goldingay R. 2006: Bat activity on riparian zones and upper slopes in Australian timber production forests and the effectiveness of riparian buffers. *Biol. Conserv. 129: 207–220.*

Mahony, M., 1999. Review of the declines and disappearances within the bell frog species group *(Litoria aurea* species group) in Australia. **In:** A. Campbell, ed. *Declines and disappearances of Australian frogs*. Page(s) 81-93. Canberra: Environment Australia

Mansergh, I. M. 1984.'The status, distribution and abundance of Dasyurus maculatus (Tiger Quoll) in Australia with particular reference to Victoria', Australian Zoolology, 21(2):109-22.

Marchant and Higgins 1993. *Handbook of Australian, New Zealand and Antarctic Birds*. Oxford University Press, Melbourne. ;

Martínez-Vilalta, A. & A. Motis 1992. Family Ardeidae (Herons). **In**: del Hoyo J., A. Elliott & J. Sargatal, eds. Handbook of the Birds of the World. Page(s) 376-42. Barcelona: Lynx Edicions.

McKenzie, N.L., Start, A.N. and Bullen, R.D. (2002). Foraging ecology and organization of a desert bat fauna. *Australian Journal of Zoology* **50**: 529–548.

McKilligan, N. 2005. *Herons, Egrets and Bitterns*, CSIRO Publishing.

Menkhorst, P. and Knight, F. 2004. A Field Guide to the Mammals of Australia, 2nd Edn., Oxford University Press, South Melbourne.

Menkhorst, P. and Seebeck, J.1990. 'Distribution and Conservation Status of Bandicoots in Victoria', In: Seebeck, J., Brown, P., Wallis, R. and Kemper, C. (Eds.) Bandicoots and Bilbies, Surrey Beatty and Sons, Sydney.

Mills DJT, Norton TW, Parnaby HE, Cunningham RB and Nix HA 1996. Designing surveys for microchiropteran bats in complex forest landscapes – a pilot study for south-east Australia. *Forest Ecology and Management* 85: 149**–**161.

Mitchell, P 2002. *NSW Ecosystems Study: Background and Methodology*. Groundtruth Consulting, Gladesville, NSW.

Morcombe, M. 2004. *Field Guide to Australian Birds*, Steve Parish Publishing.

National Parks and Wildlife Service 1997. Urban Bushland Biodiversity Study - Western Sydney, National Parks and Wildlife Service.

NSW Department of Primary Industries (DPI) 2015. Weeds declared in the Local Control Authority area of the Council of the Shire of Hornsby. Available: http://weeds.dpi.nsw.gov.au/WeedDeclarations/Results

NSW Department of Primary Industries (DPI), 2013. *Mapping of Key Fish Habitat – LGAs in Sydney Area.* NSW DPI, Fisheries Ecosystem Branch.

NSW Flora Online (2011). Plantnet. [Online]. http://plantnet.rbgsyd.nsw.gov.au/ [Accessed 18 December 2013.]

NSW National Parks and Wildlife Service (NPWS), 1998. *Vertebrate Fauna Survey – A project undertaken as part of the NSW Comprehensive Regional Assessment*. Project Number NA 01/EH.

NSW National Parks and Wildlife Service 1995. *Endangered Fauna of Western New South Wales*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service (NPWS), 2002. *Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney, Final Edition.* NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service (NSW NPWS), 2003. Draft Recovery Plan for the Barking owl (Ninox connivens). NSW NPWS, Sydney.

NSW Scientific Committee 2000. Final Determinations http://www.environment.nsw.gov.au/committee/finaldeterminations.htm accessed 26/11/2012

NSW Scientific Committee 2001. Final Determinations http://www.environment.nsw.gov.au/committee/finaldeterminations.htm accessed 28/11/2012

NSW Scientific Committee, 2008. Glossy Black-cockatoo - Review of Current Information in NSW. http://www.environment.nsw.gov.au/resources/nature/schedules/GlossyBlackCockatoo.pdf

Office of Environment and Heritage (OEH), 2004. *Draft Threatened Species Survey Guidelines*. OEH, Hurstville.

Office of Environment and Heritage (OEH) 2013a. Sydney Basin Bioregions, http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Subregions.htm [Accessed 17th December 2013].

Office of Environment and Heritage, 2013b. Glossy Black Cockatoo – profile. Available: http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10140. [Accessed December 2013].

Office of Environment and Heritage, 2013c. Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas – profile. Available: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10133 [Accessed December 2013].

Office of Environment and Heritage, 2013d. *The Native Vegetation of the Sydney Metropolitan Area. Volume 1: Technical Report. Version 2.0.* Office of Environment and Heritage, Department of Premier and Cabinet, Sydney.

Office of Environment and Heritage, 2014a. Major Projects offsets policy. State Government of NSW.

Office of Environment and Heritage, 2014b. Framework for Biodiversity Assessment. State Government of NSW.

Office of Environment and Heritage 2014c. Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae - key threatening process listing. Available http://www.environment.nsw.gov.au/determinations/exoticrustfungiFD.htm. [Accessed January 2014].

Office of Environment and Heritage 2014d. Infection of frogs by amphibian chytrid causing the disease chytridiomycosis - key threatening process listing. Available: http://www.environment.nsw.gov.au/animals/AmphibianChytridKTPListing.htm. [Accessed January 2014].

Office of Environment and Heritage 2014e. Infection of native plants by *Phytophthora cinnamomi* - key threatening process listing. Available: http://www.environment.nsw.gov.au/determinations/PhytophthoraKTPListing.htm [Accessed January 2014].

Office of Environment and Heritage (OEH), 2015a. *Atlas of NSW Wildlife.* (online). Available: http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx [Accessed March 2015].

Office of Environment and Heritage, 2015b. NSW Vegeation Information System (online). Available: http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx

Office of Environment and Heritage (OEH), 2015c. Threatened Species Profile Database (online). Available: http://www.environment.nsw.gov.au/asmslightprofileapp/account/login?ForceLogin=1

Oliver, D., A. Ley, H. Ford & B. Williams 1999 Habitat of the Regent Honeyeater Xanthomyza phrygia and the value of the Bundarra-Barraba region for the conservation of avifauna. Pacific Conservation Biology. 5:224--239.

Parsons Brinckerhoff, 2004. Hornsby Quarry and Environs Land Capability Study. Report prepared for Hornsby Council by Parsons Brinckerhoff 2004.

Payne, R. 1991. ‘New findings of the rare tree Syzygium paniculatum (Myrtaceae) in the Wyong area, NSW, Cunninghamia, 2(3):495-498.

Payne, R. 1997. The Distribution and Reproductive Ecology of Syzygium paniculatum and Syzygium australe (Myrtaceae) in the Gosford-Wyong Region. Unpublished Thesis prepared for the award of Masters of Natural Resources, University of New England, Armidale NSW.

Pells Sullivan and Maynink (PSM), 2007. Former CSR quarry Hornsby & associated lands. Unpublished report.

Pennay M, Law B and Reinhold L 2004. *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats*. New South Wales Department of Environment and Conservation, Hurstville.

Pyke, G.H. & A.W. White, 1996. Habitat requirements for the Green and Golden Bell Frog *Litoria aurea* (Anura:Hylidae). Australian Zoologist. 30(2):224-232.

Reed, P.C., Lunney, D. and Walker, P. 1990. ‘A 1986-7 survey of the Koala Phascolarctos cinereus in NSW and an ecological interpretation of its distribution’, In: Biology of the Koala, pp: 55-74;8

Reijnen, R., Foppen, R., Braak, C. T. and Thissen, J, 1995. The effects of car traffic on breeding bird populations in woodland. III. Reduction of density in relation to the proximity of main roads, Journal of Applied Ecology, 32 (1) 187-202.

Reinhold L, Law B, Ford G and Pennay M 2001. *Key to the bat calls of the south-east Queensland and north-east New South Wales.* Forest Ecosystem Research and Assessment Technical Paper 2001-07. Department of Natural Resources and Mines, Queensland, 62pp.

Shields J, Chrome F (1992) 'Parrots and Pigeons of Australia.' (Angus and Robertson: Sydney)

Simpson, K. and Day, N. 1999. Field guide to the birds of Australia 6th edn., Penguin Books Australia Ltd, Ringwood Victoria.

Simpson, K. and Day, N. 2004. Field guide to the birds of Australia 7th edn., Penguin Books Australia Ltd, Ringwood Victoria.

Smith, P and Smith, J, 2008, Native Vegetation Communities of Hornsby Shire, 2008 Update, Report and GIS layer prepared for Hornsby Shire Council November 2008, P. and J. Smith Ecological Consultants, Blaxland.

Webster, R. & P. Menkhorst 1992 The Regent Honeyeater *Xanthomyza phrygia*: population status and ecology in Victoria and New South Wales. Arthur Rylah Institute for Environmental Research Technical Report Series Number 126. Dept of Conservation & Environment, Melbourne.

Appendix A Likelihood of occurrence

Provided below are the likelihood tables for threatened species listed under the Commonwealth EPBC Act. Species, populations and communities considered to have the potential, are likely or are known to occur are highlighted blue.

The analysis of the likelihood of occurrence table included previous surveys conducted by Eco Logical Australia (ELA).

Key to the table:

- TSC Act = Listing under the NSW *Threatened Species Conservation Act 1995*
- EPBC Act = Listing under the *Environment Protection and Biodiversity Conservation Act 1999*
- CE = Critically Endangered
- E = Endangered (EPBC Act)
- E1 = Endangered (TSC Act)
- E2 = Endangered Population (TSC Act)
- E4 = Extinct (TSC Act)
- V = Vulnerable
- M = Migratory (EPBC Act)
- Mar = Marine (EPBC Act)

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Acacia bynoeana	Bynoe's Wattle	E1	V	*Acacia bynoeana* is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains, and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (DECC 2007).	6	Unlikely - little ironstone gravels found within the study area
Acacia gordonii	-	E1	E	*Acacia gordonii* is restricted to the north-west of Sydney, occurring in the lower Blue Mountains in the west, and in the Maroota/Glenorie area in the east, within the Hawkesbury, Blue Mountains and Baulkham Hills local government areas. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops (DECC 2007).	2	Unlikely – verified in field assessment
Acacia pubescens	Downy Wattle	V	V	*Acacia pubescens* occurs on the NSW Central Coast in Western Sydney, mainly in the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It is associated with Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest growing on clay soils, often with ironstone gravel (NPWS 1997; Benson and McDougall 1996).	EPBC	Unlikely – verified in field assessment
Allocasuarina glareicola		-	E	*Allocasuarina glareicola* is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil (DECC 2007).	EPBC	Unlikely – verified in field
Asterolasia elegans	-	E1	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys (OEH 2014).	EPBC	Unlikely – verified in field
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	*Cryptostylis hunteriana* is known from a range of vegetation communities including swamp-heath and woodland (DECC 2007). The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla* (Scribbly Gum), *E. sieberi* (Silvertop Ash), *Corymbia gummifera* (Red Bloodwood) and *Allocasuarina littoralis* (Black Sheoak); where it appears to prefer open areas in the understorey of this community and is often found in association with the *C. subulata* (Large Tongue Orchid) and the *C. erecta* (Tartan Tongue Orchid) (DECC 2007).	EPBC	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Darwinia biflora	-	V	V	*Darwinia biflora* is an erect or spreading shrub to 80cm high associated with habitats where weathered shale capped ridges intergrade with Hawkesbury Sandstone, where soils have high clay content (NPWS 1997).	202	**Potential** – no individuals recorded during targted searches however potential habitat is present
Deyeuxia appressa	-	E1	E	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown. Was then collected in 1941 from Killara, near Hornsby. Has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas (OEH 2014).	EPBC	Unlikely – verified in field
Eucalyptus camfieldii	Camfield's Stringybark	V	V	*Eucalyptus camfieldii* is associated with shallow sandy soils bordering coastal heath with other stunted or mallee eucalypts, often in areas with restricted drainage and in areas with laterite influenced soils, thought to be associated with proximity to shale (DECC 2007).	36	Unlikely - verified in field assessment
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	*Eucalyptus nicholii* naturally occurs in the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite (DECC 2007). This species is widely planted as an urban street tree and in gardens but is quite rare in the wild (DECC 2007). Plantings undertaken for horticultural and aesthetic purposes are not considered threatened species under the TSC Act.	2	Unlikely – out of natural range
Eucalyptus scoparia	Wallangarra White Gum	E1	V	Known in NSW only from the Tenterfield district where it is very uncommon. Grows on rocky hillsides in shrubby woodland close to granite outcrops.	3	Unlikely – out of natural range
Genoplesium baueri	Bauer's Midge Orchid	E1	E	Known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils.	17	**Potential** – no individuals found in the study area following targeted surveys although some habitat present.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Genoplesium plumosum	Tallong Midge Orchid	E1	E	*Genoplesium plumosum* occurs on very shallow soils overlying flat to gently sloping sheets of sandstone, with low scrub/heath dominated by Violet Kunzea (*Kunzea parvifolia*), Common Fringe-myrtle (*Calytrix tetragona*) and Eggs and Bacon (*Dillwynia* sp.), with scattered shrubs of Hairpin Banksia (*Banksia spinulosa*), Black She-oak (*Allocasuarina littoralis*), Bitter Cryptandra (*Cryptandra amara*), Slender Wattle (*Acacia elongata*), Narrow-leaf Geebung (*Persoonia linearis*), Coral Heath (*Epacris microphylla*) and a Beard Heath (*Leucopogon* sp.) (NPWS 2002). The habitat is surrounded by Brittle Gum (*Eucalyptus mannifera*) and Scribbly Gum (*E. rossii*) low woodland, with Argyle Apple (*E. cinerea*) present at some sites (NPWS 2002).	2	Unlikely – verified in field assessment
Grevillea caleyi	Caley's Grevillea	E1	E	*Grevillea caleyi* is restricted to an eight kilometre square area around Terrey Hills, approximately 20 kilometre north of Sydney. It occurs in three major areas of suitable habitat, namely Belrose, Ingleside and Terrey Hills / Duffys Forest within the Ku-ring-gai, Pittwater and Warringah local government areas. It occurs on ridgetops between elevations of 170 to 240 m asl, on laterite soils in open or low open forests, generally dominated by *Eucalyptus sieberi, Corymbia gummifera* and *E. haemastoma* (DECC 2007).	1	Unlikely – verified in field assessment
Grevillea shiressii	-	V	V	*Grevillea shiressii* occurs along creek banks in wet sclerophyll forest, on sandy soil on Hawkesbury sandstone, restricted to the Gosford area (DECC 2007).	EPBC	Unlikely – verified in field assessment
Haloragis exalata subsp. *exalata*	Wingless Raspwort	V	V	*Haloragis exalata* has been recorded in 4 widely scattered localities in eastern NSW; the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW; where it appears to require protected and shaded damp situations in riparian habitats (DECC 2007).	EPBC	Unlikely – verified in field assessment
Haloragodendron lucasii	-	E1	E	Known locations of this species are confined to a very narrow distribution on the north shore of Sydney. *Haloragodendron lucasii* is associated with low woodland on sheltered slopes near creeks on moist loamy sand on bench below small sandstone cliff lines, with continuous seepage (Benson and McDougall 1997).	4	Unlikely – verified in field assessment
Kunzea rupestris	-	V	V	Restricted, with most locations in the Maroota - Sackville - Glenorie area and one outlier in Ku-ring-gai Chase National Park, all within the Central Coast botanical subdivision of NSW. Currently known to exist in 20 populations, 6 of which are reserved. Grows in shallow depressions on large flat sandstone rock outcrops. Characteristically found in short to tall shrubland or heathland (OEH 2014).	1	No – verified in field

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Lasiopetalum joyceae	-	V	V	*Lasiopetalum joyceae* grows in ridgetop woodland, heath, woodland or open scrub, often with a clay influence (NPWS 1997).	25	Unlikely – verified in field assessment
Leptospermum deanei	-	V	V	*Leptospermum deanei* has been recorded in Hornsby, Warringah, Ku-ring-gai and Ryde local government areas, in woodland on lower hill slopes or near creeks, at sites with sandy alluvial soil or sand over sandstone (DECC 2007). It has also been recorded in riparian scrub dominated by *Tristaniopsis laurina* and *Baeckea myrtifolia*; woodland dominated by *Eucalyptus haemastoma*; and open forest dominated by *Angophora costata, Leptospermum trinervium* and *Banksia ericifolia* (DECC 2007).	6	Unlikely – verified in field assessment.
Melaleuca biconvexa	Biconvex Paperbark	V	V	*Melaleuca biconvexa* occurs in coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district. It grows in damp places often near streams (PlantNet 2011).	1	Unlikely – no suitable habitat.
Melaleuca deanei	Deane's Paperbark	V	V	Found in heath on sandstone (DECC 2007), and also associated with woodland on *broad* ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	66	Unlikely –- verified in field assessment
Pelargonium sp. *striatellum*	Omeo Stork's-bill	E1	E	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities (OEH 2014).	EPBC	No – verified in field assessment
Persoonia hirsuta	Hairy Geebung	E1	E	*Persoonia hirsuta* occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west (DECC 2007). It grows in dry sclerophyll eucalypt woodland and forest on sandstone (PlantNet 2011).	6	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Persoonia mollis subsp. *maxima*	-	E1	E	Deep gullies or on the steep upper hillsides of narrow gullies incised from Hawkesbury Sandstone, characterised by steep sideslopes, rocky benches and broken scarps, with creeks fed by small streams and intermittent drainage depressions. Occurrences of this plant have been recorded on the dry upper-hillsides of gullies and in more exposed aspects *E. haemastoma* (Scribbly Gum), *E. punctata* (Grey Gum)) (NPWS 1999).	282	Unlikely – verified in field assessment
Persoonia nutans	Nodding Geebung	E1	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000). Endemic to the Western Sydney (Benson and McDougall 2000).	1	Unlikely – verified in field assessment
Pimelea curviflora var. *curviflora*	-	V	V	*Pimelea curviflora* var. *curviflora* is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (DECC 2007). Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology (Pittwater Council 2000).	EPBC	Unlikely – no suitable habitat.
Pimelea spicata	Spiked Rice-flower	E1	E	In western Sydney, *Pimelea spicata* occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (*Ibid.*). Has been located in disturbed areas that would have previously supported CPW (*Ibid.*).	EPBC	Unlikely – verified in field assessment
Prostanthera marifolia	Seaforth Mintbush	CE	CE	*Prostanthera marifolia* is currently only known from the northern Sydney suburb of Seaforth and has a very highly restricted distribution. It occurs in localised patches in or in close proximity to the Duffys Forest EEC. It grows on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses (DECC 2007).	EPBC	Unlikely – out of range.
Pterostylis saxicola	Sydney Plains Greenhood	E1	E	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where Pterostylis saxicola occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated (OEH 2012).	EPBC	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Streblus pendulinus	Siah's Backbone	-	E	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest (SEWPaC 2012).	EPBC	Unlikely – verified in field assessment
Syzygium paniculatum	Magenta Lilly Pilly	V	V	This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities (Payne 1997). In the Ourimbah Creek valley, *S. paniculatum* occurs within gallery rainforest with *Alphitonia excelsa, Acmena smithii, Cryptocarya glaucescens, Toona ciliata, Syzygium oleosum* with emergent *Eucalyptus saligna*. At Wyrrabalong NP, *S. paniculatum* occurs in littoral rainforest as a co-dominant *with Ficus fraseri, Syzygium oleosum, Acmena smithii, Cassine australe*, and *Endiandra sieberi*. Payne (1991) reports that the species appears absent from Terrigal formation shales, on which the gully rainforests occur. *S. paniculatum* is summer flowering (November-February), with the fruits maturing in May (DECC 2007).	4	Unlikely – verified in field assessment
Tetratheca glandulosa	-	V	V	Associated with ridgetop woodland habits on yellow earths (Travers Morgan 1991) also in sandy or rocky heath and scrub (NPWS 1997). Often associated with sandstone / shale interface where soils have a stronger clay influence (NPWS 1997). Flowers July to November.	173	Unlikely – verified in field assessment
Thesium australe	Austral Toadflax	V	V	In eastern NSW it is found in very small populations scattered along the coast, and from the Northern to Southern Tablelands. Grassland on coastal headlands or grassland and grassy woodland away from the coast.	EPBC	Unlikely – no suitable habitat within the study area
Amphibians						
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	18	Unlikely – habitat limited due to heavy modification and quality of watercourses in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Litoria aurea	Green and Golden Bell Frog	E1	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke and White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2009). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DEC 2005). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 2004). Ponds that are typically inhabited tend to be free from predatory fish such as *Gambusia holbrooki* (Mosquito Fish) (DEC 2005; NPWS 2003). Formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extends into east Gippsland. Records from west to Bathurst, Tumut and the ACT region. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Inhabits marshes, dams and stream-sides, particularly those containing *Typha* spp. (Bullrushes) or *Eleocharis* spp. (Spikerushes).	1	Unlikely – no suitable habitat
Litoria littlejohni	Littlejohn's Tree Frog	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. The majority of records are from within the Sydney Basin Bioregion with only scattered records south to the Victorian border and this species has not been recorded in southern NSW within the last decade. Records are isolated and tend to be at high altitude. This species breeds in the upper reaches of permanent streams and in perched swamps (OEH 2014).	EPBC	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Mixophyes balbus	Stuttering Frog	E	V	Stuttering Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only Mixophyes species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range (OEH 2014).	EPBC	Unlikely – verified in field assessment
Fish						
Epinephelus daemelii	Black Rockcod	-	V	Black Rockcod inhabit caves, gutters and beneath bomboras on rocky reefs. Larger juveniles use rocky shelves in estuaries. They are opportunistic carnivores, eating mainly other fish and crustaceans. Black Rockcod are apparently slow growing. Smaller fish are mostly females, but they generally change sex to become males at around 100-110 cm in length.	EPBC	No. Marine or estuarine habitat not found on site.
Macquaria australasica	Macquarie Perch	E (under FM Act 1994)	E	Australian Grayling occur in freshwater streams and rivers, especially clear gravelly streams with a moderate flow, as well as estuarine areas. The fish is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Spawning occurs in freshwater from late summer to winter, with exact timing being dependant on location and annual conditions. Omnivorous, feeding on a variety of small aquatic organisms, including crustaceans, insects and their larvae, and algae.	EPBC	No. The quarry is not a flowing creek and is disconnected from the estuary.
Prototroctes maraena	Australian Grayling	-	V	Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the upper Hawkesbury and Shoalhaven catchments. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries. Habitat for this species is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie Perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods.	EPBC	Unlikely. No records of this species are found in the Hornsby-Berowra region. The quarry does not have good quality habitat found in lakes and pools this species occupies.
Reptiles						

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Hoplocephalus bungaroides	Broad-headed Snake	E	V	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. It shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring (OEH 2014).	EPBC	Unlikely – verified in field assessment.
AVES (diurnal birds)						
Anthochaera phrygia	Regent Honeyeater	E1	E1, Mi	Regent Honeyeaters mostly occur in dry box-ironbark eucalypt woodland and dry sclerophyll forest associations, wherein they prefer the most fertile sites available, e.g. along creek flats, or in broad river valleys and foothills. In NSW, riparian forests containing *Casuarina cunninghamiana* (River Oak), and with *Amyema cambagei* (Needle-leaf Mistletoe), are also important for feeding and breeding. At times of food shortage (e.g. when flowering fails in preferred habitats), Honeyeaters also use other woodland types and wet lowland coastal forest dominated by *Eucalyptus robusta* (Swamp Mahogany) or E. maculata (Spotted Gum) (Franklin et al. 1989; Geering & French 1998; Ley & Williams 1992; Oliver et al. 1999; Webster & Menkhorst 1992). Regent Honeyeaters sometimes occur in coastal forest, especially in stands dominated by Swamp Mahogany and Spotted Gum, but also in those with Southern Mahogany *E. botryoides*, and in those on sandstone ranges with banksias Banksia in the understorey (Franklin et al. 1989; Higgins et al. 2001; Menkhorst 1997c). They have been recorded in open forest including forest edges, wooded farmland and urban areas with mature eucalypts (Garnett 1993). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000). In NSW, most records are scattered on and around the Great Dividing Range, mainly on the North-West Plains, North-West Slopes and adjacent Northern Tablelands, to west of Armidale; the Central Tablelands and Southern Tablelands regions; and the Central Coast and Hunter Valley regions. The species is concentrated around two main locations, the Capertee Valley and the Bundarra-Barraba area, but Honeyeaters are also recorded along the coast in the Northern Rivers and Mid-North Coast Regions, and in the Illawarra and South Coast Regions, from Nowra south to Moruya, where small numbers are recorded in most years (D. Geering 1997, unpublished data; Higgins et al. 2001; Webster & Menkhorst 1992).	4	Unlikely – limited habitat in the study area; may occasionally fly over area.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Botaurus poiciloptilus	Australasian Bittern	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. Favours permanent freshwater wetlands with tall, dense vegetation, particularly Typha spp. (Bullrushes) and Eleocharis spp. (Spikerushes) (OEH 2014).	EPBC	No – no suitable habitat in study area
Dasyornis brachypterus	Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone (OEH 2014).	EPBC	No – no suitable habitat.
Lathamus discolor	Swift Parrot	E	E1, Ma	Breeds in Tasmania between September and January. Feeds mostly on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), White Box (*E. albens*) and Forest Red Gum (*E. tereticornis*) (DECC 2007). Box-ironbark habitat in drainage lines and coastal forest in NSW is thought to provide critical food resources during periods of drought or low food abundance elsewhere (Mac Nally et al. 2000).	EPBC	Unlikely – although suitable habitat within the study area, species is likely to only flyover area rather than utilise resources
MAMMALIA - terrestrial (excluding bats)						
Dasyurus maculatus	Spotted-tailed Quoll Spotted-tailed Quoll (SE mainland population)	V -	- E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest and in NSW within 200 kilometres of the coast. Preferred habitat is mature wet forest (Belcher 2000b; Green & Scarborough 1990; Watt 1993), especially in areas with rainfall 600 mm/year (Edgar & Belcher 2008; Mansergh 1984). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable (Catling et al. 1998, 2000). This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	8	Unlikely – some habitat in area but limited suitable undisturbed forest and close proximity to urban interface across study area.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Isoodon obesulus	Southern Brown Bandicoot (eastern)	E1	E1	This species is associated with heath, coastal scrub, sedgeland, heathy forests, shrubland and woodland on well drained, infertile soils, within which they are typically found in areas of dense ground cover. Suitable habitat includes patches of native or exotic vegetation which contain understorey vegetation structure with 50–80 per cent average foliage density in the 0.2–1 metres height range. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire, but requires a mosaic of burnt and unburnt areas for survival (Menkhorst & Seebeck 1990).	EPBC	Unlikely – limited heathy forests across the study area
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north (OEH 2014).	EPBC	No – no suitable habitat
Phascolarctos cinereus	Koala	V	V	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: *Eucalyptus tereticornis*, *E. punctata*, *E. cypellocarpa*, *E. viminalis*	5	**Potential** – limited suitable habitat across the study area.
Pseudomys novaehollandiae	New Holland Mouse	-	V	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. A social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha and the species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (SEWPaC 2012)	EPBC	No – limited suitable habitat in study area and close proximity to urban interface
MAMMALIA - terrestrial (bats)						

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	EPBC	**Potential** -, although species not found, based on habitat assessments, suitable habitat is present in study area.
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	35	**Likely** – suitable foraging habitat present in study area. No camps detected during field assessment.
Migratory terrestrial species						
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	EPBC	Unlikely – no suitable habitat
Hirundapus caudacutus	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	EPBC	Unlikely
Merops ornatus	Rainbow Bee-eater	-	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May. Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs.	EPBC	Unlikely – limited suitable habitat.
Monarcha melanopsis	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	EPBC	Unlikely – limited suitable habitat.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Monarcha trivirgatus	Spectacled Monarch	-	M	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	EPBC	Unlikely – limited suitable habitat.
Myiagra cyanoleuca	Satin Flycatcher	-	M	Wetter, denser forest, often at high elevations (Simpson & Day 2004).	EPBC	Unlikely – limited suitable habitat.
Rhipidura rufifrons	Rufous Fantail	-	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	EPBC	Unlikely – limited suitable habitat.
Anthochaera phrygia	Regent Honeyeater	E1	E1, Mi	SEE DIURNAL BIRDS ABOVE	-	Unlikely – limited habitat in study area
Migratory wetland species						
Ardea alba	Great Egret	-	M	The Great Egret is common and widespread in Australia (McKilligan, 2005). The Eastern Great Egret has been reported in a wide range of wetland. These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Kushlan & Hancock 2005; Marchant & Higgins 1993; Martínez-Vilalta & Motis 1992). The species usually frequents shallow waters. It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	EPBC	No – no habitat in study area
Ardea ibis	Cattle Egret	-	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan, 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leaves the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (McKilligan, 2005).	EPBC	No – no habitat in study area
Gallinago hardwickii	Latham's Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1993).	EPBC	No – no habitat in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Rostratula australis	Painted Snipe (Australian subspecies)	E	E, M	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (OEH 2012). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). Breeding is often in response to local conditions; generally occurs from September to December (OEH 2012). Forages nocturnally on mud-flats and in shallow water (OEH 2012). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	EPBC	No – no habitat in study area
Migratory Marine Species						
Diomedea epomophora epomophora	Southern Royal Albatross	-	V, M	Marine forager	EPBC	No – no habitat in study area
Diomedea epomophora sanfordi	Northern Royal Albatross	-	E, M	Marine forager	EPBC	No – no habitat in study area
Diomedea exulans antipodensis	Antipodean Albatross	V	V, M	Marine forager	EPBC	No – no habitat in study area
Diomedea exulans	Wandering Albatross	E	V, M	Marine forager	1	No – no suitable habitat in study area
Diomedea exulans exulans	Tristan Albatross	-	E, M	Marine forager	EPBC	No – no habitat in study area
Diomedea exulans gibsoni	Gibson's Albatross	V	V, M	Marine forager	EPBC	No – no habitat in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Limicola falcinellus	Broad-billed Sandpiper	V	M	The eastern form of the Broad-billed Sandpiper breeds in northern Siberia before migrating southwards in winter to Australia (DECC 2007). In Australia, Broad-billed Sandpipers over-winter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast (DECC 2007). In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary (DECC 2007). There are few records for inland NSW (DECC 2007). Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat (DECC 2007). Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons (DECC 2007). Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	1	No. Habitat not suitable.
Macronectes giganteus	Southern Giant-Petrel	E	E, M	Marine Forager	EPBC	No – no habitat in study area
Macronectes halli	Northern Giant-Petrel	V	V, M	Marine Forager	EPBC	No – no habitat in study area
Thalassarche bulleri	Buller's Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area
Thalassarche cauta cauta	Shy Albatross, Tasmanian Shy Albatross	V	V, M	Marine Forager	EPBC	No – no habitat in study area
Thalassarche cauta salvini	Salvin's Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area
Thalassarche cauta steadi	White-capped Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area
Thalassarche eremita	Chatham Albatross	-	E, M	Marine Forager	EPBC	No – no habitat in study area
Thalassarche melanophris	Black-browed Albatross	V	V, M	Marine Forager	EPBC	No – no habitat in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
Thalassarche melanophris impavida	Campbell Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area

(blank)

Appendix B Plot and transect field data

Plots labelled from "Plot 1, Plot 4, and Plot 7" were gathered during the December 2014 survey period, "Plot 1, Plot 3 Plot 5 and Plot 6" during the December 2013 survey period.

Vegetation Zone 1

Vegetation Type: Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin

Condition: Moderate/Good (Poor)

Plot Name	NPS	NOS	NMS	NGC (G)	NGC (S)	NGC (O)	EPC	NTH	OR	FL	Easting	Northing	Zone
1	16	44	0	0	0	22	35	0*	0%	29	322914	6269614	56
2	8	2	0	0	0	0	38	0*	0%	38	323301	6269610	56

* This zone was merged with zone 3 due to the very small size impacted (0.06ha), which is less than minimum size of 0.25 ha. The higher value of 0.2 was utilised for overstorey regeneration for all plots entered,

Vegetation Zone 2

Vegetation Type: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin

Condition: Moderate/Good (Moderate)

Plot Name	NPS	NOS	NMS	NGC (G)	NGC (S)	NGC (O)	EPC	NTH	OR	FL	Easting	Northing	Zone
3	18	43.6	0	0	0	46	29.5	1	100%	3	323550	6269789	56
4	32	43	3.5	16	0	24	0	0	100%	61	323933	6269414	56
5	28	56	1.5	56	0	10	0	1	100%	31	323072	6269432	56

Vegetation Zone 3

Vegetation Type: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin

Condition: Moderate/Good (Poor)

Plot Name*	NPS	NOS	NMS	NGC (G)	NGC (S)	NGC (O)	EPC	NTH	OR	FL	Easting	Northing	Zone
6	6	24	0	0	2	0	88.6	0	20%	0	323578.3	6269783	56
7	8	36.5	1	0	0	2	113	1	20%	2	323502	6269326	56

Appendix C Plot and transect field data sheets

(blank)

Appendix D Flora species recorded

The flora lists include species recorded from opportunistic surveys and biometric plots.

Table 16: Native flora species list recorded during the field survey

	Scientific Name	Common Name	Opportunistic	Biometric plots
1	*Acacia decurrens*	Black Wattle	x	
2	*Acacia linifolia*		x	
3	*Acacia longifolia* subsp. *longifolia*	Sydney Golden Wattle	x	x
4	*Acacia myrtifolia*	Red-stemmed Wattle	x	
5	*Acacia ulicifolia*	Prickly Moses		x
6	*Adiantum aethiopicum*	Common maidenhair	x	
7	*Allocasuarina littoralis*	Black She-oak		x
8	*Allocasuarina* sp.		x	
9	*Allocasuarina torulosa*	Forest Oak		x
10	*Angophora costata*	Sydney Red Gum	x	x
11	*Angophora floribunda*	Rough-barked Apple	x	x
12	*Austrodanthonia* sp.		x	
13	*Banksia serrata*	Old-man Banksia	x	x
14	*Bossiaea heterophylla*	Variable Bossiaea		x
15	*Bossiaea obcordata*	Spiny Bossiaea		x
16	*Breynia oblongifolia*	Coffee Bush	x	x
17	*Carex inversa*			x
18	*Ceratopetalum gummiferum*	New South Wales Christmas-bush		x
19	*Clematis aristata*	Old Man's Beard		x
20	*Commelina cyanea*	Native Wandering Jew		x
21	*Corymbia gummifera*			x
22	*Corymbia maculata*	Spotted Gum	x	
23	*Cryptostylis* sp.			x
24	*Cyathochaeta diandra*			x
25	*Cynodon dactylon*	Couch	x	x
26	*Dianella caerulea* var. *caerulea*	Blue Flax Lily	x	
27	*Dianella longifolia* var. *longifolia*			x
28	*Dichondra repens*	Kidney Weed	x	x
29	*Elaeocarpus reticulatus*	Blueberry Ash		x
30	*Entolasia marginata*	Bordered Panic		x
31	*Entolasia stricta*		x	x
32	*Epacris pulchella*	Wallum Heath	x	x
33	*Eucalyptus pilularis*	Blackbutt	x	x
34	*Eucalyptus resinifera*	Red Mahogany		x
35	*Eucalyptus saligna*	Sydney Blue Gum	x	x
36	*Eustrephus latifolius*	Wombat Berry	x	x
37	*Exocarpos cupressiformis*	Cherry Ballart	x	
38	*Glycine tabacina*		x	

	Scientific Name	Common Name	Opportunistic	Biometric plots
39	*Goodenia hederacea*	Forest Goodenia	x	
40	*Grevillea robusta* #	Silky Oak	x	
41	*Guioa semiglauca*	Guioa		x
42	*Hibbertia aspera*	Rough Guinea Flower	x	
43	*Hibbertia empetrifolia*			x
44	*Hovea linearis*			x
45	*Imperata cylindrica*	Blady Grass	x	x
46	*Indigofera australis*	Australian Indigo	x	
47	*Kennedia rubicunda*	Dusky Coral Pea		x
48	*Lepidosperma laterale*		x	
49	*Leptospermum trinervium*		x	x
50	*Leucopogon parviflorus*	Coastal Beard-heath		x
51	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush	x	x
52	*Lomandra longifolia*	Spiny-headed Mat-rush	x	x
53	*Lomandra obliqua*		x	
54	*Lomatia silaifolia*	Crinkle Bush		x
55	*Melaleuca styphelioides*	Prickly-leaved Tea-tree	x	
56	*Oplismenus aemulus*	Australian Basket Grass		x
57	*Oplismenus imbecillis*	Creeping Beard Grass		x
58	*Oxalis perennans*		x	
59	*Ozothamnus diosmifolius*	Rice Flower	x	x
60	*Pandorea pandorana*	Wonga Wonga Vine		x
61	*Persoonia linearis*	Narrow-leaved Geebung	x	
62	*Persoonia pinifolia*	Pine-leaved Geebung		x
63	*Phyllanthus hirtellus*	Thyme Spurge		x
64	*Pittosporum revolutum*	Wild Yellow Jasmine		x
65	*Pittosporum undulatum*	Native Daphne	x	x
66	*Platysace lanceolata*	Shrubby Platyscae	x	
67	*Poa labillardierei*	Tussock		x
68	*Polyscias sambucifolia*	Elderberry Panax	x	
69	*Pomax umbellata*		x	
70	*Poranthera microphylla*			x
71	*Pteridium esculentum*	Common Bracken	x	x
72	*Pterostylis* sp.			x
73	*Schizaea bifida*	Forked Comb Fern		x
74	*Smilax glyciphylla*	Sweet Sarsaparilla	x	x
75	*Syncarpia glomulifera*	Turpentine	x	x
76	*Themeda australis*	Kangaroo Grass	x	
77	*Xanthorrhoea* sp.		x	x

# Denotes native planted or non-indigenous to the area

Table 17: Exotic species list recorded during the field survey

	Scientific Name	Common Name	Opportunistic	Biometric plots
1	*Ageratina adenophora*	Crofton Weed	x	x
2	*Ageratina riparia*	Creeping Crofton Weed	x	
3	*Anagallis arvensis*	Scarlet Pimpernel	x	
4	*Andropogon virginicus*	Whisky Grass	x	
5	*Araujia sericifera*	Moth Vine	x	
6	*Asparagus aethiopicus*	Aparagus Fern	x	x
7	*Asparagus asparagoides*	Bridal Creeper		x
8	*Asphodelus* sp.			x
9	*Bidens pilosa*	Cobblers Pegs	x	x
10	*Bromus catharticus*	Prairie Grass		x
11	*Centaurium* sp.		x	
12	*Chloris gayana*			x
13	*Chloris* sp.		x	
14	*Chrysanthemoides* sp.			x
15	*Cinnamomum camphora*	Camphor Laurel	x	x
16	*Cirsium vulgare*	Spear Thistle	x	
17	*Conyza* sp.			x
18	*Cortaderia selloana*	Pampas Grass	x	
19	*Cosmos bipinnatus*		x	x
20	*Cotoneaster glaucophyllus*	Cotoneaster	x	
21	*Crataegus monogyna*	Hawthorn		x
22	*Cytisus scoparius*	Scotch Broom	x	
23	*Ehrharta erecta*	Panic Veldtgrass	x	x
24	*Eragrostis curvula*	African Lovegrass	x	
25	*Erodium* sp.			x
26	*Erythrina* x *sykesii*	Coral Tree	x	
27	*Genista monspessulana*	Montpellier Broom	x	x
28	*Hedera helix*	English Ivy	x	x
29	*Hypochaeris radicata*	Catsear	x	
30	*Ipomoea indica*	Morning Glory	x	x
31	*Jacaranda mimosifolia*	Jacaranda	x	x
32	*Lantana camara*	Lantana	x	x
33	*Ligustrum lucidum*	Large Leaved Privet	x	x
34	*Ligustrum sinense*	Small Leaved Privet	x	x
35	*Lonicera japonica*	Japanese Honeysuckle		x
36	*Modiola caroliniana*	Red-flowered Mallow		x
37	*Monstera deliciosa*	Fruit Salad Plant	x	
38	*Nephrolepis cordifolia*	Fishbone Fern	x	x
39	*Nerium oleander*	Oleander	x	
40	*Ochna serrulata*	Mickey Mouse Plant	x	x
41	*Oxalis* sp.			x
42	*Paspalum dilatatum*	Paspalum	x	x

	Scientific Name	Common Name	Opportunistic	Biometric plots
43	*Pennisetum clandestinum*	Kikuyu	x	x
44	*Plantago lanceolata*	Lamb's Tongues	x	
45	*Rosa* sp.			x
46	*Rubus* sp.	Blackberry		x
47	*Rumex* sp.			x
48	*Senecio madagascariensis*	Fireweed	x	
49	*Senna pendula*	Bird-of-Paradise Shrub	x	x
50	*Sida rhombifolia*	Paddy's Lucerne	x	x
51	*Solanum jasminoides*	Potato Vine		x
52	*Solanum mauritianum*	Wild Tobacco Bush	x	
53	*Solanum* sp.		x	
54	*Sporobolus* sp.		x	
55	*Tradescantia fluminensis*	Wandering Jew		x
56	*Trifolium repens*	White Clover	x	x
57	*Verbena bonariensis*	Purpletop	x	
58	*Vicia* sp.			x
59	*Watsonia* sp.			x

Appendix E Fauna species recorded

The fauna list includes species recorded from opportunistic surveys and Anabat survey.

Table 18: Fauna species list recorded during the field survey

	Common Name	Scientific Name	Observation Type
1	Australian Brush-turkey	*Alectura lathami*	O
2	Australian Magpie	*Cracticus tibicen*	O
3	Australian Raven	*Corvus coronoides*	O
4	Bell Miner	*Manorina melanophrys*	W
5	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O
6	Brush Turkey	*Alectura lathami*	O
7	Channel-Billed Cuckoo	*Scythrops novaehollandiae*	W
8	Eastern Water Dragon	*Physignathus lesueurii*	O
9	Grey Butcherbird	*Cracticus torquatus*	W
10	Laughing Kookaburra	*Dacelo novaeguineae*	W
11	Pacific Black Duck	*Anas superciliosa*	O
12	Pied Currawong	*Strepera graculina*	W
13	Red-bellied Black snake	*Pseudechis porphyriacus*	O
14	Superb Fairy-wren	*Malurus cyaneus*	O
15	Swamp Wallaby	*Wallabia bicolor*	O
16	Water Dragon	*Physignathus lesueurii*	O
17	Gould's Wattled Bat	*Chalinolobus gouldii*	A
18	White-striped Freetail Bat	*Tadarida australis*	A
19	Little Forest Bat	*Vespadelus vulturnus*	A

O denotes observed, W denotes heard, A denotes Anabat.

(blank)

Appendix F Anabat survey results

Bat calls were analysed by Danielle Adams – Bennett and reviewed by Alicia Scanlon of ELA who has seven years' experience in the identification of ultrasonic echolocation recordings, using the program AnalookW (Version 3.8 25 October 2012, written by Chris Corben, www.hoarybat.com, Corben and O'Farrell 2002). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW. Available: (http://www.forest.nsw.gov.au/research/bats/default.asp).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Reinhold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et. al. 2006) were followed:

- Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al. 2002)
- Recordings containing less than three pulses were not analysed and these sequences were labeled as short (Law et al. 1999)
- Four categories of confidence in species identification were used (Mills et al. 1996):
    - definite – identity not in doubt
    - probable – low probability of confusion with species of similar calls
    - possible – medium to high probability of confusion with species with similar calls
    - low/short – calls made by bats which cannot be identified to even a species group.

- *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al. 2004)
- Sequences not attributed to microbat echolocation calls were labeled as junk or non-bat calls and don't represent microbat activity at the site
- Sequences labelled as low/short were of poor quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at the site

Echolocation calls were recorded over three nights between 15 and 17 December 2014 at Hornsby Quarry, NSW. Of the 149 sequences recorded, 125 (83%) could be identified to species level (**Table 19** to **Table 21**) with the remainder being too short or of low quality preventing positive identification.

There were up to seven species identified, including potentially one species listed as vulnerable under the NSW TSC Act (Table 19 to **Table 21**, **Figure 11** to **Figure 16**).

General microbat activity was moderate at site 1 with calls recorded on average less often than every two minutes but more often than every ten minutes throughout the survey period. Microbat activity was low at sites 2 and 3 with calls recorded on average less often than every ten minutes throughout the survey period. There were few long sequences or feeding buzzes recorded in the data set, indicating that the area was not an important foraging resource for microbats at the time of the survey.

Chalinolobus gouldii (Gould's Wattled Bat) was the most commonly recorded species, followed by *Tadarida australis* (White-striped Freetail Bat) and *Vespadelus vulturnus* (Little Forest Bat). The remaining species identified were represented by fewer than 20 calls in total.

The calls of the **Eastern False Pipistrelle**, ***Scoteanax rueppellii* (Greater Broad-nosed Bat)** and *Scotorepens orion* (Eastern Broad-nosed Bat) are very difficult to separate because many elements of their calls overlap in the range 32 – 39 kHz. The single call recorded was at a frequency of 35.27 kHz placing it within the range of all three species and as no other defining characteristics were observed the call was assigned a mixed species label of **Eastern False Pipistrelle** / **Greater Broad-nosed Bat** / Eastern Broad-nosed Bat.

The calls of ***Myotis macropus* (Large-footed Myotis)** are very similar to all *Nyctophilus* species and it is often difficult to separate these species. Calls can only be identified as *Nyctophilus* spp. when the time between calls (TBC) is higher than 95ms and the initial slope (OPS) is lower than 300. Calls can only be identified as **Large-footed Myotis** when the time between calls (TBC) is lower than 75ms and the initial slope (OPS) is greater than 400. Where the TBC is between 75 and 95ms and the OPS is between 300 and 400 calls are assigned mixed label of **Large-footed Myotis** / Long-eared Bats.

The calls of Gould's Wattled Bat and the Mormopterus group of species can be difficult to separate. Calls of *Mormopterus ozimops ridei* (species 2) (Eastern Freetail Bat) have a flat shape (slope of less than 100 OPS) and frequency between 28.5 – 31 kHz. Gould's Wattled Bat is distinguished by a frequency of 27.5 – 32.5 kHz and alternation in call frequency between pulses. When no distinguishing characteristics were present calls were assigned a mixed labels of Gould's Wattled Bat / Eastern Freetail Bat.

Table 19: AnaBat results from 15 December 2014 at Hornsby Quarry, Site 1

Scientific name	Common name	Definite	Probable	Possible	Total
Chalinolobus gouldii	Gould's Wattled Bat	41	4	1	46
Chalinolobus gouldii / Mormopterus ozimops ridei (species 2)	Gould's Wattled Bat / Eastern Freetail Bat			16	16
Tadarida australis	White-striped Freetail Bat	18			18
Low					3
Short					8
Total					91

Table 20: AnaBat results from 15 December 2014 at Hornsby Quarry, site 2

Scientific name	Common name	Definite	Probable	Possible	Total
Chalinolobus gouldii	Gould's Wattled Bat	18		1	19
Falsistrellus tasmaniensis* / Scoteanax rueppellii* / *Scotorepens orion*	**Eastern False Pipistrelle / Greater Broad-nosed Bat** / Eastern Broad-nosed Bat			1	1
Myotis macropus* / *Nyctophilus sp.*	**Large-footed Myotis** / Long-eared Bat			1	1

Short					4
Total					25

***Threatened species**

Table 21: AnaBat results from 17 December 2014 at Hornsby Quarry, site 3

Scientific name	Common name	Definite	Probable	Possible	Total
Chalinolobus gouldii	Gould's Wattled Bat	7	2		9
Chalinolobus morio	Chocolate Wattled Bat			2	2
Vespadelus vulturnus	Little Forest Bat	13			13
Low					2
Short					7
Total					33

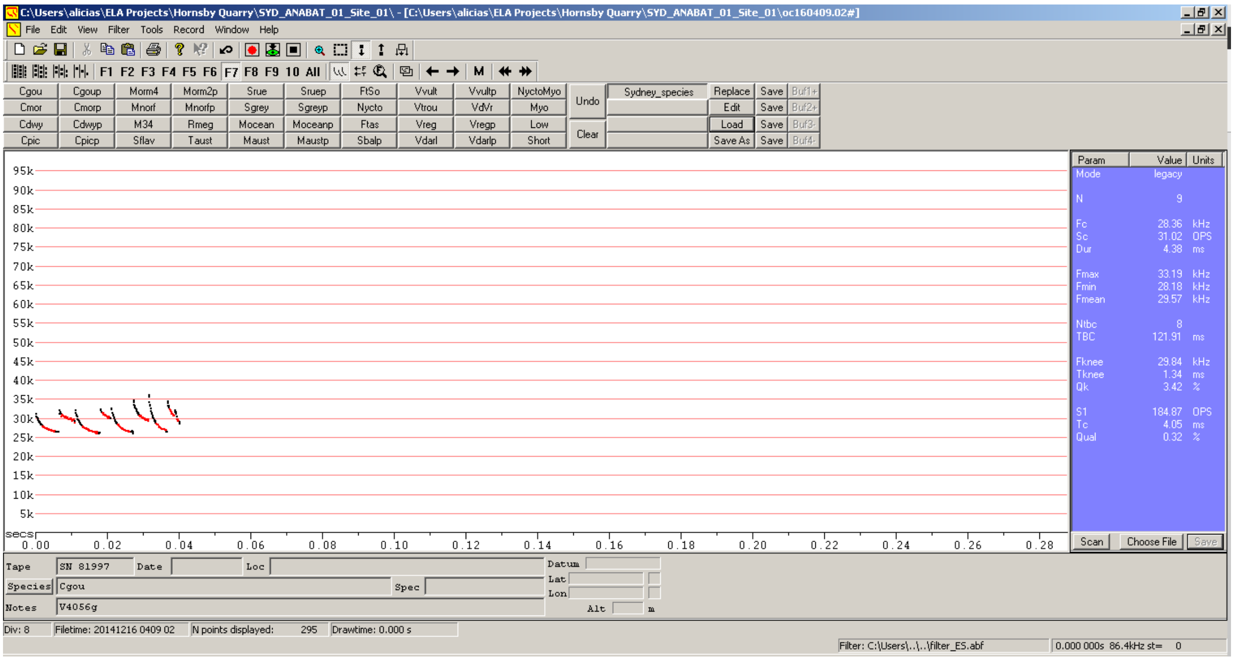

Figure 11: Call profile for *Chalinolobus gouldii* recorded at site 2, Hornsby Quarry at 04:09 on 16 December 2014

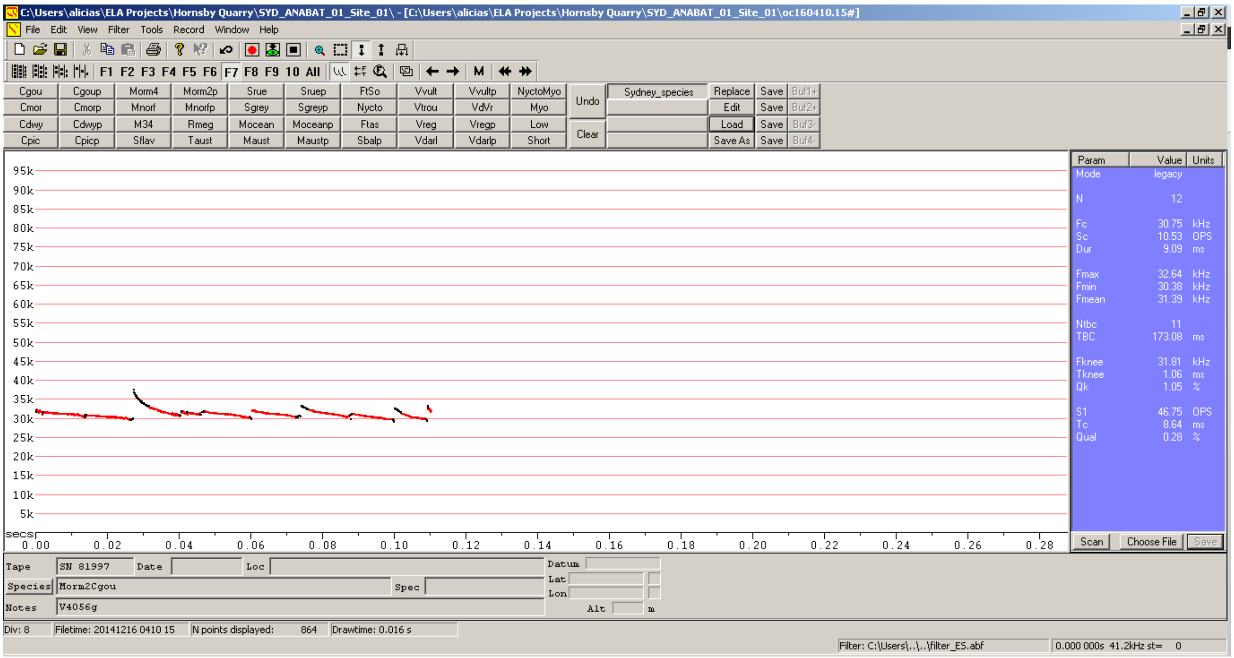

Figure 12: Call profile for *Chalinolobus gouldii* / *Mormopterus ozimops ridei* (species 2) recorded at site 1, Hornsby Quarry at 04:04 on 16 December 2014

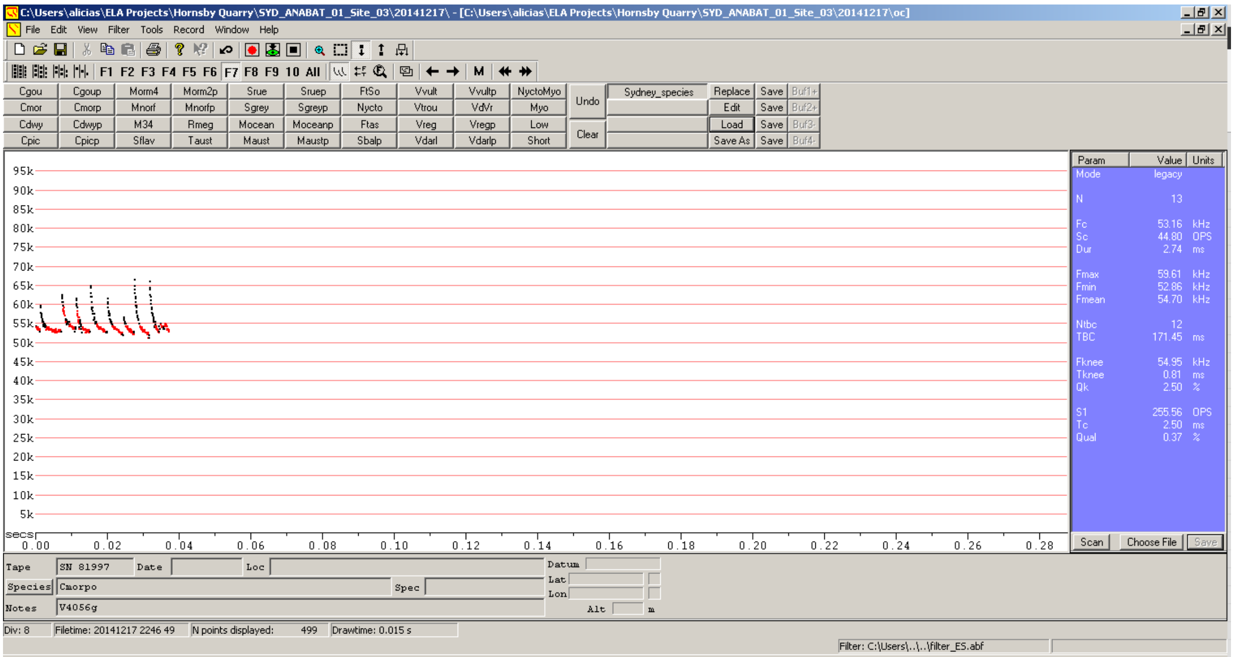

Figure 13: Possible call profile for *Chalinolobus morio* recorded at Hornsby Quarry at 22:46 on 17 December 2014

