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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 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 Kuringgai" (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 surrounded 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.

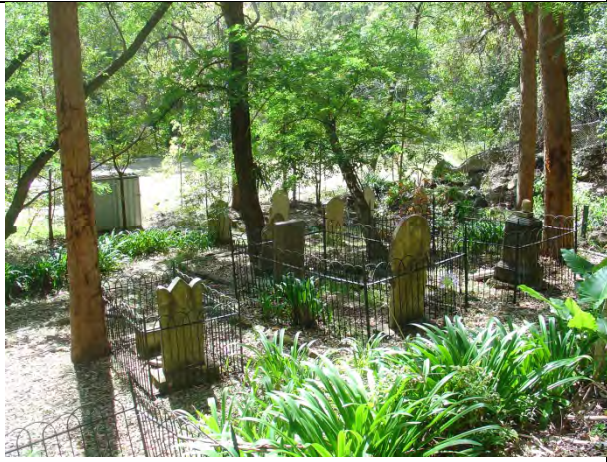
	
Plate 2 Heritage Walk Depression era stairs circa August 1994 (Hornsby Shire Council, 1994)	Plate 3 Heritage Walk Depression era stairs circa December 2013
	
Plate 4 Cool room	Plate 5 Cool room location
	
Plate 6 Old Man's Valley Cemetery	Plate 7 Higgins Homestead/Memorial

	
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)	<i>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.</i>
Associative significance SHR criteria (b)	<i>This item is associated with the period of use of the Hornsby Quarry and is a physical example of the works undertaken for the quarry.</i>
Aesthetic significance SHR criteria (c)	<i>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.</i>
Social significance SHR criteria (d)	<i>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.</i>
Research Potential SHR criteria (e)	<i>No research potential significance was identified for this item.</i>
Rarity SHR criteria (f)	<i>No rarity significance was identified for this item.</i>
Representativeness SHR criteria (g)	<i>No representative significance was identified for this item.</i>
Statement of significance	<i>"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"</i>

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)	<i>"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.</i> <i>"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".</i>
Associative significance SHR criteria (b)	<i>"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".</i>
Aesthetic significance SHR criteria (c)	<i>"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".</i>
Social significance SHR criteria (d)	<i>"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".</i>

Significance criteria	Application of criteria
Research Potential SHR criteria (e)	<i>"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".</i>
Rarity SHR criteria (f)	<i>"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".</i>
Representativeness SHR criteria (g)	<i>"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".</i>
Statement of significance	<i>"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.</i> <i>"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".</i>

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)	<i>"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".</i>
Associative significance SHR criteria (b)	<i>No associative significance was identified for this item.</i>
Aesthetic significance SHR criteria (c)	<i>No aesthetic significance was identified for this item.</i>
Social significance SHR criteria (d)	<i>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".</i>
Research Potential SHR criteria (e)	<i>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.</i>
Rarity SHR criteria (f)	<i>No rarity significance was identified for this item.</i>
Representativeness SHR criteria (g)	<i>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".</i>
Statement of significance	<i>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.</i>

Table 9 Hornsby Quarry Industrial Machinery and Buildings (Parsons Brinckerhoff Australia Pty Ltd, 2004)

Significance criteria	Application of criteria
Historical significance SHR criteria (a)	<i>"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".</i>
Associative significance SHR criteria (b)	<i>No associative significance was identified for this item.</i>
Aesthetic significance SHR criteria (c)	<i>"The quarry machinery provides physical evidence of an important period of industrial achievement in the Hornsby Shire".</i>
Social significance SHR criteria (d)	<i>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.</i>
Research Potential SHR criteria (e)	<i>No research potential significance was identified for this item.</i>
Rarity SHR criteria (f)	<i>No rarity significance was identified for this item.</i>
Representativeness SHR criteria (g)	<i>No representative significance was identified for this item.</i>
Statement of significance	<i>The quarry machinery provides physical evidence of local industrial achievement and can provide a connection to the local Hornsby community's past.</i>

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.	Fulfil 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.	Fulfil 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.	Fulfil 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.