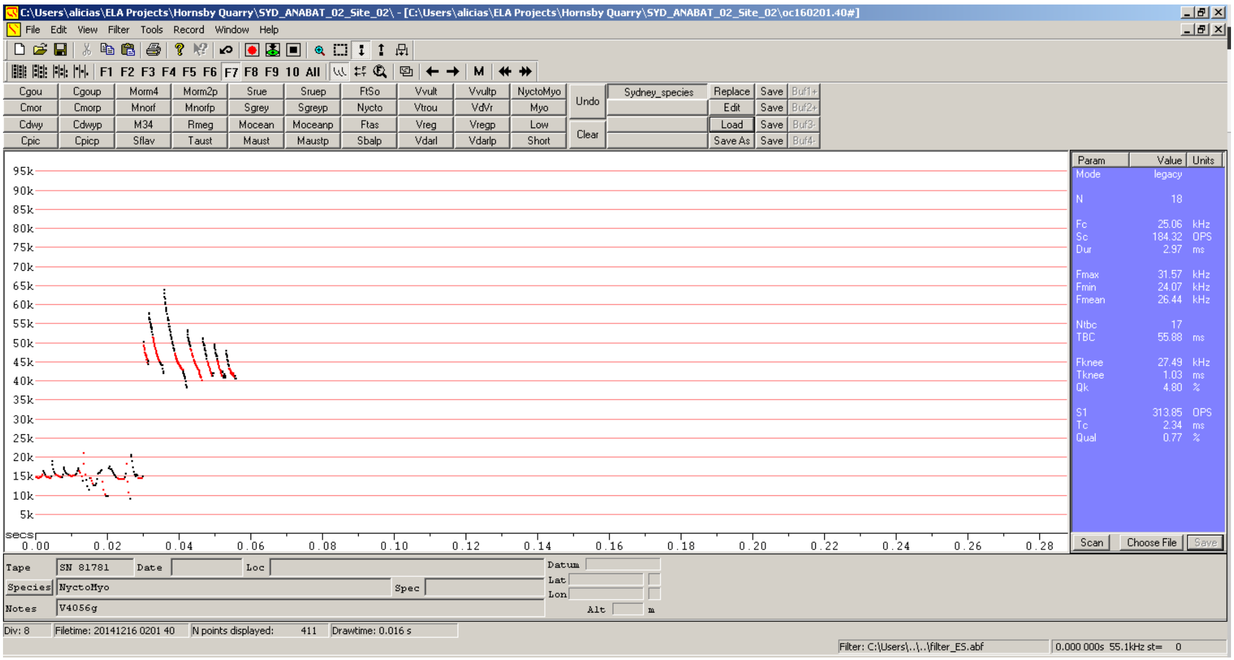

Figure 14: Call profile for Myotis macropus / Nyctophilus spp. recorded at Hornsby Quarry at 02:01 on 16 December 2014. Also shown is an unknown call at 15kHz

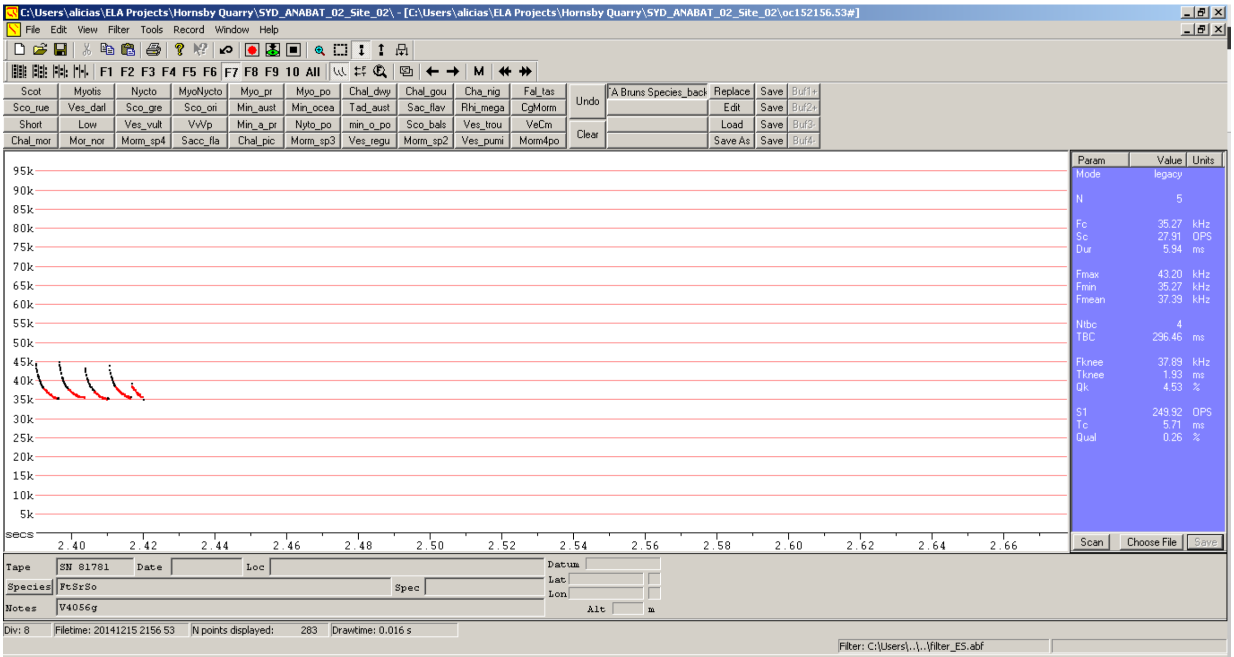

Figure 15: Call profile for *Falsistrellus tasmaniensis* / *Scoteanax rueppellii* / *Scotorepens orion* recorded at Hornsby Quarry at 21:56 on 15 December 2014

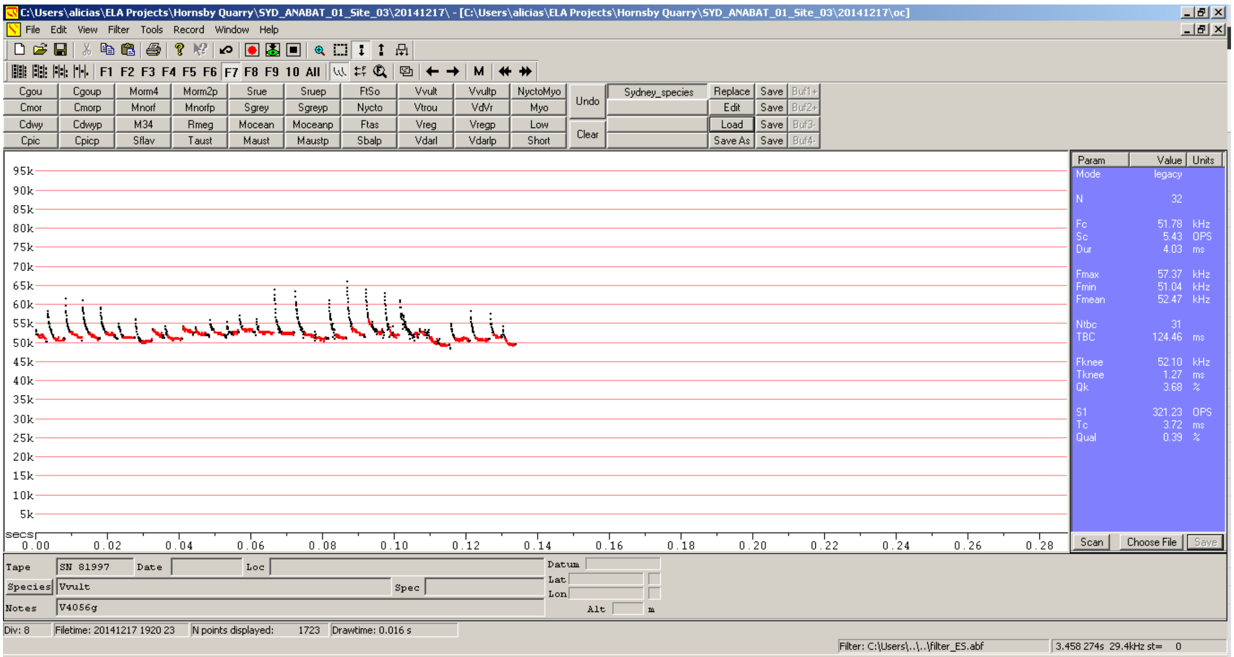

Figure 16: Call profile for *Vespadelus vulturnus* recorded at Hornsby Quarry at 19:20 on 17 December 2014

Appendix G Hollow- bearing tree survey results

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
Large	Trunk	Eucalyptus pilularis	110	0	No	Stag	1	Diurnal birds, Mammals (ex. Bats) and bats	1	ELA 2014
Medium	Trunk	Eucalyptus pilularis	100	0	No	Stag	2	Bats	2	ELA 2014
Medium	Trunk	Eucalyptus pilularis	50	0	No	Stag	3	Bats	3	ELA 2014
Small	Branch	Eucalyptus pilularis	100	50	No		4	Diurnal birds, Mammals (ex. Bats) and bats	4	ELA 2014
Large	Trunk	Eucalyptus pilularis	200	40	No	Open Trunk Hollow	5	Diurnal birds, Mammals (ex. Bats) and bats	5	ELA 2014
Large	Trunk	Stag	85	0	Yes	Nesting material in hollow	Tree 54	Diurnal Birds, Mammals (ex. Bats), Bats	76	AECOM 2014
Medium	Branch	Stag	75	0	N/A		Tree 55	Diurnal Birds, Mammals (ex. Bats), Bats	77	AECOM 2014
Medium	Branch	Stag	75	0	N/A		Tree 55	Diurnal Birds, Mammals (ex. Bats), Bats	78	AECOM 2014
Medium	Branch	Stag	75	0	N/A		Tree 55	Diurnal Birds, Mammals (ex. Bats), Bats	79	AECOM 2014
Medium	Spout	Angophora	50	20	N/A	One leader dead and rotting	Tree 56	Diurnal Birds, Mammals (ex. Bats), Bats	80	AECOM 2014
Medium	Fissure	Eucalyptus	115	40	N/A	Base burnt out, numerous bark	Tree 57	Diurnal Birds, Mammals (ex. Bats),	81	AECOM 2014

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
						fissures on trunk		Bats		
Small	Fissure	Stag	35	0	N/A		Tree 58	Bats	82	AECOM 2014
Medium	Fissure	Unknown	40	90	N/A	Longitudinal rot along trunk and 1 limb,	Tree 59	Diurnal Birds, Mammals (ex. Bats), Bats	83	AECOM 2014
Medium	Spout	Angophora	70	75	N/A	Multi-stemmed. Two leaders appear senescent	Tree 60	Diurnal Birds, Mammals (ex. Bats), Bats	84	AECOM 2014
Small	Spout	Angophora	70	75	N/A	Multi-stemmed	Tree 60	Mammals (ex. Bats), Bats	85	AECOM 2014
Large	Spout	Eucalyptus	105	90	Yes	Upper limbs appear senescent. Wear around hollow entrance	Tree 61	Diurnal Birds, Mammals (ex. Bats), Bats	86	AECOM 2014
Medium	Fissure	Eucalyptus	105	90	N/A		Tree 61	Diurnal Birds, Mammals (ex. Bats), Bats	87	AECOM 2014
Medium	Trunk	Stag	60	0	Yes	Wear and scratching around hollow	Tree 62	Diurnal Birds, Mammals (ex. Bats), Bats	88	AECOM 2014
Small	Fissure	Stag	45	0	N/A		Tree 63	Bats	89	AECOM 2014
Large	Spout	Stag	90	0	N/A		Tree 64	Diurnal Birds, Mammals (ex. Bats), Bats	90	AECOM 2014
Large	Trunk	Stag	90	0	N/A		Tree 64	Diurnal Birds, Mammals (ex. Bats), Bats	91	AECOM 2014
Large	Spout	Stag	90	0	N/A		Tree 64	Diurnal Birds, Mammals (ex. Bats), Bats	92	AECOM 2014
Small	Fissure	Stag	90	0	N/A		Tree 64	Bats	93	AECOM 2014
Small	Spout	Eucalyptus	90	80	N/A		Tree 65	Mammals (ex. Bats), Bats	94	AECOM 2014

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
Medium	Spout	Eucalyptus	90	80	N/A		Tree 65	Diurnal Birds, Mammals (ex. Bats), Bats	95	AECOM 2014
Medium	Spout	Eucalyptus	90	80	N/A		Tree 65	Diurnal Birds, Mammals (ex. Bats), Bats	96	AECOM 2014
Medium	Branch	Eucalyptus	90	80	Yes	Wear and scratching around hollow	Tree 65	Diurnal Birds, Mammals (ex. Bats), Bats	97	AECOM 2014
Large	Branch	Eucalyptus	90	80	N/A		Tree 65	Diurnal Birds, Mammals (ex. Bats), Bats	98	AECOM 2014
Medium	Spout	Eucalyptus	60	85	Yes	Wear around hollow entrance	Tree 66	Diurnal Birds, Mammals (ex. Bats), Bats	99	AECOM 2014
Medium	Spout	Eucalyptus	100	85	N/A		Tree 67	Diurnal Birds, Mammals (ex. Bats), Bats	100	AECOM 2014
Medium	Spout	Eucalyptus	100	85	N/A		Tree 67	Diurnal Birds, Mammals (ex. Bats), Bats	101	AECOM 2014
Small	Spout	Eucalyptus	100	85	Yes	Wear around hollow entrance	Tree 67	Mammals (ex. Bats), Bats	102	AECOM 2014
Medium	Branch	Eucalyptus	100	85	N/A		Tree 67	Diurnal Birds, Mammals (ex. Bats), Bats	103	AECOM 2014
Small	Fissure	Unknown	30	5	N/A	Tree with failed and lopped branches. Potential microbat habitat	Tree 68	Bats	104	AECOM 2014
Medium	Trunk	Stag	50	0	N/A		Tree 69	Diurnal Birds, Mammals (ex. Bats), Bats	105	AECOM 2014
Small	Branch	Stag	50	0	N/A		Tree 69	Mammals (ex. Bats), Bats	106	AECOM 2014
Medium	Branch	Stag	50	0	N/A		Tree 69	Diurnal Birds,	107	AECOM

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
								Mammals (ex. Bats), Bats		2014
Small	Fissure	Stag	50	0	N/A		Tree 69	Bats	108	AECOM 2014
Large	Trunk	Angophora	110	90	N/A	Large hollow in base of tree	Tree 70	Diurnal Birds, Mammals (ex. Bats), Bats	109	AECOM 2014
Small	Spout	Eucalyptus	35	70	N/A	Co-dominant	Tree 71	Mammals (ex. Bats), Bats	110	AECOM 2014
Small	Spout	Eucalyptus	35	70	N/A	Co-dominant	Tree 71	Mammals (ex. Bats), Bats	111	AECOM 2014
Large	Spout	Eucalyptus	50	40	N/A	Vertically opening spout possibly hollow	Tree 72	Diurnal Birds, Mammals (ex. Bats), Bats	112	AECOM 2014
Medium	Branch	Eucalyptus	25	10	N/A	Co-dominant- one leader rotted with possible hollows	Tree 73	Diurnal Birds, Mammals (ex. Bats), Bats	113	AECOM 2014
Small	Branch	Unknown	65	65	N/A	Trunk base burnt and hollowed out.	Tree 74	Mammals (ex. Bats), Bats	114	AECOM 2014

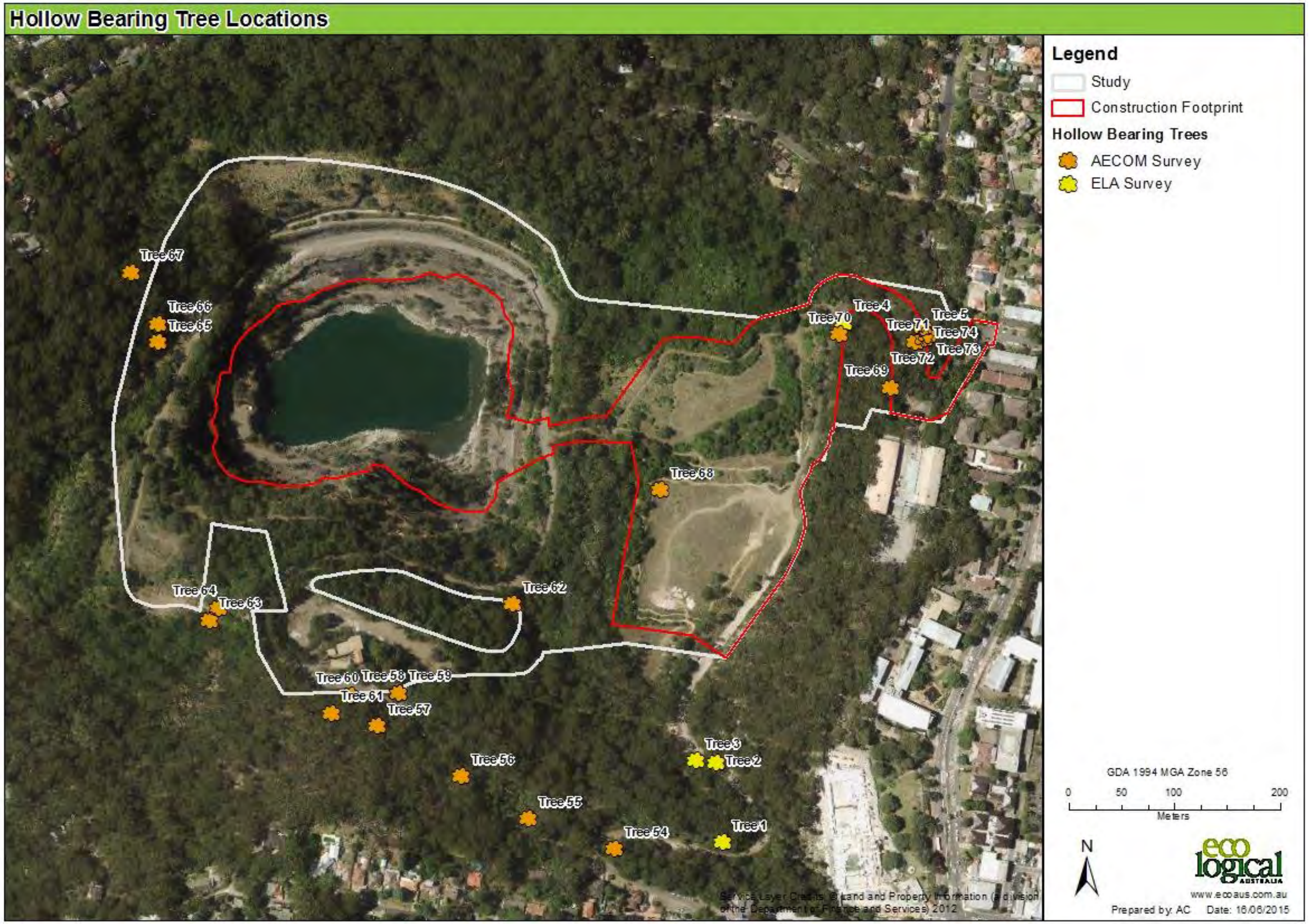

Figure 17: HBT Locations

(blank)

Appendix H Study area description

Description	This site consists of the disused Hornsby Quarry and contains a large inner void from which material was mined. The site contains areas of forest, areas that have been cleared and spoil piles. Parts of the site are used for recreational purposes including mountain bike riding. An historical site, including a cemetery, is part of the quarry grounds but is excluded from the project footprint. The following vegetation communities were identified occurring in the site: 1. Blue Gum High Forest 2. Sandstone Blackbutt Woodland 3. Weeds and exotics. In addition to these vegetation communities, there were areas within the void that contain natives that had established on the quarry walls and benches. This vegetation was not considered for a plant community type because the natural soil profile no longer existed. Similarly, areas of spoil pile or overburden were not allocated to a plant community type for the same reason. The site is dominated by the quarry void which is deep, with inaccessible walls and steep sides which were unable to be surveyed.
Condition	Poor to Good. The communities in this site ranged in condition. Where the canopy and understorey component was intact, condition was good. This was largely in the drier sclerophyll forests in the north-east of the site near Bridge Road and along parts of Quarry Road. By contrast areas in poor condition were generally found where the vegetation types were wetter, including areas of Blue Gum High Forest. The Blue Gum High Forest was modified with some native understorey components, but large areas of *Ligustrum* spp. and some *Lantana camara*. Some vegetated areas within the site were artificial in that they were exotics existing on spoil piles or overburden. The Quarry site was highly modified and in poor condition.
Threatened species of plant?	No threatened plant species were found at this site.
Threatened community?	This site contains one threatened community: Blue Gum High Forest. This community exists in a highly altered state with very little native understorey and a large component of woody weeds. The community meets the definition under the TSC Act but not the EPBC Act. This is because this vegetation is highly modified with significant weed invasion in the understorey and limited native species in the groundcover.

Photos	 Quarry void with water (December 2013). Note regenerating *Allocasuarina* on the walls.  View from inner void fence showing recruiting native vegetation, water in void and benches / walls with no vegetation.

Sandstone Blackbutt Woodland in moderate-good condition.

Part of search area for *Genoplesium baueri*. Note the exposed rock and deep leaf litter.

Typical micro-habitat for *Genoplesium baueri* (at one of the reference sites). Note gaps between plants and minimal leaf litter cover.

Track edge at *Genoplesium baueri* reference site. Note absence of canopy at track edge. This site was approximately 10 kilometres to the north-north-east of the Quarry.

Typical Blue Gum High Forest in poor condition. Note the density of exotics in the understorey.

Sandstone Blackbutt Woodland in moderate-good condition.

Sandstone Blackbutt Woodland in moderate-good condition.

Sandstone Blackbutt Woodland in poor condition. Note the density of exotic grasses in the ground layer and lack of native shrub species in the understorey.

AnaBat echolocation recording device location, potential flyway adjacent to the heritage cemetery.

(blank)

Appendix I EPBC Act Significant Impact Criteria

The proposed project footprint of the project supports areas of native vegetation and potential and known habitat for two threatened fauna species. A full list of species recorded within a ten kilometre radius of the project footprint is found in **Appendix A**, however not all of these species or their habitats are likely to be impacted by the project. Potentially impacted species are listed below. Each species has been assessed for potential impacts that may result from the project.

Threatened Flora

- *Darwinia biflora*
- *Genoplesium baueri*

Threatened Fauna

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Grey-headed Flying-Fox (*Pteropus poliocephalus*)
- Koala (*Phascolarctos cinereus*)

THREATENED FLORA

Darwinia biflora

Darwinia biflora is a threatened species listed as vulnerable under the EPBC Act. *D. biflora* occurs on the edges of weathered shale-capped ridges, where they intergrade with Hawkesbury Sandstone. The vegetation structure is usually woodland, open forest or scrub-heath. There were some areas of marginal potential habitat for this species in the impact area.

D. biflora was not recorded during the targeted field survey; however this species has been recorded 202 times within ten kilometres from the Wildlife Atlas search of the study area.

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

1: Lead to a long-term decrease in the size of an important population of a species

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, key source populations either for breeding or dispersal populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range.

Darwinia biflora was not recorded during the field survey as such it is unlikely that this constitutes an important population.

2: Reduce the area of occupancy of an important population

D. biflora was not recorded during the field survey and therefore the proposed works are unlikely to reduce any known population.

3: Fragment an existing important population into two or more populations

The project footprint is contained within the known distribution of this species, which is between Maroota, Cowan, North Ryde and Kellyville. The project would not result in the fragmentation of known populations and would not significantly affect habitat connectivity for this species. This is because this species has a relatively large distribution and exists in a fragmented matrix.

4: Adversely affect habitat critical to the survival of a species

D. biflora was not recorded during the field survey and therefore the habitat is not considered to be habitat critical to the survival of this species.

5: Disrupt the breeding cycle of an important population

D. biflora was not recorded during the field survey and as the proposed works will be localised, it is not likely that the breeding cycle of an important population of this species will be disrupted.

6: Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

In areas within the Hornsby Quarry containing potential habitat in the project footprint, disturbance regimes consist of fire suppression, increased runoff due to roads or stormwater outlets and increases in weed incursions. The project would not significantly alter these current disturbance regimes, but may push out these regimes to adjoining potential habitat. However it is unlikely that this would significantly impact this species which has not been detected within the project footprint.

7: Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The proposed project will not result in invasive species that are harmful to *D. biflora* becoming established in their habitat.

8: Introduce disease that may cause the species to decline,

The proposed project is unlikely to result in introducing diseases that may cause *D. biflora* to decline.

9: Interfere substantially with the recovery of the species.

As the project does not involve the removal of individuals of this species and the project would result in the removal of a small area of potential habitat for *D. biflora* and is not limited to the range of this species known habitat the project are unlikely to interfere with the recovery of this species.

Is a significant impact likely to result?

No, based on the above assessment it is concluded that the project is unlikely to have a significant impact on *D. biflora*. No referral to the DotE for assessment and approval by the Environment Minister for the species is recommended.

Genoplesium baueri

G. baueri is listed as endangered under the EPBC Act. It is associated with sparse sclerophyll forest and moss gardens in sands and sandy loams over sandstone (OEH 2015).

G. baueri has been recorded within 30 metres adjacent to the study area with a specimen recorded immediately south and downslope of the Hornsby Quarry in 2009. The species can be affected by increases in runoff, sedimentation and weed invasion. No specimens were observed during the targeted search of the Hornsby Quarry. The proposed widening of the access roads would impact on a small amount of very low potential habitat. All areas that were likely to contain this species were subject to a targeted survey during optimal flowering conditions and season. Despite a lengthy and targeted survey, completed when two reference sites were in flower, no individuals of this species were found.

A targeted survey during the correct season, during favourable conditions by experienced ecologists did not detect this species at the Quarry. It was concluded that this species is not present within the study area, despite the presence of marginal habitat.

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

1: Lead to a long-term decrease in the size of an important population of a species

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, key source populations either for breeding or dispersal populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range.

Genoplesium baueri was not recorded during the field survey as such it is unlikely that this constitutes an important population.

2: Reduce the area of occupancy of an important population

Genoplesium baueri was not recorded during the field survey and therefore the proposed works are unlikely to reduce any known population.

3: Fragment an existing important population into two or more populations

The brittle midge orchid is endemic to New South Wales. The species generally occurs within coastal areas from Ulladulla on the south coast to Port Stephens on the mid-north coast, although it has been recorded from as far west as Woodford in the Blue Mountains and Penrose State Forest in the southern highlands (DotE 2015). The project footprint is contained within the known distribution of this species. The project would not result in the fragmentation of known populations and would not significantly affect habitat connectivity for this species. This is because this species has a relatively large distribution and exists in a fragmented matrix.

4: Adversely affect habitat critical to the survival of a species

Genoplesium baueri was not recorded during the field survey and therefore the habitat is not considered to be habitat critical to the survival of this species.

5: Disrupt the breeding cycle of an important population

Genoplesium baueri was not recorded during the field survey. The breeding cycle of this species is cued to significant rainfall in summer. No breeding habitat or known populations of this species will be impacted by the proposed works.

6: Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

In areas within the Hornsby Quarry containing potential habitat in the project footprint, disturbance regimes consist of fire suppression, increased runoff due to roads or stormwater outlets and increases in weed incursions. The project would not significantly alter these current disturbance regimes, but may push out these regimes to adjoining potential habitat. However it is unlikely that this would significantly impact this species which has not been detected within the project footprint.

7: Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The proposed project will not result in invasive species that are harmful to *Genoplesium baueri* becoming established in its habitat. A targeted survey of this species showed that the species is not present within the project footprint.

8: Introduce disease that may cause the species to decline,

The proposed project is unlikely to result in introducing diseases that may cause *Genoplesium baueri* to decline.

9: Interfere substantially with the recovery of the species.

As the project does not involve the removal of individuals of this species and the project would result in the removal of a small area of marginal habitat for *Genoplesium baueri* and is not limited to the range of this species' known habitat, the project are unlikely to interfere with the recovery of this species.

Is a significant impact likely to result?

No, based on the above assessment it is concluded that the project is unlikely to have a significant impact on *Genoplesium baueri*. No referral to the DotE for assessment and approval by the Environment Minister for the species is recommended.

THREATENED FAUNA

Large-eared Pied Bat

Chalinolobus dwyeri (Large-eared Pied Bat) is listed as vulnerable under the EPBC Act The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

Large-eared Pied Bat is found in well-timbered areas containing gullies. It frequents low to mid-elevation dry open forest and woodland close to caves, crevices in cliffs, old mine workings and disused mud nests of *Hirundo ariel* (Fairy Martin). The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years (DECC 2005).

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

The Large-eared Pied Bat was not recorded during a targeted survey within the study area, but has been recorded three times within the ten kilometre Wildlife Atlas search.

The walls of the Quarry void may contain cave-like crevices with moisture required for roost sites for this species. The site contains areas of potential foraging habitat include both woodlands and forests, thus impacts to potential secondary habitat is all native vegetation within the project footprint. There may also be some indirect impacts, primarily from noise and light. It is proposed to mitigate these potential indirect impacts by conducting the works within daylight hours (during standard work hours) and not during the night, and fitting noise producing equipment with attenuation devices (mufflers).

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

1. Lead to a long-term decrease in the size of an important population of the species

No. The study area does not contain any known breeding areas and the paucity of records suggests that the species would rarely pass through the area while foraging/migrating. Therefore, an important population of this species is unlikely to occur. Further a targeted survey for microbats in the study area showed that this species was not present.

2. Reduce the area of occupancy of an important population

No. An important population of Large-eared Pied Bat does not occur within the study area.

3. Fragment an existing important population into two or more populations

No. An important population of Large-eared Pied Bat does not occur within the study area.

4. Adversely affect habitat critical to the survival of a species

No. The potential foraging habitat for the species within the study area is not considered to be critical to the species survival.

5. Disrupt the breeding cycle of an important population

No. No breeding habitat will be impacted by the project.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

No. The loss of potential foraging habitat from the site is unlikely to cause a decline in the species.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

No.

8. Introduce disease that may cause the species to decline, or

No.

9. Interfere substantially with the recovery of the species.

No.

Is a significant impact on the species likely to result?

No.

Grey-headed Flying Fox

Pteropus poliocephalus (Grey-headed Flying-fox) are listed as vulnerable under the EPBC Act. Grey-headed Flying-foxes are found within 200 kilometres of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. 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 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (DECC 2005).

Individual camps may have tens of thousands of animals and are used for mating, birth and the rearing of young. Annual mating commences in January and a single young is born each October or November. Site fidelity to camps is high with some camps being used for over a century. They travel up to 50 kilometres to forage (DECC 2005).

This species feeds on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. They also forage in cultivated gardens and fruit crops and can inflict severe crop damage (DECC 2005).

The project footprint for the project would not disturb any known flying fox roosting camps. The nearest Grey-headed Flying-fox roost or “camp” is located to the south-east at Gordon, around eight kilometres and at the Parramatta Park bat camp is located south. There are several other camps located throughout the Sydney metropolitan area that are located further from the project. The project includes surface infrastructure along large sections of tunnel.

Foraging habitat would be lost through the clearing of potential marginal foraging habitat across the project footprint. Areas of potential foraging habitat to be cleared have been calculated based on the clearing of native vegetation within the project footprint. While the species would also forage on cultivated gardens and fruit crops, this has not been included in the analysis; as such foraging habitat is widespread within the Sydney urban area and including such data within the calculation of available regional Grey-headed Flying-fox habitat extent would be problematic. It is anticipated that direct impacts to Grey-headed Flying-foxes would be the loss of up to 0.9 hectares of potential secondary habitat within the project footprint (note that this figure excludes urban / native and exotics).

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

1. Lead to a long-term decrease in the size of an important population of the species

No. The project study area does not support a breeding population (camp) of Grey-headed Flying-fox. While there would be some loss of foraging habitat, the species forages widely on a variety of vegetation. Therefore, the study area is unlikely to support an important population of this species and no decline is expected to result in foraging Grey-headed Flying-fox populations.

2. Reduce the area of occupancy of an important population

No. An important population of Grey-headed Flying-fox does not occur within the study area.

3. Fragment an existing important population into two or more populations

No. The species is highly mobile and an important population of Grey-headed Flying-fox does not occur within the study area.

4. Adversely affect habitat critical to the survival of a species

No breeding habitat (camps) would be impacted by the project. There will be some loss of foraging habitat (0.9 hectares) with the camp in closest proximity to the study area located to the south at Gordon, around 8.5 kilometres away. Under the DECC (2009c) Draft National Recovery Plan foraging habitat within a 50 kilometre radius of a roost site with greater than 30,000 individuals is foraging habitat critical to survival. The Gordon camp site can vary in the number of individuals present from zero to 80,000 (Ku-ring-gai Council 2013) and the data for this camp suggests that the camp will vary during the breeding season (summer) between 20,000 and 40,000. Therefore there is foraging habitat present which meets the definition of habitat critical to the survival of the species. However, the amount of loss of habitat is not considered to be significant in terms of the regional context, as from analysis of the Native Vegetation mapping GIS dataset for the Sydney Metropolitan Area (Office of Environment and Heritage 2013d), more than 77,000 hectares of native vegetation were identified as occurring within 50 kilometres of the Gordon camp site, noting that this dataset is limited in its extent to the Sydney metropolitan Catchment management Authority area, and thus includes approximately 50% of the native vegetation within 50 kilometres of the camp site.

5. Disrupt the breeding cycle of an important population

No. No breeding habitat (camps) would be impacted by the project.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

No. The species forages widely across the landscape on a variety of vegetation. The loss of 0.9 hectares of foraging habitat within the project study area is unlikely to cause a decline in the species.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

No.

8. Introduce disease that may cause the species to decline, or

No.

9. Interfere substantially with the recovery of the species.

No.

Is a significant impact on the species likely to result?

No.

Koala

Phascolarctos cinereus (Koala) is listed as vulnerable under the EPBC Act and has a fragmented distribution throughout eastern Australia, ranging from north-east Queensland to the Eyre Peninsula in South Australia (DotE 2013 sprat). In NSW, this species mainly occurs on the central and north coasts. There are also some populations west of the Great Dividing Range.

The Koala is associated with both wet and dry eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70 per cent (Reed et al. 1990) with acceptable eucalypt food trees. This species feeds on more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (DECC rec plan). Primary and secondary food trees have been identified for each Koala management area in NSW but some primary food species of the Sydney metropolitan are: *Eucalyptus amplifolia, E. tereticornis*, and *E. microcorys* (DECC 2008d).

The Koala was not recorded within the study area. One secondary feed tree species, *E. resinifera,* was found in the study area. Koalas have only been recorded five times within the database search area with the most recent record being from 2000. No Koalas have been recorded from the Quarry site. An old (1968) record exists for this species in Berowra Valley Regional Park. The most recent record from 2000 is from Crosslands Road, Galston approximately six kilometres to the north of the Quarry.

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

1. Lead to a long-term decrease in the size of an important population of the species

No. An important population does not occur as the region is not identified in recovery plans, is not a key source population, and is not near the limit of the species' range.

The Koala is also not expected to occur within the study area as the majority of potential habitat is fragmented and isolated. Whilst Hornsby Quarry site is connected to other potential habitat, if Koalas are present, they would likely be migrating males.

There are no important populations of Koala within the project footprint. Important Koala populations in the Sydney Basin Bioregion are south-west at Campbelltown and in the Central Coast. The population at Pittwater is thought to be extinct (DotE 2015 SPRAT page).

2. Reduce the area of occupancy of an important population

No (see above). No important population is present. A small area of potential habitat at Hornsby Quarry will be reduced in extent.

3. Fragment an existing important population into two or more populations

No. An existing important population within the study area is not present. Impacts on potential habitat at Hornsby Quarry would be at the edge of the vegetation extent, and other vegetation within the study area is already fragmented and isolated, and therefore no fragmentation of habitat is expected.

4. Adversely affect habitat critical to the survival of a species

No. Koala habitat is only present at the site as marginal. This habitat is unlikely to be critical to the survival of the species, given there was no population detected on site and that no primary feed trees exist within the impact area and secondary feed trees did not cover 50 per cent of the potential habitat.

5. Disrupt the breeding cycle of an important population

No. An important population was not detected on the site and the proposed works will not impact on breeding at any known population.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

No. The loss of habitat from the study area is considered to be marginal and unlikely to lead to the decline of the species.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

No. The decline in Koala has been attributed to habitat loss and degradation, mortality through road kill and predation by domestic animals, disease and climate change. The project will not introduce any invasive species that is known to be harmful to Koala.

8. Introduce disease that may cause the species to decline, or

No. The decline of the Koala has been attributed to the chlamydia and more recently to the Koala retrovirus. It is believed that these diseases are present in the NSW populations, although not always expressed symptomatically. Given the presence of these diseases in the populations in NSW, the project will not be introducing a disease that may cause decline in Koala populations.

9. Interfere substantially with the recovery of the species.

No given the marginal potential habitat present and the absence of a population at the site.

Is a significant impact on the species likely to result?

No.

(blank)

Appendix J FBA Methodology and where addressed in document

Table 22: Location of FBA methodology requirements for a 'Biodiversity Assessment Report' for stages 1 and 2 and where these are addressed in this report

Report section	Information	Maps & data	FBA reference	Section in this Report
Introduction	Introduction to the biodiversity assessment including: • identification of development site footprint, including: ○ operational footprint ○ construction footprint indicating clearing associated with temporary construction facilities and infrastructure • general description of development site • sources of information used in the assessment, including reports and spatial data.	• Site Map (as described in Section 3.2) • Location Map (as described in Section 3.2) • Digital shape files for all maps and spatial data	Chapter 3 and Section 3.2	Chapter 1 – Introduction and Chapter 2 Methodology Appendix H -study area description with photographs.

Report section	Information	Maps & data	FBA reference	Section in this Report
Landscape features	Identification of landscape features at the development site, including: • IBRA bioregions and subregions, NSW landscape region and area (ha) • native vegetation extent in the outer assessment circle or buffer area • cleared areas • evidence to support differences between mapped vegetation extent and aerial imagery • rivers and streams classified according to stream order • wetlands within, adjacent to and downstream of development site • landscape value score components, including: ○ identification of method applied (i.e. linear or site-based) ○ percent native vegetation cover in the landscape ○ connectivity value ○ patch size ○ area to perimeter ration • landscape value score.	• IBRA bioregions and subregions (as described in Paragraphs 4.1.1.3–4) • NSW landscape regions (as described in Paragraphs 4.1.1.5–6) • Rivers and streams (as described in Paragraphs 4.1.1.8–10 • Wetlands (as described in Paragraphs 4.1.1.11–13) • Other landscape features (as required by SEARs) • Native vegetation extent (as described in Paragraphs 4.1.1.12–15) • State, regional and local biodiversity links (as described in Paragraphs 4.1.1.16–17) • Regional vegetation used to calculate patch size	Section 4.1, Appendix 4 and Appendix 5	Chapter 3 – Landscape features

Report section	Information	Maps & data	FBA reference	Section in this Report
Native vegetation	Identify native vegetation extent within the development site, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery. Describe PCTs within the development site, including: • vegetation class • vegetation type • area (ha) for each vegetation type • species relied upon for identification of vegetation type and relative abundance • justification of evidence used to identify a PCT (as outlined in Paragraph 5.2.1.8) • EEC status (as outlined in Subsection 5.2.1) • estimate of percent cleared value of PCT. Describe vegetation zones within the development site, including: • condition class and subcategory (where relevant) • area (ha) for each vegetation zone • survey effort as described in Paragraphs 5.2.1.5–7 (number of plots/transects). Where use of local data is proposed: • identify relevant vegetation type • identify source of information for local benchmark data • justify use of local data in preference to database values.	• Map of native vegetation extent within the development site (as described in Section 5.1) • Map of PCTs within the development site • Map of condition class and subcategory (where relevant) • Map of plot and transect locations relative to PCTs and condition class • Map of EECs • Plot and transect field data (MS Excel format) • Plot and transect field data sheets • Table of current site value scores for each vegetation zone within the development site • Map of vegetation zones with a current site value score of <17.	Chapter 5	Chapter 2 – Methodology for details on methods, Appendix B, C and D for details on species data and plot sheets. Chapter 4 – Native vegetation

Report section	Information	Maps & data	FBA reference	Section in this Report
Threatened species	Identify ecosystem credit species associated with PCTs on the development site as outlined in Section 6.3, including: • list of species derived • justification for exclusion of any ecosystem credit species predicted above. Identify species credit species on the development site as outlined in Sections 6.5 and 6.6, including: • list of candidate species • justification for inclusions and exclusions based on habitat features • indication of presence based on targeted survey or expert report • details of targeted survey technique, effort, timing and weather • species polygons • species that cannot withstand a further loss. Where use of local data is proposed: • identify relevant species or population • identify aspect of species/population data • identify source of information for local data • justify use of local data in preference to database values. Where expert reports are used in place of targeted survey: • identify the relevant species or population • justify the use of an expert report • indicate and justify the likelihood of presence of the species or population and information considered in making this assessment • estimate the number of individuals or area of habitat (whichever unit of measurement applies to the species/individual) for the development site, including a description of how the estimate was made • identify the expert and provide evidence of their expert credentials.	• Table of vegetation zones and landscape Tg values, particularly indicating where these have changed due to species exclusion • Targeted survey locations • Table detailing the list of species credit species and presence status on site as determined by targeted survey, indicating also where presence was assumed and/or where presence was determined by expert report • Species credit species polygons (as described in Paragraph 6.5.1.19) • Table detailing species and habitat feature/component associated with species and its abundance on site (as described in Paragraph 6.5.1.19) • Species polygons for species that cannot withstand a loss	Chapter 6	Chapter 2 – methodology for survey details and Appendix F and G for anabat results and HBT survey results; Chapter 5 – Threatened Species Appendix A likelihood of occurrence for EPBC Act species.

Report section	Information	Maps & data	FBA reference	Section in this Report
Avoid and minimise impacts	Demonstration of efforts to avoid and minimise impact on biodiversity values in accordance with Section 8.3. Identification of final project footprint during construction and operation in accordance with Subsection 8.3.3. Assessment of direct and indirect impacts unable to be avoided at the development site in accordance with Sections 8.3 and 8.4. The assessment would include but not be limited to: type, frequency, intensity, duration and consequence of impact. Statement of onsite measures proposed to avoid and minimise direct and indirect impacts of the Major Project.	• Table of measures to be implemented before, during and after construction to avoid and minimise the impacts of the project, including action, outcome, timing and responsibility • Map of final project footprint, including construction and operation • Maps demonstrating indirect impact zones where applicable	Chapter 8	Chapter 6 – Avoidance and mitigation measures Chapter 7 – Assessment of impacts

Report section	Information	Maps & data	FBA reference	Section in this Report
Impact summary	Identification of areas not requiring assessment in accordance with Section 9.5. Identification of areas not requiring offset in accordance with Section 9.4. Identification of PCTs and species polygons requiring offset in accordance with Section 9.3. Identification of impacts that require further consideration in accordance with Section 9.2, including: • the entity and/or impact for which further consideration is necessary • supporting information relevant to the impact, as outlined in Subsection 9.2.2. Ecosystem credits and species credits that measure the impact of the Major Project on biodiversity values at the development site, including: • future site value score for each vegetation zone at the development site • change in landscape value score • number of required ecosystem credits for the impact of development on each vegetation zone at the development site • number of required species credits for the impact of development on each threatened species that occurs on the development site.	• Map of areas not requiring assessment • Map of PCTs and species polygons not requiring offset • Map of PCTs and species polygons requiring offset • Map of the occurrence of the entity or impact that requires further consideration • Table of PCTs requiring offset and the number of ecosystem credits required • Table of species and populations requiring offset and the number of species credits required • Full biodiversity Credit Calculator output • Submitted proposal in the Credit Calculator	Chapter 9 Subsections 10.4.3 and 10.4.4	Chapter 8 – Impact summary and offsets
Biodiversity credit report	Credit profiles for ecosystem credits and species credits at the development site.	• Table of credit type and matching credit profile • Biodiversity credit report from the Credit Calculator	Subsection 10.4.5	Chapter 9 – Summary and biodiversity credit report

(blank)

HEAD OFFICE
Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

SYDNEY
Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

HUSKISSON
Suite 1, 51 Owen St
Huskisson NSW 2540
T 02 4443 5555
F 02 4443 6655

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601
F 08 8941 1220

BRISBANE
Suite 1 Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7191
F 07 3854 0310

1300 646 131
www.ecoaus.com.au

Appendix H

Technical working paper: Socio-Economic

Roads and Maritime Services

Hornsby Quarry: Road Construction Spoil Management Project

Socio-economic impact assessment

July 2015

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia Pty Ltd

Level 21, 420 George Street, Sydney NSW 2000, Australia

Contents

Glossary of terms and abbreviations

Term	Definition
ABS	Australian Bureau of Statistics
AWDT	Average Weekday Daily Traffic
EIS	Environmental Impact Statement
ENM	Excavated Natural Material
EP&A	Environmental Planning and Assessment
FTE	Full-Time Equivalent
GRP	Gross Regional Product
GSP	Gross State Product
LGA	Local Government Area
NSW	New South Wales
RE1	Public Recreation Zoned Land
SA1	Statistical Area 1
SEARs	Secretary's Environmental Assessment Requirements
TAFE	Technical and Further Education
VENM	Virgin Excavated Natural Material

(blank page)

Executive summary

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction ('the project').

This technical working paper presents an assessment of the potential social and economic impacts as a result of the project. This assessment has been undertaken in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and the *Roads and Maritime Services Socio-economic Assessment Practice Note* (Roads and Maritime, 2013) and includes socio-economic profiling of the study area, an assessment of potential positive and negative impacts of the project and an assessment of management and mitigation measures.

During the duration of the project, there is the potential for a boost in the local and regional economies due to project expenditure. Local and regional businesses would principally benefit from this expenditure through purchases made by businesses and workers associated with the project, to build and support the development of the project.

It was determined through economic multipliers that project expenditure would contribute a total (direct and indirect) of $120 million of output, $23 million of household income, around 235 full-time equivalent jobs and $40 million of value added to the New South Wales economy over the total project duration.

The project facilitates the infilling and rehabilitation of the site upon completion of the project to provide recreational facilities for the community such as additional walking and mountain bike trails. The project removes the ongoing safety risk to the community by stabilising the quarry site so it can be opened to the public. The project is a safe and sustainable solution to addressing community concerns regarding the safety of the quarry site. The project has the potential to positively impact the local and regional economies by removing the ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community.

There are potential long term benefits for local businesses from increased recreational tourism at the redeveloped quarry site. Businesses that may directly benefit from increased tourism include food and beverage retailers, accommodation providers, and other retail outlets catering to the needs of those using the rehabilitated quarry site for recreational purposes.

The project will require the temporary closure and/or changes to walking paths and mountain bike trails in the bushland surrounding the Hornsby Quarry site. The closure and/or changes to these paths are necessary to ensure public safety.

There is the potential for residents, users of community infrastructure and local businesses to experience impacts to amenity due to the project in the form of increases in noise and vibration, potential increases in dust and changes in visual amenity.

An increase in heavy vehicles on the existing road network during the project would potentially result in congestion due to increased delays at intersections along the project corridor and in surrounding areas. The increase in truck volumes, as a proportion of overall traffic, is anticipated to be minor as the Pacific Highway and local road network is already currently considered congested.

Access to the TAFE NSW – Northern Sydney Institute Hornsby Campus ('Hornsby TAFE') via Bridge Road will be temporarily reduced from two-lanes for bi-directional traffic to one lane that would need to be shared for entry and exit from the Hornsby TAFE. Consultation with Hornsby TAFE is ongoing and appropriate mitigation measures will be developed to ensure access to the site would be maintained. This would include the preparation of a Traffic Management Plan identifying traffic protocols for the shared access road.

Cumulative impacts to local residents, community facilities and businesses are most likely to result from the concurrent construction of the NorthConnex project and Hornsby West Side Development. Cumulative impacts will arise from the additional workforce vehicles on the local road network, additional project expenditure and additional employment opportunities in the area.

The study recommends a number of mitigation measures that are intended to minimise any impacts that would be associated with the project. These are detailed in **Section 6.0** of this report.

On balance, it is considered that the overall social and economic impacts of the project would be positive for the region.

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project).

On 13 January 2015, Roads and Maritime received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for NorthConnex identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage.

The Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during tunnel excavation activities from late 2015, noting that it is not a standalone solution. The Hornsby Quarry site is located close to NorthConnex and would minimise the distance required for haulage. In particular, spoil from the northern interchange compound and northern portals could be solely handled and reused at the Hornsby Quarry site. The handling, management and reuse of up to 1.5 million cubic metres of spoil at the Hornsby Quarry site would also alleviate the need for an increased number of other sites accepting small spoil volumes, thus reducing overall potential impacts within the wider community and the environment.

Hornsby Shire Council has also been actively seeking opportunities for material to fill the quarry void, with the aim of future rehabilitation of the Hornsby Quarry site and return to use for public recreation. Beneficially reusing spoil from NorthConnex would be an important first step towards preparing the Hornsby Quarry site in anticipation of Hornsby Shire Council separately rehabilitating and developing the site for public recreation in the future.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of noise and vibration from the project. This social and economic assessment has been prepared to inform the EIS being prepared for the Hornsby Quarry Road Construction Spoil Management Project.

1.2 The project

The Hornsby Quarry site would receive a minimum of one million cubic metres of excavated natural material (ENM) and/ or virgin excavated natural material (VENM) from the approved NorthConnex construction sites. Only ENM and/ or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the project area.
- Dewatering of the void (to be undertaken by Hornsby Shire Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.

- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil at three stockpile sites within the Hornsby Quarry site using dozers and wheel loaders.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.
- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete.

Detailed descriptions of each project activity can be found in **Section 4.1** of the EIS for the project.

An indicative project program is provided in **Table 1-1**.

Table 1-1 Indicative program

Phase	Indicative project timeframe															
	2015				2016				2017				2018			
Site establishment (including preparatory works)																
Establishment of conveyor																
Spoil haulage and stockpiling																
Spoil emplacement (operation of conveyor)																
Site clean-up and demobilisation																

An overview of project activities is included in **Table 1-2**. Detailed descriptions of each activity can be found in **Section 4.1** of the EIS for the project.

Table 1-2 Overview of works

Phase	Typical activities
Site establishment	The following works would be completed: • Dewatering of the void to a suitable working level. • Clearing and grubbing, and establishment pf erosion and sediment controls. • Establishment of a compound site. • Establishment of security fencing and signage around the project site. • Widening and sealing of the currently unsealed quarry access road (Bridge Road) to facilitate all weather access.
Conveyor construction works	The construction of the conveyor works would include establishment of footings and the conveyor.
Spoil haulage and stockpile maintenance	Trucks would enter and leave via Bridge Road during standard work hours over a maximum period of 28 months. Spoil would be unloaded from the haulage trucks and stockpiled using dozers. It is expected that this activity would commence whilst the conveyer is still being constructed.
Spoil emplacement	Once the conveyer is constructed, these works would occur concurrently with spoil haulage and stockpiling activities, but would also continue for a period after the completion of spoil haulage onto the site. The activities include: • Placement of spoil from the stockpiles into the conveyor by front end loader. • Transport of the spoil via conveyor to the quarry void rim where the spoil would fall directly into the void. • Front-end loaders and articulated trucks would move the spoil along the quarry floor with dozers and rollers spreading the material. Periodic maintenance pumping would be undertaken during all phases in accordance with Council's existing groundwater licence.
Site demobilisation and rehabilitation	The construction compound and conveyor would be dismantled and removed from the site. Disturbed areas would be rehabilitated to a standard agreed with the Council. Security fencing would be removed, however would be retained around the quarry void if the void is deemed to remain an ongoing risk to public safety. Public access would then be reinstated to the areas outside the void exclusion zone.

1.3 Project location

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The site covers about 35 hectares and is owned by Hornsby Shire Council.

The Hornsby Quarry site comprises the quarry void, internal access roads and a cleared area to the east which were used as processing areas when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the site is zoned for public recreation (RE1) under the *Hornsby Local Environmental Plan 2013*, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for public safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible.

The Hornsby Quarry site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and the cleared former processing areas. Dense bushland comprising the Berowra Valley National Park occurs directly to the west.

1.4 Purpose of this report

The SEARs for the project were issued on 2 July 2015 and have informed the preparation of the EIS for the project. The SEARs provide combined land use, property and socio-economic requirements and include:

- *An assessment of potential impacts on directly affected properties and land uses, including impacts related to access, land use and amenity related changes;*
- *An assessment of the effects on existing mountain bike trails and recreation areas within Old Man's Valley, including, where applicable, details of rerouted trails and access paths; and*
- *An assessment of social and economic impacts to businesses along Pennant Hills Road and the Pacific Highway, and the community associated with traffic, access, property, public domain and amenity related changes.*

This technical working paper presents the assessment of the potential social and economic impacts as a result of the project. The SEARs that relate to land use and property impacts are addressed in the land use and property assessment (**Section 7.1** of the EIS). This assessment has been undertaken in accordance with the SEARs and the *Roads and Maritime Services Socio economic Assessment Practice Note* (Roads and Maritime, 2013).

1.5 Methodology

This study has been conducted in accordance with the guidance presented in the *Roads and Maritime Services Socio-economic Assessment Practice Note* (Roads and Maritime, 2013). A moderate to comprehensive level of assessment has been adopted in accordance with Roads and Maritimes guidance.

The methodology for this study covers the existing socio-economic context, an assessment of impacts and mitigation measures as follows:

- Define the relevant study area for the project, taking into account the extent or scale of the potential impacts of the project, including both direct and indirect impacts, and the context of the area surrounding the project.
- A profile of the project area and surrounds, including any relevant statistics to provide a better understanding of the social and economic circumstances of the project area that will be potentially affected by the project.

- A description of any groups or particular communities that may be affected by the project, including directly impacted property owners, the general community, local businesses and recreational users, as well as those indirectly affected through traffic impacts, including public transport routes and cycling restrictions. Any economic impacts will be considered at a local and regional level, where appropriate.
- An assessment of the impacts of the project on individual businesses on a property-by-property basis, where appropriate.
- An assessment of the impacts of the project with regard to property impacts, business impacts, community values, as well as access and connectivity. The focus will be largely on directly affected properties but will also consider those in the vicinity of the project, as well as impacts on through traffic and transport movements in the project area.
- A cumulative assessment of the socio-economic impacts of all phases of the project, combined with the impacts of other planned and anticipated projects.
- Identification of measures to mitigate or manage the socio-economic impacts as a result of the project.

1.5.1 Economic multipliers

Economic multipliers are used to quantify economic impacts or changes in economic activity resulting from a stimulus such as the carrying out of the project. These multipliers can be calculated from input-output tables. The Australian Bureau of Statistics (ABS) prepares a national input-output table, the most recent being for 2009/10 (ABS*, Australian National Accounts: Input-Output Tables 2009/10, 5209.0.55.001*, 20 September 2013). The table describes inter-industry transactions among 114 industries, showing the fixed amounts of inputs that are required to produce a given output at the national level. The table is compiled in accordance with the Australian national accounting system, and international Government accounting standards.

State-level input-output tables can be derived by adjusting the national table to reflect each state's inter-industry transactions and final demand flows, based on information and data at the state level within the Australian national accounting system and on the latest Census data.

Four multipliers are usually used to measure economic impact: output (value of production or turnover), value added (which can be directly compared to gross domestic product and gross state product), household income and employment. Two types of multipliers can be calculated:

- Type 1 multipliers, which measure the direct and production-induced impacts of a stimulus or activity – the latter impacts refer to the subsequent rounds of purchases of inputs by businesses supplying the direct suppliers of the stimulus or activity (industrial flow-on effects).
- Type 2 multipliers, which capture the Type 1 effects and also measure the consumption-induced effects that flow from the expenditure of income that is earned from the production of additional output.

Input-output multipliers are based on a number of assumptions that provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy. This interdependence arises solely from the sales and purchase links between industries and is based on estimates of transactions occurring over a recent historical period. The limitations of input-output analysis therefore include:

- *Lack of supply-side constraints* – it is assumed that extra output can be produced in one area without taking resources away from other activities, thus potentially overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.

- *Fixed prices* – it is assumed that any change in the demand for productive factors would not induce any change in their cost.
- *Fixed ratios for intermediate inputs and production* – it is assumed that there is a fixed input structure in each industry and fixed ratios for production (as described by fixed technological coefficients).
- *No allowance for purchasers' marginal responses to change* – it is assumed that households consume goods and services in exact proportion to their initial budget shares and that this applies equally to industrial consumption of intermediate inputs and factors of production.
- *Absence of budget constraints* – it is assumed for consumption-induced effects (Type 2 multipliers) that household and government consumption is not subject to budget constraints.

It is preferable to apply Type 1 multipliers, because an input-output model is based on the above simplifying assumptions which have the effect of imposing few constraints to economic expansion. As a result, Type 2 multipliers could overstate potential impacts, particularly where assessing the expansion of an existing activity rather than the contribution of an existing activity.

1.6 Definition of the study area

The study area for the socio-economic assessment has been identified as the geographical statistical areas (as defined by the ABS) that encompass the project, as well as the wider catchment as it relates to the proposed haulage routes and the Hornsby Quarry site.

The study area comprises the areas that are most likely to experience social or economic impacts, as the spoil from the construction of NorthConnex is transported to the Hornsby Quarry site. The area comprises the areas immediately surrounding the quarry as well as the areas along the following haulage routes:

- Into Hornsby Quarry - Pacific Highway from the intersection with Pennant Hills Road, along George Street and onto Bridge Road.
- Out of Hornsby Quarry:
    - Non-peak hours - Bridge Road and south along George Street and the Pacific Highway onto Pennant Hills Road.
    - Peak hours - Bridge Road and north along Jersey Street North, the Pacific Highway, Yirra Road, Belmont Parade and Ku-ring-gai Chase Road to connect with the M1 Pacific Motorway.

Appendix A provides the ABS Statistical Area 1 reference codes that have been used to define the study area and **Figure 1-1** presents a map of the study area for the socio-economic assessment.

1.7 Structure of this report

The report has the following structure:

- **Section 1** introduces the project;
- **Section 2** presents an overview of community consultation and the key social and economic issues;
- **Section 3** provides a summary and analysis of the existing social and economic environment;
- **Section 4** details the potential social and economic impacts of the project;

- **Section 5** details the mitigation and management strategies recommended to address the potential social and economic impacts of the project;
- **Section 6** provides the references used to assist in the preparation of this report;
- **Appendix A** presents the statistical areas used to define the study area for the socio-economic assessment;
- **Appendix B** provides a detailed set of data tables for the socio-economic characteristics of the study area; and
- **Appendix C** presents the community infrastructure identified in the study area.

(blank page)

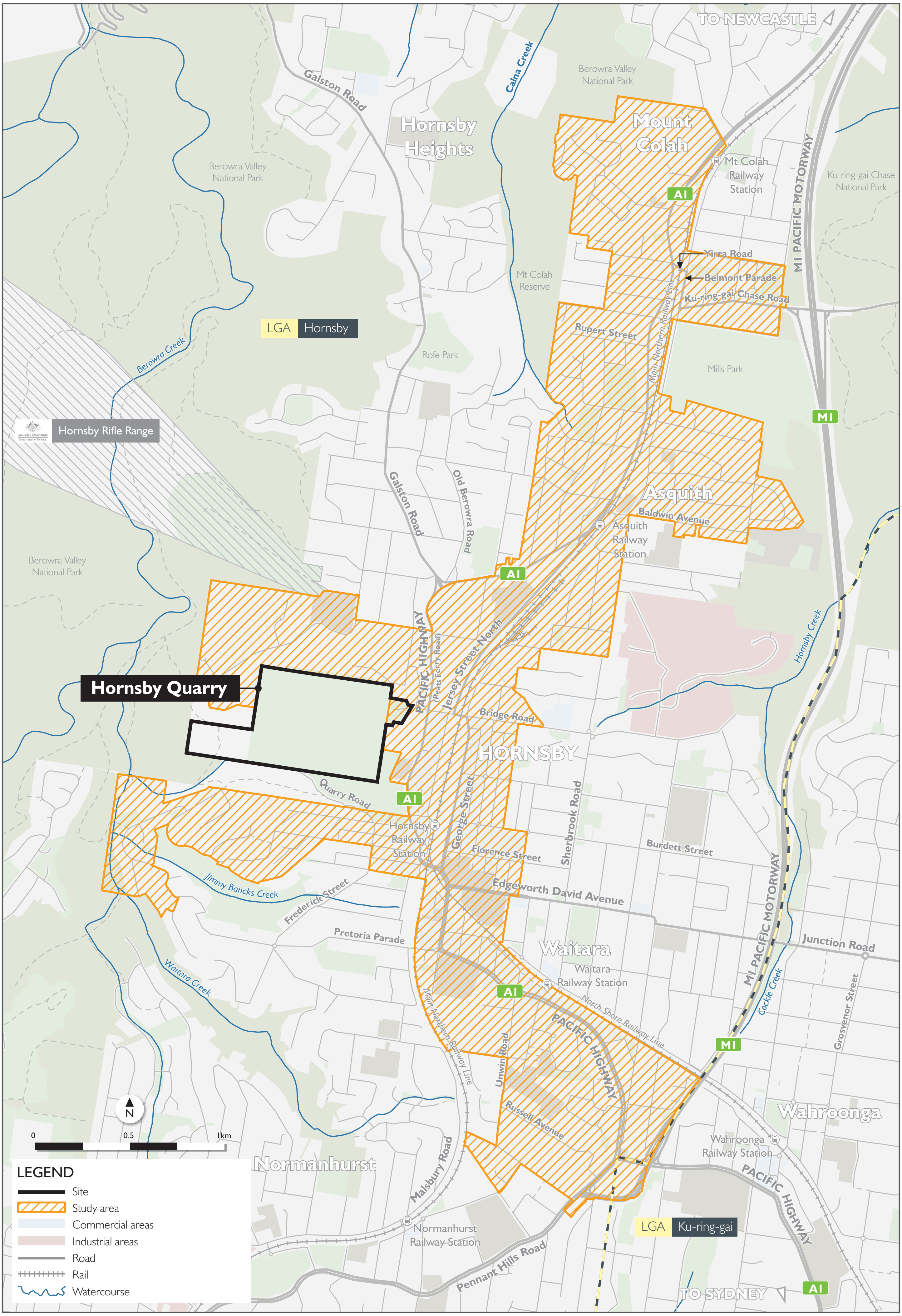

Figure 1-1 Study area for the socio-economic assessment

(blank page)

2 Consultation and key stakeholder issues

Consultation with key stakeholders, including local communities, community groups and local businesses will occur throughout the EIS process. Community consultation being conducted as part of the project is discussed in detail in **Chapter 5** (Consultation) of the Hornsby Quarry EIS.

Table 2-1 identifies potential community and key stakeholder issues identified through stakeholder mapping.

Table 2-1 Potential community and stakeholder issues

Issue	Detail	Report section
Businesses and the economy	• The haulage route should minimise impacts to businesses and the local economy.	• Section 4.1
Properties	• There is a concern that property damage could occur as a result of vibration from haulage.	• Section 4.2
Amenity	• The project needs to take into account the air quality, noise and emission impacts from trucks hauling the spoil. • The project needs to consider the impacts on visual amenity at the Hornsby Quarry site.	• Section 4.3
Community and recreational facilities	• Impacts on local schools, childcare facilities and health facilities. • The peak out-route passes several schools during school drop off times. • The project results in the temporary loss of public space and access. • Impacts to recreational opportunities (including mountain bike facilities) at the Hornsby Quarry.	• Section 4.4 and Section 4.5
Traffic and transport (including access arrangements)	• The haulage route passes through residential and commercial areas. • Safety concerns from the increase in the amount of traffic around schools and child care facilities. • The proposed route has the potential to impact freight and commuter traffic. • The spoil haulage route should minimise impacts on access to the staff and student carpark for the Hornsby TAFE.	• Section 4.5
Uncertainty	• Uncertainty around project scale and design.	• Section 4.4

(blank page)

3 Existing context

3.1 Overview of existing environment

3.2 Socio-demographic profile of local residents

Data for the socio-demographic profile of the local resident population has been collated from the 2011 Census of Housing and Population (ABS, 2012) Basic Community Profiles, unless otherwise stated. A detailed set of data tables are provided at **Appendix B**.

The study area has been profiled by examining the data for statistical areas defined as Statistical Area 1 (SA1) by the Australian Bureau of Statistics (ABS). The study area adopted for this assessment is presented in **Section 1.6** and **Appendix A** of this report.

The geographical area of comparison is Hornsby Local Government Area (LGA).

The following indicators provide the key characteristics of people that reside in the study area and how they compare with Hornsby LGA and New South Wales:

- **Population:** In 2011, the population of the study area was 15,292 residents and the population of Hornsby LGA was 156,847 residents. The population of Hornsby LGA increased by 3.6 per cent between 2006 and 2011. This was slower than the average population growth across New South Wales (NSW) of 5.6 per cent over the same period.
- **Population Projections:** The population of Hornsby LGA is projected to increase 23 per cent between 2011 and 2031 resulting in 201,750 residents by 2031. This growth is predicted to be slower than New South Wales growth of 27 per cent over the same period.
- **Median Age:** In 2011, the average median age in the study area was 39 years. This is in line with the median age of Hornby LGA and NSW of 39 and 38 years, respectively.
- **Population Age:** In 2011, 14.5 per cent of residents in the study area were aged 65 years and over. Residents in Hornsby LGA aged 65 years and over accounted for 14.4 per cent of the total population. Between 2006 and 2011, the proportion of residents in Hornsby LGA aged 65 years and older, has increased by 1 percentage point.
- **Indigenous Population:** The indigenous population of the study area and Hornsby LGA accounted for 0.5 per cent and 0.4 per cent of the total population, respectively. These were lower than the NSW average of 2.5 per cent of the population identifying as indigenous.
- **Language spoken at home:** In 2011, 34.7 per cent of residents in the study area and 28.4 per cent of the residents in Hornsby LGA spoke a language other than English at home. Both the study area and Hornsby LGA had a higher proportion of residents speaking a language other than English at home than the NSW average of 22.0 per cent.
- **Population mobility:** The study area has a higher level of internal migration than both Hornsby LGA and NSW averages. In the study area, 16.0 per cent of residents lived at a different address one year ago and 45.0 per cent lived at a different address five years ago. This is significantly higher than the Hornsby LGA and NSW averages of 11.6 per cent and 13.9 per cent, respectively, for one year migration and 34.1 per cent and 36.9 per cent respectively for five year migration.
- **Dwellings:** In 2011, the majority of dwellings in the study area were apartments/units (45.9 per cent), followed by separate houses (42.2 per cent) and semi-detached dwellings (11.4 per cent). The study area has less separate houses and more apartment/unit dwellings than Hornsby LGA or NSW averages.
- **Household size and composition:** The average household size in the study area was 2.6 people per household. The majority of these households were family households (70.3 per cent).

The average house sizes in Hornsby LGA and NSW were 2.9 and 2.6 people per household, respectively. Hornsby LGA and NSW had higher proportions of family households than the study area at 80.1 per cent and 71.9 per cent family households, respectively.

- **Housing tenure:** The majority of housing in the study area was rented in 2011 (34.6 per cent), followed by housing owned with a mortgage (33.9 per cent) and then housing owned outright (28.1 per cent). The study area had a greater proportion of renting than Hornsby LGA or NSW averages (20.3 per cent and 30.1 per cent respectively).
- **Median incomes:** The median household income in the study area in 2011 ranged between $818 and $2,700 per week. The Hornsby LGA median household income was $1,824 per week and the NSW median was $1,237. The median household income in some areas within the study area is significantly higher than the Hornsby LGA and NSW median household incomes, while the median household income in some areas within the study area is significantly lower than the Hornsby LGA and NSW medians.
- **Socio-economic advantage/disadvantage indexes:** The Index of Relative Economic Advantage/Disadvantage is a continuum of advantage to disadvantage. A higher score on the Index indicates an area has attributes of “higher advantage” such as a relatively high proportion of people with high incomes or a skilled labour force. It also means an area has a low proportion of people with low incomes and relatively few unskilled people in the labour force. In 2011, Hornsby LGA recorded an Index of Relative Economic Advantage/Disadvantage of a score of 1106 and decile of 10. This is a relatively high score, highlighting that the area is relatively advantaged when compared to other regions across Australia.
- **Need for assistance:** In 2011, 4.7 per cent of the population of the study area was identified as requiring assistance with core activities. This was higher than the Hornsby LGA average of 3.7 per cent requiring assistance with core activities, but lower than the NSW average of 4.9 per cent requiring assistance with core activities.
- **Labour force status:** In 2011, the unemployment rate for the study area was 5.6 per cent. This was higher than the Hornsby LGA unemployment rate (4.8 per cent), but lower than the NSW average unemployment rate (5.9 per cent).
- **Industry of employment:** In 2011, 14.4 per cent of residents of the study area were employed in the health care and social assistance industry. The second most common industry of employment was professional, scientific and technical services (12.8 per cent) and retail trade (9.9 per cent). Hornsby LGA had a similar distribution of industries of employment with 12.9 per cent of residents employed in the health care and social assistance industry and 12.8 per cent of residents employed in the professional, scientific and technical services industry.

In summary, the study area is generally homogenous with the wider Hornsby LGA socio-economic characteristics. Residents are more likely to live in non-family households, in rental apartments or flats, and have been living at their current address for less than 5 years than the remainder of Hornsby LGA and NSW. Residents generally have high socio-economic indexes and are more likely to speak a language other than English at home than the NSW average.

3.3 Community facilities

The immediate area surrounding the Hornsby Quarry is predominately bushland, with residential properties located to the north and south of the Hornsby Quarry. Community facilities adjacent to the Hornsby Quarry site are located to the east, along the Pacific Highway, and to the south of the site, on Dural Street.

The facilities within closest proximity to the Hornsby Quarry site include:

- TAFE NSW – Northern Sydney Institute Hornsby Campus ('Hornsby TAFE');
- Multiple child care centres;
- Mt Wilga Hospital;
- Hornsby Uniting Church;
- Hornsby Shire Council Chambers;
- Hornsby Court House;
- Hornsby Police Station;
- Hornsby Mall;
- Hornsby Transport Interchange;
- Hornsby Park and playground; and
- Hornsby Aquatic and Leisure Centre.

The broader study area is home to a significant amount of community infrastructure, particularly along the proposed haulage route. The broad study area incorporates the suburbs of Hornsby, Waitara, North Wahroonga and Asquith, all containing facilities that are essential to meeting the local needs of the people within these communities. Of particular note, the broader study area contains a large concentration of education facilities, ranging from early childhood through to tertiary, and aged care facilities.

Figure 3-1 indicates the proximity of community infrastructure to the project and **Appendix C** provides a list of community infrastructure presented in **Figure 3-1**.

The bushland immediately surrounding the Hornsby Quarry, including Old Mans Valley and Berowra Valley National Park, is used for recreational purposes and contains mountain bike trails and a number of walking trails, including Benowie walking track, which leads to the Blue Gum Walk and Hornsby Shire mountain bike trail. The Hornsby Quarry site is currently used by a number of mountain bike riding and walking clubs for social and recreational uses, including day use and overnight camping. Hornsby Shire Council recorded an estimated 300 visitors undertaking approximately 900 laps each week in 2013/14.

The Hornsby Quarry site is recognised as currently unstable and, as such, the bushland around the site must be used with caution, limiting the recreational activity that can take place. The site does not provide infrastructure such as toilet or drinking water facilities for recreational users. Access roads through the site are provided and used in emergencies such as bushfires.

(blank page)

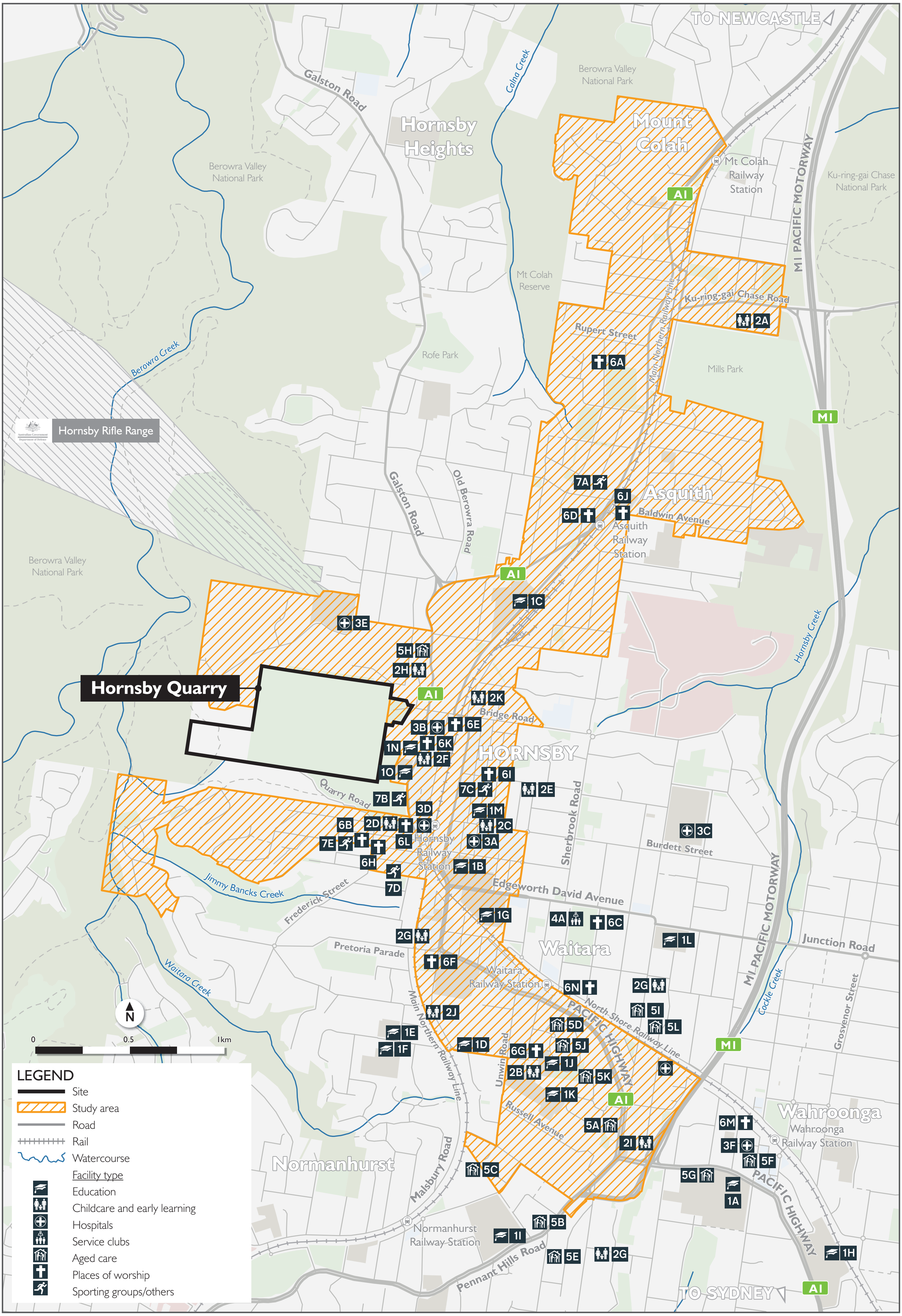

Figure 3-1 Community facilities in the vicinity of the project

(blank page)

3.4 Economic / business environment

The Hornsby LGA has a relatively diversified economy and is not heavily reliant on one industry. In 2011-12, the Hornsby LGA had an estimated $6 billion gross regional product (AECOM GRP Model, 2014). The largest contributing industries to the economy were manufacturing, health care/social assistance, professional/scientific/ technical services and education/training all contributing around eight to nine per cent of total industry contribution to the economy (gross sector value added) (AECOM GRP Model, 2014)

There were 4,318 businesses in the Hornsby, Waitara, Asquith and Mount Colah areas in 2013 (ABS, 2014a). The largest numbers of businesses were in the industries of professional/scientific/technical services, construction and rental/hiring/real estate services. Most of the businesses in the study area were small businesses with 64 per cent of businesses having turnover of less than $200,000 and 98 per cent of businesses employing less than 20 employees[1] (ABS, 2014a).

A number of businesses were identified as being located on the haulage routes along the Pacific Highway (between Pennant Hills Road and George Street, Hornsby), George Street, Bridge Road (west of George Street), Jersey Street North and the Pacific Highway (between Wattle Street and Yirra Road). These businesses fall within the following industries:

- Retailers, including supermarkets and pharmacies.
- Cafés, restaurants, pubs and bars.
- Accommodation services.
- Service stations and mechanics.
- Car dealerships.
- Other service providers such as funeral homes, travel agents, real estate agents, physiotherapists, dry cleaners, dentists, beauty and hair salons.

Figure 3-2 shows the current land use in the vicinity of the project.

[1] The ABS defines a small business as having less than 20 employees.

(blank page)

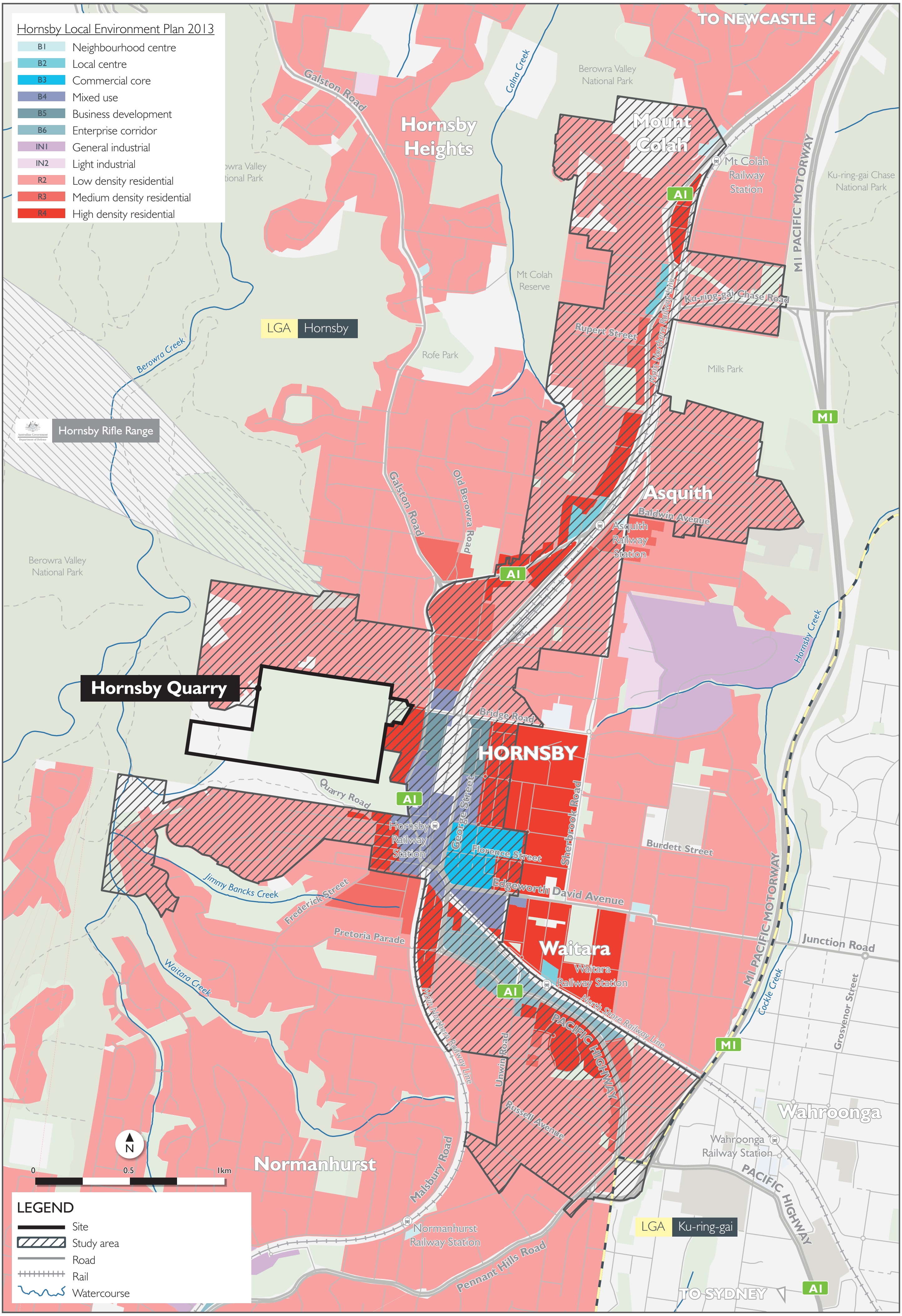

Figure 3-2 Employment and residential land in the vicinity of the project

(blank page)

3.5 Travel patterns

3.5.1 Passenger vehicles and public transport

Private vehicles are the predominant mode of transport in the study area with 47 per cent of residents travelling to work by car (as a driver or passenger). This is consistent with the higher than average vehicle ownership in the Hornsby LGA of 1.7 cars per household (the Sydney Metropolitan average is 1.6 cars per household).

The study area also has a high proportion of residents travelling by train to work compared with the Hornsby LGA average. In the study area, 26 per cent of residents travelled by train to work, while in Hornsby LGA, 21 per cent travelled by train to work. Train travel is a key method of transport for journeys to work in the area, particularly to the Sydney central business district.

Hornsby Station is located to the east of the Pacific Highway opposite Dural Lane. The North Shore, Northern and Central Coast & Newcastle Lines stop at Hornsby Train Station. Trains run every four mins during the morning peak and every four and a half minutes during the evening peak.

Hornsby has a number of bus services operating in the project area. Hornsby station has a major bus interchange and both HillsBus and Transdev operate buses that stop at this station. The frequency of bus services operating at this interchange ranges from every 10 minutes to once an hour.

Walk-only trips in the area represent 14 per cent of the average weekday travel mode share in Hornsby. Pedestrian footpaths are provided along the sides of the roads, with regular crossings via signalised intersections as well as two pedestrian overpasses at Hornsby train station. There are no separated cyclist facilities within the Hornsby area.

3.5.2 Freight and commercial travel patterns

Traffic surveys, completed for the NorthConnex project in December 2013, found that heavy vehicles represented around three to six per cent of total traffic across the weekday (referred to as average weekday daily traffic (AWDT)) on the Pacific Highway. This is mainly due to the nature of the Pacific Highway, whereby it passes through urban areas, characterised by highly signalled traffic flows. It is generally considered an unfavourable environment for long distance freight travelling between Pennant Hills Road and the M1 Pacific Motorway and as such the majority of freight and commercial vehicles travelling on this road are local freight movements for delivery to and from local businesses (refer to Technical working paper: Traffic and transport for the NorthConnex EIS) (AECOM, 2014).

3.6 Summary

The study area is home to a significant amount of community infrastructure essential to meeting the needs of the local communities. Of significant importance is the bushland immediately surrounding the Hornsby Quarry which is currently used for recreational purposes and contains a 6km mountain bike trail and a number of walking trails. The bushland is currently used by a number of mountain bike riding and walking clubs for social and recreational uses, including day use and overnight camping.

The proposed haulage route is generally considered congested due to the high dependency of local residents on transportation by car and the movements associated with local freight and commercial vehicles (refer to **Section 4.5**).

(blank page)

4 Impact assessment

During the project there is the potential for positive and negative impacts on local residents, businesses and the regional economy. An assessment of the potential impacts has been undertaken to determine the type, direction and magnitude of the potential impacts.

The following potential impacts during the project have been identified:

- Increase in output, industry value added, household income and employment from direct and indirect impacts due to project expenditure and employment;
- Amenity impacts, resulting in decreased air quality, increased noise and vibration and decreased visual amenity for community facilities, residential properties and businesses in close proximity to the haulage route, and residential properties and Hornsby TAFE adjacent to the Hornsby Quarry site;
- Changes in accessibility to residential properties, community facilities and businesses due to traffic congestion from project traffic along haulage routes;
- Community cohesion impacts from the potential closure and/or changes to the mountain bike trails and some walking trails in bushland adjacent to the Hornsby Quarry site; and
- Cumulative impacts due to concurrent construction activities associated with NorthConnex, Hornsby West Side Development and other construction projects in the region.

The following potential benefits following completion of the project have been identified:

- Reduction in ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community;
- Facilitating the rehabilitation of the Hornsby Quarry site, resulting in potential improvements in landscape character and visual amenity;
- Facilitating the rehabilitation of the Hornsby Quarry site and the expected subsequent provision by Hornsby Shire Council of additional walking and bike paths for public use, potentially resulting in increased community cohesion; and
- Removal of the ongoing safety risk to the community by stabilising the quarry site so it can be opened to the public.

4.1 Economic and business impacts

The expenditure of the project would be of significant benefit to the economy. This expenditure would inject economic stimulus benefits into the local, regional and state economies. Local and regional businesses would principally benefit from this expenditure through purchases made by businesses and workers associated with the project, to build and support the development of the project. The analysis assumes that ten per cent of labour, plant and equipment, materials or other inputs would be sourced from interstate or overseas.

The workforce expected to be created during the project (classified as ‘initial’ employment in this assessment) includes:

- Up to 80 employees for early works (site preparation, site establishment and establishment of conveyor);
- 15 employees for spoil management; and
- 20 employees for site demobilisation.

These employees will be required for varying durations over the approximate 33 month project lifetime.

The workforce presented above does not include those employed in the haulage of spoil from the NorthConnex construction sites to the Hornsby Quarry site. These workers have been included as part of the NorthConnex workforce. The impact of this workforce has been assessed in the Business Impacts Technical Assessment of the NorthConnex EIS.

The full-time equivalent (FTE) Hornsby Quarry Spoil Management workforce is presented in **Table 4-1**. The employment presented in the table below differs from the employment presented above as it represents the FTE positions required per year for the project and takes into account the duration of employment and the number of individuals employed.

Table 4-1 Hornsby Quarry Spoil Management Workforce, FTE positions per year

Workforce (FTE/year)	2015	2016	2017	2018	Total
Early works (site preparation, site establishment and establishment of the conveyor)	20	20			40
Spoil management		11	15	11	37
Site demobilisation				15	15
Total positions (FTE)	**20**	**31**	**15**	**26**	**92**

Table 4-2 presents the direct, indirect and total impacts of project expenditure on the New South Wales economy over the 33 month project duration.

Direct impacts (including employment) are the initial and 'first-round' effects of project expenditure where 'first round' effects refer to the impacts on businesses supplying directly to the project. Businesses that may directly benefit from the project may include local construction contractors and those businesses who service or supply goods to the construction industry such as food and beverage retailers, accommodation providers, and other retail outlets that would cater to the day-to-day needs of the project workforce. The increase in turnover may subsequently lead to increased employment opportunities and incomes for those businesses (and employees) providing goods and services.

The project expenditure would also have flow-on effects to other businesses in the area and to the wider state economy. These flow-on effects are also referred to as indirect effects.

The assessment of direct, indirect and total impacts of project expenditure has been conducted using the economic multiplier methodology presented in **Section 1.5.1**. As project expenditure was not available for the assessment, the 'initial' employment coefficient from the state-level input-output table was used to estimate project expenditure based on FTE employment provided.

Table 4-2 shows that for New South Wales[2]:

- Project expenditure, in terms of output, contributes an estimated $88 million directly, with flow-on (indirect) effects of $33 million, giving an estimated total impact of $120 million (rounded).
- Household income generated by carrying out the project is estimated to be $16 million with flow-on effects of $7 million, giving an estimated total household income contribution of $23 million.

[2] The analysis assumes that four per cent of labour, plant and equipment, materials or other inputs would be sourced from interstate and six per cent of equipment, materials and other inputs would be sourced from overseas.

- Direct employment (initial and ‘first round’) supported by the project is estimated to average 138 FTE positions during the 33 month project (including 92 FTE jobs presented in **Table 4-1** – classified as ‘initial’ employment). Flow-on employment is estimated to average 96 FTE positions over the 33 months, giving a total of 235 FTE positions (rounded) over the project duration, or on average 59 FTE positions per year.
- Value added attributable to the project is estimated to be around $27 million directly, with flow-on effects of around $13 million, giving an estimated total value added contribution of $40 million. This is the estimated contribution to Gross State Product (GSP).

Table 4-2 Direct, indirect and total impacts of expenditure on the New South Wales economy

Area	Increase in industry output	Increase in household income	Increase in employment	Increase in value added
	$ million	$ million	FTE positions [(a)]	$ million
Direct	88	16	138	27
Indirect	33	7	96	13
Total [(b)]	120	23	235	40

Source: AECOM (2014)

Notes:

(a) Total FTE positions supported over the project duration (2015-2018). The average number of FTE positions supported per year is 59 FTE positions.

(b) Totals may not sum due to rounding.

4.1.2 Economic and business benefits arising from the completion of the project

In its current state, Hornsby Quarry presents an ongoing safety risk and requires ongoing maintenance costs to ensure wall stability. The project has the potential to positively impact the local and regional economy by removing the ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community.

The Hornsby Shire Council has been actively exploring options for infilling the quarry void to rehabilitate the site for public use. The project facilitates the infilling and rehabilitation of the Hornsby Quarry site to provide recreational facilities for the community without significant capital outlay required by the Hornsby Shire Council and the community, thus enabling community funds to be utilised elsewhere.

There are potential long term benefits for local businesses from increased recreational tourism at the redeveloped quarry site. Businesses that may directly benefit from increased tourism include food and beverage retailers, accommodation providers, and other retail outlets catering to the needs of those using the rehabilitated quarry site for recreational purposes.

4.2 Property impacts

No residential properties or businesses would be acquired (partially or fully) for the project. The project would be confined to land owned by Hornsby Shire Council. Hornsby Shire Council has been consulted during the design development for the project and is supportive of works to fill and stabilise the Hornsby Quarry void, as a necessary first step towards potential rehabilitation and development of the Hornsby Quarry site for recreational purposes in the future.

4.3 Amenity impacts

Amenity impacts include any factors that affect the ability of a resident, visitor or business owner to enjoy their home and daily activities, for example, noise, vibration, detrimental changes to views or changes to air quality. Amenity impacts may also affect passive or active users of the open space and recreational facilities surrounding the Hornsby Quarry site such as the walking and mountain bike tracks and Hornsby Park.

Amenity impacts during the project have been discussed in detail in **Section 6.2** (Noise and vibration), **Section 6.3** (Air quality) and **Section 7.2** (Visual and urban design) of the EIS for the project.

With reference to those assessments, the potential impacts to residents and businesses during the project within the study area as a result of changes in amenity would occur as a result of:

- Changes in visual amenity due to activities at the Hornsby Quarry site and the increase in vehicles on the road network;
- Increases in noise and vibration, including increases in road traffic noise; and
- Potential changes in local air quality due to increased dust emissions associated with surface disturbance and/or the handling, transport and management of spoil.

4.3.1 Visual Amenity

It is anticipated that visual amenity would not be impacted for residences along Fern Tree Close and Manor Road due to the project. These residents are currently screened by existing vegetation, which would be maintained throughout the life of the project.

It is anticipated that visual impacts during the project would be primarily limited to the increase in vehicles on the local road network for the transport of materials and spoil.

Residents and community facilities located on Bridge Road may be visually impacted through the clearance of some vegetation adjacent to Bridge Road. Visual amenity for the Hornsby TAFE may be impacted as buildings adjacent to the Hornsby Quarry site would have clear views to the future stockpile area where the conveyor infrastructure is to be established. This receiver location is expected to experience the greatest visual change of all receivers external to the Hornsby Quarry site. However, the intermittent nature of users of the Hornsby TAFE site would act to mitigate the extent and duration of potential visual impacts.

Visitors to Hornsby Mountain Bike Trail and Benowie Walking Track would have partial views of the site establishment activities, depending on the timing and nature of rerouting proposed by Hornsby Shire Council. It is anticipated that some trails would be rerouted to ensure the safety of the public and would maintain adequate distance from the project. Some temporary closures of the trails may occur, during which no site activities would be visible. Nonetheless, given the intermittent nature of visitors to these trails, the visual impacts are not considered to be significant.

Works for the project would be limited to standard work hours only. Therefore, there will be no visual impacts during night time hours as a result of lighting or other activities.

4.3.2 Noise and Vibration

Noise mitigation surrounding stationary plant and equipment (such as mulchers) and noise mounds about 5 metres high surrounding the stock piling area have been included in the design of the project to mitigate noise from works at the Hornsby Quarry site. The noise assessment conducted for this project determined that no sensitive receivers would be highly noise affected (noise levels greater than 75 dB(A)) due to works on the Hornsby Quarry site. However, some receivers will experience moderate effects, including:

- Residential receivers overlooking the sight could experience moderate exceedances of up to 23 dB(A) during times of noise intensive works associated with the site establishment phase. Noise would reduce with distance, and receivers in the second or third rows back from the site could experience maximum exceedences of up to 14 dB(A) during site establishment.

- During the spoil haulage and emplacement phase, residential receivers overlooking the site could experience exceedances of the noise management levels of up to 19 dB(A) and receivers in the second or third rows back from the site could experience maximum exceedences of up to 5 dB(A) during spoil haulage and emplacement.
- Classrooms at the Hornsby TAFE that look directly over the project site could experience exceedances of the internal noise criterion of up to 9 dB(A) during the site establishment phase and up to 2 dB(A) exceedences during the ‘conveyor construction and haulage’ and ‘spoil haulage and emplacement’ phases.

The noise assessment indicates that noise levels at commercial and industrial receivers and community facilities, including childcare centres and places of worship, adjacent to the site would generally remain compliant with the applicable noise management levels.

Visitors to Hornsby Shire Mountain Bike Trail and Benowie Walking Track during work hours are expected to be affected by noise during works, depending on the timing and nature of rerouting proposed by Hornsby Shire Council. It is anticipated that some trails would be rerouted to ensure the safety of the public and would maintain adequate distance from the project, limiting the noise impact on recreational users of the site.

The noise assessment determined that any increase in noise from haulage of spoil along the Pacific Highway would remain compliant with the applicable noise criteria, except on Bridge Road to the west of the Pacific Highway. The noise assessment predicted that noise levels on Bridge Road to the west of the Pacific Highway would increase by about 7-10 dB(A) dependent on the time of day, exceeding the noise criteria for these sensitive receivers and resulting in a number of residences at this location being impacted by noise during work hours. Noise levels on Bridge Road to the east of the Pacific Highway are expected to remain below noise management levels.

The site establishment and project works, as well as all haulage vehicles and workforce vehicles would be limited to standard work hours only. Therefore, there will be no noise impacts during night time hours as a result of project spoil haulage and handling activities.

Due to the relatively large offset distances between the site and sensitive receivers and the nature of the work, the project is not predicted to result in exceedances of the applicable structural damage and human comfort vibration criteria.

4.3.3 Air Quality

The air quality assessment determined that the project dust deposition rates and cumulative concentrations of total suspended particulates, carbon monoxide, volatile organic compounds and polycyclic concentrations of total aromatic hydrocarbons would all be well below the applicable assessment criteria.

For particulate matter concentrations, the project contributions to the airshed are generally below applicable criteria however the air quality assessment noted some exceedances of the cumulative criteria at sensitive receptors located adjacent to the site. These exceedences are attributable to high existing background concentrations. These exceedances could be minimised through the implementation of management and monitoring measures, to be documented in a dust management plan for the project.

Sensitive receivers that may be impacted by reduced air quality would include recreational users of the walking and mountain bike tracks and Hornsby Park, residential properties overlooking the site and students and teachers at the Hornsby TAFE campus.

The visual, noise and vibration and air quality impact assessments determined that there would be no amenity impacts on retirement villages, place of worship, schools (other than Hornsby TAFE), hospitals and childcare centres due to carrying out of the project.

For businesses, residences and community facilities, including aged care facilities, places of worship, educational facilities, hospitals and recreational facilities along the haulage routes, the increase in noise from haulage vehicles is not expected to exceed acceptable noise levels and air quality impacts are expected to be negligible. Businesses and community facilities with outdoor areas such as outdoor seating or play areas are not expected to be significantly impacted by changes in amenity due to the project.

4.3.4 Amenity benefits arising from the completion of the project

The project will facilitate Hornsby Shire Council's rehabilitation of the quarry void to provide a space for community use and recreation. There is potential for the future character of the Hornsby Quarry site to change dramatically due to Hornsby Shire Council's rehabilitation of the site, whereby landscape character and visual amenity will be positively impacted. Visual amenity would improve for residents and businesses adjacent to the Hornsby Quarry site from the redevelopment and rehabilitation of the site for use as recreational land.

4.4 Community cohesion and severance

Community severance occurs when people are separated from the facilities, services and social networks they wish to use within their community. This can be due to modified travel patterns or psychological barriers created by transport infrastructure such as highways or bridges, and can manifest in outcomes such as trip delays, diversions and traffic noise. Severance also arises where there are changes in the comfort and attractiveness of areas.

Existing physical connections and linkages in the study area are instrumental in shaping current community cohesion. Existing paths of travel by vehicle, bicycle and foot are critical to maintaining community cohesion and also contribute to the community character of the area. Access to existing community infrastructure such as educational facilities, health services and places of worship is also seen as fundamental to creating and maintaining a sense of community cohesion and wellbeing.

Access to community infrastructure will be maintained throughout the project to maintain links to the community for residents. Access to community facilities in the immediate vicinity of the project such as Hornsby College, Hornsby Uniting Church, Hornsby Shire Council Chambers, Hornsby Court House and Hornsby Police Station will remain throughout the project. Residents may experience some congestion and resulting delays around these facilities during peak times as a result of haulage vehicles using the local road network.

There is no formal footpath on either side of Bridge Road (from where it turns south towards the Hornsby TAFE), however pedestrians currently use the roadside verge or Bridge Road itself to access the TAFE. Pedestrian access to the TAFE via Bridge Road would be restricted during the project, for safety reasons.

Signage would be provided to redirect pedestrians along an alternate route to Hornsby TAFE entrances on Pacific Highway / Peats Ferry Road. **Figure 4-1** shows the indicative alternative access route for pedestrians. This is not a highly utilised access point for the Hornsby TAFE and all other access points to the Hornsby TAFE would be maintained throughout the project.

Access to public transport, including Hornsby Train Station and the station bus interchange, will be maintained throughout the project. Residents and workers accessing the station by bus or car may experience some congestion and resulting delays during peak times as a result of haulage vehicles using the local road network.

The project has been designed to avoid direct impacts to community facilities, with the exception of unavoidable restrictions to existing mountain bike and pedestrian trails. The project will require the closure and/or changes to some walking paths and mountain bike trails in the bushland surrounding the Hornsby Quarry during the project. The paths are used by a variety of walking and mountain bike riding groups for both day and overnight recreational activities. They are also popular with the general public for recreational purposes. The closure and/or changes to these paths is necessary during the project to ensure public safety. A map showing the trails that would be closed and those that would remain open during the project is provided in **Section 4.1** (Project description) of the EIS for the project.

Appropriate signage would be erected prior to and during works to advise the public of the alterations to mountain bike and pedestrian trails, including information regarding alternative cycling and walking routes.

Exclusion fencing is currently maintained around the quarry void by Hornsby Shire Council to prevent public access for safety reasons. The project would result in public exclusion zones being expanded to include the site area for the duration of the project. Exclusion zones would be required to ensure the safety of the public and personnel undertaking the works. The expanded exclusion zone would include areas which are currently publicly accessible, including part of the mountain bike trail and walking tracks.

Residents, particularly elderly residents, and business owners are likely to experience uncertainty about the project prior to and during the project but it is expected that this can be managed through continuing consultation.

4.4.1 Community cohesion benefits arising from the project

The project has the potential to improve community cohesion of the study area and bring the community together through enabling the provision of additional public recreational space. Recreational walking and bike paths for public use provide open and recreational space for the community to meet and share.

The project also reduces the ongoing safety risk to the community by stabilising the quarry site, providing Council with the option to open the site to the public. The project is a safe and sustainable solution to addressing community concerns regarding the safety of the quarry site.

As there is no acquisition of residential properties, the project is not expected to impact the sense of belonging in the surrounding communities.

(blank page)

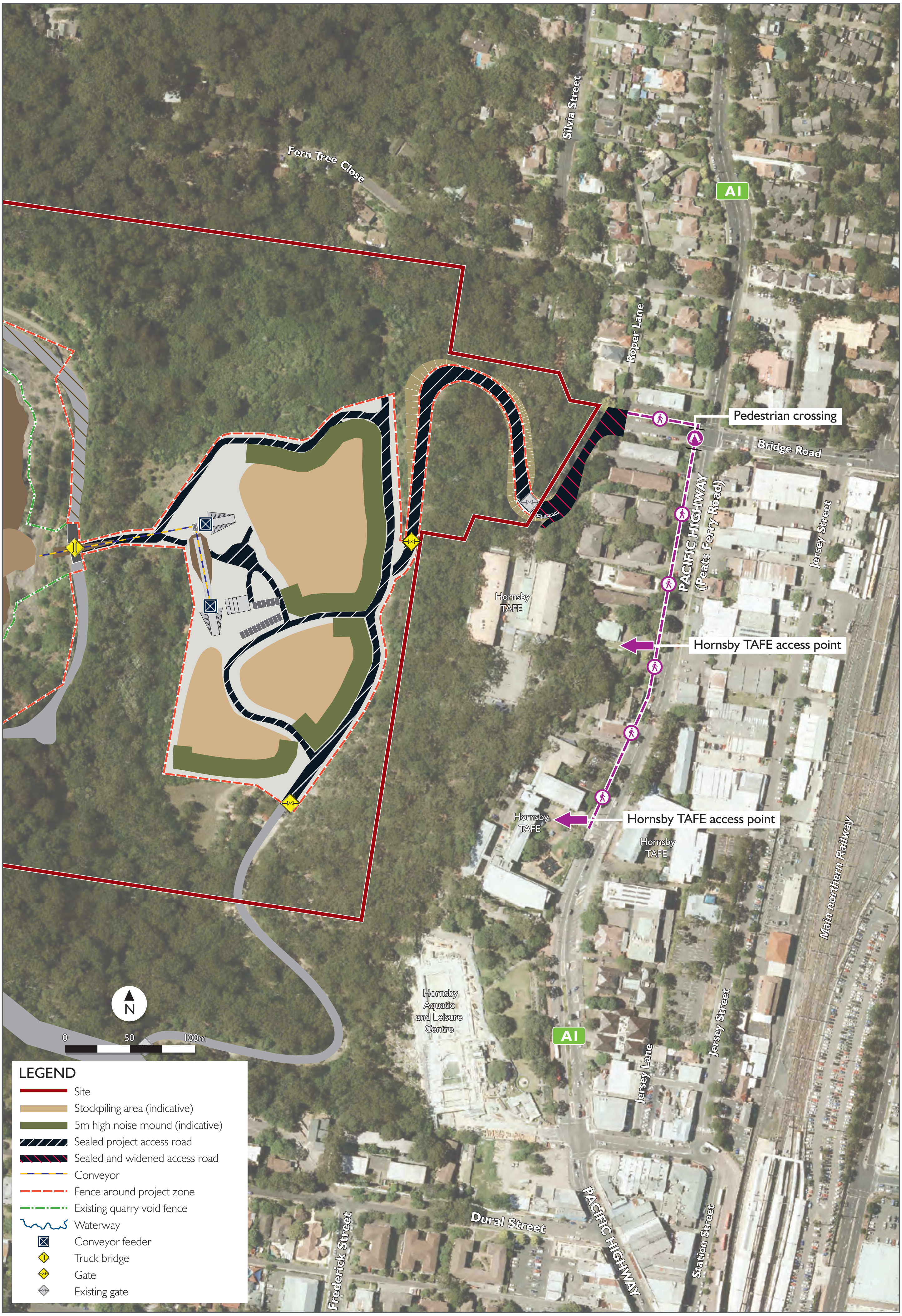

Figure 4-1 Indicative alternative pedestrian access

(blank page)

4.5 Traffic and access arrangements

The traffic and transport impact assessment prepared for the project describes in detail potential changes to conditions for road users as a result of the project, including:

- Increased congestion on the Pacific Highway, Pennant Hills Road and the local road network;
- Changes in accessibility to the Hornsby TAFE; and
- An increase in bus service travel times due to slower travel speeds and increased intersection delays.

Traffic attributable to the project will arise from the haulage of spoil and project workforce movements. The maximum number of trucks accessing the Hornsby Quarry site per hour at the peak of project works would be 35 vehicles per hour. The total maximum number of trucks is estimated to be 385 vehicles per weekday during the peak of spoil generation at NorthConnex tunnelling sites. All works and haulage associated with spoil management on the Hornsby Quarry site would be confined to standard work hours, being:

- 7:00 am to 6:00 pm from Monday to Friday;
- 8:00 am to 1:00 pm on Saturdays; and
- No work to be conducted on Sundays or public holidays.

Traffic attributable to the project workforce is not expected to impact on peak period traffic. The project workforce is expected to begin their shifts at 6:00am, avoiding peak traffic periods. Traffic generated by the project workforce is estimated to be approximately 20 light vehicles per day.

An increase in heavy vehicles on the existing road network during the project would potentially result in congestion due to increased delays at intersections along the project corridor and in surrounding areas. Businesses that rely on deliveries from and to their premises may experience some increases in transit times due to increased traffic on the road network from project heavy vehicles. Residents trying to access community facilities, such as schools, child care centres, community centres, health care and places of worship may experience some delays due to increased congestion on the local road network. Heavy vehicles will be required to comply with school zone travel speeds to maintain road safety around schools.

It is not anticipated that this increase in congestion will impact freight movements, as the Pacific Highway and local road networks are not major freight thoroughfares and are mainly used for freight and deliveries for local businesses. The increase in truck volumes, as a proportion of overall traffic, is anticipated to be minor as the Pacific Highway and local road network is already currently considered congested.

Users of public transport services could potentially be impacted by:

- An increase in bus service travel times due to slower travel speeds and increased intersection delays;
- Longer travel times to and from bus stops by supplementary travel modes (eg car passenger, walking to/from bus stop, etc) due to an increase in traffic volumes, slower travel speeds and increased intersection delays; and
- Increased delays at intersections for on-road cyclists due to an increase in traffic volumes travelling along the corridor.

It is anticipated that vehicle and pedestrian access to individual properties or businesses in the vicinity of the project, including those located on Bridge Road, will not be impacted during the project. Therefore, it is expected that local residents will not be deterred from shopping at local businesses or visiting community facilities during the project. Parking along Bridge Road will be maintained throughout the project.

Vehicular access to the Hornsby TAFE via Bridge Road will be maintained throughout the project. However, access will be temporarily reduced from two-lanes for bi-directional traffic to one lane that would need to be shared for entry and exit from the Hornsby TAFE. Access from Bridge Road to the Hornsby TAFE is mainly used to access workshop buildings and for deliveries. All other access points to the Hornsby TAFE site will be maintained throughout the project.

Consultation with Hornsby TAFE is ongoing and appropriate mitigation measures will be developed as part of ongoing consultation activities to ensure access to the site would be maintained. This would include the preparation of a Traffic Management Plan identifying traffic protocols for the shared access road (including right of way and appropriate safety protocols to ensure the safety of Hornsby TAFE visitors, students and staff). Consultation with the Hornsby TAFE has also explored opportunities for the temporary relocation of Hornsby TAFE deliveries to the main entrance of the Hornsby TAFE (via the Pacific Highway) to avoid conflicts with haulage traffic, where possible.

Traffic and transport impacts during the project are discussed in detail in **Section 6.1** (Traffic and Transport) of the EIS for the project.

4.5.1 Traffic and access benefits arising upon completion of the project

Upon completion of the project, it is anticipated that traffic on the Pacific Highway and local roads in study area will return to levels experienced before the project's commencement. Access to residential properties, businesses, community facilities and public transport is not expected to be negatively impacted.

4.5.2 Cumulative impacts

Cumulative impacts to local residents, community facilities and businesses are most likely to result from the concurrent construction of the NorthConnex project and Hornsby West Side Development. Cumulative impacts will arise from the additional construction workforce vehicles on the local road network, additional expenditure and additional employment opportunities in the area.

Cumulative impacts are likely to intensify the impacts identified as a result of the Hornsby Quarry project, particularly with regard to employment and economic stimulus. The demand for labour for major projects such as NorthConnex, Hornsby West Side Development and other projects in the area would increase employment opportunities for local residents. There is potential for wages to increase due to higher demand for construction workers.

The opportunity for local businesses to supply goods or services to the construction of these projects and their construction workforces has the potential to increase business turnover due to higher demand from the multiple projects.

There is the potential for construction workforce vehicles for NorthConnex to contribute further to congestion on the road network as additional vehicles use the local road network when staff drive to, and from, their shifts. This is not expected to impact peak period traffic as these workforces are expected to begin their shifts outside of peak hours. The development proposed at Hornsby West Side may increase construction vehicles, including heavy vehicles used in the construction of the development, if it were to be constructed concurrent to the project.

The NorthConnex project construction site is located some distance away from the Hornsby Quarry site and, as such, local residents, community facilities and local businesses are not expected to be affected by cumulative amenity impacts.

5 Mitigation and management strategies

The recommended measures to mitigate or manage impacts generated during the project are summarised in **Table 5-1**.

Table 5-1 Mitigation measures

Impact	Detail
Amenity	
Noise and Vibration	Mitigation measures specific to noise and vibration can be found in **Section 6.2** of the EIS for this project.
Air quality	Mitigation measures specific to air quality can be found in **Section 6.3** of the EIS for this project.
Visual Amenity	Mitigation measures specific to landscape character and visual amenity can be found in **Section 7.2** of the EIS for this project.
Traffic and access arrangements	
Accessibility	Mitigation measures specific to traffic and access arrangements can be found in **Section 6.1** of the EIS for this project.
Community cohesion	
Community cohesion	A community involvement plan would be developed and implemented to provide timely, regular and transparent information about changes to access and traffic conditions, details of future work programs and general works progress throughout the project. Information would be provided in a variety of ways including letter box drops, media releases, internet sites, signage and a hotline.
Cumulative impacts	
Cumulative impacts	Monitor the development of significant projects with significant proximity to the project and amend the Construction Environment Management Plan for the project if, or when, required.

(blank page)

6 Conclusion

This report has identified and assessed the potential impacts to local residents, users of community facilities and local businesses associated with spoil management at Hornsby Quarry site.

This assessment has been conducted with regard to the existing social and economic environment, an assessment of potential positive and negative impacts and an assessment of management and mitigation measures.

During the project, there is the potential for a boost in the local and regional economies due to project expenditure. Local and regional businesses would principally benefit from this expenditure through purchases made by businesses and workers associated with the project, to build and support the development of the project.

A total of 235 FTE jobs (including direct and indirect employment) are expected to be created during the 33 month duration of the project. Employment opportunities would grow in the region through the potential increase in business patronage and through the increase in demand for project workers.

In its current state, Hornsby Quarry presents an ongoing safety risk and requires ongoing maintenance costs to ensure wall stability. The project has the potential to positively impact the local and regional economy by removing the ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community. The project removes the ongoing safety risk to the community by stabilising the quarry site so it can be opened to the public.

While the project will require the closure and/or changes to walking paths and mountain bike trails in the bushland surrounding the Hornsby Quarry, the project will facilitate the infilling and rehabilitation of the site by Council to provide additional recreational facilities for the community in future.

There are potential long term benefits for local businesses from increased recreational tourism at the redeveloped quarry site. Businesses that may directly benefit from increased tourism include food and beverage retailers, accommodation providers, and other retail outlets catering to the needs of those using the rehabilitated quarry site for recreational purposes.

Visual impacts are not anticipated during night time hours as works would be limited to standard work hours only. Residents of Fern Tree Close and Manor Road will not experience visual amenity impacts due to the project. Temporary visual amenity impacts are likely to occur for residences and community facilities located on Bridge Road, Hornsby TAFE and visitors to Hornsby Mountain Bike Trail and Benowie Walking Track, with direct and indirect views of the quarry site.

Noise mitigation surrounding plant and equipment and noise mounds about 5 metres high surrounding the stockpile area have been included in the design of the project to mitigate noise from works at the site. The noise assessment conducted for this project determined that no sensitive receivers would be highly affected by noise due to works on the site. However, some receivers such as residents overlooking the sight and students and teachers at Hornsby TAFE, will experience minor effects due to their proximity to the site. Noise impacts will be limited to standard work hours as no night time work is expected over the project duration.