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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 diatrema, 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 Diatrema 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.

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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 diatrema 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 Diatrema Hornsby Quarry and surrounding vegetation should be considered during conveyor construction/use and stabilisation works, to minimise impacts to the diatrema.
- 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.

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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

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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.

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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			
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 of 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 conveyor is still being constructed.
Spoil emplacement	Once the conveyor 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

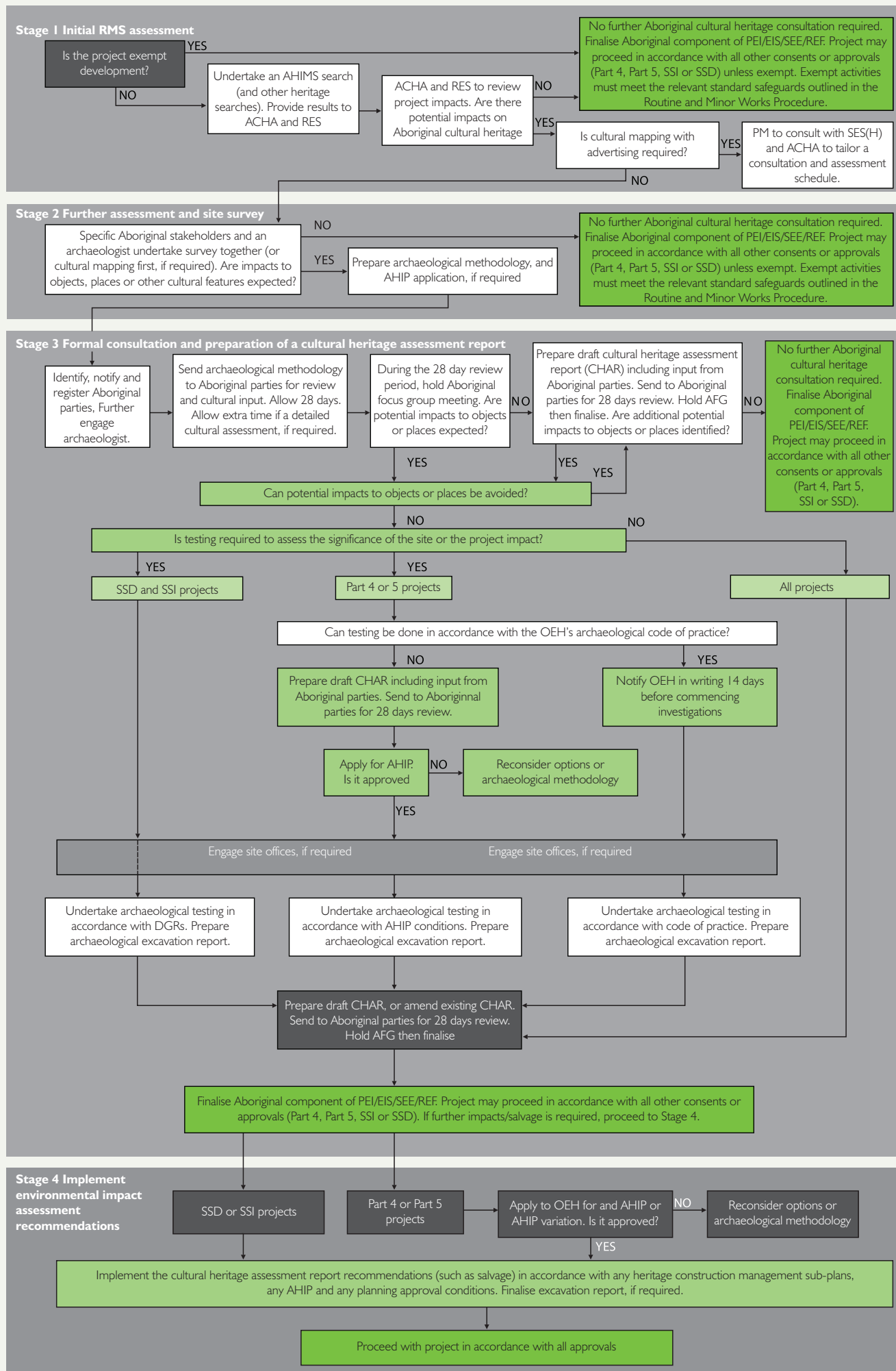


Figure 2 The PACHCI process (Roads and Maritime Services, 2011)