The noise assessment determined that any increase in noise from haulage of spoil along the Pacific Highway would remain compliant with the applicable noise criteria, except on Bridge Road to the west of the Pacific Highway, where noise levels would increase by approximately 6 dB(A), exceeding the noise criteria for these sensitive receivers.

Due to the relatively large offset distances between the site and sensitive receivers and the nature of the work, the project is not predicted to result in exceedances of the applicable structural damage and human comfort vibration criteria.

The air quality assessment noted some exceedances in the Office of Environment and Heritage (OEH) air quality criteria at sensitive receptors located adjacent to the site, due to high background concentrations. These exceedances could be minimised through the implementation of monitoring and measures to be outlined in a dust management plan. Sensitive receivers that may be impacted by reduced air quality would include recreational users of the walking and mountain bike tracks, residential properties overlooking the site and students and teachers at Hornsby TAFE.

The visual, noise and vibration and air quality impact assessments determined that there would be no amenity impacts on retirement villages, place of worship, schools (other than Hornsby TAFE), hospitals or childcare centres due to the project.

An increase in heavy vehicles on the existing road network during the project would potentially result in congestion due to increased delays at intersections along the project corridor and in surrounding areas. The increase in truck volumes, as a proportion of overall traffic, is anticipated to be minor as the Pacific Highway and local road network is already currently considered congested.

Residents trying to access community facilities, such as schools, child care centres, community centres, health care and places of worship may experience some delays due to increased congestion on the local road network. Project vehicles will be required to comply with school zone travel speeds to maintain road safety around schools.

Access to the Hornsby TAFE via Bridge Road will be temporarily reduced from two-lanes for bi-directional traffic to one lane that would need to be shared for entry and exit from the Hornsby TAFE. Hornsby TAFE has been consulted and appropriate mitigation measures will be developed to ensure access to the site would be maintained. This would include the preparation of a Traffic Management Plan identifying traffic protocols for the shared access road.

Cumulative impacts to local residents, community facilities and businesses are most likely to result from the concurrent construction of the NorthConnex project and Hornsby West Side Development. Cumulative impacts will arise from the additional construction workforce vehicles on the local road network, additional expenditure and additional employment opportunities in the area.

Where necessary, a number of mitigation measures have been proposed to minimise any impacts that would be associated with undertaking the project.

Overall the positive impacts on businesses and the economic benefit of the project are expected to outweigh any negative impacts that cannot be satisfactorily mitigated.

7 References

AECOM Australia (2014), AECOM GRP Model, Hornsby LGA 2012/13 Gross Regional Product and Industry Value Add, unpublished.

Australian Bureau of Statistics (1995), *Cat. no. 5246.0, Information Paper: Australian Natonal Accounts: Introduction to Input-Output Multipliers,* Canberra, Australia, www.abs.gov.au (ABS).

Australian Bureau of Statistics (2007), *Cat. no. 1292.0, Australian and New Zealand Industrial Classification (ANZSIC)*, Canberra, Australia, www.abs.gov.au (ABS).

Australian Bureau of Statistics (2011), *Cat. no. 1270.0.55.001, Australian Statistical Geography Standard (ASGS): Volume 1 – Main Structure and Greater Capital City Statistical Areas*, July 2011, Canberra, Australia, www.abs.gov.au (ABS).

Australian Bureau of Statistics (2012), *2011 Census of Housing and Population, Community Profile, Hornsby LGA, Study Area SA1s, New South Wales*, www.abs.gov.au (ABS).

Australian Bureau of Statistics (2013), Cat. no. 5209.0.55.001, Australian National Accounts*: Input-Output Tables - Electronic Publication, 2009-10*, Canberra, Australia, www.abs.gov.au (ABS)

Australian Bureau of Statistics (2014a), Counts of Australian Businesses, including entries and exits, June 2013, Catalogue Number 8165.0, www.abs.gov.au (ABS)

Australian Bureau of Statistics (2014b), *Cat. no. 5220.0, Australian National Accounts: State Accounts, 2013-14*, Canberra, Australia, www.abs.gov.au (ABS)

Department of Planning and Environment (2014), NSW State and Local Government Area Population Projections, 2014 Final, www.planning.nsw.gov.au

Roads and Maritime (2013), *Environmental Planning and Impact Assessment Practice Note: Socio-economic Assessment*, Roads and Maritime, Sydney.

(blank page)

Appendix A

Study area

(blank page)

Appendix A – Study area

Table 7-1 ABS reference codes

Statistical Area Level 1, ABS reference codes			
1140306	1140324	1140518	1140530
1140311	1140325	1140519	1140532
1140312	1140501	1140520	1140540
1140313	1140502	1140521	1140548
1140314	1140507	1140522	1140567
1140315	1140508	1140523	1140570
1140316	1140510	1140524	1140571
1140317	1140511	1140527	
1140318	1140513	1140528	

Source: ABS (2011), Australian Statistical Geography Standard

(blank page)

Appendix B

Socio-economic profile

(blank page)

Appendix B – Socio-economic profile

Table 7-2 Key demographic characteristics of the study area, 2011

Key demographic characteristic	Study Area	Hornsby LGA	NSW
Total population	15,292	156,847	6,917,658
Median age	39*	39	38
Population 15+	12,570	126,419	5,585,148
% aged 15+	82.2%	80.6%	80.7%
Population aged 65+	2,223	22,586	1,018,179
% aged 65+	14.5%	14.4%	14.7%
Indigenous population	75	562	172,620
% Indigenous	0.5%	0.4%	2.5%
Speaks language other than English at home	5,302	44,582	544,106
% ESL	34.7%	28.4%	22.0%
Has need for assistance with core activities	723	5,838	338,362
% Need for assistance	4.7%	3.7%	4.9%
Median total household income ($/weekly)	$818-$2,700	$1,824	$1,237

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, TableBuilder 2011

* Average median age of all SA1s in the study area.

Table 7-3 Population projections

Year	Hornsby LGA	NSW
2011	163,800	7,218,550
2016	171,400	7,708,850
2021	181,100	8,230,400
2026	191,300	8,739,950
2031	201,750	9,228,350

Source: New South Wales state and regional population projections, 2011 – 2031, NSW Department of Planning and Infrastructure, 2014 release

Table 7-4 Household characteristics, 2011

Households	Study Area	Hornsby LGA	NSW
Average household size	2.6	2.9	2.6
Family households	70.3%	80.1%	71.9%
Non-family households	29.7%	19.9%	28.1%
Total households	**5,763**	**52,671**	**2,471,295**

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-5 Dwellings, 2011

Dwellings	Study Area	Hornsby LGA	NSW
Separate house	42.2%	75.5%	69.5%
Semi-detached, row or terrace house, townhouse	11.4%	7.6%	10.7%
Flat, unit or apartment	45.9%	16.5%	18.8%
Other dwelling	0.4%	0.3%	0.9%
Dwelling structure not stated	0.2%	0.1%	0.1%
Total occupied private dwellings	**5,770**	**52,672**	**2,471,299**

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-6 Housing tenure, 2011

Housing tenure	Study Area	Hornsby LGA	NSW
Owned outright	28.1%	36.8%	33.2%
Owned with a mortgage	33.9%	39.9%	33.4%
Renting	34.6%	20.3%	30.1%
Other tenure type	1.2%	1.5%	0.8%
Tenure type not stated	2.2%	1.5%	2.6%
Total Households	**5,765**	**52,673**	**2,471,296**

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-7 Socio-economic Indexes for Areas (SEIFA), 2011

SEIFA index	Disadvantage	Social-economic advantage/ disadvantage	Economic resources	Education and occupation
Hornsby LGA	1085	1106	1083	1122

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Socio-Economic Indexes for Areas (SEIFA).

Table 7-8 Method of Travel to work, 2011

Mode	Study Area	Hornsby LGA	NSW
Car (driver or passenger)	55.6%	71.1%	78.1%
Train	33.8%	18.6%	7.7%
Bus	0.9%	3.9%	4.6%
Truck	0.9%	0.9%	1.5%
Walked only	7.0%	3.6%	5.1%
Other	1.8%	1.8%	3.0%
Total One Method	**6,087**	**60,699**	**2,516,427**

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-9 Labour force characteristics, 2011

Labour force statistics	Study Area	Hornsby LGA	NSW
Total labour force	8,058	82,482	3,334,857
Employed full-time	4,983	49,753	2,007,925
% Full-time	61.8%	60.3%	60.2%
Employed part-time	2,231	24,883	939,464
% Part-time	27.7%	30.2%	28.2%
Employed away from work	271	2,679	120,121
% Away from work	3.4%	3.2%	3.6%
Employed hours not stated	124	1,238	70,821
% Hours not stated	1.5%	1.5%	2.1%
Unemployed	449	3,929	196,526
Unemployment rate	5.6%	4.8%	5.9%

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-10 Internal Migration, 2011

Internal Migration	Study Area	Hornsby LGA	NSW
Persons who lived at a different address 1 year ago	2,414	14,435	946,005
% of total population	16.0%	11.6%	13.9%
People who lived at a different address 5 years ago	6,390	37,119	2,380,678
% of total population	45.0%	34.1%	36.9%

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-11 Industry of employment, 2011

Industry	Study Area	Hornsby LGA	NSW
Agriculture, forestry and fishing	0.1%	0.5%	2.2%
Mining	0.2%	0.2%	1.0%
Manufacturing	5.9%	6.4%	8.4%
Electricity, gas, water and waste services	0.7%	0.9%	1.1%
Construction	5.2%	6.1%	7.3%
Wholesale trade	5.4%	5.9%	4.4%
Retail trade	9.9%	9.2%	10.3%
Accommodation and food services	5.1%	4.7%	6.7%
Transport, postal and warehousing	3.2%	3.0%	4.9%
Information media and telecommunications	3.7%	3.6%	2.3%
Financial and insurance services	7.8%	7.2%	5.0%
Rental, hiring and real estate services	1.5%	1.6%	1.6%
Professional, scientific and technical services	12.8%	12.8%	7.9%
Administrative and support services	3.9%	3.2%	3.3%
Public administration and safety	4.9%	4.8%	6.1%
Education and training	8.0%	10.3%	7.9%
Health care and social assistance	14.4%	12.9%	11.6%
Arts and recreation services	1.3%	1.4%	1.5%
Other services	3.6%	3.4%	3.7%
Inadequately described/Not stated	2.3%	2.0%	2.5%
Total	**7,598**	**78,553**	**3,138,330**

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Appendix C

Community facility inventory

(blank page)

Appendix C – Community facility inventory

Inventory of community and recreational facilities within the study area and surrounds

Group	Description
Education Facilities	
1A	Abbotsleigh School for Girls
1B	AU Academy
1C	Asquith Boys' High school
1D	Barker College
1E	Clarke Road School
1F	Hornsby South Public School
1G	Hornsby Girls' High School
1H	Knox Grammar School
1I	Normanhurst Boys' High School
1J	Our Lady of the Rosary Catholic School
1K	St Leo's Catholic College
1L	Waitara Public School
1M	Hornsby Ku-ring-Gai Community College
1N	TAFE NSW - Northern Sydney Institute
1O	Hornsby College
Childcare and early learning facilities	
2A	Alphabet Academy
2B	Catholic Care Family and Early Learning Centre
2C	Hornsby Central Preschool Kindergarten
2D	Hornsby Ku-ring-gai Montessori Preschool
2E	Hornsby Shire Council Nursery and Preschool Centre
2F	Hornsby TAFE Children's Centre
2G	Mountbatten Institute
2H	Mt Errington Early Learning Centre
2I	Peter Rabbit Preschool
2J	The Jack and Jill Kindergarten
2K	The Three Bears Kindergarten
2L	Wahroonga Long Day Care Centre
2M	Wahroonga Next Generation Child Care Centre
Hospitals and emergency services	
3A	Hornsby Cardiac Diagnostic Unit
3B	Hornsby Fire Station
3C	Hornsby Ku-ring-gai Hospital
3D	Hornsby Police Station
3E	Mt Wilga Private Hospital
3F	Neringah Hospital Wahroonga
3G	Northern Sydney Ambulance Station (Wahroonga)
Service clubs	
4A	Rotary Club of Waitara
Aged Care facilities	
5A	Belvedere Aged Care Facility
5B	Bowden Brae Retirement Village
5C	Bramblewood Retirement Village
5D	Catholic Community Services- Chantal Cottage Respite
5E	Greenwood Aged Care
5F	Hammond Care Neringah Hospital
5G	Netherby Aged Care Facility

Group	Description
5H	Regis Ku-ring-gai Gardens
5I	Tallwood's Corner Aged Care Service
5J	The Grange Village
5K	Wahroonga Nursing Home
5L	Wynwood House
Places of Worship	
6A	Australia Ling Liang Church
6B	Baha'i Community of Hornsby
6C	Breakthrough Church
6D	Church of Christ, Asquith
6E	Community Church, Hornsby
6F	Hornsby Baptist Church
6G	Hornsby Catholic Parish
6H	Hornsby Uniting Church
6I	Potters House Fellowship Hornsby
6J	St Patrick's Catholic Church
6K	St Peter's Anglican Church
6L	Sydney Manna Church
6M	The Hive Church
6N	Waitara Seventh-day Adventist Church
Sporting groups/Others	
7A	Asquith Scout Hall
7B	Hornsby Aquatic and Leisure Centre
7C	Hornsby Ku-ring-gai Police Community Youth Club
7D	Hornsby RSL Gymnastics Club
7E	Hornsby Wing Chun Academy

Appendix I

Technical working paper:
Non-Aboriginal Heritage

Roads and Maritime Services

Hornsby Quarry Road Construction Spoil Management Project

Technical working paper: non-Aboriginal heritage assessment

July 2015

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, Australia

Contents

List of tables

List of figures

List of plates

Glossary of terms and abbreviations

Term	Meaning
OEH	NSW Office of Environment and Heritage.
Roads and Maritime	Roads and Maritime Services.
SEPP	State Environmental Planning Policy.
LEP	Local Environmental Plan
SHR	State Heritage Register
S170	Section 170

Executive summary

Roads and Maritime has identified the former Hornsby Quarry site as one of the preferred locations for receipt and management of spoil from the NorthConnex project, a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at Carlingford. Roads and Maritime is proposing that spoil generated during the construction of the roads and road infrastructure facilities associated with the NorthConnex project be received at the Hornsby Quarry site for handling, management and beneficial reuse to stabilise the current quarry void on the site. The proposal would contribute to the potential future rehabilitation and redevelopment of the quarry by Hornsby Council for recreational purposes and public benefit.

The proposal is declared to be State significant infrastructure under Part 5.1 of the *Environmental Planning and Assessment Act 1979* by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on non-Aboriginal heritage.

The proposal would allow the Hornsby Quarry site to receive up to 1.5 million cubic metres of excavated natural material (ENM) and virgin excavated natural material (VENM) from the construction of roads and road infrastructure facilities forming part of the NorthConnex project. Spoil handling, management and beneficial reuse at the Hornsby Quarry site would include site establishment and conveyer construction, dewatering of the quarry void, spoil haulage onto site, spoil stockpiling, spoil emplacement into the void via conveyer.

This report has been prepared for the purpose of identifying and assessing the potential environmental impacts of the construction and operation of the project on non-Aboriginal heritage.

An inspection of Hornsby Quarry site was undertaken by heritage specialists Dr Darran Jordan and Ms Rochelle Coxon on 13 December 2013. This inspection was undertaken as part of early investigations into spoil management locations for the NorthConnex project.

A further inspection was undertaken by Dr Darran Jordan on 15 December 2014. This inspection was aimed at informing the preparation of a non-Aboriginal heritage impact assessment for the project, and guiding the development of the project design to avoid impacts on non-Aboriginal heritage where reasonable and feasible.

During the field inspections, the area was surveyed for previously unrecorded items as well as previously identified items of historic heritage. Non-Aboriginal heritage items in proximity to the Hornsby Quarry site were also inspected to confirm the assessed historic heritage significance of those items. This inspection was undertaken to inform an assessment of potential impacts to non-Aboriginal heritage values within the project area. The identified items were mapped and photographed. Items of historic heritage value identified in proximity to the Hornsby Quarry area are summarised in the following table.

Table 1-1 Items of historic heritage value in proximity to the Hornsby Quarry

Item Name	Listing	Significance
Diatreme Hornsby Quarry and surrounding vegetation	Australian Heritage Places Inventory Identifier 2613 Register of the National Estate Place ID 2613 NSW State Heritage Inventory Item A54/538	Local
Old Man's Valley Cemetery/Higgins Family Cemetery	Register of the National Estate Place ID 2614 NSW State Heritage Register Listing No. 01764 NSW State Heritage Inventory Item A55 National Trust of Australia Listing No. 9167	State
Heritage walk depression era sandstone steps	Hornsby LEP 2013 Items 513 and 537	Local
Sandstone receptacle	Hornsby LEP 2013 Item A55	Local
Cool room	Hornsby LEP 2013 Item A55	Local
Higgins Homestead/Memorial	Hornsby LEP 2013 Item A55	Local
Hornsby Quarry Industrial Machinery and Buildings	Unlisted	Local

Of these heritage items, the project will unavoidably impact on the ‘Diatreme Hornsby Quarry and surrounding vegetation’. There will be direct impacts to this heritage item due to the erection and use of the conveyor and the placement of spoil into the quarry void. There will be no direct impacts to other non-Aboriginal heritage items, including no direct impacts within the State Heritage Register curtilage of the ‘Old Man's Valley Cemetery/Higgins Family Cemetery’.

The project may have minor indirect impacts on non-Aboriginal heritage items during works on the site, through introduction of new visual elements within view-lines to and from heritage items. Access to heritage items may also be blocked or restricted for the duration of the works.

The following management and mitigation measures have been identified and are recommended for application to the project to ensure minimal impacts on non-Aboriginal heritage:

- Archival recording of the extent of the diatreme will be undertaken following initial dewatering of the quarry void to show the full extent of the geological feature. This will occur prior to any works commencing within the void. The archival recordings would be made available to Hornsby Shire Council for its records and future use.
- The identified heritage items ‘Old Man’s Valley Cemetery/Higgins’ Family Cemetery’, ‘sandstone receptacle’, ‘cool room’, ‘site of Higgins homestead/memorial and sandstone stairs’ and ‘Hornsby Quarry Industrial Machinery and Buildings’ should be avoided during the proposed works.
- All Roads and Maritime staff and contractors working at the Hornsby Quarry site should be made aware of the location of heritage items and informed of their responsibility regarding the protection of those items.
- A dilapidation survey should be conducted immediately prior to the commencement of work. This dilapidation survey would enable the condition of the items located within 100 metres of vibration intensive works to be assessed and to produce a baseline recording to be used as comparison to ensure the project does not impact on the condition of the heritage items.
- Appropriate dust management measures should be considered and developed in consultation with a suitably qualified heritage specialist in relation to the listed heritage item ‘Old Man’s Valley Cemetery/Higgins’ Family Cemetery’.

- The location of the item Diatreme Hornsby Quarry and surrounding vegetation should be considered during the conveyor construction/use and stabilisation works so that the diatreme itself is not damaged during this phase of works.
- A Heritage Management Plan would be developed to protect known heritage values during the proposed works. The Plan should include procedures for an appropriately qualified heritage consultant to conduct periodic inspections of heritage sites for which baseline dilapidation surveys are undertaken, to monitor their condition during construction. The Plan should also outline stop work procedures for use in the event of unexpected finds and should contain measures to protect surrounding heritage items.

(blank page)

2 Introduction

2.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry site for handling, management and beneficial reuse of spoil generated by road construction (the project).

On 13 January 2015 Roads and Maritime received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for the NorthConnex project identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage. Following design development, the Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during road construction from late 2015.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act.

Roads and Maritime has formed the opinion that the proposal is likely to significantly affect the environment, such that an EIS is required to be prepared. Therefore, the proposal is declared to be State significant infrastructure under Part 5.1 of the EP&A Act by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on non-Aboriginal heritage.

This technical working paper: non-Aboriginal heritage assessment has been prepared to inform the EIS for the project.

2.2 The project

The Hornsby Quarry site would receive up to 1.5 million cubic metres of excavated natural material ENM) and/or VENM from the approved NorthConnex construction sites. Only ENM and/ or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road and track) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the construction area.
- Dewatering of the void (to be undertaken by Hornsby Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.
- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil at stockpile sites within the Hornsby Quarry site using dozers.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.

- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete. An indicative program is provided below in Table 1.

Table 1 Indicative program

Construction activity	Indicative construction timeframe 2015				2016				2017				2018			
Site establishment works (including preparatory works)				■												
Establishment of conveyer					■											
Spoil haulage and stockpiling					■	■	■	■	■	■	■	■	■	■		
Spoil emplacement (operation of conveyor)						■	■	■	■	■	■	■	■	■	■	
Site clean-up and demobilisation														■	■	

An overview of the works is included in Table 2. Detailed descriptions of each activity can be found in Section 4.1 of the EIS for the project.

Table 2 Overview of project works

Phase	Proposed activities
Site establishment (including preparatory works)	The following works would be completed: - Dewatering of the void to a suitable working level. - Clearing and grubbing, and establishment pf erosion and sediment controls. - Establishment of a compound site. - Establishment of security fencing and signage around the construction site. - Widening and sealing of the currently unsealed quarry access road (Bridge Road) to facilitate all weather access.
Establishment of conveyor	The construction of the conveyor would include establishment of footings and the conveyor.
Spoil haulage and stockpiling	Trucks would enter and leave via Bridge Road during standard work hours over a maximum period of 28 months. Spoil would be unloaded from the dump trucks and stockpiled using dozers. It is expected that haulage and stockpiling would commence whilst the conveyer is still being constructed.
Spoil emplacement	Once the conveyer is constructed, these works would occur concurrently with spoil haulage and stockpiling activities, but would also continue for a period after the completion of spoil haulage onto the site. The activities include: - Placement of spoil from the stockpiles into the conveyor by front end loader. - Transport of the spoil via conveyor to the quarry void rim where the spoil would fall directly into the void. - Front-end loaders and articulated trucks would move the spoil along the quarry floor and dozers and rollers will spread the material. Periodic maintenance pumping of water from the void would be conducted during spoil haulage and emplacement activities.
Site demobilisation and rehabilitation	The compound and conveyor would be dismantled and removed from the site. Disturbed areas would be rehabilitated to a standard agreed with the Council. Security fencing would be removed, however would be retained around the quarry void if the void is deemed to remain an ongoing risk to public safety. Public access would then be reinstated to the areas outside the void exclusion zone.

2.3 Project location

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The site covers about 35 hectares and is owned by Hornsby Shire Council (refer to Figure 1).

The site comprises a quarry void, internal access roads and a cleared area to the east which was used as a processing area when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the site is zoned for public recreation (RE1) under the *Hornsby Local Environmental Plan 2013*, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible.

The site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and the past processing area. Dense bushland comprising the Berowra Valley National Park occurs directly to the west. Any noise management and mitigation measures (such as acoustic treatment) along Bridge Road are to be determined at the detailed design stage.

2.4 Purpose of this report

The SEARs for the project were issued on 2 July 2015. The SEARs have informed the preparation of the EIS for the project. The SEARs requirements specific to potential impacts on non-Aboriginal heritage along with the action taken to address them in this assessment, are summarised in the following table.

Table 3 SEARs Requirements

SEARs requirement	Assessment action
Impacts to State and local historic heritage (including conservation areas, built heritage, landscapes and archaeology) should be assessed, including—in particular—the Hornsby Diatreme and surrounding vegetation, Hornsby Heritage steps, the Old Man's Valley Cemetery, street trees on Dural Street, and the TAFE college. Where impacts to State or locally significant historic heritage are identified, the assessment shall:	Impacts to State and local historic heritage were assessed. Section 6 of this report contains details of the heritage items identified in proximity to the project area.
outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996),	Mitigation and management measures consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996) are included in Section 10.
be undertaken by a suitably qualified heritage consultant(s) with relevant heritage expertise (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria),	This assessment was undertaken by Dr Darran Jordan, a suitably qualified archaeologist and heritage specialist at AECOM. No archaeological excavations were required for this assessment.
include a statement of heritage impact for all heritage items/conservation areas to be impacted (including significance assessment). This should include detailed mapping of all heritage items and how they are affected by the proposal,	Statements of heritage impact, impact assessments and statements of significance are included in Sections 7 and 8 of this report. Heritage curtilages are mapped in Figure 2.

SEARs requirement	Assessment action
include details of any proposed mitigation measures (architectural and landscape),	Mitigation and management measures consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996) are included in Section 10.
consider impacts from, including but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant),	Impacts to heritage are considered in Sections 7 and 8 of this report.
where physical archaeological test excavations are proposed, develop an appropriate archaeological assessment methodology, including research design, in consultation with the Heritage Council of New South Wales (for items of State significance) and the Department, to guide the test excavations, and include the results of these excavations, and	No archaeological excavations were required for this assessment.
provision of future mitigation strategies for all identified archaeological impacts that would arise from the proposal.	Mitigation and management measures consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996) are included in Section 10.

Initial investigations and assessments were completed in November 2013 (AECOM, 2013) as part of the investigation of spoil management locations for the NorthConnex project. The past report identified the potential environmental constraints related to non-Aboriginal heritage within areas of the Hornsby Quarry site. A further inspection was undertaken by Dr Darran Jordan on 15 December 2014. This inspection was aimed at informing the preparation of a non-Aboriginal heritage impact assessment for the project, and guiding the development of the project design to avoid impacts on non-Aboriginal heritage where reasonable and feasible. This non-Aboriginal heritage report supplements past assessments, and identifies potential non-Aboriginal heritage constraints within the footprint of the project. The study area for this assessment is shown in Figure **2**.

This assessment has been undertaken in accordance with the SEARs and the following guidelines:

- *NSW Heritage Manual* (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996b);
- *The Burra Charter* (the Australia ICOMOS charter for places of Cultural Significance) (ICOMOS (Australia), 2013);
- *Assessing Heritage Significance* (NSW Heritage Office, 2001a);
- *Assessing Significance for Historical Archaeological Sites and 'Relics'* (NSW Heritage Branch, 2009);
- *Heritage Curtilages* (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996a); and
- *Levels of Heritage Significance* (NSW Heritage Office, 2008).

2.5 Structure of this report

The report has the following structure:

- Chapter 1 introduces the project.
- Chapter 2 details the legislation and statutory controls relevant to the project.
- Chapter 3 details the methodology for the non-Aboriginal heritage assessment.
- Chapter 4 provides a summary of background information and inventory search results.
- Chapter 5 outlines the findings of the field inspection.
- Chapter 6 details the significance assessments.
- Chapter 7 details the impact assessment results.
- Chapter 8 provides a statement of heritage impact.
- Chapter 9 details the mitigation and management recommendations.
- Chapter 10 provides the references used to assist in the preparation of this report.

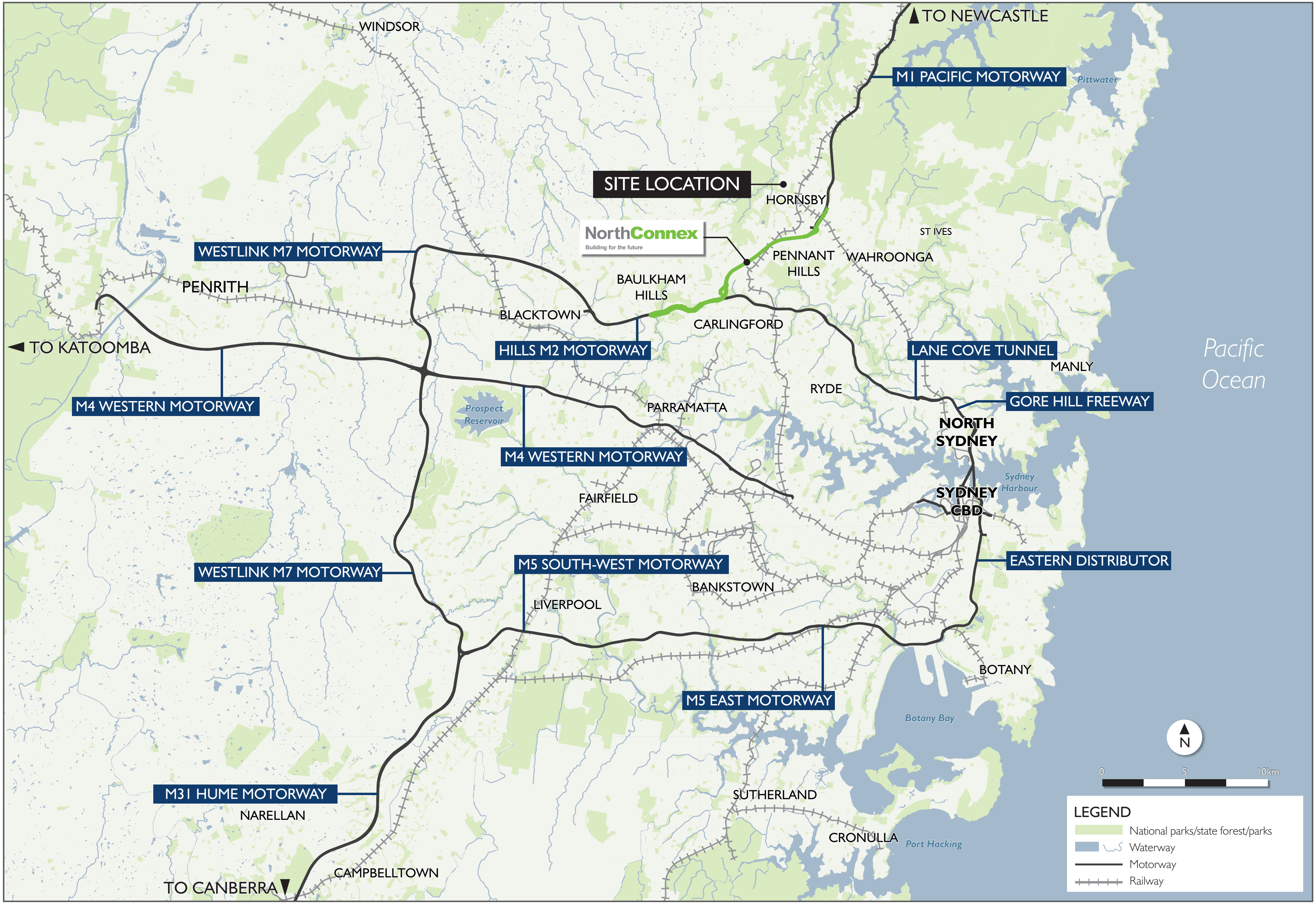

Figure 1 Regional context of the project

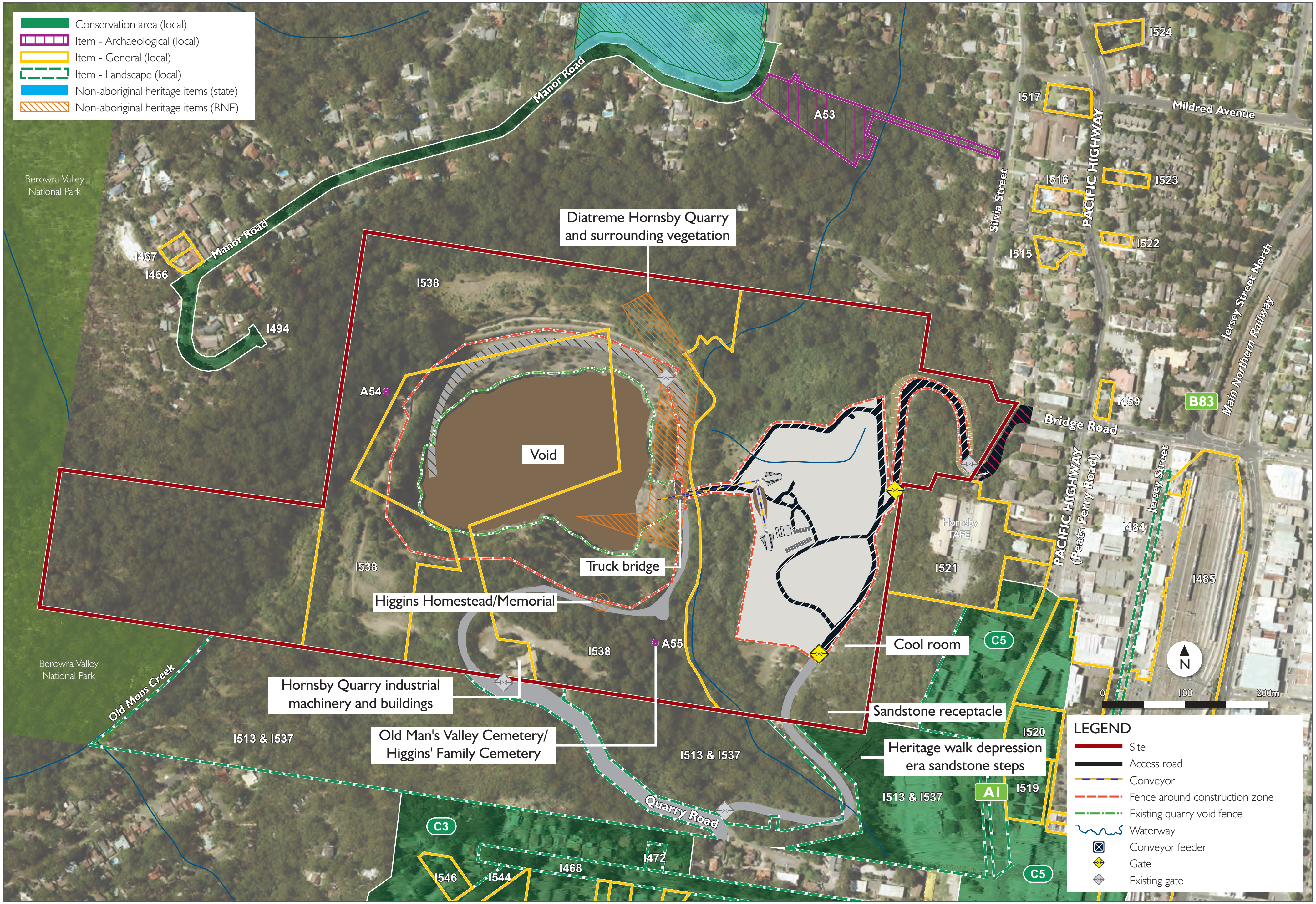

Figure 2 Proposed spoil disposal options and historic heritage constraints

(blank page)

3 Statutory Controls

A number of planning and legislative documents govern how heritage is managed in NSW and Australia. This project has been declared to be State significant infrastructure (SSI). Approval for this project is being sought under Part 5.1 of the EP&A Act. Under SSI, certain requirements are not applicable. Under State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP), a road or road infrastructure facility is permissible without consent on any land if carried out by or on behalf of a public authority. The following section provides a brief overview of the requirements under each planning and legislative document as they apply to the project.

3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999*, proposed 'actions' that have the potential to significantly impact on matters of national environmental significance, the environment of Commonwealth land or that are being carried out by a Commonwealth agency must be referred to the Australian Government. If the Commonwealth Minister for the Environment determines that a referred project is a 'controlled action', the approval of that minister would be required for the project in addition to any planning approvals required by State legislation. An action is defined as a project, development, undertaking, activity, series of activities, or alteration.

The EPBC Act defines 'environment' as both natural and cultural environments and therefore includes Aboriginal and historic heritage items. Under the EPBC Act, protected heritage items are listed on the National Heritage List (items of significance to the nation) or the Commonwealth Heritage List (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE). The RNE has been suspended and is no longer a statutory list.

3.2 Environmental Planning and Assessment Act 1979

The EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) provide the framework for environmental planning in NSW and include provisions to ensure that proposals that have the potential to impact upon the environment are subject to detailed assessment and provide opportunity for public involvement. In NSW, environmental impacts are interpreted as including impacts to cultural heritage.

Roads and Maritime is seeking approval for this project under Part 5.1 of the EP&A Act. The project has been declared to be State significant infrastructure.

3.3 The Heritage Act 1977

The *Heritage Act 1977* was enacted to conserve the environmental heritage of NSW. Under section 32 of the Act, places, buildings, works, relics, moveable objects or precincts of heritage significance are protected by means of either Interim Heritage Orders (IHO) or by listing on the State Heritage Register (SHR). Items that are assessed as having State heritage significance can be listed on the SHR by the Minister for the Environment on the recommendation of the Heritage Council of NSW.

Archaeological relics (any relics that are buried) are protected by the provisions of section 139, which make it illegal to disturb or excavate any land knowing or suspecting that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed. In such cases, an excavation permit under section 140 is required. No formal listing is required for archaeological relics; they are automatically protected if they are of local significance or higher.

Proposals to alter, damage, move or destroy places, buildings, works, relics, moveable objects or precincts protected by an IHO or listed on the SHR require an approval under Section 60. Demolition of whole buildings will not normally be approved except under certain conditions (Section 63). Some of the sites listed on the SHR or on LEPs may either be 'relics' or have relics associated with them. In such cases, a section 60 approval is also required for any disturbance to relics associated with a listed item.

Under section 170 of the Act, NSW government agencies are required to maintain a register of heritage assets. The register places obligations on the agencies, but not on non-government proponents, beyond their responsibility to assess the impact on surrounding heritage items.

3.4 Hornsby Local Environmental Plan 2013

Local Environmental Plans (LEPs) are prepared by Councils to assist in guiding planning decisions in their local government areas. LEPs also establish the requirements for the use and development of land through zoning and development controls. The *Hornsby Local Environment Plan 2013* (Hornsby LEP) applies to the Hornsby Quarry site.

Under the Hornsby LEP, heritage items and relics are protected and consent is required to be granted when:

- Demolishing or moving a heritage item, Aboriginal object, building, work, relic or tree within a heritage conservation area
- Altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in the applicable Schedule of the LEP
- Disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed
- Disturbing or excavating an Aboriginal place of heritage significance
- Erecting a building on, or subdividing, land on which a heritage item is located or that is within a heritage conservation area.

Schedule 5 of the LEP contains a list of identified heritage items, conservation areas and archaeological sites, which are considered to be of local or State significance.

As noted, the project is permissible without consent; therefore development consent from Council is not required under Part 4 of the EP&A Act. Notwithstanding, the Minister for Planning will consider the potential heritage impacts of the project when determining the application for the Hornsby Quarry Road Construction Spoil Management Project.

4 Methodology

The assessment of Aboriginal heritage constraints and potential impacts for this project included:

- Desktop review including searches of relevant heritage registers and schedules and a literature review to establish the historical background.
- Field inspection by AECOM archaeologist Dr Darran Jordan and Ms Rochelle Coxon on 13 December 2013 and a further inspection by Dr Darran Jordan on 15 December 2014.
- During the field inspection, identified heritage items that could potentially to be impacted by the project (either directly or indirectly) were inspected for current condition to inform an assessment of potential impacts to heritage values.
- Assessment of the significance of heritage items following the guideline Assessing Historical Significance, Assessing Significance for Historical Archaeological Sites and Relics (NSW Heritage Branch. 2009).
- Impact assessment and preparation of a statement of heritage impact in accordance with *Statements of Heritage Impact* (NSW Heritage Branch, 2002) and recommendation of mitigation measures for each potentially impacted item.

4.1 Desktop review

A review was undertaken of archaeological and historical data relevant to the project, which included heritage registers, databases and schedules, local histories and archaeological reports. This literature and data review was used to identify known non-Aboriginal heritage sites located within the study area.

Initial searches of the wider study area were conducted as a part of the preliminary assessment for the project in 2013. An updated search was undertaken in April 2015 of the following relevant heritage inventories for items within or immediately adjacent to the study area:

- Statutory:
  - World Heritage List (World Heritage Committee, UNESCO).
  - Commonwealth Heritage List (Australian Heritage Council).
  - National Heritage List (Australian Heritage Council).
  - Australian Heritage Places Inventory (Australian Heritage Council).
  - State Heritage Register (NSW Heritage Branch, OEH).
  - State Heritage Inventory (NSW Heritage Branch, OEH).
  - Section 170 Heritage and Conservation Registers compiled by Roads and Maritime, Sydney Trains, Transport for NSW and Sydney Water.
  - Schedule 5 of the Hornsby LEP.
- Non-statutory:
  - Register of the National Estate (Australian Heritage Council).
  - Register of the National Trust of Australia (NSW).

In addition to searching registers, past reports and studies relating to the area as well as historical documents and parish maps were examined as part of the background research.

Heritage items and areas identified in the searches of these registers and schedules are listed in Section 6.1 and shown in Figure **2**.

4.2 Field inspection

Known non-Aboriginal heritage items and areas identified as having the potential to be impacted directly or indirectly by the project were subject to a targeted inspection to determine their current condition. Field inspections were undertaken by AECOM archaeologist Dr Darran Jordan and Ms Rochelle Coxon on 13 December 2013 and a further inspection by Dr Darran Jordan on 15 December 2014.

Each listed item was photographed and compared to past descriptions and photos and the position of each item was recorded with a global positioning system (GPS).

The field inspection also included investigation of potential items of non-Aboriginal heritage outside of recorded listing locations that may be impacted by the project.

Results from these inspections were used to inform an assessment of potential impacts on non-Aboriginal heritage values.

.

5 Historical context

5.1 Aboriginal land use

The Hornsby Quarry site is located within the traditional country area of the Guringai Aboriginal people. The Guringai are also referred to as Kuringgai, Kurikgai and Kuring-gai. Reverend Lancelot Edward Threlkeld's study of Aboriginal language, tradition and custom stated: "the next great tribe is the Kuringgai on the sea coast. Their 'taurai' (hunting ground or territory) is known to extend north to the Macleay River, and I found that southwards it reached the Hawkesbury. Then, by examining the remains of the language of the natives about Sydney and southwards, and by other tests, I assured myself that the country thereabout was occupied by sub-tribes of the Kurringgai" (Threlkeld, 1892:ix).

The traditional territory of the Guringai contained such clan groups as the Awaba, Borregegal, Cadigal, Cammeragal/Camaraigal, Garigal, Gayimai and Walkeloa (Gibberagong Environmental Education Centre, 1983:9; J Kohen, 1993). This area was closely bordered by the Darug/Dharug area to the east, the Awabakal and Darkinung areas to the north and north-east and the Turuwal to the south (Horton, 1996).

The Guringai area was rich in natural resources, containing both coastal and inland areas. Both riverine and coastal areas were utilised for fish and shellfish (oysters, mussels and cockles), as evidenced by the presence of shell middens and fish traps (Ku-ring-gai Council, 2013). Yams, bulbs and seeds were utilised for food, along with the burrawang (macrozamia) nut, fern roots, lillypillies and berries. As well as bush foods, many plants were utilised for their medicinal qualities. Faunal species including possums and birds were hunted, while in coastal areas marine animals such as turtles, dugongs and seals are also likely to have been a part of the diet (Gibberagong Environmental Education Centre, 1983:12).

The Guringai utilised hunting tools such as boomerangs, spears and clubs. Fishing spears were made from plant stems with prongs added, made from grass tree flower stems, fish bones or shells and affixed by bees wax and gum (Gibberagong Environmental Education Centre, 1983:14). Fibrous grasses and oyster shell were also utilised to make hooks and fishing lines (Gibberagong Environmental Education Centre, 1983:15). A record of the Guringai living space is also present throughout the traditional country in the form of rock art and engravings. Known motifs include fish, dugong and human figures.

5.2 Early settlement

The arrival of European settlers radically transformed the life of the Guringai, as access to land and traditional food resources were blocked by growing settlements and pastoral developments (Gibberagong Environmental Education Centre, 1983:17). In the late 1780s a smallpox epidemic swept through the Guringai people, (Tench, 1793) causing a decline in population numbers in the area.

In 1823 European Thomas Edward Higgins was promised a land grant by Governor Brisbane. This grant, 250 acres in size, was formally recorded in 1836. From then on Thomas Higgins and his family set about clearing and developing the land within the grant area. Cultivation, market gardens and orchards were developed, as were properties and structures for Thomas Higgins and his family (OEH, 2015). Between the 1860s and 1880s, houses were built for Ann (nee Higgins) and her husband Mathew Harrington, Clara (nee Higgins) and her husband Peter McKenzie, Thomas Edward Higgins IV and Maria Agnes Duffy Nairn (nee Higgins) and her husband Thomas McKinnon. Around the late 1880s or early 1890s a house was built for Thomas Harrington, the son of Ann and Mathew Harrington. In addition to the original Higgins homestead and the homes for various family members thereafter, the Higgins family and their descendants also developed other structures and features in the landscape, including a communal cool room built into a sandstone overhang. The Higgins family also developed their own cemetery, which Thomas Higgins was buried in following his death in 1885, with other family members to follow (Parsons Brinckerhoff, 2004). Part of the Higgins land grant was sold and subdivided in the 1880s.

5.3 Early 20th Century to present day

By 1903 mining had commenced in the area for blue metal, which at that stage was excavated by hand and transported by horse and cart. The mining operation at Hornsby developed into a commercial enterprise by the 1920s. The quarry was only in sporadic use during the 1950s, but accelerated from 1959 onwards after Farley and Lewers Ltd acquired the quarry and council lease. The 1960s saw quarry development demolish the remnant house structures relating to the Higgins' period of use, with machinery, infrastructure and offices gradually added to the area as part of the quarrying operation (Parsons Brinckerhoff, 2004).

By the 1990s the quality of extracted material at the quarry had lessened, leading to its closure. In 2002, the Hornsby Quarry site was purchased by Hornsby Shire Council (OEH, 2015).

6 Results

This section describes the findings of the inventory and database searches and results of the field inspection of heritage items identified within the project site.

6.1 Heritage inventory search results

A search of the heritage registers and inventories was undertaken on 15 April 2015. The register search results are summarised in Table 4.

Table 4 Heritage items identified on heritage registers

Register	Heritage items	Assessed significance
Items within the study area		
World Heritage List	No listed items	n/a
Commonwealth Heritage List	No listed items	n/a
National Heritage List	No listed items	n/a
Register of the National Estate (non statutory)	Hornsby Diatreme Area (Place ID 2613)	Registered Place
	Higgins Family Cemetery (Place ID 2614)	Indicative Place
State Heritage Register	Old Mans Valley Cemetery (Listing No. 01764)	State
S170 Registers	No listed items	n/a
Register of the National Trust of Australia	Old Mans Valley Cemetery/Higgins' Family Cemetery (Listing No. 9167)	State
Hornsby LEP 2013	Diatreme Hornsby Quarry and surrounding vegetation (Item A54/538)	Local
	Old Mans Valley Cemetery, including Higgins Family Cemetery, sandstone receptacle, cool room and site of Higgins homestead on which the Higgins Family Memorial is located (Item A55)	State
Items adjacent to the study area		
World Heritage List	No listed items	n/a
Commonwealth Heritage List	No listed items	n/a
National Heritage List	No listed items	n/a
Register of the National Estate	No listed items	n/a
State Heritage Register	No listed items	n/a
S170 Registers	No listed items	n/a
Register of the National Trust of Australia	Hornsby Park - Lone Pine and sandstone steps (Item 513)	Local
	TAFE College—Buildings “K” and “M” and grounds (excluding other buildings) (Item 521)	Local
	Sandstone steps (Item 537)	Local
Hornsby LEP 2013	No listed items	n/a

Of the heritage items included in Table 1, a number are outside the proposed project site and would not be affected by the proposal. The curtilage for 'Hornsby Park and Lone Pine and sandstone steps' (Item 513) is located immediately adjacent to the eastern and southern boundaries of the project site. The sandstone steps, which are also listed separately (Item 537), are located immediately outside the south eastern boundary of the project site. The TAFE College—Buildings "K" and "M" and grounds (excluding other buildings) (Item 521) are located adjacent to the eastern boundary of the project site. The item 'Street Trees', located on Dural Street and listed in the Hornsby LEP 2013 (Item 468), was noted to be to the south of the proposed area of impact. These items of local significance are not located within the proposed area of impact and will not be directly or indirectly impacted by the project.

In addition to the listed items, a past study undertaken in the area has also identified the remnant Hornsby Quarry industrial machinery and buildings as having heritage value (Parsons Brinckerhoff Australia Pty Ltd, 2004).

Those heritage items identified within the project site boundary are listed in Table 5 and shown Figure **2**.

Table 5 Coordinates of heritage items identified within the project site

Item	GDA94 Easting	GDA94 Northing
Diatreme Hornsby Quarry and surrounding vegetation	323236	6269775
Old Man's Valley Cemetery/Higgins Family Cemetery	323218	6269536
Heritage walk depression era sandstone steps	323440 to 323482	6269375 to 6269410
Sandstone receptacle	323428	6269448
Cool room	323410	6269485
Higgins Homestead/Memorial	323152	6269580
Hornsby Quarry Industrial Machinery and Buildings	323055	6269505

6.2 Field inspection

A targeted inspection was carried out for known non-Aboriginal heritage items and areas identified as having the potential to be impacted directly or indirectly by the project (identified in Table 5).

6.2.1 Diatreme Hornsby Quarry and surrounding vegetation

A diatreme is a natural, geological feature composed of a long vertical pipe or plug, in this case composed of dolerite. It was formed when magma extruded through the overlying strata in a past volcanic event. At the Hornsby location the dolerite core is surrounded by volcanic breccia containing coal, sandstone and shale (see Plate 1). The volcanic event that formed it has tentatively been dated to between 50 and 210 million years BP (Parsons Brinckerhoff Australia Pty Ltd, 2004:175).

The diatreme has been exposed in the wall of the Hornsby Quarry as a result of excavation to extract blue metal between 1903 and the quarry's closure in the 1990s. The Diatreme Hornsby Quarry is an oval shaped depression in the landscape measuring around 300 metres by 200 metres. Its sides are stepped down in terraces and the base of the depression has filled with water from natural run-off and rain. Due to water covering the lower portions it was not possible to estimate the total depth of the feature during field inspections. Although the NSW State Heritage Inventory and Hornsby LEP listings also note surrounding vegetation as a feature of the item, there are no descriptions in either listing of the heritage value of the vegetation. Vegetation clearance has previously been undertaken within and surrounding the quarry void. Regrowth is currently present both within the void and in the immediately surrounding area.

Plate 1 **Diatreme Hornsby Quarry**

6.2.2 Old Man's Valley Cemetery/Higgins Family Cemetery, sandstone receptacle, cool room, site of Higgins homestead/memorial and sandstone stairs

The NSW State Heritage Register lists Old Man's Valley Cemetery as an item with State significance. The Hornsby LEP lists the cemetery as part of a complex of items, also including the sandstone receptacle, cool room, Higgins homestead/memorial and sandstone stairs.

The sandstone stairs connect a current vehicle track to the upper slopes of the area close to the contemporary Hornsby Aquatic and Leisure Centre. The stairs are made of hand-carved sandstone (see Plate 2 and Plate 3). A past assessment noted reference to the stairs being a depression era (circa 1930s) development made as part of unemployment relief works. The same study however also noted oral history evidence from Higgins family descendants stating that the stairs predated this, having been present in the 1920s linking some of the Higgins family houses (Parsons Brinckerhoff Australia Pty Ltd, 2004:169). This suggests that, like the nearby receptacle and cool room, the stairs are evidence of the use and development of the area by the pioneer settlers of the Higgins family.

The cool room contains two shelves and has been built into a natural sandstone overhang. It is lined with concrete and metal, with broken glass evident in and around it, possibly dating to the period of use (see Plate 4 and Plate 5). The cool room itself is approximately one metre wide and one metre high. It is located upslope from a vehicle track. A past assessment identified it as a communal cool room that was equidistant between the historic Higgins family structures: McKenzie House, McKinnon House and Thomas Higgins IV House (Parsons Brinckerhoff Australia Pty Ltd, 2004:171).

The general area surrounding the cool room, sandstone receptacle and stairs was noted in a past assessment as having potential archaeological sensitivity, with the possibility of subsurface deposits associated with the since demolished house structures. Past structures in this general area included the home of Ann (nee Higgins) and Mathew Harrington, the house of Thomas Harrington, the home of Clara (nee Higgins) and Peter McKenzie, the home of Nairn (nee Higgins) and Thomas McKinnon and the home of Thomas Edward Higgins IV and Maria Agnes Duffy. These structures dated from the 1860s to the 1880s. Some are known to have been destroyed by rot or bushfire, while others survived until the 20th century, demolished in the 1960s during the development works for the Hornsby Quarry (Parsons Brinckerhoff Australia Pty Ltd, 2004:176-177).

The cemetery contains twenty-three known burials dating from 1879 until 1931. It is located at the base of a slope to the south-east of Hornsby Quarry. The family cemetery contains burials of the Higgins family and their descendants. An interpretation board at the site has a layout plan of the burials, with listed family names including Higgins, Jansson and McKenzie. Physical elements include sandstone and marble headstones (some reconstructed during restoration work), as well as the damaged remnants of monumental masonry, cast iron railings and white-painted bricks. Following restoration, the cemetery was surrounding by protective fencing. Current vegetation protects the area from view and provides shade across its extent. There are informal paths between the graves as well as garden beds with remnant plantings of alyssum, violets, lilies and freesias (see Plate 6).

The various homes of the Higgins family that were once in this area have since been demolished. At the site of the original family homestead an area has been fenced off and a memorial was erected there in 1970. The memorial has the following text written on it: “On this site stood the homestead of the Higgins Family Pioneers of the Hornsby District 1834 – 1970” (see Plate 7). The area has been identified as having subsurface potential for intact deposits relating to the Higgins Family Homestead and the demolished structures and features that were associated with it.

The sandstone receptacle is located further up the slope that contains the cool room, and downslope from the contemporary Hornsby Aquatic and Leisure Centre. It is oval in shape with sparrow pecking visible on its inner edges and an engraved motif on a stone within the oval basin of the receptacle (see Plate 8 and Plate 9). It is most likely associated with the Higgins family and could date to the same period as the nearby cool room, but its precise date and purpose have not been identified during previous studies.

Plate 2 Heritage Walk Depression era stairs circa August 1994 (Hornsby Shire Council, 1994)

Plate 3 Heritage Walk Depression era stairs circa December 2013

Plate 4 Cool room

Plate 5 Cool room location

Plate 6 Old Man's Valley Cemetery

Plate 7 Higgins Homestead/Memorial

Plate 8 Sandstone receptacle (Parsons Brinckerhoff Australia Pty Ltd, 2004:173)

Plate 9 Sandstone receptacle (Parsons Brinckerhoff Australia Pty Ltd, 2004:173)

6.2.3 Hornsby Quarry Industrial Machinery and Buildings

Remnant structures and equipment from the period of operation for the Hornsby Quarry are still extant in this area. Although the quarrying of blue metal in the Hornsby area first started around 1903, these items date to the latter quarry period of commercial operation from the 1960s onwards. Structures remnant in this area include a steel-frame workshop, concrete block office, pieces of equipment, a crushing and screening plant, an administration building, a sub-station, pumps, stairs, pipes and fences. The structures have been subject to natural deterioration and impacts from vandalism, including rubbish dumping, intentional breakage and graffiti (see Plate 10 and Plate 11).

Plate 10 Hornsby Quarry Machinery

Plate 11 Hornsby Quarry structure with graffiti

7 Significance assessments

7.1 Significance assessment criteria

In order to understand how development will impact on a heritage item, it is essential to understand why an item is significant. An assessment of significance is undertaken to explain why a particular site is important and to enable the appropriate site management and curtilage to be determined. Cultural significance is defined in the Australia ICOMOS Charter for the conservation of places of cultural significance (the Burra Charter) as meaning "aesthetic, historic, scientific or social value for past, present or future generations" (Article 1.1). Cultural significance may be derived from a place's fabric, association with a person or event, or for its research potential. The significance of a place is not fixed for all time, and what is of significance to us now may change as similar items are located, more historical research is undertaken and community tastes change.

The process of linking this assessment with a site's historical context has been developed through the NSW Heritage Management System and is outlined in the guideline *Assessing Heritage Significance* (NSW Heritage Office, 2001a), part of the NSW Heritage Manual (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996b). The *Assessing Heritage Significance* guidelines establish seven evaluation criteria (which reflect four categories of significance and whether a place is rare or representative) under which a place can be evaluated in the context of State or local historical themes. Similarly, a heritage item can be significant at a local level (i.e. to the people living in the vicinity of the item), at a State level (i.e. to all people living within NSW) or be significant to the country as a whole and be of National or Commonwealth significance.

Following amendments to the *Heritage Act* in 2009, to be of State significance an item must meet two or more of the criteria below. Items can be deemed of local significance if they meet one or more criteria.

Criterion (a) – an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area). The site must show evidence of significant human activity or maintains or shows the continuity of historical process or activity. An item is excluded if it has been so altered that it can no longer provide evidence of association.

Criterion (b) – an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area). The site must show evidence of significant human occupation. An item is excluded if it has been so altered that it can no longer provide evidence of association.

Criterion (c) – an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area). An item can be excluded on the grounds that it has lost its design or technical integrity or its landmark qualities have been more than temporarily degraded.

Criterion (d) – an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons. This criterion does not cover importance for reasons of amenity or retention in preference to proposed alternative.

Criterion (e) – an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area). Significance under this criterion must have the potential to yield new or further substantial information. Under the guideline, an item can be excluded if the information would be irrelevant or if it only contains information available in other sources.

Criterion (f) – an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area). The site must show evidence of the element/function, etc, proposed to be rare.

Criterion (g) – an item is important in demonstrating the principal characteristics of a class of NSW's: cultural or natural places; or cultural or natural environments. An item is excluded under this criterion if it is a poor example or has lost the range of characteristics of a type.

The Heritage Council requires the summation of the significance assessment into a succinct paragraph, known as a Statement of Significance. The Statement of Significance is the foundation for future management and impact assessment.

In the following tables, details of the significance criteria for each historic item identified in the study area are outlined, followed by a statement of significance for each item. Existing statements have been utilised.

Table 6 Diatreme Hornsby Quarry and surrounding vegetation (NSW Office of Environment & Heritage, 2015)

Significance criteria	Application of criteria
Historical significance SHR criteria (a)	*It reflects the mix of land-use (industrial and recreational) in the Shire. The quarry operated from 1909 to WWII, reopened in 1950s. Bushland walks were created in the 1930s as part of unemployment relief. Circa Date: 1909-1950s.*
Associative significance SHR criteria (b)	*This item is associated with the period of use of the Hornsby Quarry and is a physical example of the works untaken for the quarry.*
Aesthetic significance SHR criteria (c)	*Eroded valley of volcanic rock surrounded by parkland. Volcanic Rock in an area predominantly of sandstone has created an unusual environment, part of which is recreational reserve, part used for quarrying blue metal.*
Social significance SHR criteria (d)	*Due to the link to quarrying in this area, the site has the potential to contribute to the local community's sense of place, and can provide a connection to the local community's past.*
Research Potential SHR criteria (e)	*No research potential significance was identified for this item.*
Rarity SHR criteria (f)	*No rarity significance was identified for this item.*
Representativeness SHR criteria (g)	*No representative significance was identified for this item.*
Statement of significance	*"Volcanic rock in an area predominantly of sandstone has created an unusual environment, part of which is a recreational reserve, part used for quarrying blue metal. It reflects the mix of land use (industrial and recreational) in the shire"*

Table 7 Old Man's Valley Cemetery/Higgins' Family Cemetery (NSW Office of Environment & Heritage, 2015)

Significance criteria	Application of criteria
Historical significance SHR criteria (a)	*"Old Man's Valley Cemetery is of state significance for demonstrating the earliest application of professional conservation techniques and management methods to a small private cemetery in NSW. It has since provided an exemplar for the proper conservation and protection of cemeteries generally, and small isolated cemeteries in particular, undertaken in accordance with the first publicly funded conservation plan prepared for a private cemetery in NSW.* *"Sited in "Old Man's Valley", which was first agricultural land then a bluestone quarry (recently decommissioned), the Cemetery is not only associated with the economic development of the locality but has local historical significance for its evidence of the settlement and occupation of the Old Man's Valley by a pioneering settler family. The cemetery is now the major surviving physical evidence in the valley of almost 150 years of occupation by the Higgins family. An unusually late private cemetery with interments dating from 1879 to 1931, its establishment and use appears to have been a direct response to the isolation of Old Man's Valley and the difficulties of transporting the dead to established communal burial grounds. The ages of those buried (more than one third of whom did not reach maturity) attest to the hardships of pioneer life. The Old Man's Valley Cemetery serves as a distinctive reminder of the part that early convict settlers and their descendants played in the social, cultural and economic development of NSW".*
Associative significance SHR criteria (b)	*"Containing twenty-three known burials, the Higgins Family Cemetery is of local significance for its associations with the Higgins family, a pioneering settler family of the Hornsby Shire who occupied the Old Man's Valley continuously from the 1830s to 1970. The cemetery contains the burial site of the grandson of the original settlers - Second Fleet convicts Thomas Edward Higgins and his wife Eleanor McDonald - and also records the continuing presence of the descendants of these pioneer settlers in the Old Man's Valley".*
Aesthetic significance SHR criteria (c)	*"The cemetery is of local significance for its representative examples of late nineteenth and early twentieth century monumental masonry, providing a good record of the designs, inscriptions, motifs indicative of funerary symbolism and practices used in a modest family cemetery in NSW at that time".*
Social significance SHR criteria (d)	*"The Old Man's Valley Cemetery is of State significance for its social value as one of the most carefully conserved family cemeteries in NSW. Its considerable social significance to a wide array of Higgins family descendants (now living all over Australia) is evidenced by their work in funding its conservation over many years, accessing both professional advice and their own labour. More than 200 descendants gathered at the cemetery in 1990 to celebrate the bicentenary of Thomas Edward Higgins and Eleanor McDonald's arrival in Australia. Several Higgins family descendants continue to reside in the Hornsby district and conduct working-bees at the cemetery every three months which also serve as family reunions. The cemetery has also been a focus of wider community interest for some years, and is a focus of local heritage tours by visitors and educational institutions. It provides a sense of historic continuity and contributes to the community's sense of identity. It is of State significance as an exemplary example of how a small, isolated site of historical significance may be conserved and valued".*

Significance criteria	Application of criteria
Research Potential SHR criteria (e)	*"The Old Man's Valley Cemetery has local significance for its research potential to understand the living conditions, circumstances, values and genealogy of a pioneer family. The Cemetery is an important genealogical resource, recording many individuals from the network of European families that inhabited in the valley. The conservation project of the 1990s also provides an example of community organisation of resources as well as conservation techniques applied to a small-scale family cemetery that may be measured over time for their effectiveness".*
Rarity SHR criteria (f)	*"The Old Man's Valley Cemetery is of State significance as one of the few fully conserved family cemeteries in New South Wales. It is of local significance for its rarity in providing evidence of an isolated rural settlement pattern within Sydney region in this period, and as one of the few remnants of early European settlement in the Hornsby district. Dating from 1879-1931, it is also an unusually late private cemetery".*
Representativeness SHR criteria (g)	*"The Old Man's Valley Cemetery is of local significance as a representative remnant of pioneering settler life that evidences the difficulties faced by early settlers as well as the close-knit family-based community which inhabited the valley. The cemetery also has representative significance at a local level for its landscape setting amid both remnant natural vegetation and traditional European grave plantings".*
Statement of significance	*"The Old Man's Valley Cemetery is of State significance for its rarity as one of the few fully conserved family cemeteries in New South Wales and possibly the only one. It is also of State significance for the social value that this high state of conservation represents - firstly to a wide array of Higgins family descendants (now living all over Australia) who have funded its conservation over many years, accessing both professional advice and their own labour. Its social significance to the wider community is also demonstrated by its role as a heritage destination by visitors, cemetery enthusiasts and educational institutions. Acquired by Hornsby Shire Council in 2006, it provides an exemplary model of how a family cemetery may be conserved and valued.* *"Sited in Old Man's Valley, which was first agricultural land then a bluestone quarry (recently decommissioned), the cemetery is associated with the economic development of the locality and also has high local historical significance for its graves memorialising the descendants of Hornsby's earliest European settler family, Thomas Edward Higgins, son of Thomas Higgins and his wife Eleanor McDonald. Containing twenty-three known burials with internments dating from 1879 to 1931, its dates are unusually late for a private cemetery. Its establishment and use appears to have been a direct response to the isolation of Old Man's Valley and the difficulties of transporting the dead to established communal burial grounds. It is also of high local significance for its representative examples of late nineteenth and early twentieth century monumental masonry, providing a good record of the designs, inscriptions, motifs indicative of funerary symbolism and practices used in a modest family cemetery in NSW at that time. The cemetery also has high representative significance at a local level for its landscape setting amid both remnant natural vegetation and traditional European grave plantings".*

Table 8 Complex of Higgins Family heritage items (including heritage walk depression era sandstone steps, sandstone receptacle, cool room and Higgins Homestead/Memorial) (Parsons Brinckerhoff Australia Pty Ltd, 2004)

Significance criteria	Application of criteria
Historical significance SHR criteria (a)	*"This complex of relics represents an important component of the heritage of the Hornsby Shire by providing evidence of the settlement and occupation of Old Mans Valley by the Higgins family. The Higgins family were pioneer settlers not only of the valley itself, but also of the wider Hornsby area. Members of the Higgins family occupied the Old Mans Valley for over 140 years, from c. 1830 to 1970. Due to the large scale modification to the surrounding landscape caused by the quarry operation, these relics, in conjunction with the Higgins family cemetery, represent the only surviving physical evidence in the valley of almost 150 years of occupation by the descendants of Thomas Higgins II".*
Associative significance SHR criteria (b)	*No associative significance was identified for this item.*
Aesthetic significance SHR criteria (c)	*No aesthetic significance was identified for this item.*
Social significance SHR criteria (d)	*Due to the possible link to early settlement in this area, the site has the potential to contribute to the local community's sense of place, and can provide a connection to the local community's past. "This complex of items has social significance to the many descendants of the Higgins family, many of whom remember these relics from childhood days spent in the valley. They also have social significance to the wider community as they represent physical evidence associated with the pioneering settlers of the Hornsby area".*
Research Potential SHR criteria (e)	*The site of the Higgins Homestead, marked by a fenced off area and memorial, has the potential for subsurface deposits. Immediately to the east of this is an area cited in a past study to have the potential for further deposits associated with at least six residences, possibly damaged or buried under overburden deposit (Parsons Brinckerhoff Australia Pty Ltd, 2004:176-177). These areas have the potential for further research.*
Rarity SHR criteria (f)	*No rarity significance was identified for this item.*
Representativeness SHR criteria (g)	*This complex of relics provides physical evidence of an isolated rural settlement and lifestyle during the late 19th and early 20th century where luxuries such as electricity and mains water were not available. It appears that the cool room may have been a communal facility used by several of the surrounding households and thus provides evidence of the close knit family based pioneering community".*
Statement of significance	*This complex of relics represents an important component of the heritage of the Hornsby Shire by providing evidence of the settlement and occupation of Old Mans Valley by the Higgins family. It has social significance to Higgins family descendants and the local community.*

Table 9 Hornsby Quarry Industrial Machinery and Buildings (Parsons Brinckerhoff Australia Pty Ltd, 2004)

Significance criteria	Application of criteria
Historical significance SHR criteria (a)	*"The Hornsby quarry machinery serves as an important remnant and reminder of early bluestone quarry activities that commenced at the turn of century and continued until the mid 1960s. The blue metal quarried from the valley from as early as 1903 provided a much needed building material for the construction of industrial, commercial, and domestic buildings and a major resource for the construction of major and minor roads within the Shire and the rail systems throughout the Sydney area".*
Associative significance SHR criteria (b)	*No associative significance was identified for this item.*
Aesthetic significance SHR criteria (c)	*"The quarry machinery provides physical evidence of an important period of industrial achievement in the Hornsby Shire".*
Social significance SHR criteria (d)	*Due to the link to mining in this area, the site has the potential to contribute to the local community's sense of place, and can provide a connection to the local community's past.*
Research Potential SHR criteria (e)	*No research potential significance was identified for this item.*
Rarity SHR criteria (f)	*No rarity significance was identified for this item.*
Representativeness SHR criteria (g)	*No representative significance was identified for this item.*
Statement of significance	*The quarry machinery provides physical evidence of local industrial achievement and can provide a connection to the local Hornsby community's past.*

7.2 Historical Themes

Commonwealth (Australian Heritage Commission, 2001) and NSW heritage agencies (NSW Heritage Office, 2001b) use themes as a means of categorising how a place contributed to historical events at a National, State and local level. Historical themes are a means of relating site-specific developments to broader historical patterns. The themes that apply to the Diatreme Hornsby Quarry and surrounding vegetation are provided in Table 10.

Table 10 Diatreme Hornsby Quarry and surrounding vegetation Historical Themes (NSW Office of Environment & Heritage, 2015)

Australian theme	NSW theme	Local theme
3. Economy - Developing local, regional and national economies	Environment - cultural landscape- Activities associated with the interactions between humans, human societies and the shaping of their physical surroundings	Landscapes of cultural and natural interaction

The themes that apply to the Old Man's Valley Cemetery/Higgins Family Cemetery, sandstone receptacle, cool room, site of Higgins homestead/memorial and sandstone stairs are provided in Table 11.

Table 11 Old Man's Valley Cemetery/Higgins' Family Cemetery, sandstone receptacle, cool room, site of Higgins homestead/memorial and sandstone stairs Historical Themes (NSW Office of Environment & Heritage, 2015)

Australian theme	NSW theme	Local theme
3. Economy - Developing local, regional and national economies	Environment - cultural landscape- Activities associated with the interactions between humans, human societies and the shaping of their physical surroundings	Landscapes of cultural and natural interaction
3. Economy - Developing local, regional and national economies	Environment - cultural landscape- Activities associated with the interactions between humans, human societies and the shaping of their physical surroundings	Places important in developing conservation processes
7. Governing - Governing	Government and Administration - Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Developing roles for government - conserving cultural and natural heritage
8. Culture - Developing cultural institutions and ways of life	Creative endeavour - Activities associated with the production and performance of literary, artistic, architectural and other imaginative, interpretive or inventive works; and/or associated with the production and expression of cultural phenomena; and/or environments that have inspired such creative activities.	Designing and marking grave furnishings and ornamentation

Australian theme	NSW theme	Local theme
9. Phases of Life - Marking the phases of life	Birth and Death - Activities associated with the initial stages of human life and the bearing of children, and with the final stages of human life and disposal of the dead.	Burying the dead in customary ways
9. Phases of Life - Marking the phases of life	Birth and Death - Activities associated with the initial stages of human life and the bearing of children, and with the final stages of human life and disposal of the dead.	Operating and maintaining private family burial grounds

The themes that apply to the Hornsby Quarry Industrial Machinery and Buildings are provided in Table 12.

Table 12 Hornsby Quarry Industrial Machinery and Buildings Historical Themes

Australian theme	NSW theme	Local theme
3. Economy - Developing local, regional and national economies	Environment - cultural landscape- Activities associated with the interactions between humans, human societies and the shaping of their physical surroundings	Landscapes of cultural and natural interaction

7.3 Significance grading

As different elements of an item can have a different contribution to its heritage significance, it is useful to define which elements are of significance and which may detract from its significance. The NSW Heritage Division (NSW Heritage Office, 2001:11) uses the grading criteria provided in Table 13.

Table 13 Grading of significance criteria (from NSW Heritage Office, 2001:11)

Grading	Justification	Status
Exceptional	Rare or outstanding element directly contributing to an item's local and State significance.	Fulfils criteria for local or State listing.
High	High degree of original fabric. Demonstrates a key element of the item's significance. Alterations do not detract from significance.	Fulfils criteria for local or State listing.
Moderate	Altered or modified elements. Elements with little heritage value, but which contribute to the overall significance of the item.	Fulfils criteria for local or State listing.
Little	Alterations detract from significance. Difficult to interpret.	Does not fulfil criteria for local or State listing.
Intrusive	Damaging to the item's heritage significance	Does not fulfil criteria for local or State listing.

The historic heritage items have been graded in the context of the significance assessment above. The results are provided in the tables following.

Table 14 Diatreme Hornsby Quarry and surrounding vegetation grading of fabric

Grading	Element meeting criteria
Exceptional	None
High	The exposed section of volcanic rock in an area used for quarrying blue metal is unaltered.
Moderate	None
Little	None
Intrusive	None

Table 15 Complex of Higgins Family heritage items (including heritage walk depression era sandstone steps, sandstone receptacle, cool room and Higgins Homestead/Memorial) grading of fabric

Grading	Element meeting criteria
Exceptional	None
High	A high degree of original fabric is extant.
Moderate	None
Little	None
Intrusive	Modern features are present around these items, including tracks, fences, benches and bins.

Table 16 Hornsby Quarry Industrial Machinery and Buildings grading of fabric

Grading	Element meeting criteria
Exceptional	None
High	None
Moderate	A moderate degree of original fabric is extant in good condition. This item has been subject to damage.
Little	None
Intrusive	Graffiti and damage caused by neglect have impacted upon this item.

(blank page)

8 Impact Assessment

8.1 Direct Impacts

8.1.1 Diatreme Hornsby Quarry and surrounding vegetation

This project would directly impact on non-Aboriginal heritage through spoil emplacement activities. For the purposes of this assessment a worst case fill level of 64 metres RL has been considered (based on a fill volume of up to 1.5 million cubic metres). While the spoil deposition in the quarry void is unlikely to damage the item, the partial covering of the volcanic rock and associated obscuring of view-lines will alter the heritage value of the item. As the sections of the diatreme closest to the void rim would remain visible, the impacts to heritage significance of the diatreme are assessed to be minor.

Direct impacts could also occur during installation of the conveyor and stabilisation works on the edge of the Hornsby Quarry void (e.g. drilling into the rock to stabilise the conveyer structure). Given the nature of the diatreme as a large geological feature, these impacts are assessed to be minor in terms of the heritage significance of this item. In addition, during site mobilisation, the conveyer structure would be removed from site, retaining view lines to this section of the diatreme.

8.2 Indirect Impacts

8.2.1 Old Mans Valley Cemetery/Higgins Family Cemetery, sandstone receptacle, cool room, site of Higgins homestead/memorial and sandstone stairs

No direct impact on the elements that comprise this complex would result as a consequence of the works, as this complex is located outside the area of impact. However, indirect impacts may occur including obstruction of view-lines and access to these features. This would be a temporary alteration and it is assessed that the proposed works will not alter the overall heritage value of the items.

The cool room, built into a sandstone overhang, is an element that could potentially be damaged by vibration. This item, although adjacent to an existing vehicle access track and the stockpiling area that would be utilised during works, is approximately 250 metres from the proposed conveyor alignment and 200 metres from the road widening works. It is therefore assessed as unlikely that the cool room would be affected by vibration generated by the project.

The headstones in the cemetery are situated approximately 80 metres from the proposed stockpiling area at its closest point. The inspection of the cemetery identified it to be in good condition, following restoration works to repair past damage caused by vandalism and neglect. A higher level of past vibration, due to the use of blasting by explosives in the quarrying process, has not visibly impacted on the cemetery headstones despite the cemetery being in close proximity to Hornsby Quarry during its period of operation (approximately 80 metres from the edge of the current void). The construction and use of the conveyor and stockpiling activities as part of this project are assessed as negligible by comparison and unlikely to have vibration impacts on the cemetery headstones. Existing access to the cemetery via Quarry Road would not be affected by the proposed works. The current access arrangements would be retained for the duration of the works and following project completion.

The current heritage values of other items in the listed complex are unlikely to be impacted by vibration.

8.2.2 Hornsby Quarry Industrial Machinery and Buildings

No direct impacts are proposed for the elements that comprise this complex, which are to be avoided by the project. Indirect impacts may include view-lines and access to these features being blocked. This would be a temporary alteration and it is assessed that the project would not alter the overall heritage value of the item, particularly as views to and from the item have not been identified as part of its significance. The closest works are proposed approximately 150 metres away from this item.

Based on the nature of the proposed works and their distance from this item, it is assessed as unlikely that vibration would negatively impact on the assessed heritage values.

8.2.3 Cumulative and cultural landscape impacts

Spoil would be placed in the Hornsby Quarry, which would alter the current heritage landscape. However, this alteration may, in the future, facilitate Hornsby Shire Council opening this area for public access, which would in turn increase access to the area's heritage.

Other cultural landscape impacts include an alteration to the environment due to the addition of the conveyor. This is a temporary feature to be present during the placement of spoil in the quarry to a safe level to allow Hornsby Shire Council to facilitate safe access for the general public. Due to the potential benefits for heritage access in the future and the temporary nature of spoil management works at the site, it is assessed that cumulative cultural heritage impacts to the landscape would be negligible.

9 Statement of Heritage Impact

The objective of a Statement of Heritage Impact (SOHI) is to evaluate and explain how the proposed development, rehabilitation or land use change will affect the heritage value of the site and/or place. A SOHI should also address how the heritage value of the site/place can be conserved or maintained, or preferably enhanced by the proposed works.

No direct impacts are proposed to the items Old Man's Valley Cemetery/Higgins Family Cemetery, sandstone receptacle, cool room, site of Higgins homestead/memorial and sandstone stairs and Hornsby Quarry Industrial Machinery and Buildings. The items will be preserved *in situ*.

The Diatreme Hornsby Quarry and surrounding vegetation has the potential to be damaged by stabilisation works and the conveyor construction/use. Although the spoil to be placed in the quarry void may not be of sufficient volume to obscure view-lines to the diatreme, the long term proposal to fill the void of the Hornsby Quarry will eventually partially obscure view-lines to the diatreme, impacting on its heritage value. This potential impact has been assessed for the item in the following SOHI.

This non-Aboriginal heritage report has been prepared in accordance with the NSW Heritage Office and Department of Urban Affairs and Planning *NSW Heritage Manual* (1996) and NSW Heritage Office *Statements of Heritage Impact* (NSW Heritage Office, 2002). The guidelines pose a series of questions as prompts to aid in the consideration of impacts. The questions vary in the guideline, depending on the nature of the impact to the heritage site. Those questions of relevance to this project are addressed below.

How has the impact of the new development on the heritage significance of the item or area to be minimised?

The diatreme will be physically protected by the buffering of fill material against it. Visibility to the diatreme however will be partially obscured once fill deposition reaches a certain level (RL 64), which is a negative impact to this heritage item. It is anticipated that the finished level of spoil within the quarry void would result in only partial obscuring of the diatreme with view lines retained to the sections of the diatreme at the quarry rim. The placement of spoil in the quarry void will contribute to the whole site eventually being made available for use by the community and provide long-term community benefits through improvements to safety and increased opportunities for recreation (subject to Hornsby Shire Council proceeding with rehabilitation and public recreation development works). This will enhance heritage values through the allowance of public access to the site and facilitate future public access to heritage values at the quarry site.

Why is the new development required to be adjacent to a heritage item?

The diatreme is exposed as a result of previous quarrying activities. The proposed works consisting of placement of spoil in the quarry void which was created by the previous quarrying activities, would be instrumental in facilitating future rehabilitation of the quarry site such that it can be made available for use by the community in the future (subject to Hornsby Shire Council proceeding with rehabilitation and public recreation development works).

How does the new development affect views to, and from, the heritage item? What has been done to minimise negative effects?

The view-lines to the diatreme will be partially obscured once deposition in the Hornsby Quarry void reaches a certain level. This will impact on the item's heritage significance, but the finished fill level is anticipated to still provide partial views to the heritage item, and the portion of the diatreme obscured by fill material would be protected by the spoil material and is a reversible loss of local significance. Currently the area is unsafe for public access, meaning that views to the item in its current form are not possible.

Will the public, and users of the item, still be able to view and appreciate its significance?

There are no users of the item as access to the quarry is currently restricted for safety reasons. The project will benefit the item as it will contribute to the whole site potentially being made available for use by the community in the future and improve access to and appreciation of the heritage item (subject to Hornsby Shire Council proceeding with rehabilitation and public recreation development works). Any future interpretive information provided by Council about the diatreme, following redevelopment of the site, will also increase public understanding, awareness and appreciation of the item.

Has the advice of a heritage consultant been sought? Has the consultant's advice been implemented?

This report constitutes the advice of a heritage consultant with regard to the impacts of the project on non-Aboriginal heritage. Advice and recommendations regarding the management of the Diatreme Hornsby Quarry and surrounding vegetation as well as the other heritage components in the surrounding area are presented in Section 10.

9.1 Key findings

No direct impacts are proposed to the items Old Man's Valley Cemetery/Higgins Family Cemetery, sandstone receptacle, cool room, site of Higgins homestead/memorial and sandstone stairs and Hornsby Quarry Industrial Machinery and Buildings, which are to be avoided during the proposed works and preserved in situ.

Impacts to the Diatreme Hornsby Quarry and surrounding vegetation include potential damage by road upgrade works, conveyor construction/use and stabilisation works. The most significant impact is the proposal to partially cover the diatreme with fill, obscuring some view-lines to the heritage item. This impact has been assessed in the Statement of Heritage Impact above and is considered to be acceptable as the increased public benefit mitigates the impact.

Table 17 Impact types and assessment

Impact type	Impact
Major negative impacts (substantially affects fabric or values of state significance)	None
Moderate negative impacts (irreversible loss of fabric or values of local significance; minor impacts on State significance)	None
Minor negative impacts (reversible loss of local significance fabric or where mitigation retrieves some significance; loss of fabric not of significance but which supports or buffers local significance)	Partial burial of the diatreme by fill deposition will obscure some of it from view. Potential damage from stabilisation and conveyor construction/use.
Negligible or no impacts (does not affect heritage significance either negatively or positively)	None
Minor positive impacts (enhances access to, understanding or conservation of fabric of local significance)	None
Major positive impacts (enhances access to, understanding or conservation of fabric of state significance)	The proposed works will improve safety at the heritage listed area and contribute to allowing future public access.

The project would not have physical impacts on the diatreme. The emplacement of spoil in the quarry void is reversible and would not impact the physical fabric of the heritage site.

The project would have a negative impact on the overall heritage significance of the Diatreme Hornsby Quarry and surrounding vegetation as a result of spoil emplacement obscuring some view-lines to this item.

The spoil emplacement however, would also have positive effects in that it will help to facilitate public access to the site in the future and other heritage values in the long-term.

(blank page)

10 Mitigation and Management Measures

Mitigation and management measures were developed for this project and finalised through a process of internal review. The internal review for this assessment evaluated the effectiveness of the mitigation measures through comparison to past heritage projects. The resulting recommended management and mitigation measures are:

- Archival recording of the extent of the diatreme will be undertaken following initial dewatering of the quarry void to show the full extent of the geological feature. This will occur prior to any works commencing within the void. The archival recordings would be made available to Hornsby Shire Council for its records and future use.
- The identified heritage items ‘Old Man’s Valley Cemetery/Higgins’ Family Cemetery’, ‘sandstone receptacle’, ‘cool room’, ‘site of Higgins homestead/memorial and sandstone stairs’ and ‘Hornsby Quarry Industrial Machinery and Buildings’ should be avoided during the proposed works.
- All Roads and Maritime staff and contractors working at the Hornsby Quarry site should be made aware of the location of heritage items and informed of their responsibility regarding the protection of those items.
- A dilapidation survey should be conducted immediately prior to the commencement of work. This dilapidation survey would enable the condition of the items located within 100 metres of vibration intensive works to be assessed and to produce a baseline recording to be used as comparison to ensure the project does not impact on the condition of the heritage items.
- Appropriate dust management measures should be considered and developed in consultation with a suitably qualified heritage specialist in relation to the listed heritage item ‘Old Man’s Valley Cemetery/Higgins’ Family Cemetery’.
- The location of the item Diatreme Hornsby Quarry and surrounding vegetation should be considered during conveyor construction/use and stabilisation works, to minimise impacts to the diatreme.
- A Heritage Management Plan would be developed to protect known heritage values during the proposed works. The Plan should include procedures for an appropriately qualified heritage consultant to conduct periodic inspections of heritage sites for which baseline dilapidation surveys are undertaken, to monitor their condition during construction. The Plan should also outline stop work procedures for use in the event of unexpected finds and should contain measures to protect surrounding heritage items.

(blank page)

11 References

AECOM Australia Pty Ltd. (2014). *Technical Working Paper: Non-Aboriginal Heritage Assessment Northconnex*.

Australian Heritage Commission. (2001). *Australian Historic Themes*. Retrieved from http://www.environment.gov.au/heritage/ahc/publications/commission/books/pubs/australian-historic-themes-framework.pdf

Gibberagong Environmental Education Centre. (1983). *Gibberagong*. NSW Government Printer.

Hornsby Shire Council. (1994). *Item No: A 55, Old Mans Valley (Hornsby Quarry)*. Retrieved January 12, 2014, from http://hsconline.hornsby.nsw.gov.au/appenquiry/user/heritage/default.aspx?page=wrapper&id=24195

Hornsby Shire Council. (2012). *Old Mans Valley Community Land Plan of Management Adopted 21 March 2012*.

Horton, D. R. (1996). *Aboriginal Australia*. Canberra: Aboriginal Studies Press.

ICOMOS (Australia). (2013). *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*. Burwood, Victoria: Australia ICOMOS. Retrieved from http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf

Kohen, J. (1993). *Darug and their Neighbours: The Traditional Aboriginal Owners of the Sydney Region*. Sydney: Darug Link in assoc. with Blacktown and District Historical Society.

Ku-ring-gai Council. (2013). *About Ku-ring-gai Aboriginal Heritage*. Retrieved October 29, 2013, from http://www.kmc.nsw.gov.au/About_Ku-ring-gai/History_heritage/Aboriginal_heritage

NSW Heritage Branch. (2009). *Assessing Significance for Historical Archaeological Sites and “Relics.”* Parramatta. Retrieved from http://www.heritage.nsw.gov.au/docs/Arch_Significance.pdf

NSW Heritage Office. (2001a). *Assessing heritage significance*. Parramatta. Retrieved from http://www.heritage.nsw.gov.au/docs/assessingheritagesignificance.pdf

NSW Heritage Office. (2001b). *New South Wales Historical Themes*. Parramatta. Retrieved from http://www.heritage.nsw.gov.au/docs/themes2006.pdf

NSW Heritage Office. (2002). *Statements of Heritage Impact*. Parramatta: Heritage Office. Retrieved from http://www.heritage.nsw.gov.au/03_index.htm#S-U

NSW Heritage Office. (2008). *Levels of Heritage Significance* (pp. 1–5). Parramatta: Heritage Office. Retrieved from http://www.heritage.nsw.gov.au/docs/levels_of_heritage_significance_2008.pdf

NSW Heritage Office, & NSW Department of Urban Affairs and Planning. (1996a). *Heritage Curtilages*. Parramatta: Heritage Office & Department of Urban Affairs & Planning.

NSW Heritage Office, & NSW Department of Urban Affairs and Planning. (1996b). *NSW Heritage Manual*. Parramatta: Heritage Office & Department of Urban Affairs & Planning. Retrieved from http://www.heritage.nsw.gov.au/03_index.htm#M-O

NSW Office of Environment & Heritage. (2015). *NSW State Heritage Register*. Retrieved March 24, 2015, from http://www.environment.nsw.gov.au/heritage/listings/stateheritageregister.htm

Parsons Brinckerhoff Australia Pty Ltd. (2004). *Hornsby Quarry and Environs Land Capability Study and Master Plan - Technical Investigations*. Retrieved from http://www.hornsby.nsw.gov.au/media/documents/planning-and-building/quarry/pb-study/Land-Capability-Study-Technical-Volume-1-1.pdf

Tench, W. (1793). A Complete Account of the Settlement at Port Jackson. In T. Flannery (Ed.), *1788*. Melbourne: The Text Publishing Company.

Threlkeld, L. E. (1892). *An Australian Language as spoken by the Awabakal, the people of Awaba or Lake Macquarie (near Newcastle, New South Wales) being an account of their Language, Traditions, and Customs*. (J. Fraser, Ed.). Charles Potter, Government Printer.

(blank page)

Appendix J

Technical working paper: Aboriginal Heritage

Roads and Maritime Services

Hornsby Quarry: Road Construction Spoil Management Project

Technical working paper: Aboriginal heritage

July 2015

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, Australia

(blank page)

Contents

List of tables

List of figures

List of plates

Glossary of terms and abbreviations

Term	Meaning
AHIMS	Aboriginal Heritage Information Management System.
Archaeological potential	The likelihood of undetected surface and/or subsurface archaeological materials existing at a location.
Aboriginal archaeological site	The present spatial extent of visible Aboriginal archaeological material(s) at a given location.
Artefact	Any object which has been physically modified by humans.
Exposure	An area of land surface where the ground surface is visible, usually as the result of thinner vegetation cover, erosive forces or human-caused disturbance. In archaeological surveys, the percentage of ground surface that is visible is recorded. These percentages of exposure are then used to calculate effective coverage.
Ground Surface Visibility (GSV)	A term used to describe the area of the ground's surface that is visible during archaeological field surveys.
OEH	NSW Office of Environment and Heritage.
PACHCI	The Roads and Maritime Services Procedure for Aboriginal Cultural Heritage consultation and Investigation (PACHCI).
Potential Archaeological Deposit	PAD is the hypothesised presence of archaeological deposit where there is uncertainty due to a lack of visibly eroding artefacts, lack of test excavation either locally or in analogous landforms in the region.
RMS	Roads and Maritime Services.
Artefact	Any piece of rock modified by human behaviour.

(blank page)

Executive summary

Roads and Maritime Services (Roads and Maritime) has identified the former Hornsby Quarry site as one of the preferred locations for receipt and management of spoil from the NorthConnex project, a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at Carlingford. Roads and Maritime is proposing that spoil generated during the construction of the roads and road infrastructure facilities be received at the Hornsby Quarry site for handling, management and beneficial reuse to stabilise the current quarry void on the site. The proposal would contribute to the potential future rehabilitation and redevelopment of the quarry by Hornsby Council for recreational purposes and public benefit.

The proposal is declared to be State significant infrastructure under Part 5.1 of the *Environmental Planning and Assessment Act 1979* by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on Aboriginal cultural heritage.

The proposal would allow the Hornsby Quarry site to receive up to 1.5 million cubic metres of excavated natural material (ENM) and virgin excavated natural material (VENM) from the construction of roads and road infrastructure facilities forming part of the NorthConnex project. Spoil handling, management and beneficial reuse at the Hornsby Quarry site would include site establishment and conveyer construction, dewatering of the quarry void, spoil haulage onto site, spoil stockpiling, spoil emplacement into the void via conveyer.

This report has been prepared for the purpose of identifying and assessing the potential environmental impacts of the construction and operation of the Hornsby Quarry Road Construction Spoil Management Facility on Aboriginal cultural heritage.

The assessment of Aboriginal cultural heritage for the project identified the following:

- The closest AHIMS registered Aboriginal sites to the proposed works are grinding grooves #45-6-2821 (approximately 410 metres to the north) and engraving #45-6-1703 (approximately 695 metres to the west).
- No sites or areas of archaeological or cultural sensitivity were identified during this assessment or the previous AECOM assessments in this area. However, one sandstone overhang with Potential Archaeological Deposit (PAD) was identified approximately 120 metres south of the proposed works.
- The nature of the proposed works and their location mean they are unlikely to cause vibration impacts on the identified sandstone overhang with PAD, which is 120 metres from the works at its closest point.
- Physical disturbances associated with the proposed works will not directly impact on the identified overhang with PAD.

Based on the results of the inspections of the study area it is recommended that:

- Impacts to the sandstone overhang with PAD identified on Transect 23 be avoided. If the SSI footprint is within 200 m of this feature an appropriate curtilage around the item should be delineated, for example by temporary fencing with star pickets and hi-viz mesh. The feature should be clearly delineated and identified as an environmentally sensitive area. Any fencing around the item's curtilage is to be supervised by an archaeologist prior to works commencing in order to protect it from harm. The RMS Aboriginal cultural heritage advisor is to be consulted by the archaeologist to determine whether it is appropriate for any Aboriginal stakeholder/s and/or Environmental Officer/s to be present during delineation works.
- If the impacts to previously identified AHIMS sites and the sandstone overhang with PAD can be avoided, then a Stage 3 assessment is not required.

- If the current design changes and impacts to previously identified AHIMS sites and/or the sandstone overhang with PAD cannot be avoided, then it is recommended that the assessment process progress to Stage 3 for formal consultation, as per the flowchart for Roads and Maritime's PACHCI (RMS, 2011:19) and additional approvals obtained (as required) where additional impacts are identified.
- In the event that additional areas outside the study area assessed in this report are identified as having potential for Aboriginal heritage and the potential for disturbance as a result of the project, then the need for a supplementary Stage 2 assessment will need to be reviewed. If required, additional approvals would be obtained, where additional impacts are identified.

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project).

On 13 January 2015 Roads and Maritime received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for the NorthConnex project identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage. Following design development, the Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during road construction from late 2015.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act.

Roads and Maritime has formed the opinion that the proposal is likely to significantly affect the environment, such that an EIS is required to be prepared. Therefore, the proposal is declared to be State significant infrastructure under Part 5.1 of the *Environmental Planning and Assessment Act 1979* by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on Aboriginal cultural heritage.

This Aboriginal cultural heritage assessment has been prepared to inform the EIS for the Hornsby Quarry Road Construction Spoil Management Project.

1.2 The project

The Hornsby Quarry site would receive up to 1.5 million cubic metres of excavated natural material (ENM) and/or virgin excavated natural material (VENM) from the approved NorthConnex construction sites. Only ENM and/or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road and track) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the site area.
- Dewatering of the void (to be undertaken by Hornsby Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.
- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil at stockpile sites within the Hornsby Quarry site using dozers.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.

- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete. An indicative program is provided below in **Table 1**.

Table 1 Indicative program

Project activity	Indicative project timeframe															
	2015				2016				2017				2018			
Site establishment (including preparatory works)				■												
Establishment of conveyer					■											
Spoil haulage and stockpiling					■	■	■	■	■	■	■	■	■	■		
Spoil emplacement (operation of conveyor)						■	■	■	■	■	■	■	■	■	■	
Site clean-up and demobilisation														■	■	

An overview of project works is included in Table 2. Detailed descriptions of each activity can be found in Section 4.1 of the environmental impact statement for the project.

Table 2 Overview of works

Phase	Proposed activities
Site establishment (including preparatory works)	The following works would be completed: • Dewatering of the void to a suitable working level. • Clearing and grubbing, and establishment pf erosion and sediment controls. • Establishment of a compound site. • Establishment of security fencing and signage around the works site. • Widening and sealing of the currently unsealed quarry access road (Bridge Road) to facilitate all weather access.
Establishment of conveyor	The construction of the conveyor would include establishment of footings and the conveyor.
Spoil haulage and stockpile maintenance	Trucks would enter and leave via Bridge Road during standard work hours over a maximum period of 28 months. Spoil would be unloaded from the dump trucks and stockpiled using dozers. It is expected that haulage and stockpiling would commence whilst the conveyer is still being constructed.
Spoil emplacement	Once the conveyer is constructed, these works would occur concurrently with spoil haulage and stockpiling activities, but would also continue for a period after the completion of spoil haulage onto the site. The activities include: • Placement of spoil from the stockpiles into the conveyor by front end loader. • Transport of the spoil via conveyor to the quarry void rim where the spoil would fall directly into the void. • Front-end loaders and articulated trucks would move the spoil along the quarry floor and dozers and rollers will spread the material. Periodic maintenance pumping of water from the void would be conducted during spoil haulage and emplacement activities.
Site demobilisation and rehabilitation	The compound and conveyor would be dismantled and removed from the site. Disturbed areas would be rehabilitated to a standard agreed with the Council. Security fencing would be removed, however would be retained around the quarry void if the void is deemed to remain an ongoing risk to public safety. Public access would then be reinstated to the areas outside the void exclusion zone.

1.3 Project location

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The site covers about 35 hectares and is owned by Hornsby Shire Council (refer to Figure 1).

The site comprises a quarry void, internal access roads and a cleared area to the east which is likely to have been used as a processing area when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the site is zoned for public recreation (RE1) under the *Hornsby Local Environmental Plan 2013*, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for public safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible.

The site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and an area to the east which were used as processing areas when the quarry was operational. Dense bushland comprising the Berowra Valley National Park occurs directly to the west.

1.4 Purpose of this report

The SEARs for the project were issued on 2 July 2015. The SEARs have informed the preparation of the EIS for the project. The SEARs include the following requirements specific to potential impacts on Aboriginal cultural heritage:

> *Impacts to Aboriginal heritage (including cultural and archaeological significance), in particular impacts to Aboriginal objects and potential archaeological deposits (PAD), should be assessed. Where impacts are identified, the assessment shall:*
>
> - *outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the measures) generally consistent with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005) and other relevant guidelines and requirements,*
> - *be undertaken by a suitably qualified heritage consultant(s),*
> - *demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures),*
> - *assess and document the archaeological and cultural significance of cultural heritage values of affected sites, and*
> - *undertake appropriate archaeological investigations generally in accordance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010), to establish the full spatial extent and significance of any archaeological evidence across each site/area of PAD, and include the results of these excavations. If an alternative excavation method is proposed, it shall be developed in consultation with Office of Environment and Heritage.*

This technical working paper presents the assessment on the potential impacts on Aboriginal cultural heritage as a result of the project. This assessment has been undertaken in accordance with the SEARs and the Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime, 2011), abbreviated as the ‘PACHCI’ process (refer to Figure 2).

The PACHCI process is a staged approach to assessment and consultation, compiled specifically for Aboriginal archaeological assessments on Roads and Maritime projects. Stages 1 and 2 of the PACHCI process align with the OEH Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, 2010). Stage 3 of the PACHCI represents the preparation of a detailed cultural heritage impact assessment and consultation with Aboriginal stakeholders as part of that assessment. Stage 3 aligns with the OEH guideline Aboriginal Cultural Heritage Consultation requirements for proponents (the 2010 consultation guideline) (DECCW, 2010).

Initial investigations and Stage 2 assessments were completed between September and November 2013 (AECOM, 2013) and January 2014 (AECOM, 2014) as part of the investigation of spoil management locations for the NorthConnex project. The past reports identified the potential environmental constraints related to Aboriginal heritage within areas of the Hornsby Quarry site. This Aboriginal cultural heritage report supplements past assessments, and identifies potential Aboriginal heritage constraints within the footprint of the project. The study area for this assessment is shown in Figure 3.

As discussed later in this report, the assessments undertaken in accordance with the PACHCI process concluded that the assessment did not need to advance to the preparation of a detailed cultural heritage impact assessment (a Stage 3 assessment).

1.5 Structure of this report

The report has the following structure:

- Chapter 1 introduces the project.
- Chapter 2 details the legislation and statutory controls relevant to the project.
- Chapter 3 details the methodology for the Stage 2 assessment.
- Chapter 4 provides a summary and analysis of background information.
- Chapter 5 details the archaeological context.
- Chapter 6 details the archaeological assessment.
- Chapter 7 details the assessment results.
- Chapter 8 provides a summary of constraints.
- Chapter 9 details the recommendations.
- Chapter 10 provides the references used to assist in the preparation of this report.

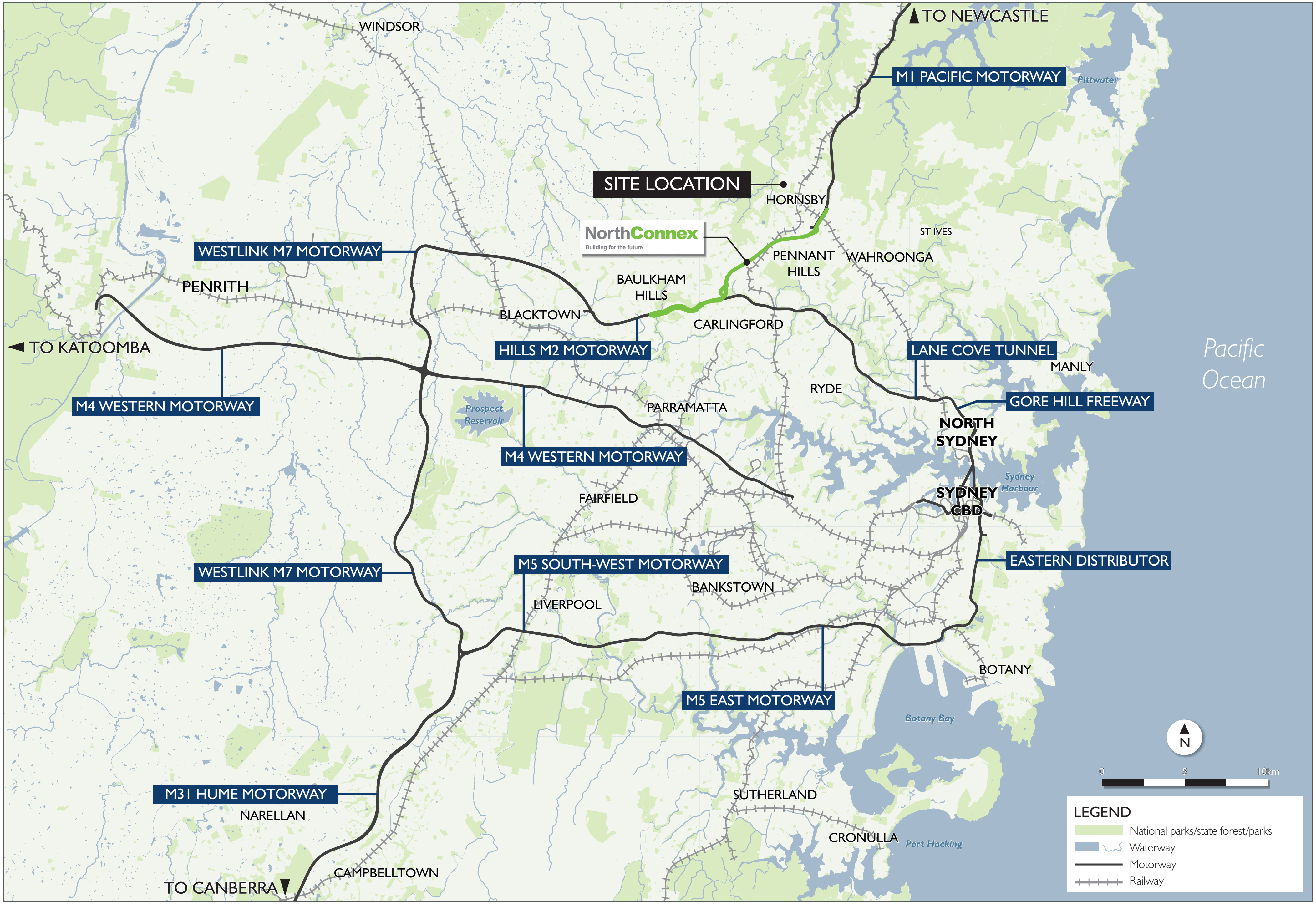

Figure 1 Regional context of the project

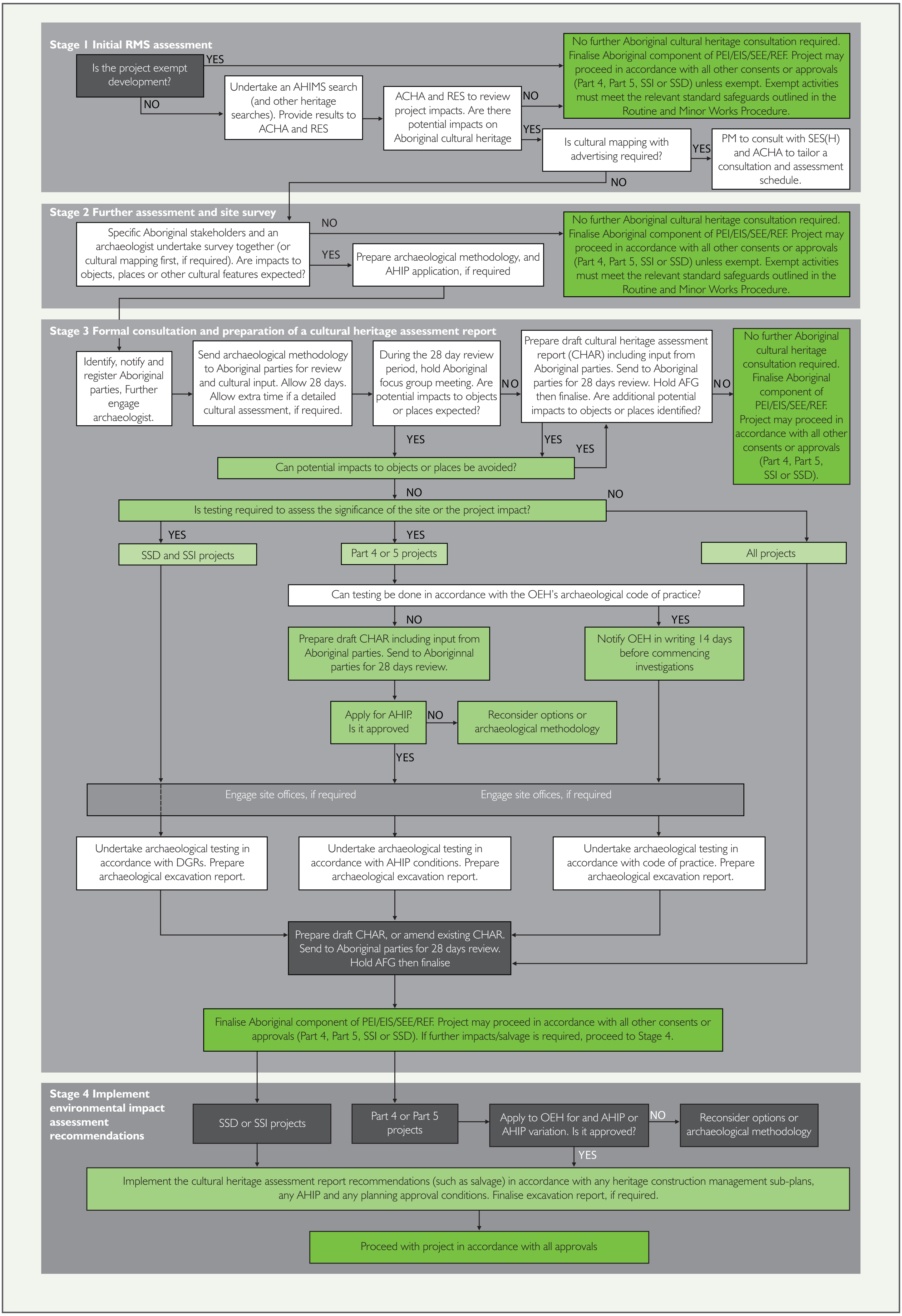

Figure 2 The PACHCI process (Roads and Maritime Services, 2011)

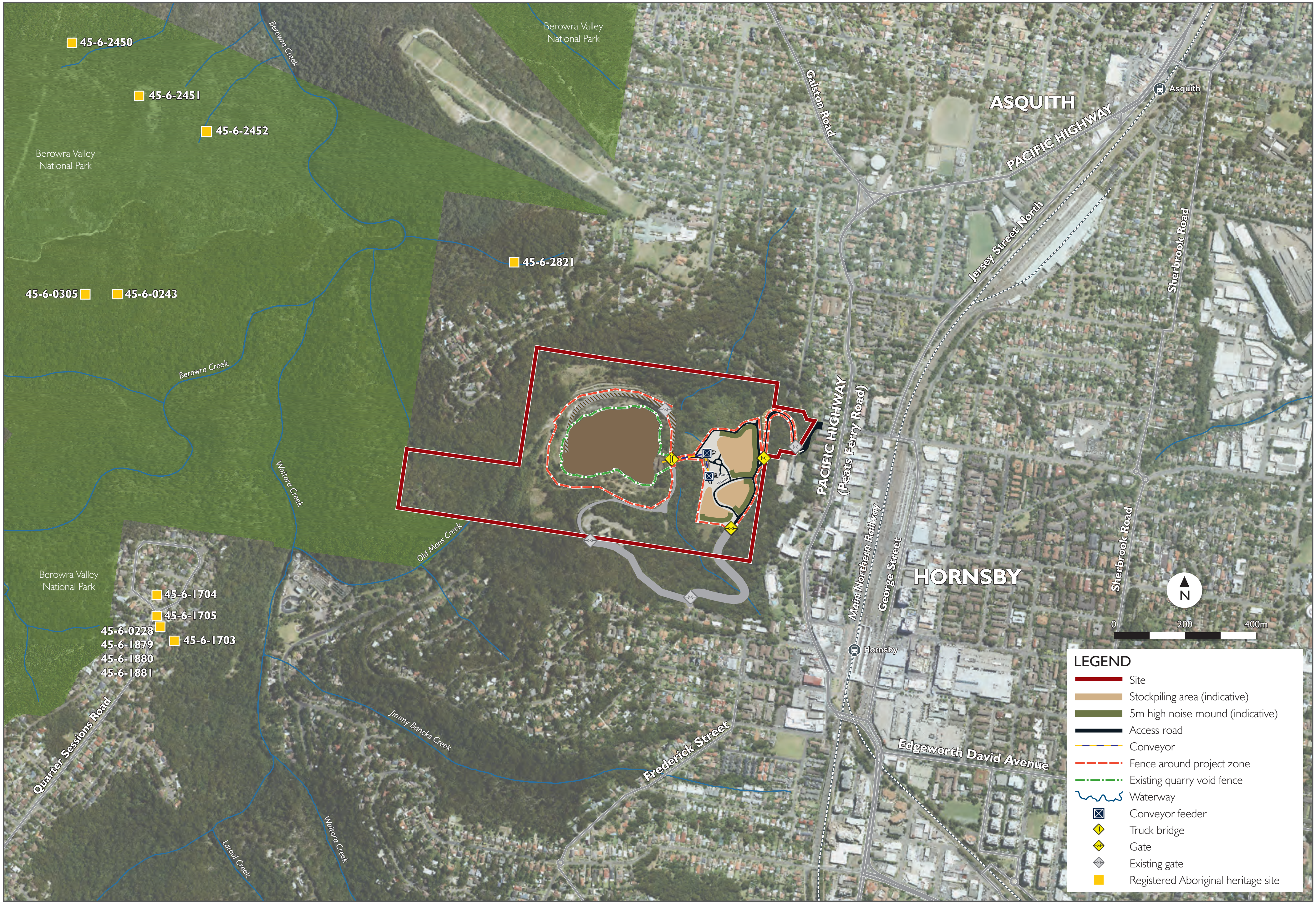

Figure 3 Proposed spoil management footprint and AHIMS sites

(blank page)

2 Legislative considerations

A number of planning and legislative documents govern how Aboriginal heritage is managed in NSW and Australia. The following section provides an overview of the requirements under each as they apply to the project.

2.1 Commonwealth legislation

2.1.1 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (ATSIHP Act) provides for the preservation and protection of places, areas and objects of particular significance to Indigenous Australians. The stated purpose of the ATSIHP Act is the 'preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters, being areas and objects that are of particular significance to Aboriginals in accordance with Aboriginal tradition' (section 4). Under the Act, 'Aboriginal tradition' is defined as 'the body of traditions, observances, customs and beliefs of Aboriginals generally or of a particular community or group of Aboriginals, and includes any such traditions, observances, customs or beliefs relating to particular persons, areas, objects or relationships' (Section 3). A 'significant Aboriginal area' is an area of land or water in Australia that is of 'particular significance to Aboriginals in accordance with Aboriginal tradition' (section 3). A 'significant Aboriginal object', on the other hand, refers to an object (including Aboriginal remains) of like significance.

For the purposes of the Act, an area or object is considered to be injured or desecrated if:

- In the case of an area:
  - It is used or treated in a manner inconsistent with Aboriginal tradition.
  - The use or significance of the area in accordance with Aboriginal tradition is adversely affected.
  - Passage through, or over, or entry upon, the area by any person occurs in a manner inconsistent with Aboriginal tradition.
- In the case of an object: It is used or treated in a manner inconsistent with Aboriginal tradition.