Figure 3 Proposed spoil management footprint and AHIMS sites

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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
<i>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:</i>	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.
<i>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,</i>	The <i>Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation</i> (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.
<i>be undertaken by a suitably qualified heritage consultant(s),</i>	This assessment was undertaken by Dr Darran Jordan, a suitably qualified archaeologist and heritage specialist at AECOM.
<i>demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures),</i>	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).
<i>assess and document the archaeological and cultural significance of cultural heritage values of affected sites, and</i>	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.
<i>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.</i>	This assessment adhered to the <i>Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010)</i> . 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".

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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 basaltic 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 siliceous 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 (<i>Oplismenus aemulus</i>)	Grasses could be used in weaving for nets and bags (Australian Government, 2007).
Black wattle (<i>Acacia mearnsii</i>)	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 (<i>Pteridium esculentum</i>)	The tuber could be eaten as a food staple (Isaacs, 2002:44).
Burrawang (<i>Macrozamia communis</i>)	Following leaching and cooking the seeds or nuts could be eaten (Isaacs, 2002:83).
Kangaroo grass (<i>Themeda australis</i>)	The seeds could be baked into cakes and the fibre used to produce fishing net (Australian National Botanic Gardens (ANBG), 2007).
Long leaf wattle (<i>Acacia longissima</i>)	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 (<i>Acacia oxycedrus</i>)	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 (<i>Eucalyptus saligna</i>)	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 Kuringgai” (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.

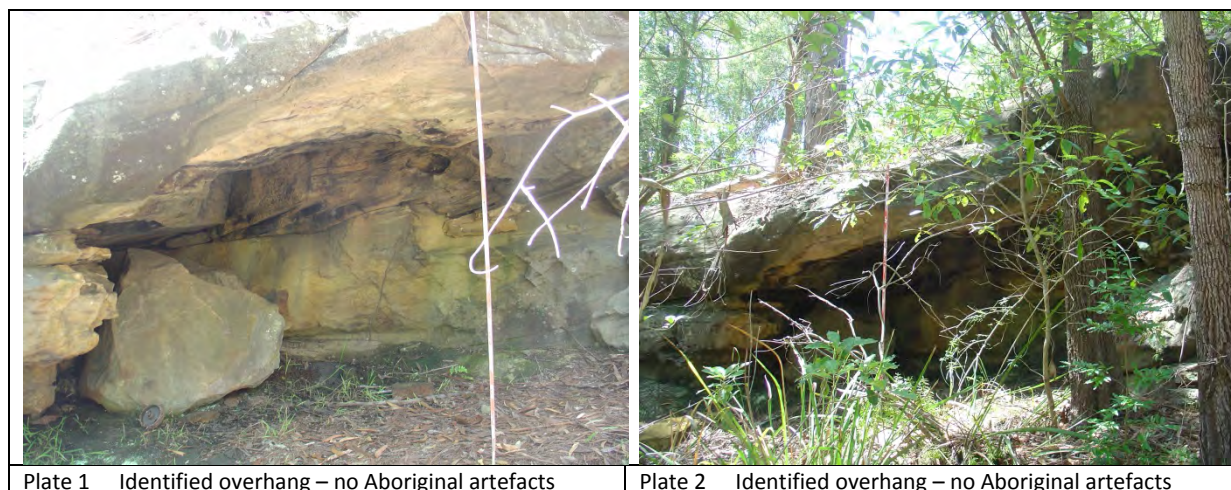
Aboriginal consultation identified the overhang as having potential cultural sensitivity within the study area, describing it as “the only feature of Aboriginal cultural heritage identified during this assessment”, noting that it was “sufficient temporary coverage for only 3-4 people and would it be 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.