The ATSIHP Act can override state and territory laws in situations where a state or territory has approved an activity, but the Commonwealth Minister prevents the activity from occurring by making a declaration to protect an area or object. However, the Minister can only make a decision after receiving a legally valid application under the ATSIHP Act and, in the case of long term protection, after considering a report on the matter. Before making a declaration to protect an area or object in a state or territory, the Commonwealth Minister must consult the appropriate Minister of that state or territory (section 13).

2.1.2 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999*, proposed 'actions' that have the potential to significantly impact on matters of national environmental significance, the environment of Commonwealth land or that are being carried out by a Commonwealth agency must be referred to the Australian Government. If the Commonwealth Minister for the Environment determines that a referred project is a 'controlled action', the approval of that minister would be required for the project in addition to any planning approvals required by State legislation.

An action is defined as a project, development, undertaking, activity, series of activities, or alteration.

The EPBC Act defines 'environment' as both natural and cultural environments and therefore includes Aboriginal and historic heritage items. Under the EPBC Act, protected heritage items are listed on the National Heritage List (items of significance to the nation) or the Commonwealth Heritage List (items belonging to the Commonwealth or its agencies).

These two lists replaced the Register of the National Estate (RNE). The RNE has been suspended and is no longer a statutory list.

2.2 State legislation

2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) provide the framework for environmental planning in NSW and include provisions to ensure that proposals that have the potential to impact upon the environment are subject to detailed assessment and provide opportunity for public involvement. In NSW, environmental impacts are interpreted as including impacts to cultural heritage.

Roads and Maritime is seeking approval for this project under Part 5.1 of the EP&A Act. The project has been declared as State significant infrastructure.

2.2.2 Secretary's Environmental Assessment Requirements

As discussed in Section 1.4, the SEARs for the project were issued on 2 July 2015. The SEARs requirements regarding Aboriginal cultural heritage for the EIS for the Hornsby Quarry Road Construction Spoil Management Project are listed in the table below, along with the actions taken to meet them.

Table 3 SEARs relating to Aboriginal cultural heritage

SEARs requirement	Assessment action
Impacts to Aboriginal heritage (including cultural and archaeological significance), in particular impacts to Aboriginal objects and potential archaeological deposits (PAD), should be assessed. Where impacts are identified, the assessment shall:	An Aboriginal heritage assessment for the Hornsby Quarry Road Construction Spoil Management Project was undertaken by AECOM. This report details the results of that assessment, which assessed potential impacts to Aboriginal heritage and areas of PAD.
outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the measures) generally consistent with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005) and other relevant guidelines and requirements,	The *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005)* and other relevant guidelines were used to inform this assessment. As no impacts on Aboriginal heritage were identified during this assessment, no mitigation measures were required. Appropriate management measures are outlined in Section 7 of this report.
be undertaken by a suitably qualified heritage consultant(s),	This assessment was undertaken by Dr Darran Jordan, a suitably qualified archaeologist and heritage specialist at AECOM.
demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures),	Consultation was undertaken for this assessment in order to obtain information on the potential cultural impacts of the project. The inspection methodology was aligned with the PACHCI process and corresponded to the due diligence process of the Code of Practice. A representative from the Metropolitan Local Aboriginal Land Council (MLALC) was engaged by Roads and Maritime to take part in the targeted inspections and to provide input into the assessment on the potential Aboriginal cultural heritage impacts of the project. Guringai Tribal Link Aboriginal Corporation (GTLAC) were also consulted. Both MLALC and GTLAC were

SEARs requirement	Assessment action
	provided with copies of the draft report with the final proposed measures and invited to provide input prior to the finalisation of this report (see Section 3.1).
assess and document the archaeological and cultural significance of cultural heritage values of affected sites, and	Archaeological and cultural significance relating to the Hornsby Quarry Road Construction Spoil Management Facility project were assessed and documented in this report. No previously recorded or new sites were identified during this assessment with risk to be affected by this project.
undertake appropriate archaeological investigations generally in accordance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010), to establish the full spatial extent and significance of any archaeological evidence across each site/area of PAD, and include the results of these excavations. If an alternative excavation method is proposed, it shall be developed in consultation with Office of Environment and Heritage.	This assessment adhered to the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010).* As no known sites or areas of PAD were identified as having risk to be affected by the proposed works, no excavation was required to establish spatial extents for sites/PADs in the project area.

2.2.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act), administered by the Office of Environment and Heritage (OEH), is the primary legislation for the protection of Aboriginal cultural heritage in NSW. The NPW Act gives the Director-General of OEH responsibility for the proper care, preservation and protection of 'Aboriginal objects' and 'Aboriginal places', defined under the Act as follows:

Article I. An *Aboriginal object* is any deposit, object or material evidence (that is not a handicraft made for sale) relating to Aboriginal habitation in NSW, before or during the occupation of that area by persons of non-Aboriginal extraction (and includes Aboriginal remains).

Article II. An *Aboriginal place* is a place declared so by the Minister administering the NPW Act because the place is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects.

Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence to harm them. Under Part 5 of the EP&A Act, an Aboriginal Heritage Impact Permit (AHIP) should be obtained if impacts to Aboriginal objects and/or places are anticipated. AHIPs are issued under section 90 of the NPW Act.

Consultation with Aboriginal communities is required under OEH policy when an application for an AHIP is considered and is an integral part of the process. AHIPs may be issued in relation to a specified Aboriginal object, Aboriginal place, land, activity or person or specified types or classes of Aboriginal objects, Aboriginal places, land, activities or persons. An AHIP is not required if the development is approved under Part 5.1 of the EP&A Act. As this project is to be approved under Part 5.1 of the EP&A Act no AHIP application will be required as part of this development.

Section 89A of the NPW Act requires notification of the location of identified Aboriginal objects within a reasonable time, with penalties for non-notification, including daily penalties. Section 89A is binding in all instances. It should be noted that the NPW Act includes a strict liability offence whereby a person may be prosecuted for harming an Aboriginal object even when the person was not aware that the object was an Aboriginal object and when the Aboriginal object may have been harmed unknowingly.

2.2.4 Hornsby Local Environmental Plan 2013

Local Environmental Plans (LEPs) are prepared by Councils to assist in guiding planning decisions in their Local Government Areas. LEPs also establish the requirements for the use and development of land through zoning and development controls. The *Hornsby Local Environment Plan 2013* (Hornsby LEP) applies to the project.

Under the Hornsby LEP, heritage items and relics are protected and consent is required to be granted when:

- Demolishing or moving a heritage item, Aboriginal object, building, work, relic or tree within a heritage conservation area
- Altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in the applicable Schedule of the LEP
- Disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed
- Disturbing or excavating an Aboriginal place of heritage significance
- Erecting a building on, or subdividing, land on which a heritage item is located or that is within a heritage conservation area.

As noted, the project is permissible without consent, therefore development consent from Council is not required under Part 4 of the EP&A Act. Notwithstanding, the Minister for Planning will consider the potential heritage impacts of the project when determining the application for the Hornsby Quarry Road Construction Spoil Management Project.

3 Methodology

The methodology for this assessment was developed as per the requirements of the PACHCI guideline. The analysis of Aboriginal heritage constraints for this project included:

- A desktop review of the proposed conveyor belt area to identify previously recorded sites of Aboriginal heritage significance and any areas with the potential for archaeological sensitivity.
- Stage 2 consultations under the PACHCI process with MLALC, as facilitated by Roads and Maritime Aboriginal Cultural Heritage Officer Mark Lester.
- Development of predictive mapping, collating information gathered through the desktop review and the consultation feedback. This was then used to focus the site inspection to areas of potential archaeological and cultural sensitivity.
- Field inspection by AECOM archaeologist Dr Darran Jordan and MLALC representative Lee Davison on 15 December 2014.
- The site inspection involved a pedestrian inspection of the study area, following a series of transects across the study area. Linear transects were placed at intervals of 50 metres across the entirety of the study area and were followed using a hand-held GPS device.
- No previously recorded items of Aboriginal cultural heritage were identified within the study area during the desktop review. The aim of the pedestrian inspection was to identify any surface expressions of Aboriginal archaeological and cultural heritage values within the study area. Notes and photographic records were taken throughout the site inspection detailing landform, ground surface visibility and areas of exposure.
- Identification and mapping of areas identified as having Aboriginal archaeological potential.
- Development of a draft archaeological testing methodology, included in this report, should a Stage 3 PACHCI assessment be required.

As discussed in Section 1.4 of this report, it was concluded that there would be no impacts as a result of the project on Aboriginal archaeological sites, areas of archaeological sensitivity or areas that have cultural value. As such, the assessment did not advance to further field investigations or consultation with the Aboriginal community.

3.1 Aboriginal community consultation

All Aboriginal community consultation was facilitated by Roads and Maritime through their Aboriginal Cultural Heritage Officer. Initial consultation was undertaken in late 2013 and early 2014 by RMS officer Clive Freeman. During the initial inspections undertaken as part of the wider Northconnex project, Metropolitan Local Aboriginal Land Council (MLALC) representative Allen Madden and Guringai Tribal Link Aboriginal Corporation (GTLAC) representative Tracey Howie participated and provided cultural feedback to AECOM archaeologist Dr Darran Jordan. GTLAC provided an inspection report assessing the cultural heritage values of the wider study area. This report is included in Appendix A.

During the follow up inspection in December 2014 all consultation was facilitated by Roads and Maritime Aboriginal Cultural Heritage Officer Mark Lester. MLALC representative Lee Davison was consulted during his participation in this assessment, following on from participation by MLALC representative Allen Madden in the previous Stage 2 assessments undertaken by AECOM (AECOM 2013 and AECOM 2014). MLALC provided an inspection report assessing the cultural heritage values specific to the Hornsby Quarry study area. This report is included in Appendix B. Roads and Maritime Aboriginal Cultural Heritage Officer Mark Lester provided a draft copy of this report on 5 May 2015 to both MLALC representative Lee Davison and GTLAC representative Tracey Howie, inviting further comment from both groups prior to finalisation of the document. A 28 day period was provided to both groups to supply any further comments, should they have any. GTLAC did not supply any further comment. MLALC provided the following statement on 27 May 2015: “I have read the report for the Hornsby Quarry: Road Construction Spoil Management Facility and have no objections”.

(blank page)

4 Summary and analysis of background information

Environmental factors such as topography, hydrology, geology, soils, flora and fauna would have been key influences on past Aboriginal occupation and land use, as well as archaeological site patterning and distribution, site survival over time, and the likelihood of detecting any extant archaeological sites. Any attempt to predict or interpret the character and distribution of Aboriginal sites in a given landscape must consider these environmental factors, along with historic and current land use practices, to enable predictions to be made concerning the likely presence or absence of sites in a given area and, where appropriate, their archaeological integrity.

4.1 Landform and topography

The landform of the study area includes multiple landform types, such as slopes, crests, rock outcrops, channels and banks. The general Hornsby landscape consists of gently undulating rises and steep low hills with balsaltic breccia present in a weathered condition. Slopes within the wider Hornsby area vary greatly in degree, with a range starting at three degrees and extending to 65 degrees (Chapman & Murphy, 1989:34). The natural landforms in the study area have been highly disturbed by development, with natural formations heavily modified. The park area has been cleared and vehicle tracks established. Sections have been developed into bike tracks, with vegetation clearance and landscape modification occurring as a result. The excavation of Hornsby Quarry during its period of use transformed the natural landscape features that were previously at this location. The quarry excavation now dominates the landscape in this area. Changes to the area mean that sites that may once have been here could have been disturbed or destroyed.

4.2 Hydrology

The study area is located within the Hawkesbury-Nepean catchment, which has been modified due to development across the wider region, with waterways in multiple areas currently enclosed by stone banks and concrete along their extent, rather than the natural creek banks. Water flow is generally higher in the Hawkesbury Sandstone areas, while the Wianamatta Shale country creeks have very little water flow during dry weather periods (Upper Parramatta River Catchment Trust, 2002).

The study area has natural water sources which would have provided both drinking water and resource foods for Aboriginal peoples. The primary watercourses of the study area are Old Man’s Creek and an unnamed creek channel on the eastern side of Hornsby Quarry (possibly connected to Old Man’s Creek prior to the excavation of Hornsby Quarry). In addition, a number of other ephemeral drainage lines also occur in the study area. Old Man’s Creek is a tributary of Berowra Creek. The area would have been moderately well-resourced in terms of water during the Aboriginal past.

4.3 Soils

The study area is underlain by the Residual Hornsby (REho) and Colluvial Hawkesbury (COha) soil landscapes. The Hornsby soil landscape contains yellow podzolic soils on midslopes, upper slopes and volcanic breccia, with red podzolic soils and yellow-brown earths on sandstone colluvium. The Hawkesbury landscape is characterised by lithosols and silecious sands on rock outcrops, yellow podzolic soils and yellow earths on fractures, benches and joints, yellow and red podzolic soils on shale lenses and siliceous sands with yellow earths along drainage lines. Both the Hornsby and Hawkesbury soil landscapes are subject to rock fall and highly permeable soils, with extreme soil erosion hazard and localised mass movement (Chapman & Murphy, 1989:34-35). The erodibility of the soil landscape means that sites that may once have been here could have been moved out of their primary context into deposits of secondary deposition.

4.4 Flora and fauna

The area has been predominantly cleared with past quarry activity and park development all having significantly altered the previous flora and fauna of the area. Plant species present at the site include long leaf wattle (*Acacia longissima*), black wattle (*Acacia mearnsii*), spike acacia (*Acacia oxycedrus*), burrawang (*Macrozamia communis*), common maidenhair (*Adiantum aethiopicum*) and common ground fern (*Calochlaena dubia*) (Australian Government, 2015).

Prior to the extensive vegetation clearance that altered the character of the area it is likely that the area would have supported tall wet sclerophyll forest. Vegetation species that are likely to have been present at that time include Sydney blue gum (*Eucalyptus saligna*), white mahogany (*E. acmenoides*), blackbutt (*E. pilularis*), forest oak (*Allocasuarina torulosa*), sassafras (*Doryphora sassafras*) and coachwood (*Ceratopetalum apetalum*). The understorey is likely to have included such species as bracken fern (*Pteridium esculentum*) and tree ferns like *Dicksonia antarctica* and *Cyathea australis* (Chapman & Murphy, 1989:35). Included in the table below are examples of plant resources and how they are likely to have been used prior to vegetation clearance and land modification (Table 4).

Table 4 Likely plant resources prior to vegetation clearance

Vegetation type	Aboriginal plant use
Basket-grass (*Oplismenus aemulus*)	Grasses could be used in weaving for nets and bags (Australian Government, 2007).
Black wattle (*Acacia mearnsii*)	Acacia leaves were ground to make flour, the gum was edible and the wood was utilised in tool manufacture (Stewart & Percival, 1997:8).
Bracken fern (*Pteridium esculentum*)	The tuber could be eaten as a food staple (Isaacs, 2002:44).
Burrawang (*Macrozamia communis*)	Following leaching and cooking the seeds or nuts could be eaten (Isaacs, 2002:83).
Kangaroo grass (*Themeda australis*)	The seeds could be baked into cakes and the fibre used to produce fishing net (Australian National Botanic Gardens (ANBG), 2007).
Long leaf wattle (*Acacia longissima*)	The gum from wattle species was mixed with honey and water to make a drink or to produce a jelly-like substance for eating (Isaacs, 2002:138).
Spike acacia (*Acacia oxycedrus*)	Acacia leaves were ground to make flour, the gum was edible and the wood was utilised in tool manufacture (Stewart & Percival, 1997:8).
Sydney blue gum (*Eucalyptus saligna*)	Oil bearing leaves could be used medicinally for headaches, colds and fevers. Gum could be applied to sores and abrasions. Bark was used as a product for various manufacture purposes (Stewart & Percival, 1997:8).

According to the Atlas of Australia, a five kilometre search area centred on Hornsby currently supports 1315 animals, including 271 birds, 50 mammals and 44 reptiles. Many of these are introduced species, such as dog, cat, goat, rabbit and fox, but others that may have been utilised as resource animals during the Aboriginal past include the sugar glider (*Petaurus breviceps breviceps*), grey-headed flying-fox (*Pteropus poliocephalus*), eastern grey kangaroo (Macropus giganteus) and red-necked Wallaby (Macropus rufogriseus) (Australian Government, 2015). Although it is not possible to reconstruct the Aboriginal past based on this information, it does indicate that flora and fauna resources would have been available in the Hornsby area.

4.5 Ethnographic context

The Hornsby Quarry site is located within the traditional country area of the Guringai Aboriginal people. The Guringai are also referred to as Kuringgai, Kurikgai and Kuring-gai. The name Kurikgai was coined by linguist and ethnographer Reverend Dr John Fraser in his introduction to Reverend Lancelot Edward Threlkeld’s posthumously published study of language, tradition and custom.

Therein Fraser stated: “*we have now come to know that this dialect was essentially the same as that spoken by the sub-tribes occupying the land where Sydney now stands, and that they all formed parts of one great tribe, the Kurikgai*” (Threlkeld, 1892:ii). In detailing the distinction further within the book Threlkeld wrote using the name Kuringgai, stating: “*The next great tribe is the Kuringgai on the sea coast. Their ‘taurai’ (hunting ground or territory) is known to extend north to the Macleay River, and I found that southwards it reached the Hawkesbury. Then, by examining the remains of the language of the natives about Sydney and southwards, and by other tests, I assured myself that the country thereabout was occupied by sub-tribes of the Kurringgai*” (Threlkeld, 1892:ix).

The traditional territory of the Guringai stretched from Sydney to Newcastle and inland to the Great Dividing Range (Attenbrow, 2002:33). The area contained such clan groups as the Awaba, Borregegal, Cadigal, Cammeragal/Camaraigal, Garigal, Gayimai and Walkeloa (Gibberagong Environmental Education Centre, 1983:9; J Kohen, 1993). This area was closely bordered by the Darug/Dharug area to the east, the Awabakal and Darkinung areas to the north and north-east and the Turuwal to the south (Horton, 1996). There has been debate regarding the location of the boundary between the Guringai area and the Darug area, with it being defined in the vicinity of Parramatta based on linguistic evidence (Ross, 1988). This is challenged by a counter-argument that the Darug territory extended to the coastline between Port Jackson and Botany Bay, based on the ethnographic observations of explorers and settlers (Kohen & Lampert, 1987; Kohen, 1985, 1988). Although language and dialect differed between varying groups, there was enough similarity and commonality through shared words that communication could and did occur (Attenbrow, 2002:33).

The Guringai area was rich in natural resources, containing both coastal and inland areas. Both riverine and coastal areas were utilised for fish and shellfish (oysters, mussels and cockles), as evidenced by the presence of shell middens and fish traps (Ku-ring-gai Council, 2013). Yams, bulbs and seeds were utilised for food, along with the burrawang (macrozamia) nut, fern roots, lillypillies and berries. As well as bush foods, many plants were utilised for their medicinal qualities. Faunal species including possums and birds were hunted, with marine animals such as turtles, dugongs and seals also likely to have been a part of the diet (Gibberagong Environmental Education Centre, 1983:12).

The Guringai utilised hunting tools such as boomerangs, spears and clubs. Fishing spears were made from plant stems with prongs added, made from grass tree flower stems, fish bones or shells and affixed by bees wax and gum (Gibberagong Environmental Education Centre, 1983:14). Fibrous grasses and oyster shell were also utilised to make hooks and fishing lines (Gibberagong Environmental Education Centre, 1983:15). A record of the Guringai living space is also present throughout the traditional country in the form of rock art and engravings. Known motifs include fish, dugong, human figures.

The arrival of European settlers radically transformed the life of the Guringai, as access to land and traditional food resources were blocked by growing settlements and pastoral developments (Gibberagong Environmental Education Centre, 1983:17). In the late 1780s a smallpox epidemic swept through the Guringai people, (Tench, 1793) causing a decline in population numbers in the area.

4.6 Archaeological Context

4.6.1 NSW Aboriginal Heritage Information Management System (AHIMS)

The Aboriginal Heritage Information Management System (AHIMS) database, administered by the Office of Environment and Heritage (OEH), contains records of all Aboriginal objects reported to the Director General of the Department of Premier and Cabinet in accordance with section 89A of the *National Parks and Wildlife Act 1974* (NPW Act). It also contains information about Aboriginal places which have been declared by the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are referred to by AHIMS as ‘Aboriginal sites’ (NSW Office of Environment & Heritage, 2013).

A search was undertaken of the AHIMS database on 17 July 2013 (AHIMS search #106367) for an approximate nine kilometre by eight kilometre area enclosing and surrounding Hornsby Quarry. This search identified 69 registered Aboriginal archaeological sites; however in the search results one of these entries was listed as ‘not a site’, leaving a total of 68 sites within the search area. The status of AHIMS sites includes the designations ‘valid’, ‘destroyed’, ‘partially destroyed’ and ‘not a site’.

The designation ‘not a site’ is applied to locations that were initially recorded as Aboriginal sites, but have since been determined through further research not to contain any cultural content. One example would be an area registered as being a Potential Archaeological Deposit (PAD) that has since been test excavated and found not to contain any cultural material. Such a registration would then be designated ‘not a site’ in the AHIMS register.

The search results were refreshed on 3 March 2015. While there were 69 sites registered within this area when the original search was undertaken on 17 July 2013, the refreshed results had a total of 71 registered sites. Taking into consideration one not being a site, with the two additional sites within this search area, there were a total of 70 registered sites in the search area

These search results are summarised in Table 5. The full report is included in Appendix C.

Table 5 AHIMS Search Results

Site Type	Number of Sites	Percentage of Sites
Engraving/Grinding grooves	1	1.43%
Artefact Scatter	3	4.29%
Potential Archaeological Deposit (PAD)	3	4.29%
Isolated Artefact	3	4.29%
Engraving	12	17.14%
Grinding Grooves	12	17.14%
Rockshelter	18	25.71%
Art Site	18	25.71%
TOTAL	**70**	**100%**

It should be noted that past experience with the AHIMS database has identified multiple errors and omissions. Site coordinates are often incorrect in AHIMS search results due to datum changes and estimates based on legacy grid coordinates.

4.6.2 Native Title

A search of the National Native Title Tribunal (NNTT) register was carried out for native title determinations. The search returned one determination reference for the Hornsby area (NNTT Number: NND2002/001) under the MLALC, with a determination dated 12/4/2002 stating: “Native title does not exist”.

A claim was filed by the Awabakal and Guringai People on 13 May 2013 for a large area covering from Maitland and Kurri Kurri in the north to Hornsby at its southern extent (and including the Hornsby Quarry area). This claim has not yet been determined according to the NNTT register. This claim (Tribunal file no. NC2013/002) is a claimant application, not a registration of determined native title.

In summary, there are no currently determined native title listings in the NNTT registers for the Hornsby Quarry site.

4.6.3 Previous archaeological surveys and excavations

Past archaeological assessments involving survey, test excavation and salvage have been conducted in the region of the study area, relating to past residential development, subdivision and road construction. Those past surveys and assessments that are most relevant to the study area are summarised in Table 6.

Table 6 Previous Archaeological Investigations in the vicinity of the study area

Author	Year	Key Findings	Location in relation to study area
Lough	1981	An archaeological survey was undertaken for Freeway No. 3, along a proposed alignment between Hornsby and Berowra.	Approximately 2.1 km to the east
Permual Murphy Wu	1993	A heritage study was undertaken of Hornsby Shire in order to provide Hornsby Shire Council with an understanding of the assets they were required to manage.	Study area within bounds of larger study
Koettig	1996	Koettig undertook an assessment of Aboriginal Heritage across the wider Hornsby Shire area. The purpose of this study was to identify locations for ongoing management.	Study area within bounds of larger study
Appleton	2001	An archaeological investigation was undertaken for a proposed subdivision at Lot 14, DP 815922 at Arrianga Place in Hornsby. An Aboriginal site consisting of four grinding grooves was identified in an unnamed creek line. It was assessed as having low scientific and low research significance. Due to its cultural value it was recommended that the site be avoided during works and protected from impacts.	410 m to the north
Russell & Stuart	2002	An Indigenous heritage study was undertaken for a proposed upgrade to the Central Coast Rail Line. The proposed rail upgrade was to occur between Hornsby and the Hawkesbury River.	Approximately 1.1 km to the east at its closest point
Parsons Brinckerhoff Australia Pty Ltd	2004	The Hornsby Quarry area and its surrounding environment was assessed as part of a land capability study. These technical investigations were not heritage based, but rather were actioned to produce a master plan for Hornsby Council's future use of the quarry area.	In study area
HLA-Envirosciences Pty Ltd	2005	A heritage assessment was undertaken for the Hornsby Rifle Range. No Aboriginal sites were registered for this area following this assessment.	Approximately 1 km to the north-west

4.7 Aboriginal site prediction model

This section provides a summary description of site types that possibly exist within the study area and provides a predictive statement on the likelihood of finding such sites.

4.7.1 Rockshelters

Rockshelters are natural features such as rock overhangs that have been utilised for Aboriginal habitation. Rockshelters can contain surface artefacts and deposits associated with occupation periods. They can also have associated artwork, such as on a panel of the rockshelter wall. Based on the number of corresponding site type located in the surrounding region, it is assessed as possible that rockshelters could occur in the study area.

4.7.2 Art Sites/Engravings

Art sites are locations where artwork has been produced by past Aboriginal people, including designs engraved into sandstone outcrops and motifs painted in ochre or pecked onto rock walls beneath overhangs or within rockshelters. Art surfaces can also be abraded and pitted. Based on the number of corresponding site type located in the surrounding region, it is assessed as possible that art sites and/or engravings could occur in the study area.

4.7.3 Grinding grooves

Grinding grooves are produced in rock surfaces, the result of sharpening and forming tools by repeated grinding against a suitable surface. Stone tools manufactured for ground edge axes and spears can result in groove impressions left in sandstone outcrops, often in association with a water resource area. Grooves may also develop as rounded depressions from the grinding of seeds and grains. It is possible that grinding grooves could occur in the study area, most likely in association with a water source.

4.7.4 Isolated artefacts

Isolated artefacts refer to a single artefact. These artefacts may have been dropped or discarded by its owner once it was of no use. This site type can also be indicative of further sub-surface archaeological deposits. These site types can be found anywhere within the landscape, however, they are more likely to occur within contexts with the same favourable characteristics for stone artefact scatter sites. It is expected that there is potential for the identification of isolated artefacts in the study area.

4.7.5 Stone artefact scatters

Stone artefact scatters consist of more than one stone artefact. Activities associated with this site type include stone tool production, hunting and gathering or domestic sites associated with campsites. Stone artefacts may be flakes of stone, cores (flakes are removed from the stone cores) or tools. Some scatters may also contain other material such as charcoal, bone, shell and ochre. It is assessed as possible that artefact scatters may be identified within the study area.

4.7.6 Modified trees

Wood and bark of trees have been used in the past by Aboriginal peoples for a variety of purposes, such as carrying implements, shield or canoes. The removal of this raw material from a tree produces a ‘scar’. The identification of a scar associated with Aboriginal custom as opposed to natural scarring can be difficult. The scar should be of a certain size and shape to be identifiable with its product; the tree should also be mature in age, from a time that Aboriginal people were still active in the area. Aboriginal people also modified trees through carving or binding branches together to form ring growths, used as markers in the landscape.

The study area has been cleared of a significant portion of its original native vegetation. It is predicted as unlikely that a culturally modified tree will be identified in areas of vegetation clearance, but likely that they may be located in areas where mature vegetation remains extant.

5 Results

5.1 Site Inspection

During the site inspection, one sandstone overhang with PAD was identified. No Aboriginal art, engraving, grooves or artefacts were observed at the overhang. However, an intact deposit was noted as present within the overhang area. The size of the area of PAD is equal to the dimensions of the overhang. Details of the overhang, including coordinates taken during this inspection, are summarised in Table 7.

Aboriginal consultation identified the overhang as having potential cultural sensitivity within the study area, describing it as “the only feature of Aboriginal cultural heritage identified during this assessment”, noting that it was “sufficient temporary coverage for only 3-4 people and would it be unlikely that it was used for permanent shelter”. The full cultural report pertaining to this inspection is included in Appendix B.

The closest AHIMS sites to the project were grinding groove site #45-6-2821 (approximately 410 m to the north) and engraving site #45-6-1703 (approximately 695 m to the west). Site #45-6-1703 was located in the Blackfellows Head area, a location purportedly named “after the discovery of an ancient Aboriginal skull” (Hornsby Shire Council, 2010:20).

Table 7 Overhang in proximity to proposed works

Length	Depth	Heights	Notes	Easting (GDA94)	Northing (GDA94)
4.6 m	2.7 m	1.55 m	No artefacts, art, grooves or engraving present. Overhang has the potential to have been used as shelter by past Aboriginal people. The deposit within the overhang is intact. This overhang was located immediately adjacent to a bike track.	323310	6269375

Plates 1 and 2 show the overhang that was identified during the site inspection.

Plate 1 Identified overhang – no Aboriginal artefacts

Plate 2 Identified overhang – no Aboriginal artefacts

5.1.1 Inspection transects

A total of 26 transects were walked across the study area, 16 of which were approximately 280 metres in length and eight were approximately 900 metres in length (refer to Figure 4). Details of individual transects are provided in Table 8 along with ratings based on the archaeology scientific ratings included in Appendix D. Transect locations are shown on Figure 4. All other AHIMS sites in the figure are based on coordinates provided by AHIMS.

Ground Surface Visibility (GSV) during the inspection averaged 35 per cent overall due to vegetation and leaf litter. Vegetation throughout the area was a mix of mature vegetation and regrowth. Regrowth was predominant in the quarry and park areas, denoting vegetation clearance as a past impact. Impacts within the area included Hornsby Quarry, vehicle, bike and walking tracks, park areas and erosion (refer Plate 3 to Plate 8).


Plate 3 Transect 2


Plate 4 Transect 12


Plate 5 Transect 16


Plate 6 Transect 21


Plate 7 Transect 21


Plate 8 Transect 21

	
Plate 9 Transect 24	Plate 10 Transect 25

Figure 4 Transects and overhang location

Table 8 Visual Inspection Results

Transect	Landform elements	Natural creek or drainage line observed	Average Ground Surface Visibility (GSV)	Average Ground Integrity (GI)	Key disturbance factors	Surface artefacts observed?	Archaeological sensitivity of area of proposed disturbance	Impact risk for area of proposed disturbance
1	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
2	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
3	Crest, upper slope, midslope, lower slope, drainage line	Yes	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
4	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
5	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
6	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
7	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
8	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
9	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
10	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
11	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
12	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low

Transect	Landform elements	Natural creek or drainage line observed	Average Ground Surface Visibility (GSV)	Average Ground Integrity (GI)	Key disturbance factors	Surface artefacts observed?	Archaeological sensitivity of area of proposed disturbance	Impact risk for area of proposed disturbance
13	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
14	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
15	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
16	Crest, upper slope, midslope, lower slope, creek channel, creek banks	Yes	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
17	Crest, upper slope, midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
18	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
19	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
20	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
21	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
22	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
23	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
24	Midslope, lower slope, drainage line	Yes	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low

Transect	Landform elements	Natural creek or drainage line observed	Average Ground Surface Visibility (GSV)	Average Ground Integrity (GI)	Key disturbance factors	Surface artefacts observed?	Archaeological sensitivity of area of proposed disturbance	Impact risk for area of proposed disturbance
25	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low
26	Midslope, lower slope	No	Moderate	Low	Hornsby Quarry and associated works, tracks, vegetation clearance, park development, erosion	No	Low	Low

(blank page)

6 Summary of constraints

One sandstone overhang with PAD was located approximately 120 metres to the south of the project. The location of the sandstone overhang is shown on Figure 4.

The identified sandstone overhang falls outside the currently proposed area of impact for the project and will not be impacted by the handling, management and beneficial reuse of spoil at the quarry site. The other transect areas inspected during this assessment have been assessed as disturbed with a low likelihood for containing Aboriginal archaeological sites. No specific cultural values were identified apart from those at the identified overhang.

(blank page)

7 Recommendations

7.1 Key Findings

The analysis of Aboriginal cultural heritage for the project identified the following:

- The closest AHIMS registered Aboriginal sites to the proposed works are grinding grooves #45-6-2821 (approximately 410 m to the north) and engraving #45-6-1703 (approximately 695 m to the west).
- No sites or areas of archaeological or cultural sensitivity were identified during this assessment or the previous AECOM assessments in this area. However, one sandstone overhang with PAD was identified approximately 120 m south of the project. The size of the area of PAD is equal to the dimensions of the overhang (4.6 m by 2.7 m by 1.55 m).
- The nature of the project and associated works and their location mean they are unlikely to cause vibrational impacts on the identified sandstone overhang with PAD, which is 120 m from the works at its closest point.
- Physical disturbances associated with the proposed works will not directly impact on the identified overhang with PAD.

7.2 Management recommendations

Based on the results of the inspections of the study area it is recommended that:

- Impacts to the sandstone overhang with PAD identified on Transect 23 be avoided. If the SSI footprint is within 200 m of this feature an appropriate curtilage around the item should be delineated, for example by temporary fencing with star pickets and hi-viz mesh. The feature should be clearly delineated and identified as an environmentally sensitive area. Any fencing around the item's curtilage is to be supervised by an archaeologist prior to works commencing in order to protect it from harm. The RMS Aboriginal cultural heritage advisor is to be consulted by the archaeologist to determine whether it is appropriate for any Aboriginal stakeholder/s and/or Environmental Officer/s to be present during delineation works.
- If the impacts to previously identified AHIMS sites and the sandstone overhang with PAD can be avoided, then a Stage 3 assessment is not required.
- If the current design changes and impacts to previously identified AHIMS sites and/or the sandstone overhang with PAD cannot be avoided, then it is recommended that the assessment process progress to Stage 3 for formal consultation, as per the flowchart for the Roads and Maritime PACHCI (RMS, 2011:19), and additional approvals obtained (as required) where additional impacts are identified
- In the event that additional areas outside the study area assessed in this report are identified as having potential for Aboriginal heritage and the potential for disturbance as a result of the project, then the need for a supplementary Stage 2 assessment will need to be reviewed. If required, additional approvals would be obtained, where additional impacts are identified

7.3 Stage 2 recommendations

If any unanticipated impacts to Aboriginal objects or places are identified during the implementation of the project, including unexpected finds and/or skeletal material, then the works must cease until further advice and/or approvals have been obtained (RMS, 2011:45). In the instance of unexpected finds and/or skeletal material being identified during works the procedure outlined in the latest version of the RMS document *Standard Management Procedure: Unexpected Heritage Items* is to be followed (Roads and Maritime Services, 2015).

7.4 Stage 3 recommendations

7.4.1 Proposed testing methodology

Should the identified sandstone overhang with PAD be subject to disturbance as part of the project, this site should be investigated further prior to works commencing.

7.4.2 Aboriginal heritage requirements

It is recommended that, should the identified sandstone overhang with PAD be subject to disturbance as part of the proposed project works, a Stage 3 investigation in accordance with the PACHCI should be undertaken for this site (RMS, 2011:31-41) and additional approvals obtained (as required) where additional impacts are identified. The following steps are would need to be undertaken for this process:

- Seek the names of Aboriginal people with cultural knowledge by letter or notify native title holders.
- Notify Aboriginal people with cultural knowledge by letter.
- Notify Aboriginal people with cultural knowledge by advertisement.
- Engage an archaeologist to implement the archaeological methodology and prepare a cultural heritage assessment report.
- Prepare register of Aboriginal parties.
- Send the names of registered parties to OEH and local Aboriginal land council(s).
- Send invitation to attend an Aboriginal focus group meeting and draft methodology for review.
- Hold an Aboriginal focus group meeting.
- Provide meeting minutes to Aboriginal parties.
- Finalise methodology.
- Provide the archaeological methodology (and the cultural heritage assessment report where required) to Senior Environmental Specialist (Heritage).
- Senior Environmental Specialist (Heritage) reviews archaeological methodology (and cultural heritage assessment report where required).
- Engage Aboriginal site officers.
- Implement archaeological testing methodologies.
- Prepare draft archaeological excavation report.
- Roads and Maritime review of archaeological report.
- Archaeologist to finalise archaeological report.
- Prepare cultural heritage assessment report OR amend existing cultural heritage assessment report.

As listed in the Roads and Maritime procedures for Stage 3, the testing methodology is to be finalised in consultation with Registered Aboriginal Parties. The testing methodology can be finalised once the final areas of impact are identified. Testing methodology needs to be considered further in relation to the finalised option and its determined impacts. It is proposed that test pits measuring 50 centimetres by 50 centimetres be excavated at regular intervals within the bounds of any identified areas of Potential Archaeological Sensitivity that will be impacted by the proposed works. The purpose of these test pits is to ascertain either the presence or absence of subsurface archaeological deposits and extent, if present. All test excavation works are to be undertaken as per the *Code of Practice for Archaeological Investigation for Aboriginal Objects in New South Wales* (NSW Department of Environment Climate Change & Water, 2010).

8 Conclusion

The desktop assessment and targeted field inspections, as detailed in this report, have not identified impacts that would result from the project on Aboriginal archaeological sites, areas of archaeological sensitivity or areas that have Aboriginal cultural value. Management and mitigation measures have been recommended to protect an overhang with PAD identified in the surrounding area. It is therefore concluded that no further assessment or consultation in accordance with PACHCI or Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, July 2005) is required for the project.

(blank page)

9 References

AECOM Australia Pty Ltd. (2013). *M1-M2 Stage 2 Aboriginal cultural heritage assessment*.

AECOM Australia Pty Ltd. (2014). *NorthConnex Additional Stage 2 Aboriginal Cultural Heritage Assessment April 2014*. Unpublished report for Roads and Maritime Services.

Appleton, J. (2001). *The archaeological investigation of the site of a proposed subdivision lot 14, DP 815922 Arrianga Place, Hornsby, North of Sydney, NSW*.

Attenbrow, V. (2002). *Sydney's Aboriginal Past: investigating the archaeological and historical records*. Sydney: University of New South Wales Press Ltd.

Australian Government. (2007). *Australian Indigenous Tools and Technology*. Retrieved November 05, 2012, from http://australia.gov.au/about-australia/australian-story/austn-indigenous-tools-and-technology

Australian Government. (2015). *Atlas of Living Australia*. Retrieved July 10, 2014, from http://www.ala.org.au/

Australian National Botanic Gardens (ANBG). (2007). *Aboriginal Plant Use - NSW Southern Tablelands*. Retrieved November 05, 2012, from http://www.anbg.gov.au/apu/index.html

Chapman, G. A., & Murphy, C. L. (1989). *Soil Landscapes of the Sydney 1:100 000 Sheet.* Soil Conservation Service of N.S.W., Sydney.

Gibberagong Environmental Education Centre. (1983). *Gibberagong*. NSW Government Printer.

HLA-Envirosciences Pty Ltd. (2005). Heritage Assessment: Hornsby Rifle Range, NSW. Prepared for United Process Solutions Pty Limited.

Hornsby Shire Council. (2010). *Bushwalking in Hornsby Shire*. Retrieved from http://www.hornsby.nsw.gov.au/media/documents/recreation-and-facilities/bushwalking/Bushwalking-in-Hornsby.pdf

Horton, D. R. (1996). *Aboriginal Australia*. Canberra: Aboriginal Studies Press.

Isaacs, J. (2002). *Bush Food: Aboriginal Food and Herbal Medicine*. Marleston: JB Books.

Koettig, M. (1996). *Hornsby Shire Aboriginal Heritage Study. Volume 1 Review and Management.* Report to Hornsby Shire Council.

Kohen, J. (1985). *Aborigines in the West: Prehistory to Present*. Sydney: Western Sydney Project.

Kohen, J. (1988). The Dharug of the Western Cumberland Plain: Ethnography and Demography. In B. Meehan & R. Jones (Eds.), *Archaeology with Ethnography: An Australian Perspective* (pp. 238–250). Canberra: Department of Prehistory, Research School of Pacific Studies, Australian National University.

Kohen, J. (1993). *Darug and their Neighbours: The Traditional Aboriginal Owners of the Sydney Region*. Sydney: Darug Link in assoc. with Blacktown and District Historical Society.

Kohen, J., & Lampert, R. (1987). Hunters and Fishers in the Sydney Region. In D. J. Mulvaney & J. P. White (Eds.), *Australians to 1788* (1st ed., pp. 343–65). Sydney: Fairfax, Syme & Weldon Associates.

Ku-ring-gai Council. (2013). *About Ku-ring-gai Aboriginal Heritage*. Retrieved October 29, 2013, from http://www.kmc.nsw.gov.au/About_Ku-ring-gai/History_heritage/Aboriginal_heritage

Lough, J. (1981). Archaeological Survey for Freeway No. 3: Hornsby to Berowra.

NSW Department of Environment Climate Change & Water. (2010). *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. Department of Environment, Climate Change and Water.

NSW Office of Environment & Heritage. (2013). *What information can you obtain from AHIMS?* Retrieved May 10, 2013, from http://www.environment.nsw.gov.au/licences/WhatInformationCanYouObtainFromAHIMS.htm

Parsons Brinckerhoff Australia Pty Ltd. (2004). *Hornsby Quarry and Environs Land Capability Study and Master Plan - Technical Investigations*. Retrieved from http://www.hornsby.nsw.gov.au/media/documents/planning-and-building/quarry/pb-study/Land-Capability-Study-Technical-Volume-1-1.pdf

Permual Murphy Wu. (1993). Hornsby Shire heritage study. Prepared for Hornsby Shire Council.

RMS. (2011). *Roads and Maritime Services procedure for Aboriginal cultural heritage consultation and investigation*. *National Parks*. RMS.

Roads and Maritime Services. (2015). *Standard Management Procedure: Unexpected Heritage Items*.

Ross, A. (1988). Tribal and Linguistic Boundaries in Sydney at the Time of First British Settlement: A Reassessment of the Evidence. In G. Aplin (Ed.), *A Difficult Infant: Sydney Before Macquarie* (pp. 42–53). Sydney: University of New South Wales Press.

Russell, M., & Stuart, I. M. (2002). Indigenous Heritage Study, Central Coast Rail Up-Grade: Hornsby to the Hawkesbury River. Sydney: Report for Halliburton KBR Pty Ltd.

Stewart, K., & Percival, B. (1997). *Bush Foods of New South Wales: A Botanic Record and an Aboriginal Oral History* (p. 52). Sydney: Royal Botanic Gardens Sydney.

Tench, W. (1793). A Complete Account of the Settlement at Port Jackson. In T. Flannery (Ed.), *1788*. Melbourne: The Text Publishing Company.

Threlkeld, L. E. (1892). *An Australian Language as spoken by the Awabakal, the people of Awaba or Lake Macquarie (near Newcastle, New South Wales) being an account of their Language, Traditions, and Customs*. (J. Fraser, Ed.). Charles Potter, Government Printer.

Upper Parramatta River Catchment Trust. (2002). *Upper Parramatta River Catchment Education Resource Kit*. Retrieved October 24, 2013, from http://www.uprct.nsw.gov.au/HTML/Info Sheets/Sub-catchment/S9 - Upper Parramatta River.htm

Appendix A GTLAC Cultural Report

Guringai Tribal Link

Aboriginal Corporation

ABN 18 351 198 069. ICN 4270

(Traditional Owners of the NSW Central Coast and Sydney's Northern Beaches)

PO Box 4061,
Wyongah NSW 2259

Phone:(02) 4396 8743
Fax:(02) 4396 9525
Mobile: 0404 182 049
Email: tracey@guringai.com.au

16th October, 2013

Clive Freeman
Aboriginal Cultural Heritage Officer
Roads and Maritime Services NSW

Emailed to: clive.FREEMAN@rms.nsw.gov.au
CC: darran.jordan@aecom.com

Dear Clive,

Please find following;
* GTLAC report for F3 to Hills M2 Motorway link road, NSW.

Thank you for including the Guringai Mob in this project.
We look forward to working with you in the future.

Tracey-lee Howie
Female Cultural
Heritage Officer
(contacts above)

ABORIGINAL CULTURAL HERITAGE IMPACT ASSESSMENT REPORT. PROPOSED TOLLED MOTORWAY LINKING the F3 to the HILLS M2 MOTORWAY NORTH ROCKS to HORNSBY, NSW.

Prepared by Tracey Howie-Guringai Tribal Link Aboriginal Corporation for Roads and Maritime Services (RMS) NSW.

October, 2013.

ABORIGINAL CULTURAL HERITAGE

IMPACT ASSESSMENT REPORT

PROPOSED TOLLED MOTORWAY LINKING the F3 to the HILLS M2 MOTORWAY, NORTH ROCKS to HORNSBY, NSW

Prepared by Guringai Tribal Link Aboriginal Corporation.

for Roads and Maritime Services (RMS) NSW.

INTRODUCTION;

Guringai Tribal Link Aboriginal Corporation (GTLAC) was contacted by Clive Freeman, Aboriginal Cultural Heritage Officer for RMS, in regards to an Aboriginal Cultural Heritage Impact Assessment for the proposed F3 to Hills M2 Motorway link road.

The proposal consists of a tolled Motorway linking the F3 (M1 Pacific Motorway) to the Hills M2 Motorway running between North Rocks and Hornsby and extending through Baulkham Hills, North Rocks, Carlingford, West Pennant Hills, Pennant Hills, Beecroft, Thornleigh, Normanhurst and Wahroongah, NSW.

This survey was to revisit previously recorded Aboriginal sites and assess undeveloped areas within the proposed construction corridor (study area) for any additional Aboriginal sites, as defined in Attachment 1.

STUDY AREA;

The study area extends from the F3 (M1 Pacfic Motorway) to the Hills M2 Motorway, passing through Baulkham Hills, North Rocks, Carlingford, West Pennant Hills, Pennant Hills, Beecroft, Thornleigh, Normanhurst and Wahroongah, NSW.

METHODOLOGY;

The survey was conducted on foot with a focus on ground surface exposures, large mature trees and previously recorded Aboriginal sites.

Representatives on site;

24/09/13;

GTLAC - Tracey Howie and Archeaologists, Darran Jordan and Chris Ellis - AECOM P/L.

02/10/13;

GTLAC - Tracey Howie, AECOM - Darran Jordan and Metropolitan LALC - Allan Madden.

HISTORICAL INFORMATION;

The study area for the proposed works, has been and still is, home to the Guringai speaking Mob (Wanangine), for generations and seasonally occupied in various locations by the Darug peoples. Pre and post European settlement.

Well known and documented members of the Guringai mob were; Boongaree, Matora, Mosquito, Jewfish, Cora(Gooseberry), Flathead, Long Dick, Sophy, Kitty and Charlotte Ashby.(nee.Webb).

Thier presence in this area was initially recorded pre 1790. References to these Guringai speaking people are located on Government Blanket list and Court Bench records taken in the Northern Beaches areas and Colonial Secretary minutes, which are held at Hornsby Library and early recordings from surveyors John Fraser,Chappell, Felton & Sarah Matthews, journals written by Rev.L.E.Threlkeld, Rev. Glennie, Matthew Flinders, Augustus Earl, R.H Mathews, and current AIATSIS maps.

The traditional areas occupied by the Guringai speaking comprises of; All of Port Jackson catchment, including the tributaries of Middle Harbour and Lane Cove River, the Broken Bay catchment, including tributaries of Brisbane Water, Cowan Creek and Pitt Water,the water shed along Peats Ridge, following along the range through to Kulnura, as well as the Lakes of the Central Coast to lower Lake Macquarie.

Guringai - People of the Coast.

Darug - People of the Plains (as described by J.Fraser 1865)

Guringai and Darug People occupied and utilised the surrounding lands and waters of the wider Hornsby Local Government Areas and beyond, for centuries prior and post to European settlement.

With a predominately seafood diet, we fished and gathered from these waters and their banks and hunted for animals, collected berries, fruits and seeds, had ceremonies, celebrations and mourned within these areas.

Care was taken to not deplete our resources and respect was given to the Land.

FINDINGS;

No Aboriginal sites were identified within the study area at the time of this survey.

Previously recorded Aboriginal sites could not be identified at the time of this survey and it appears that these sites were subjuct to a Consent to destroy Permit (issued by DEC, now known as OEH) during the construction of the existing F3 and associated roadways.

To our knowledge, some engraving sites were excavated and relocated to Kuringai Chase National Park and one was relocated to The Wildflower Gardens at St. Ives.

RECOMMENDATIONS:

Should any Aboriginal sites/objects be located during the processes of any proposed works, work must cease in that area and the Office of Environment and Heritage (OEH. formally, Department of Environment Climate Change and Water. DECCW) & GTLAC are to be notified immediately.

Should any skeletal remains be unearth during any works or associated activities, all work must cease immediately within that vicinity and the NSW Police, OEH, NSW Coroner's Office and GTLAC are to be contacted.

Section 90(1) of the National Parks and Wildlife Act, 1974 states that it is an offence to destroy, deface or damage, or cause or permit destruction or defacement of or damage to, an Aboriginal object or Aboriginal place without first obtaining the consent of the Director General of the Office of Environment and Heritage.

Statutory Considerations.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984. (Commonwealth)

The Aboriginal and Torres Strait Islander Heritage and Protection Act 1984 (Cwlth) was enacted at a Federal level to preserve and protect areas (particularly sacred sites) and objects of particular significance to Aboriginal Australians from damage or desecration. Steps necessary for the protection of a threatened place are outlined in a gazetted Ministerial Declaration (Sections 9 and 10).
This can include the prevention of development.

As well as providing protection to areas, it can also protect objects by Declaration, in particular Aboriginal skeletal remains (Section 12). Although this is a Federal Act, it can be invoked on a State level if the State is unwilling or unable to provide protection for such sites or objects.

National Parks and Wildlife Act. 1974. (NSW)

The National Parks and Wildlife Act 1974 (NPW Act) provides blanket protection for Aboriginal objects (material evidence of Indigenous occupation) and Aboriginal Places (areas of Cultural significance to the Aboriginal community) across NSW. An Aboriginal object is defined as;

any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

An Aboriginal place is any place declared to be an Aboriginal place by the Minister for the Office of Environment and Heritage (OEH), under Section 84 of the Act.

It is an offence to disturb Aboriginal objects or places without a permit authorised by the Director-General of the OEH. In addition, anyone who discovers an Aboriginal object is obliged to report the discovery to OEH

Attachment 1:

BRIEF DESCRIPTION OF ABORIGINAL SITES and OBJECTS:

(Please note that not all Aboriginal site types are listed here).

Artefacts; (as defined in NPW Act. 1974)

Stone artefacts are culturally modified stone materials that occur when a stone material is struck by another stone to manufacture stone tools and implements. Other types of artefacts are quartz, modified shells and glass or ceramic, post European settlement.

Shell midden;

Shell middens are large deposits of shell materials that have accumulated over centuries of celebrations, ceremonies and/or feasts performed on the foreshore areas. Middens usually also contain artefacts and small animal and/or bird bones.

Scarred or culturally modified trees;

Scarred and culturally modified trees are usually large trees in which the thick outer layer of the tree has been removed with a traditional tool. Large removals were used for making canoes. Other removals were used for coolamons (trays with concave edges used as buckets or large plates), shields and shelter.

Stone Hatchet/Axe;

Stone hatchets and axes are made from binding a hard rock that has been sharpened on a sandstone platform/ outcrop, to the end of a piece of wood and secured with tree resin and/or string made from rubbing strands of long, tough grasses together until they are tightly fused.

Grinding Grooves;

Grinding grooves are indented scars on sandstone platforms/outcrops, as a result of sharpening spears and axes in the same indentation over centuries. They are usually located near a constant water source.

Engraving sites;

Engraving sites are located on sandstone platforms/outcrops and boulders and are depictions of animals, human figures both natural and mythological, site indication markers, travel route markers and traditional tools. All engraving sites have a special meaning and form sections of much larger site compexes/story lines.

Ochre/Pigment Art;

Ochre art is usually located within a sandstone shelter/overhang and consists of drawings or hand stencils. Hand stencils are made by chewing a small amount of ochre mixed with egg white or water and sprayed by mouth over the hand when placed against the wall of the shelter/overhang. Another type of pigment art is charcoal drawings.

Spear;

Spear were usually made from the long narrow stem of a matured Xanthoria grass tree and were either sharpened on a sandstone at one end or had a stone spear head fixed to one end by binding it with tree resins.

Womera;

Womeras were used to propel a spear by placing the blunt end of the spear onto a sharpened stick or animal tooth that has been fixed to one end of a narrow piece of wood, about 30cm in length. Womeras made the spears travel much faster were and more accurate than just throwing them with a bare hand.

DESCRIPTION OF ABORIGINAL SITES and OBJECTS Continued:

Aboriginal Place;

An area of land or waters identified as being of Cultural significance and importance to the Aboriginal Community and,
any place declared to be an Aboriginal place by the Minister for the Office of Environment and Heritage (OEH), under Section 84 of the Act.

Water Holes;

Water holes are deep bowl like indentations in sandstone platforms/outcrops associated with fresh flowing water or permant water sources such as natural springs.

Burial sites;

Burial sites contain human remains of Aboriginal persons pre European settlement and not within the confines of a graveyard/cemetery.

Sandstone Shelters;

Stone shelters were used as protection from extreme weather conditions and for shelter whilst travelling through the ridge top areas. They usually contain a sandy floor and can contain artefact materials.

Fish Traps;

Fish traps were made from boulders that are small enough to be carried and placed in a semi-circular formation within the low lide area of the foreshore. Upon a low tide the fish trapped within the rock formation were collected for consumption.

Knapping Site;

An area continually occupied over centuries/generations for the purposes of stone tool making and containing several, usually hundreds of offcuts and discarded fragments from the tools.

Appendix B MLALC Cultural Report

ABORIGINAL CULTURAL HERITAGE ASSESSMENT

HORNSBY QUARRY

STAGE 2 PACHCI

DECEMBER 2014

Metropolitan Local Aboriginal Land council

Lee Davison

Culture and Heritage Officer

Purpose

The purpose of this assessment is to determine whether features of Aboriginal cultural heritage occur within the study area and whether they would be affected by the project or its construction process.

Any features of Aboriginal cultural heritage identified during the site survey will be included in this assessment.

Project details

Project title:

Aboriginal Cultural Heritage Assessment

Hornsby Quarry, Stage 2 PACHCI

December 2014

Location:

Hornsby Quarry, Quarry Road, Hornsby.

This assessment was completed for RMS by Lee Davison on Monday 15th of December 2014 on behalf of the Metropolitan Local Aboriginal Land Council with Darren Jordan (Archaeologist, AECOM).

Site Background

The installation of a conveyor belt is proposed to transport earth material to fill the Hornsby Quarry, as Hornsby Council plan to create a community parkland area for the public to use.

Although Allan Madden has previously surveyed within the study area, this assessment is to cover a wider area.

Description

The majority of the study area is of disturbed land as the result of the Hornsby Quarry works, including its buildings and roads in the north and south western corners. The study area also contains a state heritage listed cemetery of the Higgins family and bike trails that weave the slopes of the south-east and north-east edges. The bike trails also include a rest stop that sits in parkland central to the study area. A set of sandstone stairs that climb the slope on the eastern edge, and a "cool room" built by the Higgins family in the late 1800's, are also state heritage listed.

Sandstone outcrops and rock shelters were a focal point of this assessment.

Methodology

The site survey was conducted on foot and covered the majority of the study area, apart from the quarry and the cemetery. The quarry, its buildings and roads and the cleared parklands cover approximately 50% of the study area. The bike trails were surveyed, along with the eastern edge and quarry surrounds, as these areas contained bushland and sandstone outcrops.

Results

Sandstone outcrops were a feature of the study area, on the eastern edge and within the bike trails on the southern edge in particular.

One rock shelter was identified during the site survey and was recorded as follows:

Rock shelter with northern aspect

323305 E   6269372 N

- On S edge of bike trail at southern end of study area
- Some rubbish present – bricks, metal, tin lids
- No graffiti or Aboriginal paint art visible
- Decent soil deposit present

Depth: 2.7m

Length: 4.6m

Height: 1.55m

This rock shelter has sufficient temporary coverage for only 3-4 people and would it be unlikely that it was used for permanent shelter.

A waterway was also identified running south to north through the centre of the study area, although no groove marks were identified.

Conclusion

The rock shelter mentioned above was the only feature of Aboriginal cultural heritage identified during this assessment.

For the protection and conservation of this rock shelter, I recommend a 20-30m buffer zone for the construction and instillation of the conveyor belt.