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

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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.

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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.

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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 Pacific 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 subject 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.

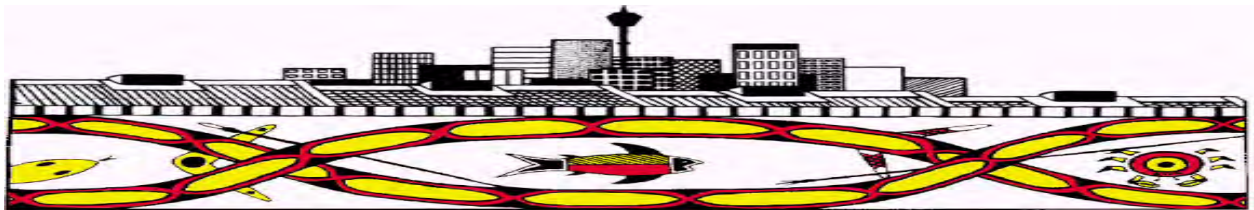
Appendix B MLALC Cultural Report

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

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	T Russell	Artefact : -	Shelter with Deposit	Val Attenbrow	2047		151.09	-33.73
45-6-2861	FR01	AGD	56	317654	6265123	Open site	Valid		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)	SAGD	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 (Pigment	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 (Pigment	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	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	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,Rt	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	cAGD	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 (Pigment	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 Smil	764,1214		151.05	-33.71
45-6-1649	Pyes Creek 1(Cherry br	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 Spui	AGD	56	321700	6269050	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	R Clegg			151.08	-33.70
45-6-1880	Blackfellows Head Spui	AGD	56	321700	6269050	Open site	Valid		Art (Pigment or Engrave	Rock Engraving	R Clegg			151.08	-33.70
45-6-1881	Blackfellows Head Spui	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 Kangaro	AGD	56	321040	6269523	Closed sit	Valid		Art (Pigment or Engrave	Shelter with Art	ASRSYS			151.07	-33.70
45-6-1703	Blackfellows Head Spui	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 Spui	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 Spi	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	1209		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	IGDA	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 Tl 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

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

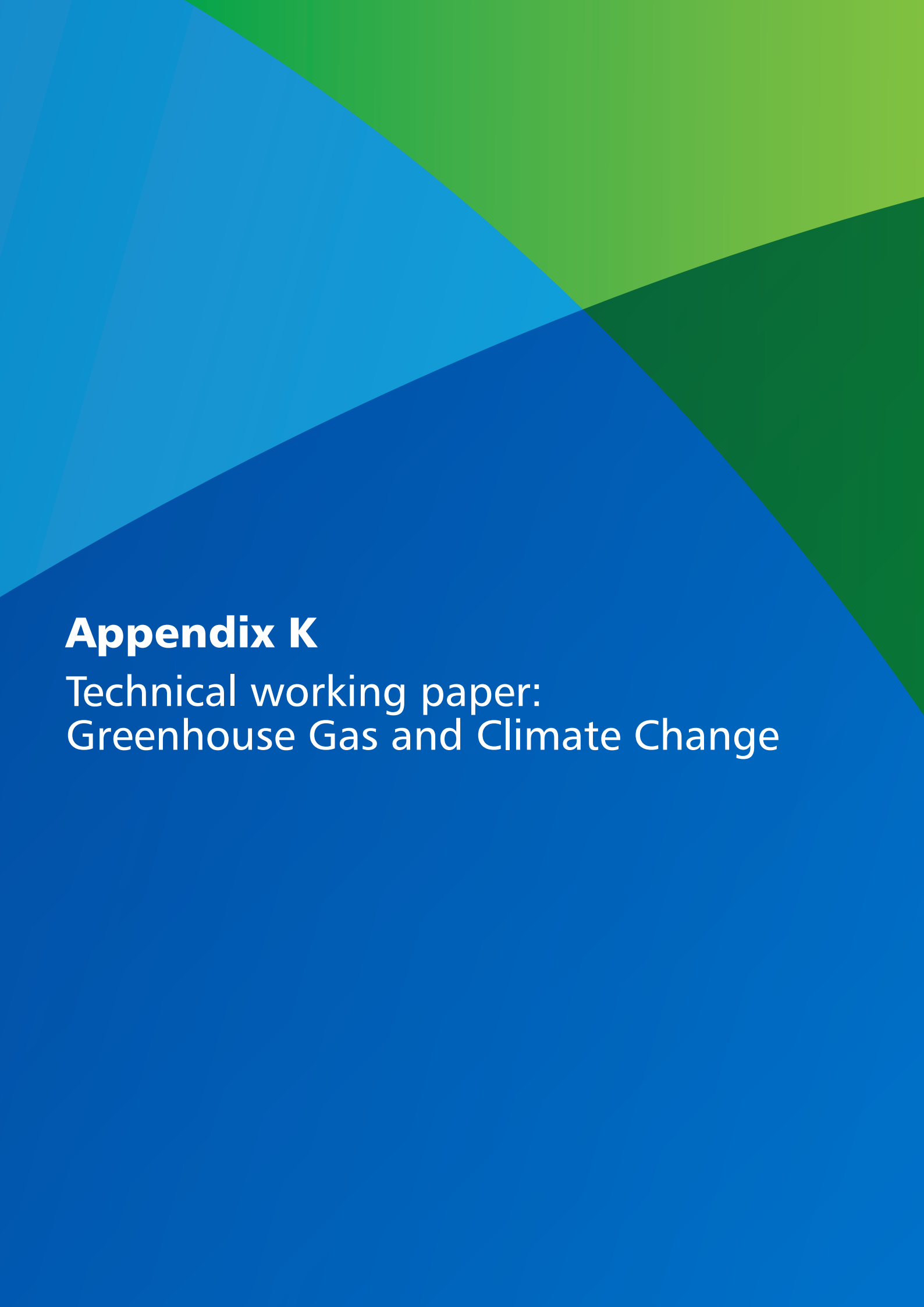
GI rating	Definition
Low	Area has been subject to significant disturbance through natural and/or anthropogenic processes (e.g., heavy earthworks).
Moderate	Area has been subject to moderate disturbance (e.g., native vegetation clearance) but retains a reasonable degree of integrity.
High	Area remains 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 <i>reasonable</i> 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.

The background of the page is composed of several overlapping triangles in shades of blue and green. A large blue triangle occupies the bottom half of the page. Above it, there are lighter blue and green triangles, creating a layered, geometric effect.

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

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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 conveyor, transport of the spoil via the conveyor into the quarry void, and movement of spoil along the quarry floor.
- Site demobilisation and rehabilitation: includes the demobilisation and removal of construction compound, conveyor 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 CO₂-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 CO₂-e indirect Scope 2 greenhouse gas emissions. The project would not import electricity from the grid.
- 4,456 t CO₂-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).

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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			
Site establishment (including preparatory works)												
Establishment of conveyer												
Spoil haulage and stockpiling												
Spoil emplacement (operation of conveyer)												
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.

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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-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 conveyor, transport of the spoil via the conveyor 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, conveyor 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 conveyor, operation of the conveyor 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.

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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 CO₂e. The breakdown of emissions by scope is shown in Figure 2 and summarised as:

- 14,475 t CO₂e direct Scope 1 greenhouse gas emissions.
- Zero t CO₂e indirect Scope 2 greenhouse gas emissions.
- 4,456 t CO₂e 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 CO₂e)

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).