Appendix C AHIMS Search Results

AHIMS Web Services (AWS)

Purchase Order/Reference : 60300684

Client Service ID : 106367

Note: This Excel report shows the sites found in AHIMS on the 03/03/2015. If this date is not the same as the original date of the Search Results letter obtained during the Basic Search, then the search results might be different. The PDF version of this report will always coincide with the Basic Search Results letter.

Site ID	Site name	Datum	Zone	Easting	Northing	Context	Site status	Primary contact	Site features	Site types	Recorders	Reports	Permits	Longitude GDA94	Latitude GDA94
45-6-2369	Bone shelter;	AGD	56	323180	6265680	Closed sit	Valid		Artefact : -	Shelter with Deposit	Val Attenbrow	2047		151.09	-33.73
45-6-2861	FR01	AGD	56	317654	6265123	Open site	Valid	T Russell	Artefact : 5		Jo McDonald Cultural Heritage Management			151.03	-33.74
45-6-2956	Colbarra Place PAD	GDA	56	317200	6263600	Open site	Valid		Potential Archaeological Deposit (PAD) : -		Streat Archaeological Services		3305	151.03	-33.75
45-6-1084	Asquith;	AGD	56	325159	6269328	Open site	Valid		Grinding Groove : -	Axe Grinding Groove	ASRSYS			151.11	-33.70
45-6-1439	Elouera Bushland Rese	AGD	56	320710	6267687	Open site	Not a Site		Art (Pigment or Engrave	Not an Aboriginal Site	Jack Campbell			151.07	-33.71
45-6-2513	CFC (Baulkham Hills) S	AGD	56	317750	6262200	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art,Shelter	ASRSYS			151.03	-33.76
45-6-0608	Lane Cove River;Turrar	AGD	56	325726	6263669	Open site	Valid		Grinding Groove : -	Axe Grinding Groove	Michael Guider			151.12	-33.75
45-5-1005	IFCH1	AGD	56	322415	6262289	Open site	Not a Site		Artefact : -	Isolated Find	Mr.Geordie Oakes,AECOM Australia Pty Ltd (previously HLA-Enviroscier			151.08	-33.76
45-6-2453	HR6	AGD	56	322400	6263970	Closed sit	Valid		Artefact : -, Art (Pigmen	Shelter with Art,Shelter	Margrit Koettig	3484		151.08	-33.75
45-6-2454	HR7	AGD	56	320750	6266340	Closed sit	Valid		Artefact : -	Shelter with Deposit	Margrit Koettig	3484,102473		151.07	-33.73
45-6-2472	CF6	AGD	56	317750	6262200	Closed sit	Valid		Artefact : -, Art (Pigmen	Shelter with Art,Shelter	Ms.Tessa Corkill			151.03	-33.76
45-6-1487	Golf Links Track;HB-13	AGD	56	325619	6269154	Open site	Valid		Grinding Groove : -	Axe Grinding Groove	J.C Lough	940		151.12	-33.70
45-6-2097	Darling Mills S. F. 2	AGD	56	317453	6262240	Closed sit	Valid		Artefact : -	Shelter with Deposit	Val Attenbrow,Mr.Rick E	1776,1809,1911,2113,2	287	151.03	-33.76
45-6-2099	Dynamited;	AGD	56	323140	6265520	Closed sit	Valid		Artefact : -	Shelter with Deposit	Val Attenbrow			151.09	-33.73
45-6-1157	Brown;Cut Inside Cave;	GDA	56	325234	6262680	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	Mr.R Taplin,Aboriginal H	102489		151.11	-33.76
45-6-1158	Brown Two Ceiling Don	AGD	56	325274	6262670	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	Mr.R Taplin,Aboriginal H	102489		151.11	-33.76
45-6-2163	CF5;Cumberland S.F.;	AGD	56	317926	6262507	Closed sit	Valid		Artefact : -	Shelter with Deposit	Mr.Rick Bullers,Ms.Tess	1776,1779,2114		151.04	-33.76
45-6-0339	Normanhurst;	AGD	56	322450	6267538	Open site	Valid		Grinding Groove : -	Axe Grinding Groove	ASRSYS			151.09	-33.72
45-6-0340	Turramurra;Pennant Hil	AGD	56	325595	6265678	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	ASRSYS			151.12	-33.73
45-6-0341	Pymble;Turramurra;	AGD	56	325717	6264126	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	ASRSYS			151.12	-33.75
45-6-0342	Asquith;	AGD	56	325528	6269152	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	ASRSYS	940		151.12	-33.70
45-6-2034	English house;	AGD	56	325440	6264850	Closed sit	Valid		Artefact : -	Shelter with Deposit	Warren Bluff	1333		151.12	-33.74
45-6-2035	Becks place;	AGD	56	325600	6264970	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	Warren Bluff	1333		151.12	-33.74
45-6-2041	Darling Mills S.F. 1	AGD	56	317050	6262430	Closed sit	Valid		Artefact : -	Shelter with Deposit	Val Attenbrow	1776,1809,1911,2113,2114		151.03	-33.76
45-6-0749	Cherrybrook 5;	AGD	56	317780	6267920	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	Doctor.Jo McDonald	1271		151.03	-33.71
45-6-1768	Cherrybrook	AGD	56	317440	6266920	Open site	Valid		Grinding Groove : -	Axe Grinding Groove	Laura-Jane Smith	360		151.03	-33.72
45-6-0937	Rogans Hill	AGD	56	319544	6266475	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS	102473		151.05	-33.72
45-6-0938	Rogans Hill;	AGD	56	319870	6266150	Open site	Valid		Art (Pigment or Engrave	Axe Grinding Groove,Rc	Margrit Koettig	102473		151.06	-33.73
45-6-0939	Rogans Hill;	AGD	56	317696	6267446	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS			151.03	-33.72
45-6-0940	Rogans Hill;(duplicate c	AGD	56	319621	6267209	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS	102473		151.05	-33.72
45-6-0941	Rogans Hill;	AGD	56	319811	6266846	Open site	Valid		Grinding Groove : -	Axe Grinding Groove	ASRSYS	102473		151.06	-33.72
45-6-0945	Rogans Hill;Glenhaven;	AGD	56	317410	6268080	Open site	Valid		Grinding Groove : -, Wa	Axe Grinding Groove,W	ASRSYS			151.03	-33.71
45-6-0946	Rogans Hill;	AGD	56	319983	6267399	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS	102473		151.06	-33.72
45-6-0947	Hornsby;	AGD	56	319238	6268116	Closed sit	Valid		Artefact : -	Shelter with Deposit	ASRSYS			151.05	-33.71
45-6-0948	Rogans Hill;Hornsby;	AGD	56	319242	6267933	Closed sit	Valid		Artefact : -, Art (Pigmen	Shelter with Art,Shelter	ASRSYS			151.05	-33.71
45-6-0949	Normanhurst;	AGD	56	320258	6267404	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS	102473		151.06	-33.72
45-6-0950	Rogans Hill;Pyes Ck 3;	AGD	56	318967	6267928	Open site	Valid		Grinding Groove : -	Axe Grinding Groove	ASRSYS	764		151.05	-33.71
45-6-0951	Rogans Hill	AGD	56	320172	6267128	Closed sit	Valid		Artefact : -	Shelter with Deposit	ASRSYS	102473		151.06	-33.72
45-6-0955	Rogans Hill;	AGD	56	319950	6266200	Closed sit	Valid		Artefact : -	Shelter with Deposit	Margrit Koettig	102473		151.06	-33.73
45-6-1647	Cherrybrook;Pyes Cree	AGD	56	318950	6268350	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	Denise Donlon,Les Smi	764,1214		151.05	-33.71
45-6-1649	Pyes Creek 1(Cherry bı	AGD	56	317620	6267040	Closed sit	Valid		Artefact : -	Shelter with Deposit	Doctor.Jo McDonald	764,1039		151.03	-33.72
45-6-0304	Pennant Hills;	AGD	56	322503	6264795	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	ASRSYS			151.09	-33.74
45-6-0306	West Pennant Hills;Rog	AGD	56	318523	6267279	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS			151.04	-33.72
45-6-0307	Hornsby;	AGD	56	320860	6269336	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	ASRSYS			151.07	-33.70
45-6-0896	Window Cave;Pennant	AGD	56	322890	6265450	Closed sit	Valid		Artefact : -	Shelter with Deposit	Val Attenbrow,T Barlow	1809		151.09	-33.73
45-6-0897	Normanhurst;	AGD	56	323375	6267007	Closed sit	Valid		Artefact : -	Shelter with Deposit	ASRSYS			151.09	-33.72
45-6-1879	Blackfellows Head Spu	AGD	56	321700	6269050	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	R Clegg			151.08	-33.70
45-6-1880	Blackfellows Head Spu	AGD	56	321700	6269050	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	R Clegg			151.08	-33.70
45-6-1881	Blackfellows Head Spu	AGD	56	321700	6269050	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	R Clegg			151.08	-33.70
45-6-1054	Lane Cove;Man Goann	AGD	56	325729	6263486	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS		580	151.12	-33.75
45-6-1073	Hornsby;Black Kangarc	AGD	56	321040	6269523	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS			151.07	-33.70
45-6-1703	Blackfellows Head Spu	AGD	56	321740	6269010	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	Doctor.Jo McDonald			151.08	-33.70
45-6-1704	Blackfellows Head Spu	AGD	56	321690	6269140	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	Doctor.Jo McDonald			151.08	-33.70
45-6-1705	Black Fellows Head Sp	AGD	56	321690	6269080	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	Margrit Koettig,Doctor.Jo McDonald			151.08	-33.70
45-6-0228	Blackfellow's Head Spu	AGD	56	321700	6269050	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	Doctor.Jo McDonald,M	209		151.08	-33.70
45-6-0977	Epping;Lane Cove Rive	GDA	56	323964	6262130	Closed sit	Valid		Artefact : -	Shelter with Deposit	Val Attenbrow,Aborigina	2047,102489		151.10	-33.77
45-6-0978	Lane Cove River;	AGD	56	324729	6263192	Open site	Valid		Grinding Groove : -, Wa	Axe Grinding Groove,W	Mr.R Taplin			151.11	-33.76
45-6-2892	PHGC 1 (Hills Golf Cou	GDA	56	319880	6263112	Closed sit	Valid		Artefact : -		Mary Dallas Consulting	3652		151.06	-33.76
45-6-2040	Coups creek;	AGD	56	323570	6265750	Closed sit	Valid		Artefact : -	Shelter with Deposit	Val Attenbrow	102203		151.10	-33.73
45-6-2990	Zig Zag Creek 01	GDA	56	320196	6267009	Closed sit	Valid		Artefact : 2, Hearth : 1		Mr.Michael Jackson	102473		151.06	-33.72
45-6-3104	Rothwell Shelter KUR0	GDA	56	325500	6265090	Open site	Valid		Potential Archaeological Deposit (PAD) : -		Aboriginal Heritage Office			151.12	-33.74
45-6-3067	Crescent 1	GDA	56	322187	6263082	Open site	Valid		Artefact : 1		Kelleher Nightingale Consulting Pty Ltd			151.08	-33.76
45-6-3082	NWRL PAD1	GDA	56	320967	6262938	Open site	Valid		Potential Archaeological Deposit (PAD) : 1		GML Heritage Pty Ltd			151.07	-33.76
45-6-3105	Canoon Rd Grooves 1 I	GDA	56	324284	6264100	Open site	Valid		Grinding Groove : -		Aboriginal Heritage Office			151.10	-33.75
45-6-3042	Eden Ave Groove 1 KU	GDA	56	325374	6262955	Open site	Valid		Grinding Groove : 1		Aboriginal Heritage Office			151.11	-33.76
45-6-3083	Crescent 3	GDA	56	321838	6263337	Open site	Valid		Artefact : -		Kelleher Nightingale Consulting Pty Ltd,Mr.Josh Symons			151.08	-33.76
45-6-2949	M2A1	GDA	56	323895	6262241	Open site	Valid		Grinding Groove : 1		Mr.Rick Bullers			151.10	-33.77
45-6-2160	CF1 a b;Cumberland S.	AGD	56	318018	6262574	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art,Shelter	Mr.Rick Bullers,Ms.Tess	1776,2114		151.04	-33.76
45-6-2161	CF3;Cumberland S. F.;	AGD	56	317123	6262357	Closed sit	Valid		Artefact : -	Shelter with Deposit	Mr.Rick Bullers,Ms.Tess	1776,1779,2113,2114		151.03	-33.76

45-6-3114	Epping to Thornleigh Th	GDA	56	322194	6263106	Open site	Valid	Artefact : -	Mr.Josh Symons	151.08	-33.76
45-6-3117	Crescent 2 (C2)	GDA	56	322259	6262900	Open site	Valid	Artefact : 1	Matthew Kelleher	151.08	-33.76

Report generated by AHIMS Web Service on 03/03/2015 for Darran Jordan for the following area at Datum :GDA, Zone : 56, Eastings : 316729 - 325947, Northings : 6261657 - 6269794 with a Buffer of 0 meters. Additional Info : Background research. Number of Aboriginal sites and Aboriginal objects found is 71

Appendix D Archaeology Scientific Ratings

Table A1: Ground Surface Visibility (GSV) Rating Scheme

GSV rating	% GSV
Very poor	0-10%
Poor	11-30%
Fair	31-50%
Good	51-70%
Very good	71-90%
Excellent	91-100%

Table A2: Ground Integrity (GI) Rating Scheme

GI rating	Definition
Low	Area has been subject to significant disturbance through natural and/or anthropogenic processes (e.g., heavy earthworks).
Moderate	Area has been subject to moderate disturbance (e.g., native vegetation clearance) but retains a reasonable degree of integrity.
High	Area remains in a natural or near-natural state.

Table A3: Archaeological Sensitivity Rating Scheme

Rating	Definition
Nil	Land with no potential for subsurface archaeological deposit(s) due to past ground disturbance(s).
Low	Subsurface archaeological deposit(s) may be present. Relative to areas of high sensitivity, lower artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.
High	Subsurface archaeological deposit(s) likely to be present. Relative to areas of low sensitivity, higher artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.

Table A4: Impact Risk Rating Scheme

Impact Risk	Definition
Low	The proposed activity is unlikely to disturb, destroy, damage or deface an Aboriginal object or objects.
Moderate	The proposed activity has *reasonable* potential to disturb, destroy, damage or deface an Aboriginal object or objects.
High	The proposed activity will - or is highly likely to - disturb, destroy, damage or deface an Aboriginal object or objects.

Appendix K

Technical working paper: Greenhouse Gas and Climate Change

Roads and Maritime Services

Hornsby Quarry: Road Construction Spoil Management Project

Greenhouse Gas Assessment

JULY 2015

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, Australia

(blank page)

Contents

List of tables

List of figures

(blank page)

Executive summary

AECOM Australia Pty Ltd (AECOM) has been commissioned to undertake an assessment of the likely greenhouse gas emissions that would be generated from the Hornsby Quarry Road Construction Spoil Management Project (the project).

The project has been developed in response to the need to manage approximately 2.6 million cubic metres of spoil generated from the construction of the NorthConnex project, a multi-lane motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The project site would be used to receive a minimum of one million cubic metres of excavated natural material and/or virgin excavated natural material from the approved NorthConnex construction sites.

This technical working paper presents the calculated greenhouse gas contributions of the project, and identifies recommended measures to reduce and manage those greenhouse gas emissions.

Greenhouse gas emissions associated with the project have been assessed in terms of Scope 1 (direct emissions from fuel consumed on the project site and vegetation removal), Scope 2 (indirect emissions from offsite electricity supplied to the project site) and Scope 3 (indirect emissions from upstream production of materials used on the project site) emissions. The assessment of emissions has also been broken down by three project components:

- Site Preparation: includes site establishment activities (initial dewatering of void, establishment of site compound and security fencing, and widening and sealing of Bridge Road), and construction of the conveyor.
- Spoil haulage and emplacement: includes spoil haulage from the NorthConnex project by truck and emplacement of the spoil designated stockpile sites, placement of spoil from stockpiles into the conveyer, transport of the spoil via the conveyer into the quarry void, and movement of spoil along the quarry floor.
- Site demobilisation and rehabilitation: includes the demobilisation and removal of construction compound, conveyer and security fencing, and rehabilitation of disturbed areas.

It is estimated that the project would generate approximately 18,931 t CO2-e. This quantity is comprised of:

- 14,475 t CO_2-e direct Scope 1 greenhouse gas emissions. Most of these emissions relate to the use of fuel on the project site, with some additional contributions from vegetation clearing.
- 0 t CO_2-e indirect Scope 2 greenhouse gas emissions. The project would not import electricity from the grid.
- 4,456 t CO_2-e indirect Scope 3 greenhouse gas emissions. These emissions represent the embedded energy of materials used on the site, mainly construction materials.

The majority of greenhouse gas emissions associated with the project are attributed to Scope 1 emissions (76.5 per cent). Scope 3 emissions account for 23.5 per cent of total emissions. There are no Scope 2 emissions generated by the project.

With respect to the phases of the project, the majority of greenhouse gas emissions are attributed to the spoil haulage and emplacement phase (65.4%), followed by the site preparation phase (32.9 per cent). The site demobilisation and rehabilitation phase accounts for only a small proportion of total emissions (1.7 per cent).

(blank page)

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project).

On 13 January 2015 Roads and Maritime received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for NorthConnex identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage.

The Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during tunnel excavation activities from late 2015, noting that it is not a standalone solution. The Hornsby Quarry site is located close to NorthConnex and would minimise the distance required for haulage. In particular, spoil from the northern interchange compound and northern portals could be solely handled and reused at the Hornsby Quarry site. The handling, management and reuse of up to 1.5 million cubic metres of spoil at the Hornsby Quarry site would also alleviate the need for an increased number of other sites accepting small spoil volumes, thus reducing overall potential impacts such as noise and traffic within the wider community and the environment.

Hornsby Shire Council has also been actively seeking opportunities for material to fill the quarry void, with the aim of future rehabilitation of the site and return to use for public recreation. Beneficially reusing spoil from NorthConnex would be an important first step towards preparing the site in anticipation of Hornsby Shire Council separately rehabilitating and developing the site for public recreation in the future.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015. A specific requirement relating to greenhouse gas was not included in the SEARs, however this greenhouse gas assessment has been prepared to inform the EIS being prepared for the Hornsby Quarry Road Construction Spoil Management Project.

1.1 The project

The Hornsby Quarry site would be used to receive up to 1.5 million cubic metres of excavated natural material (ENM) and/or virgin excavated natural material (VENM) from the approved NorthConnex construction sites. Only ENM and/or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road and track) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the project area.
- Dewatering of the void (to be undertaken by Hornsby Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.
- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a

period of approximately 28 months.

- Stockpiling of spoil at stockpile sites within the Hornsby Quarry site.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.
- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete. An indicative project program is provided in **Table 1**.

Table 1 Indicative program

Activity	Indicative timeframe															
	2015				2016				2017				2018			
Site establishment (including preparatory works)				■												
Establishment of conveyer					■											
Spoil haulage and stockpiling					■	■	■	■	■	■	■	■	■	■		
Spoil emplacement (operation of conveyor)						■	■	■	■	■	■	■	■	■	■	
Site clean-up and demobilisation														■	■	

1.2 Project location

The Hornsby Quarry site is located around 21 kilometres north west of the Sydney Central Business District, in Old Mans Valley to the west of Hornsby town centre. The site covers about 35 hectares and is owned by Hornsby Shire Council (Council) (refer to Figure 1). The site is accessed via local Council roads, including Quarry Road (off Dural Street and other local roads) from the south east and Bridge Road (off the Pacific Highway) from the north east.

The site comprises a quarry void, internal access roads and a cleared area to the east, which was used as a processing area when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the site is zoned for public recreation (RE1) under the Hornsby Local Environmental Plan 2013, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Council currently maintains exclusion fencing around the void to prevent public access for public safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible.

The site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and the cleared area to the east. Dense bushland comprising the Berowra Valley National Park lies directly to the west. The Pacific Highway and Main North Railway Line are located to the east, approximately 300 metres and 500 metres respectively.

The general location and key features of the project are shown in Figure **1**.

1.3 Purpose of this report

This report presents an assessment of likely greenhouse gas emissions that would be generated from the project, and provides recommended mitigation measures to reduce greenhouse gas emissions.

1.4 Structure of this report

The report has the following structure:

- Chapter 1 introduces the project.
- Chapter 2 details the policy and planning context for the assessment.
- Chapter 3 details the methodology for the assessment.
- Chapter 4 provides a summary of the assessment results.
- Chapter 5 details recommendation management measures.
- Chapter 6 provides the references used to assist in the preparation of this report.
- Appendix A provides detailed calculation methods.

Figure 1 Indicative Site layout

2 Policy and planning context

Increasing public concern and debate regarding the likelihood and magnitude of climate change impacts in Australia has resulted in national, state and international policy commitments, addressing both greenhouse gas mitigation and climate change adaptation.

The Kyoto Protocol to the United Nation Framework Convention on Climate Change (the Kyoto Protocol) (UNFCCC, 1998) was signed in 1997 and Australia ratified the protocol in December 2007. The Kyoto Protocol’s objective is to reduce greenhouse gas emissions through setting reduction targets for greenhouse gas emissions produced by ratifying countries. These targets are set using the ratifying countries’ 1990 baseline emissions. Australia committed to a target of 108 per cent of 1990 emission levels by the end of 2012. In December 2012, Australia signed the Doha Amendment to the Kyoto Protocol (UNFCCC, 2012), agreeing to a second commitment period, from 1 January 2013 until 2020.

The Australian Government’s greenhouse gas emission policies, regulations and initiatives are managed by the Clean Energy Regulator and the Department of the Environment. The National Greenhouse and Energy Reporting (NGER) Scheme provides a national framework for obligated corporations to report on greenhouse gas emissions, energy use and energy production. The Scheme operates under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act).

Currently, the Australian Government has committed to a target of reducing carbon pollution by five percent below 2000 emission levels by 2020 irrespective of what other countries do. The Government will review this position in 2015 at the Climate Summit in Paris as part of international negotiations regarding emissions reduction commitments prior to and post-2020.

The Australian Government’s Direct Action Plan sets out how this five per cent reduction target will be achieved. The Emissions Reduction Fund, as part of the Direct Action Plan, aims to reduce Australia’s greenhouse gas emissions by creating positive incentives to adopt better technologies and practices to reduce emissions.

In August 2013, the NSW State Government released the NSW Energy Efficiency Action Plan (Office of Environment and Heritage (OEH), 2013), which provides a strategic management approach to improving energy efficiency, with a target for annual energy savings of 16,000 gigawatt-hours by 2020.

(blank page)

3 Assessment Methodology

The methodology for the greenhouse gas assessment has been based on relevant greenhouse gas reporting legislation and international reporting guidelines, including:

- The Greenhouse Gas Protocol A Corporate Accounting and Reporting Standard (World Council for Sustainable Business Development and World Resources Institute, 2005).
- The National Greenhouse and Energy Reporting Act 2007.
- Australian Standard AS ISO 14064.1:2006 Greenhouse Gas Part 1: Specification with guidance at the organisational level for quantification and reporting of greenhouse gas emissions and removals (Standards Australia, 2006).
- Australian National Greenhouse Accounts: National Greenhouse Accounts Factors (NGA Factors) (Department of the Environment, 2014).
- Greenhouse Gas Assessment Workbook for Road Projects (the TAGG Workbook) (Transport Authorities Greenhouse Group (TAGG), 2013).

The TAGG Workbook provides a consistent methodology for estimating the greenhouse gas emissions for major activities that may contribute significantly to the overall emissions associated with a road project. The TAGG workbook has been adopted for the Hornsby Quarry Road Construction Spoil Management project.

To prepare the greenhouse gas inventory and calculate the greenhouse gas emissions associated with the project, the following steps were conducted:

1. Identify the assessment boundary and the sources of greenhouse gas emissions associated with the project.
2. Determine the quantity of each emission source (fuel consumed, electricity, construction materials and so on) in line with the TAGG Workbook.
3. Quantify the greenhouse gas emissions associated with each greenhouse gas source using equations and emission factors specified in the NGA Factors (Department of the Environment, 2014).
4. Present the greenhouse gas emissions associated with the project.
5. Identify opportunities (mitigation measures) which may be implemented to reduce the greenhouse gas emissions associated with the project.

Appendix A provides a detailed description of the greenhouse gas assessment methodology, including the emissions factors used for all emission sources, and detailed calculation methods used to estimate the greenhouse gas emissions from fuel combustion, vegetation clearing, and materials use.

Greenhouse gas emissions are reported in this assessment as tonnes of carbon dioxide equivalent (t $CO_{2\text{-}e}$). While there are numerous greenhouse gases generated from fossil fuel consumption, this standard metric takes account of the different global warming potentials of different greenhouse gases, and expresses the cumulative effect in a common, universal unit of measurement. This allows for all greenhouse gases produced by the project to be combined into one emissions calculation.

3.1 Greenhouse gas assessment boundary

The assessment boundary defines the scope of greenhouse gas emissions and the activities to be included in the greenhouse gas assessment. The greenhouse gas assessment boundary includes all emissions sources that can be impacted by decisions made by designers, constructors, managers and/or operators of the project.

The assessment of emissions has been separated into three components:

- **Site Preparation:** includes site establishment activities (initial dewatering of void, establishment of site compound and security fencing, and widening and sealing of the currently unsealed quarry access roads), and construction of the conveyor.
- **Spoil haulage and emplacement:** includes spoil haulage from the NorthConnex project by truck and emplacement of the spoil designated stockpile sites, placement of spoil from stockpiles into the conveyer, transport of the spoil via the conveyer into the quarry void, movement of spoil along the quarry floor and ongoing maintenance pumping throughout the site preparation stage.
- **Site demobilisation and rehabilitation:** includes the demobilisation and removal of the construction compound, conveyer and security fencing, and rehabilitation of disturbed areas.

Activities that would generate greenhouse gas emissions during the above components of the project include:

- Site Preparation
  - The combustion of diesel fuel for site establishment activities using mobile construction plant and equipment onsite.
  - Clearance of vegetation.
  - The embodied energy of construction materials, associated with the offsite mining and production of materials to be used in construction of the project.
- Spoil haulage, stockpiling and emplacement
  - The combustion of diesel fuel for the transport of spoil from the NorthConnex spoil generation locations to the Hornsby Quarry site.
  - The combustion of diesel fuel for stockpiling of spoil, movement of spoil from stockpiles to the conveyer, operation of the conveyer and movement of spoil along the quarry floor.
- Site demobilisation and rehabilitation
  - The combustion of diesel fuel for site demobilisation and rehabilitation activities using mobile plant and equipment onsite.
- All phases
  - The combustion of diesel fuel for use in site vehicles.
  - The combustion of diesel fuel for powering generators.

Emissions sources are categorised into three different ‘scope’s to delineate between ‘direct emissions’ from sources that are owned or controlled by the project and ‘indirect emissions’ that are a consequence of project activities but occur at sources owned or controlled by another entity. The three scopes are:

- **Scope 1** – direct emissions: greenhouse gas emissions generated by sources owned or controlled by the project, for example emissions generated by the use of diesel fuel by project-owned construction plant, equipment or vehicles.

- **Scope 2** – indirect emissions: greenhouse gas emissions from the generation of purchased electricity in project-owned or controlled equipment or operations. These greenhouse gas emissions are generated outside of the project's boundaries, for example the use of purchased electricity from the grid.
- **Scope 3** – indirect upstream emissions: greenhouse gas emissions generated in the wider economy due to third party supply chains as a consequence of activity within the boundary of the project, for example greenhouse gas emissions associated with the offsite mining, and production and transport of materials used in the project.

Greenhouse gas emissions associated with the project are assessed in terms of Scope 1, Scope 2 and Scope 3 emissions. Table 2 summarises the emission sources and activities considered within the project greenhouse gas assessment boundary, according to scope. There are no emission sources which generate Scope 2 emissions for this project.

Table 2 Emission sources and activities assessed, according to scope

Emission source category	Emission source	Emission scope		
		Scope 1	Scope 2	Scope 3
Site Preparation				
Fuel use (diesel)	Mobile equipment	✓		✓
	Site vehicles	✓		✓
	Generators	✓		✓
Vegetation removal	Clearance of vegetation as a result of the project	✓		
Materials	Construction materials (embodied energy)			✓
Spoil haulage, stockpiling and emplacement				
Fuel use (diesel)	Mobile equipment	✓		✓
	Site vehicles	✓		✓
	Spoil haulage	✓		✓
	Generators	✓		✓
Site demobilisation and rehabilitation				
Fuel use (diesel)	Mobile equipment	✓		✓
	Site vehicles	✓		✓

Some emissions sources may be categorised into two scopes (i.e. Scope 1 and Scope 3), to account for greenhouse gas emissions generated by sources owned or controlled by the project (Scope 1) and associated indirect upstream greenhouse gas emissions, generated outside of the project boundary, due to third party supply chains in direct relation to the project (Scope 3). For example, use of fuel by project operated equipment would generate Scope 1 greenhouse gas emissions from the combustion of fuel onsite and Scope 3 greenhouse gas emissions associated with the extraction, production and transport of the purchased fuel.

The materiality checklist provided in Appendix A of the TAGG Workbook has been used to identify potential sources of emissions to be included or excluded from the assessment. Based on this guidance, the following list of emissions sources and sinks have been excluded from the greenhouse gas assessment boundary:

- Transport of construction materials to site. All construction materials required for the project are assumed to be located within 50 kilometres from the site.
- Fuel used by workers travelling to and from the site in privately owned vehicles or by public transport.

Vegetation clearance has been included in the greenhouse gas assessment boundary in line with the materiality checklist, as more than 0.5 hectares of vegetation would be removed as part of the project.

(blank page)

4 Assessment Results

The greenhouse gas emissions source data used to estimate the greenhouse gas emissions associated with the project are provided in **Appendix A**. Assumptions have been made, where necessary, to provide a quantitative estimate of emissions.

4.1 Greenhouse gas emissions

It is estimated that the project would generate approximately 18,931 t CO_{2}.e. The breakdown of emissions by scope is shown in Figure 2 and summarised as:

- 14,475 t CO_{2}.e direct Scope 1 greenhouse gas emissions.
- Zero t CO_{2}.e indirect Scope 2 greenhouse gas emissions.
- 4,456 t CO_{2}.e indirect Scope 3 greenhouse gas emissions.

The greenhouse gas emissions results for the project are provided in detail in Table 3.

Table 3 Greenhouse gas emissions results according to emission source (t CO_{2}.e)

Emission source category	Emission source	Emission Scope			Total	% of total
		Scope 1	Scope 2	Scope 3		
Site Preparation						
Fuel use (diesel)	Mobile equipment	1,214	NA	92	1,306	6.90
	Site vehicles	22	NA	2	23	0.12
	Generators	145	NA	11	156	0.82
Vegetation removal	Clearance of Blue Gum High Forest	24	NA	NA	24	0.13
	Clearance of Sandstone Blackbutt Woodland and native regeneration	823	NA	NA	823	4.35
	Clearance of weeds and exotics	441	NA	NA	441	2.33
Materials	Steel	NA	NA	486	486	2.57
	Concrete (32MPa)	NA	NA	1,944	1,944	10.27
	Concrete (precast)	NA	NA	34	34	0.18
	Asphalt	NA	NA	965	965	5.10
	Bitumen	NA	NA	20	20	0.11
	Aggregate	NA	NA	5	5	0.02
Spoil haulage, stockpiling and Emplacement						
Fuel use (diesel)	Mobile equipment	6,505	NA	494	6,999	36.97
	Site vehicles	94	NA	7	101	0.54
	Spoil haulage trips	4539	NA	345	4884	25.80
	Generators	373	NA	28	401	2.12
Site Demobilisation and Rehabilitation						
Fuel use (diesel)	Mobile equipment	374	NA	21	294	1.56
	Site vehicles	22	NA	2	23	0.12

Note: Values have been rounded.

Table 4 provides a breakdown of the greenhouse gas emissions by project component.

Table 4 Breakdown of greenhouse gas emissions by project phase

Project phase	Emission scope			Total	% of total
	Scope 1	Scope 2	Scope 3		
Site Preparation	2,669	-	3,559	6,228	32.9
Spoil haulage, stockpiling and emplacement	11,511	-	874	12,385	65.4
Site demobilisation and rehabilitation	295	-	22	318	1.7
Total	**14,475**	**-**	**4,456**	**18,931**	**100**
% Total	**76.46**	**-**	**23.54**	**100%**	

Note: Values have been rounded

The results demonstrate that the majority of greenhouse gas emissions associated with the project are attributed to Scope 1 emissions (76.5 per cent). Scope 3 emissions account for 23.5 per cent of total emissions. There are no scope 2 emissions generated by the project.

With respect to the project components, the majority of greenhouse gas emissions are attributed to the spoil haulage and emplacement stage (65.4 per cent), followed by the site preparation stage (32.9 per cent). The site demobilisation and rehabilitation stage accounts for only a small proportion of total emissions (1.7 per cent).

Figure 2 illustrates the breakdown of emissions by emission source and scope. The consumption of diesel fuel for the operation of mobile equipment contributes the largest proportion of Scope 1 emissions (55.2 per cent) followed by the consumption of diesel fuel for spoil haulage (31.3 per cent). The embodied energy associated with the indirect production of materials used for the project, contributes the largest proportion of Scope 3 emissions (77.5 per cent).

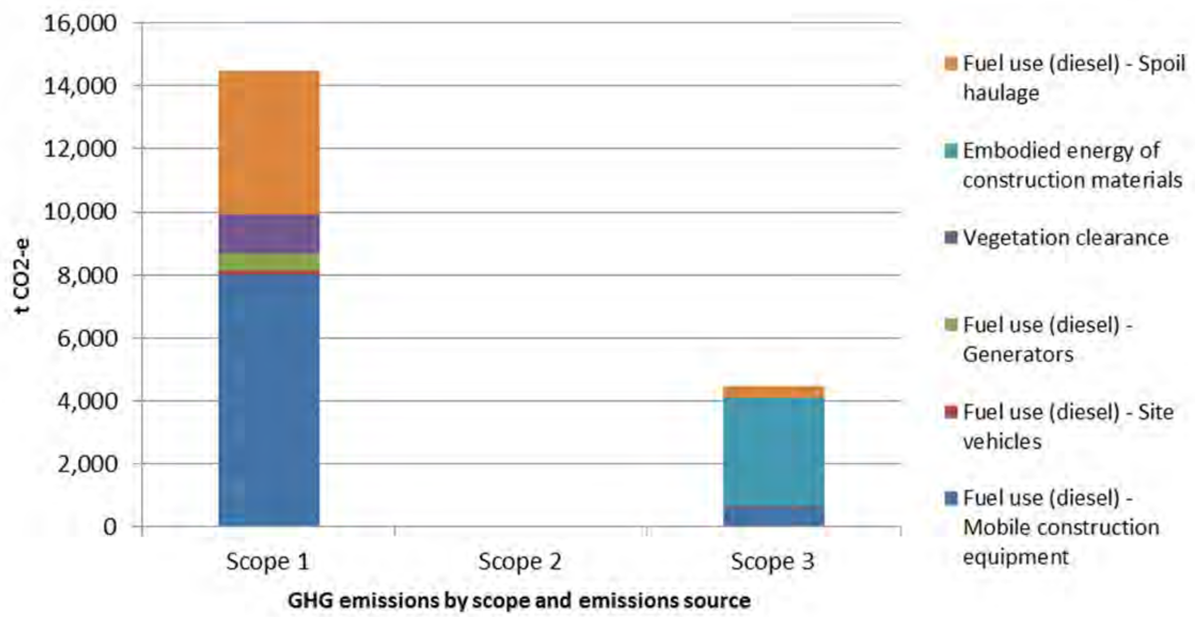

Figure 2 **Greenhouse gas emissions by scope and emissions source**

The total estimated greenhouse gas emissions from the project (approximately 20,549 t CO_2-e), equates to 0.004 per cent of the national greenhouse gas inventory for the year 2014 (Department of Environment, 2015) and 0.014 per cent of the NSW greenhouse gas inventory for 2011 to 2012 (Department of Environment, 2014)[1].

[1] NSW GHG inventory for 2011 to 2012 is the latest published inventory for NSW.

5 Mitigation and Management Measures

The design of the Hornsby Quarry Road Construction Spoil Management Project has been optimised such that measures to reduce energy and resource requirements, and therefore greenhouse gas emissions, are inherent in the project design. The Hornsby Quarry site also is the closest identified spoil management location to the NorthConnex northern construction sites, and its use for spoil management therefore minimises the distance required for spoil haulage.

Table 5 provides a list of management measures which will further reduce the greenhouse gas emissions generated by the Hornsby Quarry Spoil Management Project.

Table 5 Management measures

No.	Environmental management measure	Responsibility	Timing
GHG 1	The emissions intensity of the materials specified in the design of the project would be assessed and, where feasible and in compliance with technical specifications, purchasing power would be used to drive the procurement and use of low emission materials.	Project contractor	Procurement
GHG 2	The fuel efficiency of the project plant and equipment would be assessed prior to selection and, where feasible and reasonable, equipment with the highest fuel efficiency or equipment which uses lower greenhouse gas intensive fuel such as biofuels (eg biodiesel, ethanol) would be considered for use.	Project contractor	Procurement / pre-commencement
GHG 3	Project planning would be undertaken to ensure that the site vehicle movements and project activities have been planned efficiently and to avoid double handling of materials and additional fuel use.	Project contractor	Pre-commencement
GHG 4	Locally produced goods and services would be procured where feasible and cost effective to reduce transport fuel emissions.	Project contractor	Procurement / pre-commencement

(blank page)

6 References

Australian Standard (AS ISO 14064.1:2006) *Greenhouse Gas Part 1: Specification with guidance at the organisational level for quantification and reporting of greenhouse gas emissions and removals* (ISO 14064-1:2006, MOD).

Department of Environment, 2014. State and Territory Greenhouse Gas Inventories 2011 to 2012. Available at: http://www.environment.gov.au/system/files/resources/255447ab-3c51-412e-9756-921ef23cb8aa/files/state-territory-inventories-11-12.pdf

Department of the Environment, 2015. Quarterly Update of Australia's National Greenhouse Gas Inventory: September 2014. Available at: http://www.environment.gov.au/system/files/resources/36653a43-4e2f-4b3a-bd1d-0d676778f780/files/nggi-quarterly-update-sept-2014.pdf

Intergovernmental Panel on Climate Change (IPCC), 2013. *Fifth Assessment Report (AR5), Working Group I: The Physical Science Basis*. The report is anticipated to be published January 2014. Available at: http://www.climatechange2013.org/report/review-drafts/

Office of Environment and Heritage (OEH), 2013. *NSW Energy Efficiency Action Plan*. NSW State Government. Available at: http://www.environment.nsw.gov.au/resources/climatechange/130588eneffap.pdf
Transport Authorities Greenhouse Group Australia and New Zealand (TAGG), 2013. Greenhouse Gas Assessment Workbook for Road Projects and Supporting Document for Greenhouse Gas Assessment Workbook for Road Projects.

United Nations Framework Convention on Climate Change (UNFCCC), 1998. *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. Kyoto, Japan. Available at: http://www.kyotoprotocol.com/resource/kpeng.pdf

United Nations Framework Convention on Climate Change (UNFCCC), 2012. *Doha Amendment to the Kyoto Protocol*. Doha, Qatar. Available at: https://treaties.un.org/doc/Publication/CN/2012/CN.718.2012-Eng.pdf

World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), 2004, *The Greenhouse Gas Protocol A Corporate Accounting and Reporting Standard*, Revised Edition.

WRI &WBCSD, November 2005, The Greenhouse Gas Protocol for Project Accounting.

(blank page)

Appendix A Detailed greenhouse gas calculation methods

A.1 Greenhouse gas calculation methodology

The following steps have been taken in estimating the greenhouse gas emissions associated with the project (as per the TAGG Workbook 2013):

1. The greenhouse gas emissions relevant to the stages of project have been identified.
2. The greenhouse gas inventory boundary has been determined, which defined the emissions sources to be considered in the assessment (Table 2) and those to be excluded.
3. The emissions sources have been quantified (refer to **Table A-4** to **A-6**).
4. For the different emissions sources, emissions factors have been established and the emissions calculated. This section provides the methodology used for calculating greenhouse gas emissions from fuel use, vegetation removal and material use during the project.
5. Opportunities for mitigation have been identified, as detailed in **Section 5** of the report.

Guiding principles

The assessment has been conducted according to the following greenhouse gas accounting and reporting principles:

- Relevance – select and use greenhouse gas sources, sinks, data and methodologies appropriate for the project / organisation and intended use of greenhouse gas inventory results.
- Completeness – include all relevant greenhouse gas emissions and information which support methodology and criteria used.
- Consistency – use consistent data, calculation / modelling methods, criteria and assumptions to enable valid comparisons.
- Transparency – include clear, sufficient and appropriate information to enable others to understand the basis for results and make decisions regarding use of greenhouse gas inventory results with reasonable confidence.
- Accuracy – reduce bias and uncertainties, as much as practical.

In addition to the accounting and reporting principles presented above, the issue of materiality has also been assessed in the greenhouse gas assessment. This is a core accounting and auditing principle which ensures that sources, assumptions, values and procedures included in the greenhouse gas assessment are material to the project. As materiality is valued within the context of the project being assessed, this can vary significantly between projects.

The greenhouse gas assessment boundary is discussed in Section 0.

Specific methodologies for the calculation of emissions from each emissions source (e.g. fuel use, vegetation clearance and material use) are provided in the following sections.

Fuel

The method used to calculate the Scope 1 greenhouse gas emissions from the combustion of liquid fuels, for transport energy purposes is given by the formula below, sourced from the National Greenhouse Accounts (NGA) Factors 2014:

Greenhouse gas emissions (t CO_2-e) = ((Q x ECF) / 1000) x (EF_{CO2} + EF_{CH4} + EF_{N2O})

Where: Q is the quantity of fuel (in kL).
ECF is the relevant energy content factor (in GJ/kL).
EF_{CO2} is the relevant Carbon dioxide (CO_2) emission factor (in kg CO_2-e/GJ).
EF_{CH4} is the relevant Methane (CH_4) emission factor (in kg CO_2-e/GJ).
EF_{N2O} is the relevant Nitrous oxide (N_2O) emission factor (in kg CO_2-e/GJ).

The method used for calculating the Scope 3 greenhouse gas emissions from the combustion of liquid fuels, for transport energy purposes is given by the formula below, as given by the NGA Factors 2014:

Greenhouse gas emissions (t CO_2-e) = (Q x ECF x $EF_{Scope\ 3}$) / 1000
Where: Q is the quantity of fuel (in kL).
ECF is the relevant energy content factor (in GJ/kL).
$EF_{Scope\ 3}$ is the relevant emission factor (in kg CO_2-e/GJ).

The Scope 1 and Scope 3 emission factors for diesel (post 2004 vehicles) are given in **Table A-1**.

Table A-1 Scope 1 and Scope 3 emission factors for the use of fuels (post 2004 vehicles) (NGA Factors 2014 Tables 4 and 40)

Fuel	Energy content factor (GJ per kL)	Scope 1 emission factor (kg CO_2-e/GJ)			Scope 3 emission factor (kg CO_2-e/GJ)	Emissions per unit quantity (t CO2-e per kL)		
		CO_2	CH_4	N_2O		Scope 1	Scope 2	Scope 3
Diesel	38.6	69.2	0.01	0.6	5.3	2.6947	0	0.2046

Vegetation removal

The TAGG Workbook (2013) provides a methodology for estimating the loss of carbon sequestration potential from the removal of vegetation that would be required as part of land clearing activities during the project. The methodology provided in Appendix E of the TAGG Workbook was developed by GHD (2012) and is in line with the methodology used by the Department of the Environment to estimate Australia's national greenhouse gas emissions for reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

The methodology is based on a conservative approach, in line with relevant greenhouse gas guiding and reporting principles, and the following assumptions:

- All carbon pools are removed as part of the clearance of vegetation (e.g. debris and soil).
- All carbon removed is converted to CO_2 and released to the atmosphere.
- Sequestration as a result of revegetation works carried out as part of the project has not been included in the assessment.

The methodology estimates the greenhouse gas emissions associated with the loss of carbon sequestration that exists in vegetation at the time of clearing and the potential carbon that could have been sequestered in future if the vegetation was not cleared. The greenhouse gas emissions associated with the loss of CO_2 sequestration potential through the removal of vegetation have been calculated using the following steps:

- The potential maximum biomass class ('Maxbio' class) has been determined for the project location using vegetation maps provided in Appendix E of the TAGG Workbook.
- The class of vegetation (Table 1 of the TAGG Workbook Appendix E) and the area in hectares for each vegetation type to be cleared as part of the project has been identified.
- The vegetation clearance emissions factors have been identified for each vegetation class for the selected 'Maxbio' class from Table 2 of the TAGG Workbook Appendix E.
- The greenhouse gas emissions associated with the loss of CO_2 sequestration potential has been estimated by multiplying the area of vegetation to be cleared (in hectares) by the corresponding emissions factor (t CO2-e per hectare) for each vegetation type.
- The total estimate of greenhouse gas emissions associated with the loss of CO_2 sequestration potential for the project has been obtained by adding the results for each vegetation type.

Vegetation clearance emissions factors for the project are identified in **Table A-2.**

Table A-2 Vegetation clearance emissions factors (TAGG Workbook Appendix E, 2013)

Maxbio class	Vegetation type	Vegetation class	Emissions factor (t CO2-e per hectare)
Class 4 (150 – 250 tonnes of dry matter per hectare)	Blue Gum High Forest	B	401
Class 4 (150 – 250 tonnes of dry matter per hectare)	Sandstone Blackbutt Woodland and native regeneration	D	521
Class 4 (150 – 250 tonnes of dry matter per hectare)	Weeds and exotics	I	110

Note: the 'Maxbio' class is derived from the Australian Greenhouse Office and estimates the maximum tonnes of dry vegetation matter per hectare for a specific location. Conservative assumptions were used to classify non-native vegetation types.

Materials

Indirect Scope 3 greenhouse gas emissions from the use of materials have been calculated according to the formula below:

Greenhouse gas emissions (t CO_2-e) = Q (t) x EF (tCO_2-e/t)
Where: Q is the quantity of material (in tonnes).
EF is the relevant Emission Factor (in t CO_2-e per tonne of material).

Material emission factors have primarily been sourced from the TAGG Workbook and are given in **Table A-3**.

Table A-3 Material Emission Factors (TAGG Workbook, 2013)

Material	Emissions per unit quantity (tCO_2-e/t)	Assumption / Reference
Concrete 32MPa (cast in-situ)	1.09	Interpolated from TAGG Workbook (2011) Appendix D Concrete 40MPa (1:1.5:3) and Concrete 30MPa (1:2:4)
Concrete (precast)	0.119	SimaPro: Concrete block, at plant/DE U
Steel reinforcement/structural	1.05	TAGG Workbook (2011) Appendix D
Aggregate	0.005	TAGG Workbook (2011) Appendix D
Bitumen	0.63	TAGG Workbook (2011) Appendix D
Asphalt	0.58	Hot Mix Asphalt (400 MJ/t) TAGG Workbook (2011) Appendix D

A.2 Greenhouse gas emissions activity data

This section details the quantification of the greenhouse gas emission source data used for estimating the greenhouse gas emissions associated with the project, including the sources of information used and assumptions made. **Table A-4** to **Table A-7** detail the greenhouse gas emission source data used in the greenhouse gas assessment, including assumptions and information sources.

Table A-4 Estimated construction materials

Element	Structural Component	Quantity (m^3)
Fence		
Steel chain link fence	Steel	9
Office		
Office building	Steel	39
Office concrete slab	Concrete (32mpa) (in-situ)	54
Rebar for office concrete slab	Steel	0.5
Feeders		
Feeder concrete slabs	Concrete (32mpa) (in-situ)	144
Rebar for feeder concrete slab	Rebar	1.5
Truck Bridge		
Concrete component of bridge	Concrete (32mpa) (in-situ)	338
Rebar component of bridge	Steel	5
Conveyor		
Conveyor concrete slab	Concrete (32mpa) (in-situ)	240
Rebar for conveyor concrete slab	Steel	2
Conveyor structure	Steel	3
Concrete wall		
Precast concrete	Concrete (pre-cast)	124
Roads (sealing and widening)		
Asphalt	Asphalt	640
Bitumen	Bitumen	32
Imported aggregates	aggregate	600

Note: All construction material quantities were derived from the Construction Method Drawings (March, LLB) and confirmed by LLB. Values have been rounded.

Table A-5 Estimated operation of mobile equipment and fuel consumption

Equipment	Number of equipment	Hours of operation per week	Total hours of operation (hrs)	Quantity of diesel used (kL)	Assumptions
Site Preparation					
Preparatory Works (1 month duration)					
Generator for Initial Pit Dewatering	1	-	278	7.8	100kW generator in pit. Based on an approximate volume of 50 ML within the void, and the pump capable of approx. 50L/s.
Tipper Trucks	2	30	120	10.9	175 hp
Roller	1	30	120	1.6	CAT CS54XT
Grader	1	30	120	5.2	291 hp
Lighting Tower	1	22	88	1.9	Assume that lighting tower has a similar fuel use as a small diesel generator; 120 ph generator
Excavator	1	30	120	5.6	~300 hp
Site vehicles	4	-	-	2.0	TAGG Workbook Table 5.3 assumes a project vehicle fleet of 4 Hilux utes for a medium sized project ($2-10m), and a diesel consumption rate of 1.21 kL per month. Diesel quantity has been calculated based on this fuel consumption rate and duration of this phase.
Site Establishment Works (3 months duration)					
Excavator + breaker	2	30	360	33.8	~300 hp
Mulcher	2	40	80	2.4	
Lifting Crane	1	30	360	19.6	250 hp
Tipper Trucks	2	30	360	32.7	175 hp
Water Cart	1	30	360	16.5	Fuel consumption for 175 hp 'hydrant truck'
Wheel Loader	1	30	360	16.9	300hp
Grader	2	30	360	31.0	291 hp
Roller	2	30	360	9.4	CAT CS54XT
Lighting Tower	2	22	264	11.6	Assume that lighting tower has a similar fuel use as a small diesel generator; 120 ph generator
Concrete Truck	1	22	264	7.2	120 hp
Concrete Pump	1	22	264	15.0	250 hp pump
Vibrators	2	22	264	7.9	150 hp

Equipment	Number of equipment	Hours of operation per week	Total hours of operation (hrs)	Quantity of diesel used (kL)	Assumptions
Backhoe	1	30	360	23.4	250 hp
Generators	2	60	720	23.0	50 kilo-volt-ampere (Kva) generator.
Site vehicles	4	-	-	2.0	TAGG Workbook Table 5.3 assumes a project vehicle fleet of 4 Hilux utes for a medium sized project ($2-10m), and a diesel consumption rate of 1.21 kL per month. Diesel quantity has been calculated based on this fuel consumption rate and duration of this phase.
Establishment of Conveyer					
Excavator + breaker	2	30	360	33.8	~300 hp
Lifting Crane	2	30	360	39.1	250 hp
Tipper Trucks	2	30	360	32.7	175 hp
Water Cart	1	30	360	16.5	Fuel consumption for 175 hp 'hydrant truck'
Lighting Tower	2	22	264	11.6	Assume that lighting tower has a similar fuel use as a small diesel generator; 120 ph generator
Concrete Truck	1	30	360	9.8	120 hp
Concrete Pump	1	30	360	20.4	250 hp pump
Vibrators	2	30	360	10.8	150 hp
Backhoe	1	30	360	23.4	250 hp
Generators	2	60	720	23.0	50 kilo-volt-ampere (Kva) generator.
Site vehicles	4	-	-	4.0	TAGG Workbook Table 5.3 assumes a project vehicle fleet of 4 Hilux utes for a medium sized project ($2-10m), and a diesel consumption rate of 1.21 kL per month. Diesel quantity has been calculated based on this fuel consumption rate and duration of this phase.
Spoil haulage and emplacement					
Dozers in Pit	2	60	4,320	328.3	D8 Dozer
Dozers on Flats	2	60	4,320	241.9	D7 Dozer
Excavator / Front-end loader on Flats	2	60	4,320	406.1	CAT972H
Excavator / Front-end loader in Pit	2	60	4,320	406.1	CAT972H
Roller in Pit	2	60	4,320	112.3	CAT CS54XT

Equipment	Number of equipment	Hours of operation per week	Total hours of operation (hrs)	Quantity of diesel used (kL)	Assumptions
Articulated dump truck	2	60	4,320	211.7	725C Three Axle Articulated Truck
Water Cart on Flats	1	60	4,320	197.5	
Lighting Tower	2	22	1,584	69.5	
Generator for conveyor	1	60	4,320	440.6	500Kva generator
Generator for site & amenities	2	60	4,320	138.2	50Kva generator. 1 x generator in pit, 1 x generator at surface.
Site vehicles	4	-	-	35	TAGG Workbook Table 5.3 assumes a project vehicle fleet of 4 Hilux utes for a medium sized project ($2-10m), and a diesel consumption rate of 1.21 kL per month. Diesel quantity has been calculated based on this fuel consumption rate and duration of this phase.
32/40 Ton Truck & Dogs	-	-	-	1684.4	Diesel quantity calculated based on the following details: 1390 peak hour trips per week, 1050 offpeak hour trips per week. Trip = In and out. Peak hour trip = 29km. Non-peak trip = 23.5km. Fuel consumption = 36 litres / 100km.
Site Demobilisation and Rehabilitation					
Dozers	1	30	240	6.7	D7 Dozer
Lifting Crane	2	30	240	26.1	250 hp
Tipper Trucks	2	30	240	21.8	175 hp
Excavator	2	30	240	22.6	~300 hp
Water Cart	1	30	240	11.0	Fuel consumption for 175 hp 'hydrant truck'
Grader	1	30	240	10.3	291 hp
Roller	1	30	240	3.1	CAT CS54XT
Site vehicles	4	-	-	8	TAGG Workbook Table 5.3 assumes a project vehicle fleet of 4 Hilux utes for a medium sized project ($2-10m), and a diesel consumption rate of 1.21 kL per month. Diesel quantity has been calculated based on this fuel consumption rate and duration of this phase.

Note: Fuel quantities predominantly based on consumption rates sourced from Caterpillar Performance Handbook Edition 32 (2001) Chapter 20: Estimating Owning & Operation Costs.
Fuel quantities have been rounded.

Table A-6 Summary of greenhouse gas emission source data

Emission source category	Emission source	Quantity	Unit
Site Preparation			
Fuel use	Mobile equipment	450.5	kL
	Site vehicles	8.0	kL
	Generators	53.9	kL
Vegetation removal	Clearance of Blue Gum High Forest	0.1	hectares
	Clearance of Sandstone Blackbutt Woodland and native regeneration	1.6	hectares
	Clearance of weeds and exotics	4.0	hectares
Materials	Steel	463.3	tonnes
	Concrete (32MPa)	1,783.7	tonnes
	Concrete (precast)	286.1	tonnes
	Asphalt	1,664.0	tonnes
	Bitumen	32.0	tonnes
	Aggregate	900.0	tonnes
Spoil haulage and emplacement			
Fuel use	Mobile equipment	2,414.1	kL
	Site vehicles	35.0	kL
	Spoil haulage	1,684.4	kL
	Generators	138.2	kL
Site Demobilisation and Rehabilitation			
Fuel use	Mobile equipment	101.5	kL
	Site vehicles	8.0	kL

Note: Quantities have been rounded

Table A-7 greenhouse gas emission factors

Emissions source category	Emission source	Quantity	Unit	Emissions per unit quantity Scope 1	Scope 2	Scope 3	Units
Site Preparation							
Fuel use (diesel)	Mobile equipment	512	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
	Site vehicles	8.0	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
	Generators	53.9	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
Vegetation removal	Clearance of Blue Gum High Forest	0.1	hectares	401	NA	NA	t CO2-e per hectare
	Clearance of Sandstone Blackbutt Woodland and native regeneration	1.6	hectares	521	NA	NA	t CO2-e per hectare
	Clearance of weeds and exotics	4.0	hectares	110	NA	NA	t CO2-e per hectare
Materials	Steel	463.3	tonnes	NA	NA	1.05	t CO_2-e per tonne
	Concrete (32MPa)	1,783.7	tonnes	NA	NA	1.09	t CO_2-e per tonne
	Concrete (precast)	286.1	tonnes	NA	NA	0.119	t CO_2-e per tonne
	Asphalt	1,664.0	tonnes	NA	NA	0.58	t CO_2-e per tonne
	Bitumen	32.0	tonnes	NA	NA	0.63	t CO_2-e per tonne
	Aggregate	900.0	tonnes	NA	NA	0.005	t CO_2-e per tonne
Spoil haulage and Emplacement							
Fuel use (diesel)	Mobile equipment	2414.1	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
	Site vehicles	35.0	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
	Spoil haulage trips	1684.4	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
	Generators to staff amenities and water pumping	138.2	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
Site Demobilisation and Rehabilitation							
Fuel use (diesel)	Mobile equipment	101.5	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL
	Site vehicles	8.0	kiloliters	2.694666	NA	0.20458	t CO_2-e per kL

Note: Quantities have been rounded

Appendix L

Community Involvement Plan

Roads and Maritime Services

Draft Community involvement plan

Hornsby Quarry Road Construction Spoil Management

July 2015

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, Australia

Contents

(blank page)

1 Introduction

The purpose of the Draft Community Involvement Plan is to provide an outline of how communication and consultation activities would be carried out with the community and key stakeholders during construction and spoil haulage for the Hornsby Quarry Road Construction Spoil Management project.