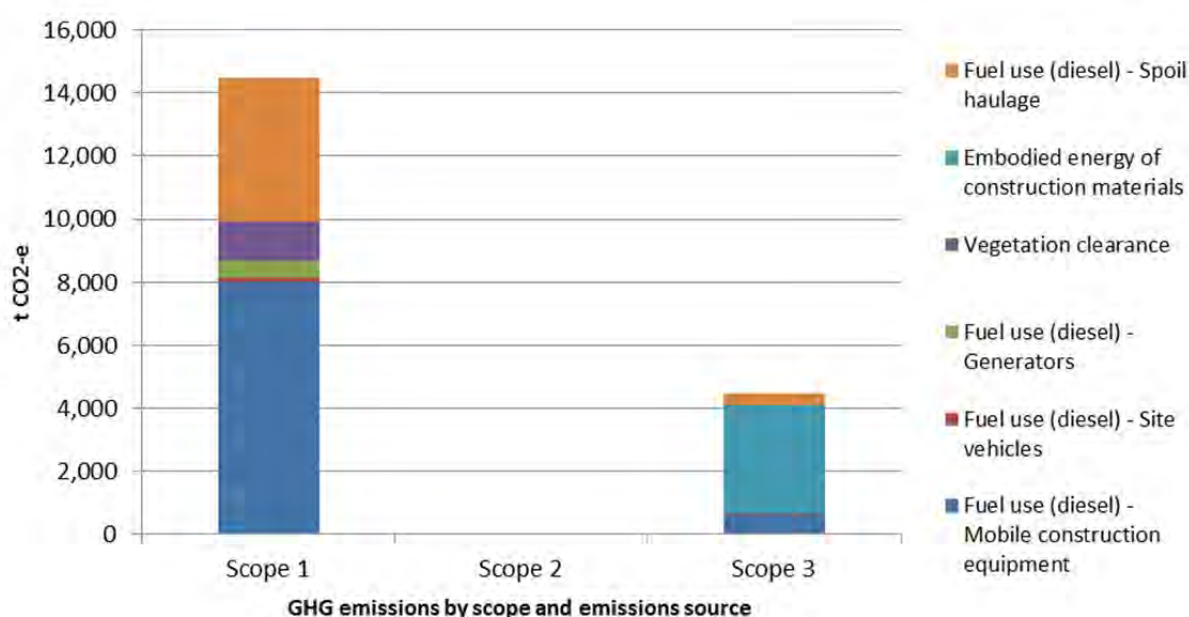


Figure 2 Greenhouse gas emissions by scope and emissions source

The total estimated greenhouse gas emissions from the project (approximately 20,549 t CO₂-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

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6 References

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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:

$$\text{Greenhouse gas emissions (t CO}_2\text{-e)} = ((Q \times ECF) / 1000) \times (EF_{\text{CO}_2} + EF_{\text{CH}_4} + EF_{\text{N}_2\text{O}})$$

Where:

- Q is the quantity of fuel (in kL).
- ECF is the relevant energy content factor (in GJ/kL).
- EF_{CO_2} is the relevant Carbon dioxide (CO_2) emission factor (in kg $\text{CO}_2\text{-e/GJ}$).
- EF_{CH_4} is the relevant Methane (CH_4) emission factor (in kg $\text{CO}_2\text{-e/GJ}$).
- $EF_{\text{N}_2\text{O}}$ is the relevant Nitrous oxide (N_2O) emission factor (in kg $\text{CO}_2\text{-e/GJ}$).

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:

$$\text{Greenhouse gas emissions (t CO}_2\text{-e)} = (Q \times \text{ECF} \times \text{EF}_{\text{Scope 3}}) / 1000$$

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 CO₂-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 CO ₂ -e per kL)		
		CO ₂	CH ₄	N ₂ O		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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO ₂ -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:

$$\text{Greenhouse gas emissions (t CO}_2\text{-e)} = Q \text{ (t)} \times EF \text{ (tCO}_2\text{-e/t)}$$

Where: Q is the quantity of material (in tonnes).