The aim of this document is to identify preliminary:

- Relevant stakeholders.
- Procedures for distributing information and receiving / responding to feedback.
- Procedures for resolving community complaints during construction.
- Key issues and how these will be managed.

This Draft Plan will be used and revised to develop a more detailed Community Involvement Plan should the project be approved and before construction starts. The Community Involvement Plan would address any Conditions of Approval for the project and consider communication and consultation during the project planning stage. The Community Involvement Plan would be updated and refined as the project progresses to ensure it continues to meet its objectives.

The final Community Involvement Plan for the project will be incorporated into the approved Community Communications Strategy for the NorthConnex project, to provide for consistent management of community issues.

(blank page)

2 Community Relations Team

A community relations team, made up of a Community Relations Manager and Community Relations Officer(s), would be engaged for the duration of construction of the project. The Community Relations Manager would be qualified and experienced in community relations and will be responsible for the preparation and implementation of the detailed Community Involvement Plan. The Community Relations Manager would be responsible for all communications and consultation on the project.

Where relevant, communications activitieswould be coordinated with the communications activities for the NorthConnex project by the communications team for the NorthConnex project.

In addition to being available for contact by the community and stakeholders to answer questions and address concerns or complaints relating to the project, the community relations team would:

- Provide clear, accessible and up to date information to the community and stakeholders.
- Keep detailed records of all stakeholder and community consultation activities.
- Identify and manage potential issues.
- Manage a complaints resolution process.
- Acknowledge and consider feedback and address community and stakeholder concerns in a timely manner.

(blank page)

3 Communications strategy and tools

3.1 Community Involvement Plan

The final Community Involvement Plan would provide specific information relating to consultation activities during the design and construction phases of the project. It would include at a minimum:

- A list of stakeholders.
- Stakeholder level of involvement and engagement.
- Map of impacted properties.
- A register of potential impacts and timings.
- A risk assessment and proposed actions to mitigate or minimise the impact to stakeholders.
- Roles and responsibilities of the community relations team.
- External and internal communication protocols.
- Procedure for dealing with complaints and enquiries.
- Procedures for early notification to the community.
- Procedures for publicising the details of design and construction work.
- Procedures for training employees and subcontractors as relevant to the implementation of the community involvement plan.
- A crisis communications plan.

3.2 Identification of stakeholders

Relevant stakeholders in the project include the local community, the broader Sydney community, community groups and organisations, government agencies, local councils, peak transport and freight bodies, and directly and indirectly impacted businesses. Relevant stakeholders would continue to be identified through the construction stage of the project. The final Community Involvement Plan would provide a comprehensive list of relevant project stakeholders and community groups.

Stakeholders identified to date have been listed below and will be confirmed as part of the final Community Involvement Plan:

- Hornsby Shire Council
- Directly affected landowners around the Hornsby Quarry site and haulage routes
- Bicycle user groups
- Pedestrian and walking groups
- Utility and service providers
- Emergency services
- Schools and educational institutions
- Childcare and early learning facilities
- Places of worship
- Hospitals
- Aged care facilities
- Environmental interest groups

- Traffic and transport interest groups
- Community clubs and organisations
- Businesses along the proposed haulage routes
- Sporting groups
- Government agencies
- Members of Parliament (State and Federal)
- The wider community in the vicinity of the proposal.

3.3 Community contact database

Using the community contact database from the planning stage of the project, a community contact database would be established and maintained. This would include all landowners adjacent to the project works and key stakeholders. Registers would be provided at the public display centre, any staffed or public display locations and on the project website to enable the community to be included in the community contacts database.

3.4 Community involvement groups

A number of local community involvement groups comprising representatives of local communities, relevant local councils and others would be established as appropriate to inform and consult the community on specific issues. The issues to be addressed as part of the community involvement groups would be determined based on the results of ongoing community consultation and in consultation with Roads and Maritime.

3.5 Liaison groups

Liaison groups would be established to address communication and coordination with affected authorities, road user groups and other groups with specific interests in the project. The liaison groups would include:

- A community liaison group including representatives from the community, local council and government agencies.
- A traffic and transport liaison group.

3.6 Public displays

A public display centre would be established and maintained near to the project site prior to the commencement of construction. The centre would be maintained throughout the construction period. The display centre would:

- Contain up to date information, plans, diagrams and / or photographs of the project works.
- Be open to the public between 9am to 5pm Monday to Friday, excluding public holidays.

3.7 Community information

Relevant authorities and the local community would be kept informed throughout the construction process through a variety of methods. The method of communication would be based on the level of information to be provided and the timeframe for delivery of information. Methods of communication would include:

- Flyer/notifications for distribution to mailboxes / premises.

- Letters, emails and telephone calls to relevant authorities.
- Community updates at key milestones (newsletters).
- Website (updated monthly and as required).
- Print and radio advertising.
- SMS.

The community would be informed of progress of the design and construction works, significant milestones, design changes, changed traffic conditions, opportunities for input, construction operations and others matters which are of interest, affect or concern to the community. The project would also maintain a 24 hour toll free telephone service throughout construction for the community to report incidents and register complaints.

3.8 Complaints management

The project would develop and implement a procedure for community contact and complaints handling and investigation during the construction period. A complaints register would be established and maintained which would record the details, response and outcome of complaints. All complaints received would be investigated and an appropriate response provided to the complainant.

(blank page)

4 Key issues and communication strategies

Some aspects of the construction activities would require specific consultation strategies due to the nature of the potential impact and / or the stakeholder groups. These are described below.

4.1 Traffic management

Changes to traffic arrangements would impact a range of stakeholders. These impacted stakeholders would range from local residents to users of the broader road network traveling through the Hornsby area. These stakeholders would include, but not necessarily be limited to:

- Local councils
- Local community – those who live and work in the vicinity of the project
- Wider community – those who utilise the road network around the project
- Local school communities
- Freight organisations
- Emergency service operators
- Relevant bus operators
- NSW Taxi Council.

4.1.1 Traffic and Transport Liaison Group

A Traffic and Transport Liaison Group (TTLG) would be established, including representatives from Roads and Maritime, emergency services, relevant bus operators and the relevant local council/s. The TTLG would provide a forum to discuss all traffic management and road safety matters associated with construction of the project. Where appropriate, the TTLG for the project would be incorporated into the existing TTLG for the NorthConnex project.

4.1.2 Community information

Information relating to traffic management and altered traffic conditions would be disseminated to the community through:

- Regular updates on the project website with details of current traffic arrangements.
- Signage in advance of changes of arrangement at bus stops.
- Signage/ advertising in advance of changes to pedestrians and cyclist facilities.

4.2 Noise and vibration

Consultation regarding construction noise and vibration would be addressed as part of wider project communications outlined in Section 3. The community relations team will consult closely with the community and key stakeholders who are potentially affected by the noise and vibration impacts of the project.

Noise and vibration impacts and mitigation and management measures are addressed in Section 6.2 of the EIS. Measures to minimise impacts at identified noise sensitive receivers have been included in the design of the project.
A Construction Noise and Vibration Management Plan (CNVMP) would be prepared and implemented, and would include the following:

- Identification of nearby residences and other sensitive land uses.
- Description of approved hours of work.
- Description and identification of all construction activities, including work areas, equipment and duration.
- Description of what work practices (generic and specific) would be applied to minimise noise and vibration.
- A complaints handling process.
- Noise and vibration monitoring procedures.
- Overview of community consultation required for identified high impact works

At this stage all works associated with the proposal are proposed to be confined to standard construction hours (7am to 6pm Monday to Friday and 8am to 1pm on Saturdays with no works on Sundays or public holidays). Out of hours works would only be undertaken under limited circumstances, comprising:

- Works which are determined to comply with the relevant Noise Management Level (NML) at the most affected sensitive receiver.
- The delivery of materials as required by the Police or other authorities for safety reasons.
- Where it is required to avoid the loss of lives, property and / or to prevent environmental harm in an emergency.
- Where agreement is reached with affected receivers.
- Where explicitly approved through an Environment Protection Licence.

If out of hours works are required for the project, specific consultation would be carried out in relation to these works. This consultation would be targeted at stakeholders and the community who are likely to be impacted by noise or vibration from these works.

Consultation for out of hours works would include community notification in accordance with the requirements of any conditions of approval and an Environmental Protection Licence issued for the project. Additional targeted consultation would be undertaken with the affected community based on the predicted level of noise exceedance of the out of hour works. This may include letter box drops, specific notifications, phone calls or individual briefings. The level of exceedance when each particular consultation tool would be utilised would be determined as part of the Construction Noise and Vibration Management Plan and associated Out of Hours Works Protocol.

4.3 Pedestrian and bicycle access to Old Mans Valley

If the project is approved, some of the existing Hornsby Mountain Bike Trail and bush walking trails will remain open with changes to access while other trails will need to be temporarily closed to allow for construction work. Consultation regarding changes to pedestrian and bicycle access at Old Mans Valley would generally be part of wider project communications outlined in Section 3. However, there would be specific consultation with Hornsby Shire Council, bicycle user groups and pedestrian groups. This consultation would include:

- The closures and changes in access to Old Mans Valley.
- The best ways for the project team to reach the members of these groups. This feedback would then be incorporated into the communication activities for the project.

5 Next steps

Subject to planning approval, the construction contractor would develop this draft Plan into a detailed Community Involvement Plan and incorporate it into the NorthConnex Community Communications Strategy with updates for any specific requirements of the planning approval.

The final Community Involvement Plan for the project will be incorporated into the approved Community Communications Strategy for the NorthConnex project, to provide for consistent management of community issues. The Plan would provide further detail of community involvement during the construction of the project as well as information on the consultation tools, activities, timing and issues mitigation approach.

(blank page)

Appendix M

Technical working paper: Groundwater

Roads and Maritime Services

Hornsby Quarry Road Construction Spoil Management Project

Technical Working Paper: Groundwater

July 2015

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia Pty Ltd

Contents

(blank page)

Executive summary

Roads and Maritime Services has identified the former Hornsby Quarry site as one of the preferred locations for receipt and management of spoil from the NorthConnex project, a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at Carlingford. Roads and Maritime is proposing that spoil generated during the construction of the roads and road infrastructure facilities associated with the NorthConnex project be received at the Hornsby Quarry site for handling, management and beneficial reuse to stabilise the current quarry void on the site. The proposal would contribute to the potential future rehabilitation and redevelopment of the quarry by Hornsby Council for recreational purposes and public benefit.

The proposal is declared to be State significant infrastructure under Part 5.1 of the *Environmental Planning and Assessment Act 1979* by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential groundwater impacts of the project as part of the Environmental Impact Statement (EIS).

The proposal would allow the Hornsby Quarry site to receive up to 1.5 million cubic metres of excavated natural material (ENM) and virgin excavated natural material (VENM) from the construction of roads and road infrastructure facilities forming part of the NorthConnex project. Spoil handling, management and beneficial reuse at the Hornsby Quarry site would include site establishment and conveyer construction, dewatering of the quarry void, spoil haulage onto site, spoil stockpiling, spoil emplacement into the void via conveyer.

This report has been prepared to calculate anticipated groundwater inflows into the quarry void for the duration of the project works to estimate the amount of water that would require extraction as part of the project, to inform the groundwater impact assessment presented in the EIS. This report has assessed the infilling of the quarry with ENM and VENM up to a fill height of reduced level (RL) 64 metres from a void base level of RL 8 metres. Groundwater inflows to the quarry have been estimated for the 33 months of project duration.

The groundwater inflow calculations undertaken in this assessment found that a total of 636 mega litres would be extracted over 33 months, including the initial pumping of 50 mega litres to dewater the existing volume of water within the void to RL 8. This calculation is considered conservative as the hydraulic gradient is a sensitive parameter and influence has been assumed at a distance of 50 metres whereas the area of influence is likely to be less in a fractured rock aquifer with low hydraulic conductivity. In the first 12 months an estimated 360 mega litres will be pumped from the quarry (initial dewatering and maintenance pumping) declining to 190 mega litres for the second year (maintenance pumping) and 85 mega litres for the last nine months of year three (maintenance pumping).

The estimates of groundwater inflow suggest that the groundwater to be pumped for the project would be compliant with the five year dewatering licence issued by the Department of Primary Industries - Water, which has an annual allocation of 370 mega litres per year.

(blank page)

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry site for handling, management and beneficial reuse of spoil generated by road construction (the project).

On 13 January 2015 Roads and Maritime received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for the NorthConnex project identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage. Following design development, the Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during road construction from late 2015.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act.

Roads and Maritime has formed the opinion that the proposal is likely to significantly affect the environment, such that an EIS is required to be prepared. Therefore, the proposal is declared to be State significant infrastructure under Part 5.1 of the EP&A Act by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of groundwater impacts of the project.

This technical working paper: groundwater has been prepared to inform the EIS for the project.

1.2 The project

The Hornsby Quarry site would receive up to 1.5 million cubic metres of excavated natural material (ENM) and/or virgin excavated natural material (VENM) from the approved NorthConnex construction sites. Only ENM and/ or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road and track) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the construction area.
- Dewatering of the void (to be undertaken by Hornsby Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.
- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil at stockpile sites within the Hornsby Quarry site using dozers.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.
- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete. An indicative program is provided in **Table 1-1.**

Table 1-1 Indicative program

Phase	Indicative timeframe															
	2015				2016				2017				2018			
Site establishment works (including preparatory works)				■												
Establishment of conveyer					■											
Spoil haulage and stockpiling					■	■	■	■	■	■	■	■	■	■		
Spoil emplacement (operation of conveyor)						■	■	■	■	■	■	■	■	■	■	
Site clean-up and demobilisation														■	■	

An overview of the works is included in **Table 1-2**. Detailed descriptions of each activity can be found in Section 4.1 of the EIS for the project.

Table 1-2 Overview of project works

Phase	Proposed activities
Site establishment (including preparatory works)	The following works would be completed: • Dewatering of the void to a suitable working level. • Clearing and grubbing, and establishment pf erosion and sediment controls. • Establishment of a compound site. • Establishment of security fencing and signage around the construction site. • Widening and sealing of the currently unsealed quarry access road (Bridge Road) to facilitate all weather access.
Establishment of conveyor	The construction of the conveyor would include establishment of footings and the conveyor.
Spoil haulage and stockpiling	Trucks would enter and leave via Bridge Road during standard work hours over a maximum period of 28 months. Spoil would be unloaded from the dump trucks and stockpiled using dozers. It is expected that haulage and stockpiling would commence whilst the conveyer is still being constructed.
Spoil emplacement	Once the conveyer is constructed, these works would occur concurrently with spoil haulage and stockpiling activities, but would also continue for a period after the completion of spoil haulage onto the site. The activities include: • Placement of spoil from the stockpiles into the conveyor by front end loader. • Transport of the spoil via conveyor to the quarry void rim where the spoil would fall directly into the void. • Front-end loaders and articulated trucks would move the spoil along the quarry floor and dozers and rollers will spread the material. Periodic maintenance pumping of water from the void would be conducted during spoil haulage and emplacement activities.
Site demobilisation and rehabilitation	The compound and conveyor would be dismantled and removed from the site. Disturbed areas would be rehabilitated to a standard agreed with the Council. Security fencing would be removed, however would be retained around the quarry void if the void is deemed to remain an ongoing risk to public safety. Public access would then be reinstated to the areas outside the void exclusion zone.

1.3 Project location

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The site covers about 35 hectares and is owned by Hornsby Shire Council. The location and site context and indicative site layout of the project are shown in Figures 1-2 and 1-3, respectively of the EIS.

The site comprises a quarry void, internal access roads and a cleared area to the east which was used as a processing area when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the site is zoned for public recreation (RE1) under the Hornsby Local Environmental Plan 2013, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible.

The site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and the past processing area. Dense bushland comprising the Berowra Valley National Park occurs directly to the west. Any noise management and mitigation measures (such as acoustic treatment) along Bridge Road are to be determined at the detailed design stage.

1.4 Purpose of this report

This report has been prepared to calculate anticipated groundwater inflows into the quarry void for the duration of the project works to estimate the amount of water that would require extraction as part of the project, to inform the groundwater impact assessment presented in the EIS. This report has assessed the infilling of the quarry with ENM and VENM up to a fill height of reduced level (RL) 64 metres from a void base level of RL 8 metres. The ENM and VENM material used as fill would be sourced solely from tunnelling and associated construction activities at the NorthConnex project and it is anticipated that the material would likely consist of sandstone, siltstone and shale. Groundwater inflows to the quarry have been estimated for the 33 months of project duration.

This technical working paper: groundwater has been prepared to inform the EIS for the project and to address the SEARs issued for the project. This technical working paper and **Section 6.3** of the EIS collectively address the SEARs issued for the project with respect to groundwater and this paper should be read in conjunction with the EIS. **Section 6.3** of the EIS identifies where in the EIS the SEARs have been addressed.

This groundwater impact assessment is based on available technical reports, data and investigations. No field investigations have been conducted as part of this assessment and data has been drawn from previous investigations conducted by others. The sources of the background documents are outlined in **Section 6**.

(blank page)

2 Existing Environment

2.1 Physical Setting

The Hornsby Quarry, centred on Old Mans Valley, is a natural drainage line that has been altered during quarry development where the surface water flow has been diverted into a drainage channel. The quarry covers an area of approximately 35 hectares with the quarry void surface area covering approximately 11.5 hectares. The quarry is benched and has been disused since the early 1990's. The quarry extends from ground surface at RL 90 metres Australian Height Datum (AHD) to the base at RL 8 metres AHD with the quarry void being approximately 3.3 million cubic metres. The void has partially infilled with water, and is pumped by Hornsby Shire Council to maintain a water level below RL 40 metres AHD.

2.2 Geology and Hydrogeology

The Hornsby Quarry was quarried primarily to obtain road building material from the Hornsby Diatreme that is composed of volcanic breccia. The diatreme has intruded the older rocks of the Hawkesbury Sandstone. Wianamatta Shale outcrops to the east and northeast of the quarry.

The geology through which the NorthConnex tunnel is to be constructed is expected to consist of Wianamatta Shale and Hawkesbury Sandstone. The crushed ENM/VENM material to be sourced from the NorthConnex project for infilling of the quarry is therefore anticipated to be composed of sandstone, siltstone and shale from the Wianamatta Shale, Mittagong Formation and Wianamatta Shale.

Groundwater is present at the Hornsby Quarry site within a shallow perched water system located above the weathered volcanic breccia and fill and deeper groundwater is present within fractured breccia and surrounding Hawkesbury Sandstone (PSM, 2007). Water flows into the quarry as surface water runoff and groundwater inflow. PSM, 2007 indicated that groundwater inflow to the quarry is approximately 0.3 litres per second although inflow rates are dependent on quarry water levels and recent rainfall conditions. Recharge to the shallow and deep aquifers is via rainfall infiltration. Discharge from the shallow aquifer is leakage into the quarry and direct discharge to Old Mans Creek and leakage into the underlying fractured rock aquifer (PB, 2004). Seepage calculations indicate that if pumping was to cease, water levels within the quarry would eventually rise to fill the quarry pit within an estimated 29 years and water would then overflow the void rim and discharge to Old Mans Creek (PB, 2004).

Water quality within the quarry is reported as being of good quality and suitable for discharge into local creeks without treatment (PB, 2004). Investigations by Parsons Brinckerhoff indicated there was no geochemical stratification within the upper ten metres of the quarry water. Salinity, pH and other geochemical conditions are not expected to alter significantly with depth as the water quality within the Hawkesbury Sandstone and seepage measured from the volcanic breccia is of good quality and low salinity.

Groundwater level fluctuations within the Hawkesbury Sandstone and volcanic breccia respond to climatic conditions, rainfall recharge via direct infiltration and evaporation from the quarry (PSM, 2007 and PB, 2004). Fluctuations are expected to oscillate seasonally in accordance with climatic seasonal variability (PSM, 2007 and PB, 2004). The depth to groundwater is expected to be variable and related to the topographical position in the landscape with the depth of groundwater likely to decrease to the west as the surface elevation decreases towards the quarry.

(blank page)

3 Groundwater Inflow Calculation

3.1 Assumptions

Groundwater inflow to the Hornsby Quarry has been calculated by application of the Darcy Equation and the following assumptions:

- The quarry dimensions have been simplified to a linear cone with
  - Width of the void at RL 10 as 90 metres
  - Width of the void at RL 90 to be 360 metres
  - Width of the void at RL 64 to be 274 metres
- The quarry would be filled to RL 64
- The duration of works would be over a period of 33 months

It has been assumed that an equal volume of fill would be placed in the quarry void each month.

3.2 Darcy Equation

Q = KIA where

> K = hydraulic conductivity (ranges between 0.0006 and 0.01m/day) [fractured igneous rock - Domenico and Schwartz, Physical and Chemical Hydrogeology, 1990]
>
> I = Hydraulic gradient – will decrease as the quarry is filled. Is estimated from Borehole HQ1, 50m away from the edge of the pit
>
> A = cross sectional area through the quarry. This has been calculated for various segments of the quarry.

3.3 Hydraulic Gradient

One of the most sensitive parameters in this equation is the hydraulic gradient. Borehole BH HQ1, located at the south western part of the quarry site approximately 50 metres from the edge of the void, extends to a depth of approximately 80 metres. This assessment has assumed that groundwater levels under natural conditions would be approximately 5 metres below ground surface. The elevation around the quarry edge varies from RL 120 in the south to RL 90 in the north, averaging RL 105 metres. Thus the average natural groundwater level (5 metres below ground surface) 50 metres from the edge of the pit is estimated to be RL 100 metres.

Due to the low hydraulic conductivity of the shale the hydraulic gradient is expected to be very steep close to the pit but will become shallower with increasing distance. As the quarry is filled the hydraulic gradient will become shallower.

3.4 Hydraulic Conductivity

Hydraulic conductivity is another sensitive parameter for which there is little local data. The hydraulic conductivity of a fractured igneous rock has been estimated at between 0.0007 metres per day and 30 metres per day (Domenico and Schwartz, Physical and Chemical Hydrogeology, 1990). A hydraulic conductivity of 0.01 metres per day has been conservatively adopted for these calculations.

3.5 Quarry Void

Hornsby Shire Council advised on 9 March 2015 that there is approximately 50 mega litres of water within the quarry void. This volume would require removal as part of initial dewatering works for the project to enable filling works to commence at the void. It is understood that Hornsby Shire Council has undertaken dewatering at the quarry void since March 2015, but a 50 mega litre volume has been used in this assessment as a conservative estimate of water to be removed as part of initial dewatering works for the project.

3.6 Methodology

The base level of the quarry has been calculated for each month as the quarry is filled, assuming the same volume is emplaced every month. Since the quarry is an inverted conical shape the base level will increase more rapidly at the beginning of filling. By application of Darcy's Law inflow to the quarry has been calculated monthly based on the revised hydraulic parameters of:

- Revised base level
- Revised hydraulic gradient
- Revised cross sectional area.

The cross sectional area has been calculated by applying the surface area of a cylinder formula for segments of the quarry:

Area of a cylinder =2*PI*r*h

Where r = radius of the quarry

h = height of exposed saturated quarry

4 Groundwater Inflow

A groundwater inflow spreadsheet was set up which calculates the groundwater inflow (Q) as cubic metres per day for each of the 33 months. The spreadsheet calculations account for the changing base levels, changing hydraulic gradients, changing quarry geometry and changing saturated surface area of the quarry as it is progressively filled.

As expected groundwater inflow is greatest as the quarry is first pumped and progressively decreases as the quarry is infilled. This method calculated that a total of 636 mega litres will be extracted over 33 months, including the initial pumping of 50 mega litres to dewater the void to RL 8. This calculation is considered conservative as the hydraulic gradient is a sensitive parameter and influence has been assumed at a distance of 50 metres whereas the area of influence is likely to be less in a fractured rock aquifer with low hydraulic conductivity.

Initially in the first month the flow rate is estimated to be 12.5 litres per second decreasing to 7.9 litres per second after the first year. In the first 12 months an estimated 360 mega litres will be pumped from the quarry (initial dewatering and maintenance pumping) declining to 190 mega litres for the second year (maintenance pumping) and 85 mega litres for the last nine months of year 3 (maintenance pumping).

The estimated groundwater inflow rate once the void has been infilled to RL 64 is estimated to be 2.8 litres per second.

4.1 Allowable extraction rate

An existing groundwater licence (Licence Number 10BL602843) has been granted to Hornsby Shire Council by the Department of Primary Industries - Water (DPI Water) for dewatering activities at the Hornsby Quarry. The allowable extraction rate under the existing groundwater licence for dewatering at the quarry.is 370 mega litres per annum or approximately 1 mega litre per day (11.6 litres per second) in operation from 17 April 2014 to 16 April 2019. The calculations undertaken as part of this assessment indicate that the pumping requirements for the project will be in accordance with the licence conditions.

Although the calculations are considered conservative, the hydraulic conductivity is a sensitive parameter and obtaining some field data via slug tests would be useful to refine these calculations to provide further confidence.

(blank page)

5 Conclusion

The calculations for groundwater inflow to Hornsby Quarry estimate that groundwater inflows would be 12.5 litres per second at the commencement of infilling (at around RL 8) to an estimated 2.8 litres per second at RL 64. These calculations are based on the assumption of a hydraulic conductivity of 0.01 metres per day for fractured igneous rock. The estimates of groundwater inflow suggest that the groundwater to be pumped for the project would be compliant with the five year dewatering licence issued by DPI-Water, which has an annual allocation of 370 mega litres per year.

(blank page)

6 References

AECOM, 2013; Hornsby Quarry – Delivery Tunnel Study. Prepared for Roads and Maritime Services.

Cardno, 2013 ; Hornsby Quarry Land Filling Preliminary Impact Assessment. . Prepared for Hornsby Shire Council.

GHD, 2009; Review of Options for Filling Hornsby Quarry Discussion Paper. Prepared for Hornsby Shire Council.

Parsons Brinckerhoff, 2004; Hornsby Quarry and Environs Land Capability Study and Master Plan p Land Capability Study. Prepared for Hornsby Shire Council.

PSM, 2007; Geotechnical and hydrogeological constraints relevant to the land-use options within Hornsby Quarry. Pells, Sullivan Meynink Pty Ltd.

(blank page)

Appendix N

Discharge water quality monitoring data

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Site ID	Date	Day	Month	Year	Time	Probe Depth (m)	Temperature (oC)	Electrical Conductivity (ms/cm)	Electrical Conductivity (µS/cm)	Turbidity (NTU)	Dissolved oxygen (mg/L)	Dissolved oxygen (%sat)
2010 85 01	85	19-Jan-2010	19	1	2010	12:30	0.1	25.46	0.91	924	0	8.5	104
2010 85 02	85	28-Jan-2010	28	1	2010	10:00	0.28	26.32	0.9	927	0.1	8.53	106.2
2010 85 02.5	85	04-Feb-2010	4	2	2010	12:00		26.61	0.89	927	0.2	8.33	104
2010 85 04.5	85	09-Mar-2010	9	3	2010	14:50		24.39	0.8	810	0.5	9.38	112.5
2010 85 05	85	16-Mar-2010	16	3	2010	14:15	0.5	23.45	0.79	819	0	7.21	84.9
2010 85 05.5	85	23-Mar-2010	23	3	2010	13:00	0.25	24.03	0.78	821	0	8.14	97
2010 85 06	85	30-Mar-2010	30	3	2010	10:30	0.5	24.44	0.83	809	0	8.04	96.6
2010 85 06.5	85	08-Apr-2010	8	4	2010	11:45		23.06	0.81	807	0	7.9	92.3
2010 85 07	85	13-Apr-2010	13	4	2010	13:45	0.1	22.55	0.82	823	0.4	7.4	85
2010 85 07.5	85	21-Apr-2010	21	4	2010	12:00		21.83	0.83	824	0	7.82	89.4
2010 85 08	85	27-Apr-2010	27	4	2010	11:30	0.1	21.34	0.84	821	0.6	7.51	85.1
2010 85 08.5	85	05-May-2010	5	5	2010	13:20		20.34	0.86	830	0.5	7.69	85.4
2010 85 09	85	11-May-2010	11	5	2010	14:00		19.4	0.88	841	0	7.83	85.2
2010 85 10	85	25-May-2010	25	5	2010	13:30		17.45	0.86	856	0	7.55	78.9
2010 85 10.5	85	01-Jun-2010	1	6	2010	12:10		17.02	0.87	858	0	7.51	77.8
2010 85 10.7	85	08-Jun-2010	8	6	2010	13:00	0.1	16.37	0.88	845	5.2	7.1	73
2010 85 13	85	15-Jul-2010	15	7	2010	13:25		13.96	0.88	871	0	6.71	65.2
2010 85 14	85	27-Jul-2010	27	7	2010	8:30	0.5	13.49	0.89	884	-0.1	7.77	74.6
2010 85 15	85	10-Aug-2010	10	8	2010	13:10		13.44	0.89	878	0	8.11	77.8
2010 85 17	85	07-Sep-2010	7	9	2010	13:40		15.04			0.1	10.68	105.9
2010 85 20	85	19-Oct-2010	19	10	2010	12:40		18.66	0.91	884	0.2	10.02	107.5
2010 85 21	85	03-Nov-2010	3	11	2010	13:45		19.64	0.89	878	0	10.63	116.2
2010 85 23	85	02-Dec-2010	2	12	2010	9:00	0.5	22.46	0.86	830	0	9.2	106.5
2010 85 23	85	08-Dec-2010	8	12	2010	14:00	0.5	24.17	0.85	858	2.8	10.04	120
2010 85 23	85	09-Dec-2010	9	12	2010	13:30	0.5	24.18	0.85	860	0	9.94	118.7
2010 85 24	85	22-Dec-2010	22	12	2010	13:00	0.5						
2011 85 01.5	85	14-Jan-2011	14	1	2011	10:40	0.5	26	0.87	865	-0.2	9	111.3
2011 85 02	85	18-Jan-2011	18	1	2011	12:40		26.51	0.86	865	0.8	8.64	107
2011 85 02.5	85	25-Jan-2011	25	1	2011	9:45	0.5	26.6	0.87	867	-0.1	8.44	106
2011 85 02.5	85	01-Feb-2011	1	2	2011	12:30	0.5	27.3	0.91	881	0.4	9.03	115
2011 85 10	85	19-May-2011	19	5	2011	15:00	0.1	16.76	0.89	877	0	9.17	95.9

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Site ID	Date	Day	Month	Year	Time	Probe Depth (m)	Temperature (oC)	Electrical Conductivity (ms/cm)	Electrical Conductivity (µS/cm)	Turbidity (NTU)	Dissolved oxygen (mg/L)	Dissolved oxygen (%sat)
2011 85 12	85	14-Jun-2011	14	6	2011	14:40	0.5	14.95	0.92	879	0.5	8.25	81
2011 85 13	85	30-Jun-2011	30	6	2011	13:10	0.5	13.88	0.88	892	0	6.05	59
2011 85 16	85	12-Aug-2011	12	8	2011	9:30	0.5	13	0.89	879	-0.2	9.5	90
2011 85 16	85	16-Aug-2011	16	8	2011	9:32	0.5	13.3	0.88	880	0	10.6	100
2011 85 17	85	31-Aug-2011	31	8	2011	9:00	0.5	14.57	0.86	861	0	13	128.8
2011 85 20	85	13-Oct-2011	13	10	2012	10:55		17.8	0.85	847	0	11.47	120.8
2011 85 21	85	25-Oct-2011	25	11	2011	14:57	0.1	19.97	0.85	835	-0.01	11.4	124.3
2011 85 23	85	22-Nov-2011	22	11	2011	14:40	0.1	23.51	0.79	832	0.5	9.76	113.4
2012 85 01	85	13-Jan-2012	13	1	2012	12:55		24.61	0.77	800	0	8.09	111
2012 85 03	85	09-Feb-2012	9	2	2012	8:50		24.15	0.72	770	-0.2	9.07	108
2012 85 12	85	13-Mar-2012	13	3	2012	9:15	0.1	23.81	0.73	762	0.4	9.1	107.9
2012 85 13	85	03-Jul-2012	3	7	2012	12:30	0.1	13.49	0.84	822	0.7	7.13	68.5
2012 85 16	85	22-Aug-2012	22	8	2012	14:15	0.1	12.98	0.86	856	0.5	11.11	105.6
2012 85 18	85	20-Sep-2012	20	9	2012	14:05	0.1	16.32	0.85	856	1	12.32	125.8
2012 85 22	85	13-Nov-2012	13	11	2012	13:45	0.1	22.1	0.86	843	2.3	9.64	110.8
2012 85 24	85	10-Dec-2012	10	12	2012	14:38	0.24	23.24	0.83	837	0.9	8.14	95.5
20130109085	085	09-Jan-2013	09	01	2013	14:26		26.31	0.83	882	1.7	8.89	110.5
20130215085	085	15-Feb-2013	15	02	2013	01:43	0.50	24.81	0.80	839	0.9	10.60	128.10
20130409085	085	09-Apr-2013	09	04	2013	14:00	0.1	22.53	0.75	835	3.4	6.66	84.8
20131216085	085	16-Dec-2013	16	12	2013	14:00	0.10	25.10	0.71	799	1.5	9.17	111.50
20140114085	085	14-Jan-2014	14	01	2014	14:30	0.10	25.72	0.78	805	3.7	9.72	119.50
20140121085	085	21-Jan-2014	21	01	2014	09:15	0.03	26.53	0.77	801	7.0	7.99	99.60
20140123085	085	23-Jan-2014	23	01	2014	09:20	0.50	25.76	0.78	802	3.5	9.06	111.40
20140128085	085	28-Jan-2014	28	01	2014	09:30	0.10	20.58	0.89	860	2.6	9.26	103.20
20140128085	085	28-Jan-2014	28	01	2014		0.10	20.57	0.89	860	2.8	9.26	103.20
20140204085	085	04-Feb-2014	04	02	2014	14:55	0.10	22.57	0.84	925	2.6	8.07	93.80
20140211085	085	11-Feb-2014	11	02	2014	14:40	0.10	22.39	0.79	857	2.0	8.04	92.90
20140219085	085	19-Feb-2014	19	02	2014	09:30	0.10	22.79	0.78	857	2.1	8.51	99.10
20140327085	085	27-Mar-2014	27	03	2014	15:15	0.10	23.53	0.77	867	1.2	7.60	89.80
20140415085	085	15-Apr-2014	15	04	2014	13:30	0.10	22.74	0.78	865	1.0	8.15	94.80
20140512085	085	12-May-2014	12	05	2014	14:10	0.10	19.67	0.79	848	0.6	8.83	96.50
20140623085	085	23-Jun-2014	23	06	2014	10:31	0.10	15.61	0.81	869	0.8	9.95	100.10
20140716085	085	16-Jul-2014	16	07	2014	09:02	0.10	12.09	0.82	889	1.1	11.34	105.50
20140911085	085	11-Sep-2014	11	09	2014	14:40	0.10	14.76	0.85	897	0.8	12.92	115.36

Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	pH (x.xx)	Salinity (ppt)	Weather	Wet/Dry	Weather comments	Nuisance organisms	N organism comment	Oily Films	Oily films comments	Odour	Odour comments	Frothing	Frothing
2010 85 01	8.3	0.46	fine	dry	no rain 1 wk	n		n		n		n	
2010 85 02	8.4	0.45	fine	dry		n		n		y	sl algal odour	n	
2010 85 02.5	8.54	0.45	overcast	showers		n		n		n		n	
2010 85 04.5	8.5	0.39	fine	dry		n		n		n		n	
2010 85 05	8.32	0.4	fine	dry		n		n		n		n	
2010 85 05.5	8.48	0.42	fine	dry		n		n		n		n	
2010 85 06	8.43	0.42	overcast	dry	raining	n		n		n		n	
2010 85 06.5	8.31	0.41	fine	dry		n		n		n		n	
2010 85 07	7.15	0.41	fine	dry		n		n		n		n	
2010 85 07.5	8.25	0.42	fine	dry		n		n		n		n	
2010 85 08	8.1	0.42	fine	dry		n		n		n		n	
2010 85 08.5	8.22	0.43	fine	dry		n		n		n		n	
2010 85 09	8	0.44	fine	dry		n		n		n		n	
2010 85 10	8.03	0.43	overcast	wet		n		n		n		n	
2010 85 10.5	7.95	0.44	overcast	wet		n		n		n		n	
2010 85 10.7	7.91	0.41	fine			n		n		n		n	
2010 85 13	7.81	0.44	fine	dry		n		n		n		n	
2010 85 14	7.8	0.45	overcast	dry	showers over	n		n		n		n	
2010 85 15	7.73	0.45	raining	wet		n		n		n		n	
2010 85 17	8.3		fine	dry		n		n		n		n	
2010 85 20	8.27	0.46	fine	dry		n		n		n		n	
2010 85 21	8.39	0.45	fine	wet		n		n		n		n	
2010 85 23	8.43	0.44	overcast	wet	30mm in 48h	n		n		y	algal odour	n	
2010 85 23	8.48	0.43	fine	dry									
2010 85 23	8.38	0.43	overcast	dry		n		n		n		n	
2010 85 24													
2011 85 01.5	8.5	0.44	fine	dry		n		n		y	sl algal	n	
2011 85 02	8.4	0.43	fine	dry		n		n		n		n	
2011 85 02.5	8.3	0.44	fine, hot	dry	no rain 12 day	n		n		y	sl algal	n	
2011 85 02.5	8.5	0.46				n		n		y	sl algal	n	
2011 85 10	8.08	0.45	fine	dry		n		n		n		n	

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	pH (x.xx)	Salinity (ppt)	Weather	Wet/Dry	Weather comments	Nuisance organisms	N organism comment	Oily Films	Oily films comments	Odour	Odour comments	Frothing	Frothing
2011 85 12	7.8	0.46	drizzle, after	wet		n		n		n		n	
2011 85 13		0.44	overcast	wet		n		n		n		n	
2011 85 16	8.14	0.45	overcast	wet		n		n		n		n	
2011 85 16	8.18	0.44	sunny, cold	dry		n		n		n		n	
2011 85 17	8.05	0.43	fine	dry	fine	n		n		y	sl algae small	n	
2011 85 20	8.37	0.43	dry, overcas	dry		n		n		n		n	
2011 85 21	7.4	0.44	overcast	dry	2mm overnig	n		n		n		n	
2011 85 23	8.3	0.4	overcast	dry	6mm rain ove	n		n		n		n	
2012 85 01	8.25	0.39	fine	dry		n		n		n		n	
2012 85 03	8.42	0.36	overcast	dry		n		n		y	slight algal sr	n	
2012 85 12	8.43	0.37	fine	dry		n		n		n		n	
2012 85 13	7.96	0.42	fine	dry		n		n		n		n	
2012 85 16	8.34	0.43	sunny	dry		n		n		n		n	
2012 85 18	8.56	0.43	sunny	dry		n		n		n		n	
2012 85 22	8.45	0.43	sunny	dry		n		n		n		n	
2012 85 24	8.41	0.42											
20130109085	8.48	0.42	overcast	dry		N		N		N		N	
20130215085	8.60	0.40	Sunny	Dry		No		No		No		No	
20130409085	8.31	0.38											
20131216085	8.40	0.38	Clear	Dry		No		No		No		No	
20140114085	8.68	0.39	Sunny	Dry		Yes	Green in quarry pit, slight algal odour			Yes	slight algal od	No	
20140121085	8.53	0.39											
20140123085	8.66	0.39	Overcast	Dry		No		No		No		No	
20140128085	8.15	0.45	Clear	Dry		No		No		No		No	
20140128085	8.15	0.45											
20140204085	8.24	0.42	Drizzle	Dry									
20140211085	8.18	0.40				No		No		No		No	
20140219085	8.37	0.39	Overcast	Wet		No		No		No		No	
20140327085	8.16	0.41	Overcast	Wet		No		No		No		No	
20140415085	8.20	0.39	Overcast	Dry									
20140512085	8.25	0.39	Clear	Dry		No		No		No		No	
20140623085	8.21	0.41	Overcast	Dry		No		No		No		No	
20140716085	7.81	0.41	Drizzle	Dry		No		No		No		No	
20140911085	8.51	0.43	Sunny	Dry		No		No		No		No	

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)

Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Flow ranking	Flow rate (ranking to 2004, then 'lpm' from nov 2007	Flow depth	Velocity	Flow comments	Water appearance	Water site/sampling comments	Lab	Lab report	Suspended Solids (mg/L)	Ammonium-Nitrogen (mg/L)	Oxidised Nitrogen (mg/L)	TKN (mg/L)
2010 85 01			34cm			cc	quite turbulant,	L10004200	61984	1	0.005	0.005	
2010 85 02			34cm			cc		L10006790	62404	1	0.005	0.005	
2010 85 02.5		3500	34cm			cc		L10008659	62449	1	0.005	0.005	
2010 85 04.5			34cm			cc		L10020570	64026	1	0.005	0.005	
2010 85 05		3600	34cm			cc	probe in concre	L10022588	64157	1	0.04	0.01	
2010 85 05.5		3600	34cm			cc		L10024562	64696	1	0.03	0.01	
2010 85 06		3600	34cm			cc		L10025892	64909	1	0.02	0.01	
2010 85 06.5		3600	34cm			cc		L10028068	65305	1	0.01	0.02	
2010 85 07		3600	34cm			cc		L10029075	65461	1	0.005	0.01	
2010 85 07.5	average	3600				cc		L10030952	65620	1	0.005	0.005	
2010 85 08	average	3600				cc		L10032076	65869	1	0.005	0.005	
2010 85 08.5	average	3600				cc		L10034189	66330	1	0.005	0.005	
2010 85 09	average	3600				cc		L10035199	66594	1	0.005	0.005	
2010 85 10	average	3600				cc		L10039107	67115	1	0.005	0.005	
2010 85 10.5	average	3600				cc		L10040691	67392	1	0.005	0.005	
2010 85 10.7	average	3600				sl turbid	turbid in flow b	L10042860	67701	2	0.01	0.05	
2010 85 13	average	3600				cc		L10051738	69283	1	0.03	0.06	
2010 85 14	av	3600				cc		L10054559	69538	1	0.005	0.05	
2010 85 15	average	3600				cc		L10058668	70038	1	0.005	0.06	
2010 85 17						cc		L10065121	71339	1	0.01	0.01	
2010 85 20		3600				cc		L10075880	73028	1	0.005	0.005	
2010 85 21	average	3600				cc		L10080009	73555	1	0.005	0.005	
2010 85 23	1cm below upper mark on weir					cc		L10088117	74946	1	0.005	0.005	
2010 85 23	average	3600											
2010 85 23	average	3600				cc		L10090326	75249	1	0.005	0.005	
2010 85 24								L10096933	75669				
2011 85 01.5	av	3600				cc		L11004615	76235	1	0.005	0.005	
2011 85 02	average	3600				cc		L11005569	76310	1	0.01	0.005	
2011 85 02.5	av	3600				cc							
2011 85 02.5	av	3600				cc		L11009006	76824				
2011 85 10	average	3600				cc		L11035099	81067	1	0.005	0.005	

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Flow ranking	Flow rate (ranking to 2004, then 'lpm' from nov 2007	Flow depth	Velocity	Flow comments	Water appearance	Water site/sampling comments	Lab	Lab report	Suspended Solids (mg/L)	Ammonium-Nitrogen (mg/L)	Oxidised Nitrogen (mg/L)	TKN (mg/L)
2011 85 12	av	3600				clear		L11040767	81960	1	0.005	0.01	
2011 85 13	av	3600				cc	7mm overnght	L11044886	82629		0.02	0.03	
2011 85 16	av					cc		L11056006	84350	1	0.01	0.04	
2011 85 16	av							L11056956	84369	1	0.005	0.02	
2011 85 17	av	3600				cc		L11060975	85056	3	0.005	0.005	
2011 85 20	ab av	4000				cc		L11071761	86650	2	0.005	0.005	
2011 85 21	av	3600				cc		L11074620	87007	1	0.005	0.005	
2011 85 23	average	3600				cc		L11081829	88124	1	0.005	0.005	
2012 85 01	average	3600				cc	pumping just st	L12003212	89688	1	0.005	0.005	
2012 85 03	av	3600				cc		L12010300	90529	1	0.005	0.005	
2012 85 12	average	3600				cc		L12026343	91810	1	0.005	0.005	
2012 85 13	average	3600				cc		L12057229	95824	1	0.02	0.01	
2012 85 16						cc		L12070732	97775	1	0.005	0.005	
2012 85 18	average					cc		L12077995	98880	1	0.005	0.005	
2012 85 22	average					cc	lid off tanks	L12092192	101111	1	0.005	0.005	
2012 85 24								L12099579	102357	1	0.005	0.005	
20130109085	average	3600				cc		L13002773	103107	1	0.005	0.005	
20130215085	Average					Clear, Colourless		L13013371	104982	1	0.005	0.02	
20130409085								L13029540	107087	3	0.005	0.005	
20131216085	Average					Clear, Colourless		L13104495	117827	1	0.005	0.005	
20140114085	Average					Clear, Colourless		L14003765	118592	3	0.005	0.005	
20140121085								L14005845	118808	3	0.005	0.005	
20140123085						Clear, Colourless		L14006899	118915	6	0.005	0.005	
20140128085							clear colourless	L14008410	119040	2	0.005	0.005	
20140128085								L14008410	119040	2	0.005	0.005	
20140204085						Clear, Colourless	sample from pu	L14010691	119517	1	0.005	0.005	
20140211085						Clear, Colourless		L14012411	119880	2	0.005	0.005	
20140219085	Average					Clear, Colourless	Sample taken f	L14014937	120113	1	0.005	0.005	
20140327085	Average					Clear, Colourless		L14024757	121650	2	0.005	0.005	
20140415085						clear, coloured		L14029904	122422	2	0.005	0.005	
20140512085	Average					Clear, Colourless		L14036319	123443	1	0.005	0.005	
20140623085						Clear, Colourless		L14047408	125291	1	0.005	0.005	
20140716085						Clear, Colourless		L14052314	126174	2	0.005	0.005	
20140911085	Average					Clear, Colourless		L14068297	128766	3	0.005	0.005	

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Soluble Reactive Phosphorus (mg/L)	Chlorophyll-A (ug/L)	Faecal Coliforms (CFU/100ml)	Enterococci (CFU/100ml)	E Coli (CFU/100mL)	Bicarbonate Alkalinity (mg/CaCO3/L)	Chloride (mg/L)	Sulphate as SO_4^{2-} (mg/L)	Fluoride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)
2010 85 01	0.19	0.006		1.3	0.5	1								
2010 85 02	0.2	0.006		2.2	5									
2010 85 02.5	0.21	0.007		1.9	3									
2010 85 04.5	0.29	0.009		5.6	26	7								
2010 85 05	0.28	0.007		2.4	21	2								
2010 85 05.5	0.23	0.005		2.6	30	2								
2010 85 06	0.25	0.007		2.6	7	4								
2010 85 06.5	0.24	0.007		4.1	15									
2010 85 07	0.2	0.007		5	12	2								
2010 85 07.5	0.21	0.008		5.8	3	1								
2010 85 08	0.17	0.008		3.4	13	0.5								
2010 85 08.5	0.21	0.006		3.7	3	2								
2010 85 09	0.2	0.004		3.3	1	0								
2010 85 10	0.18	0.009		3.2	5	1								
2010 85 10.5	0.18	0.01		3.1	3	3								
2010 85 10.7	0.24	0.016		2.4	20	23								
2010 85 13	0.26	0.01		3.5	3	2						68.1		
2010 85 14	0.23	0.011		7.5	6	3								
2010 85 15	0.23	0.008		3.6	6	0.5								
2010 85 17	0.2	0.009		2.8	3	0.5								
2010 85 20	0.18	0.005		2	5	5								
2010 85 21	0.16	0.006		2	0.5	0.5								
2010 85 23	0.18	0.004		1.9	12	6								
2010 85 23														
2010 85 23	0.18	0.004		0.9	0.5	3								
2010 85 24				1.5										
2011 85 01.5	0.16	0.006		1.5	32	3								
2011 85 02	0.19	0.006		1.6	12	1								
2011 85 02.5														
2011 85 02.5				1.6										
2011 85 10	0.18	0.005		3.8	3	0.5								

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Soluble Reactive Phosphorus (mg/L)	Chlorophyll-A (ug/L)	Faecal Coliforms (CFU/100ml)	Enterococci (CFU/100ml)	E Coli (CFU/100mL)	Bicarbonate Alkalinity (mg/CaCO3/L)	Chloride (mg/L)	Sulphate as SO_4^{2-} (mg/L)	Fluoride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)
2011 85 12	0.19	0.006		5.3	16	3								
2011 85 13	0.24	0.011		4.4	21	3								
2011 85 16	0.24	0.01		6.5	4	1								
2011 85 16	0.25	0.011		6.9	1	5								
2011 85 17	0.19	0.01		3.6	1	0.5								
2011 85 20	0.16	0.005		1	2	2								
2011 85 21	0.17	0.004		0.3	0.5	1								
2011 85 23	0.16	0.004		1.5	9	15								
2012 85 01	0.17	0.006		1.9	0.5	4								
2012 85 03	0.18	0.007		5	34	5								
2012 85 12	0.19	0.006		0.3	3	2								
2012 85 13	0.18	0.008		4.7	3	0.5								
2012 85 16	0.2	0.01		6.5	14									
2012 85 18	0.16	0.008		2.5	1	5								
2012 85 22	0.16	0.006		0.8	3	2								
2012 85 24	0.18	0.006		2.1	11	8								
20130109085	0.18	0.007		2	13	3								
20130215085	0.23	0.007		4.5	5	0.5								
20130409085	0.21	0.009		4.7	15	3								
20131216085	0.28	0.012		4.4	6	80								
20140114085	0.23	0.008		3.9	21	16								
20140121085	0.23	0.009		9	36	45								
20140123085	0.23	0.009		3.7	22	40								
20140128085	0.29	0.014		6.3	16	11								
20140128085	0.29	0.014		6.3	16	11								
20140204085	0.25	0.019		8.4	12	13								
20140211085	0.22	0.014		8.8	6	1								
20140219085	0.21	0.011		8.1	11	1								
20140327085	0.2	0.011		10.5	27									
20140415085	0.18	0.01		9.3	21	1								
20140512085	0.24	0.026		12.7	14	4								
20140623085	0.22	0.013		15.9	17	2								
20140716085	0.23	0.017		16.9	6	3								
20140911085	0.22	0.013		13.4	5	1								

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Calcium (mg/L)	Aluminium (ug/L)	Arsenic (ug/L)	Cadmium (ug/L)
2010 85 01				
2010 85 02				
2010 85 02.5				
2010 85 04.5				
2010 85 05				
2010 85 05.5				
2010 85 06				
2010 85 06.5				
2010 85 07				
2010 85 07.5				
2010 85 08				
2010 85 08.5				
2010 85 09				
2010 85 10				
2010 85 10.5				
2010 85 10.7				
2010 85 13	49	16	0.5	0.5
2010 85 14		5	0.5	0.5
2010 85 15				
2010 85 17				
2010 85 20		5	0.5	0.5
2010 85 21				
2010 85 23				
2010 85 23				
2010 85 23				
2010 85 24				
2011 85 01.5				
2011 85 02				
2011 85 02.5				
2011 85 02.5				
2011 85 10				

Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Calcium (mg/L)	Aluminium (ug/L)	Arsenic (ug/L)	Cadmium (ug/L)
2011 85 12				
2011 85 13				
2011 85 16				
2011 85 16				
2011 85 17				
2011 85 20				
2011 85 21				
2011 85 23				
2012 85 01				
2012 85 03				
2012 85 12				
2012 85 13				
2012 85 16				
2012 85 18				
2012 85 22				
2012 85 24				
20130109085				
20130215085				
20130409085				
20131216085				
20140114085				
20140121085				
20140123085				
20140128085				
20140128085				
20140204085				
20140211085				
20140219085				
20140327085				
20140415085				
20140512085				
20140623085				
20140716085				
20140911085				

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Chromium (ug/L)	Copper (ug/L)	Lead (ug/L)	Manganese (ug/L)	Molybdenum (ug/L)	Nickel (ug/L)	Selenium (ug/L)	Silver (ug/L)	Uranium (ug/L)	Zinc (ug/L)	Boron (ug/L)	Iron (ug/L)	Mercury (ug/L)
2010 85 01													
2010 85 02													
2010 85 02.5													
2010 85 04.5													
2010 85 05													
2010 85 05.5													
2010 85 06													
2010 85 06.5													
2010 85 07													
2010 85 07.5													
2010 85 08													
2010 85 08.5	0.5			5		0.5						36	
2010 85 09													
2010 85 10													
2010 85 10.5	0.5			7		1				2.5		7	
2010 85 10.7	0.5			6		1				2.5		208	
2010 85 13	0.5	0.5	0.5	7	12	1	1.5	0.5	0.5	9	24	11	
2010 85 14	0.5	0.5	0.5	0.5	11	0.5	1.5	0.5	0.5	0.5	16	8	
2010 85 15													
2010 85 17													
2010 85 20	0.5	1	0.5	2	11	0.5	1.5	0.5	0.5	5	15	10	0.1
2010 85 21													
2010 85 23													
2010 85 23													
2010 85 23													
2010 85 24													
2011 85 01.5													
2011 85 02													
2011 85 02.5													
2011 85 02.5													
2011 85 10													

Appendix N – Dewatering Discharge Water Quality Data 2010-2014 (Hornsby Shire Council)
Monitoring point: Site 085, a square notch weir uphill of the discharge point in Old Mans Creek

Chem ID	Chromium (ug/L)	Copper (ug/L)	Lead (ug/L)	Manganese (ug/L)	Molybdenum (ug/L)	Nickel (ug/L)	Selenium (ug/L)	Silver (ug/L)	Uranium (ug/L)	Zinc (ug/L)	Boron (ug/L)	Iron (ug/L)	Mercury (ug/L)
2011 85 12													
2011 85 13													
2011 85 16													
2011 85 16													
2011 85 17													
2011 85 20													
2011 85 21													
2011 85 23													
2012 85 01													
2012 85 03													
2012 85 12													
2012 85 13													
2012 85 16													
2012 85 18													
2012 85 22													
2012 85 24													
20130109085													
20130215085													
20130409085													
20131216085													
20140114085													
20140121085													
20140123085													
20140128085													
20140128085													
20140204085													
20140211085													
20140219085													
20140327085													
20140415085													
20140512085													
20140623085													
20140716085													
20140911085													

rms.nsw.gov.au

contactus@rms.nsw.gov.au

Customer feedback
Roads and Maritime
Locked Bag 928
North Sydney NSW 2059

Transport
Roads & Maritime Services

August 2015
15.498
ISBN: 978-1-925357-55-4