EF is the relevant Emission Factor (in t CO₂-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					
<i>Preparatory Works (1 month duration)</i>					
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.
<i>Site Establishment Works (3 months duration)</i>					
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.
<i>Establishment of Conveyer</i>					
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

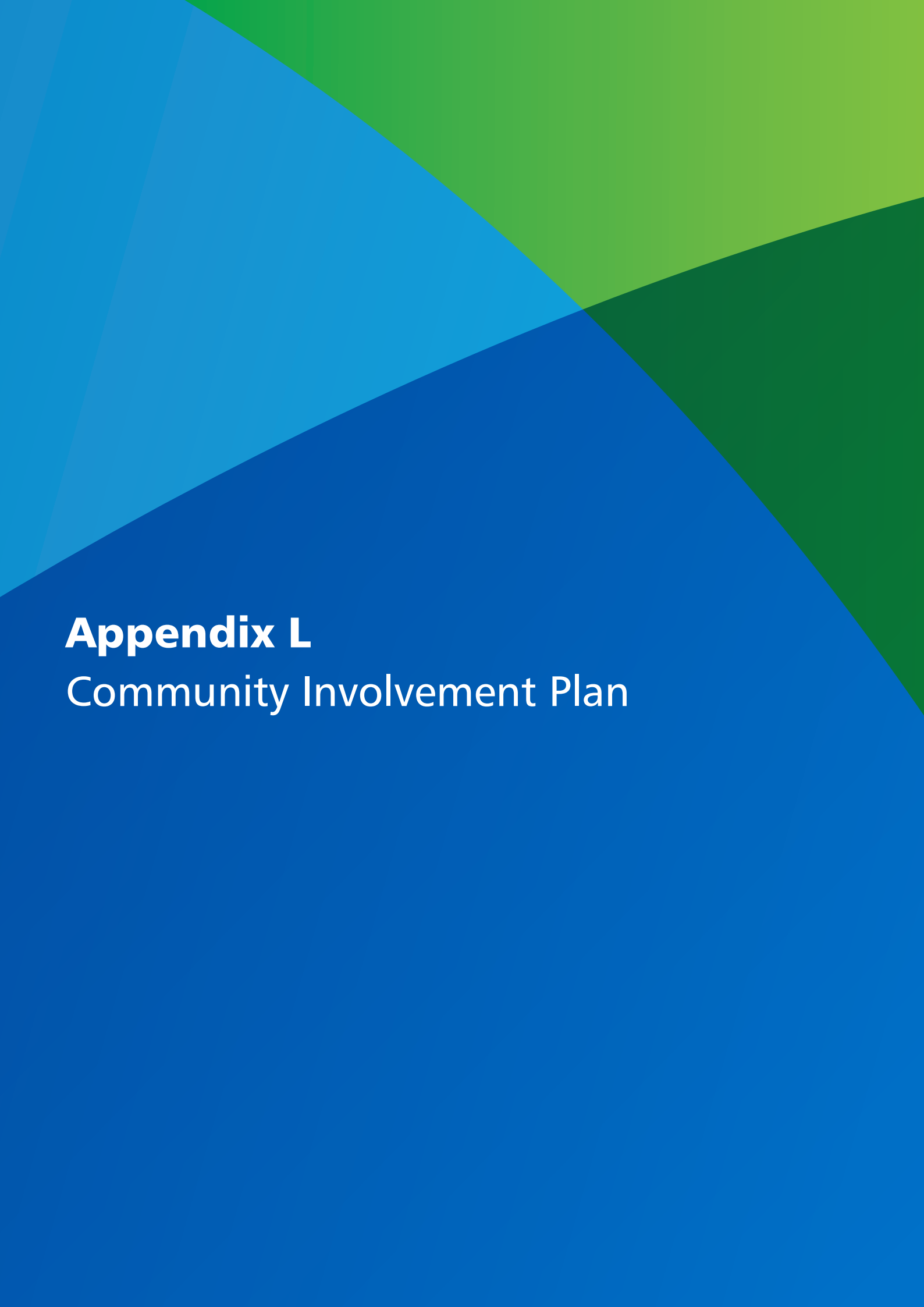
Emission source category	Emission source	Quantity	Unit
Site Preparation			
Fuel use	Mobile equipment	450.5	kL
	Site vehicles	8.0	kL
	Generators	53.9	kL
Vegetation removal	Clearance of Blue Gum High Forest	0.1	hectares
	Clearance of Sandstone Blackbutt Woodland and native regeneration	1.6	hectares
	Clearance 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

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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

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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.

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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 activities would 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.

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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.

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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:

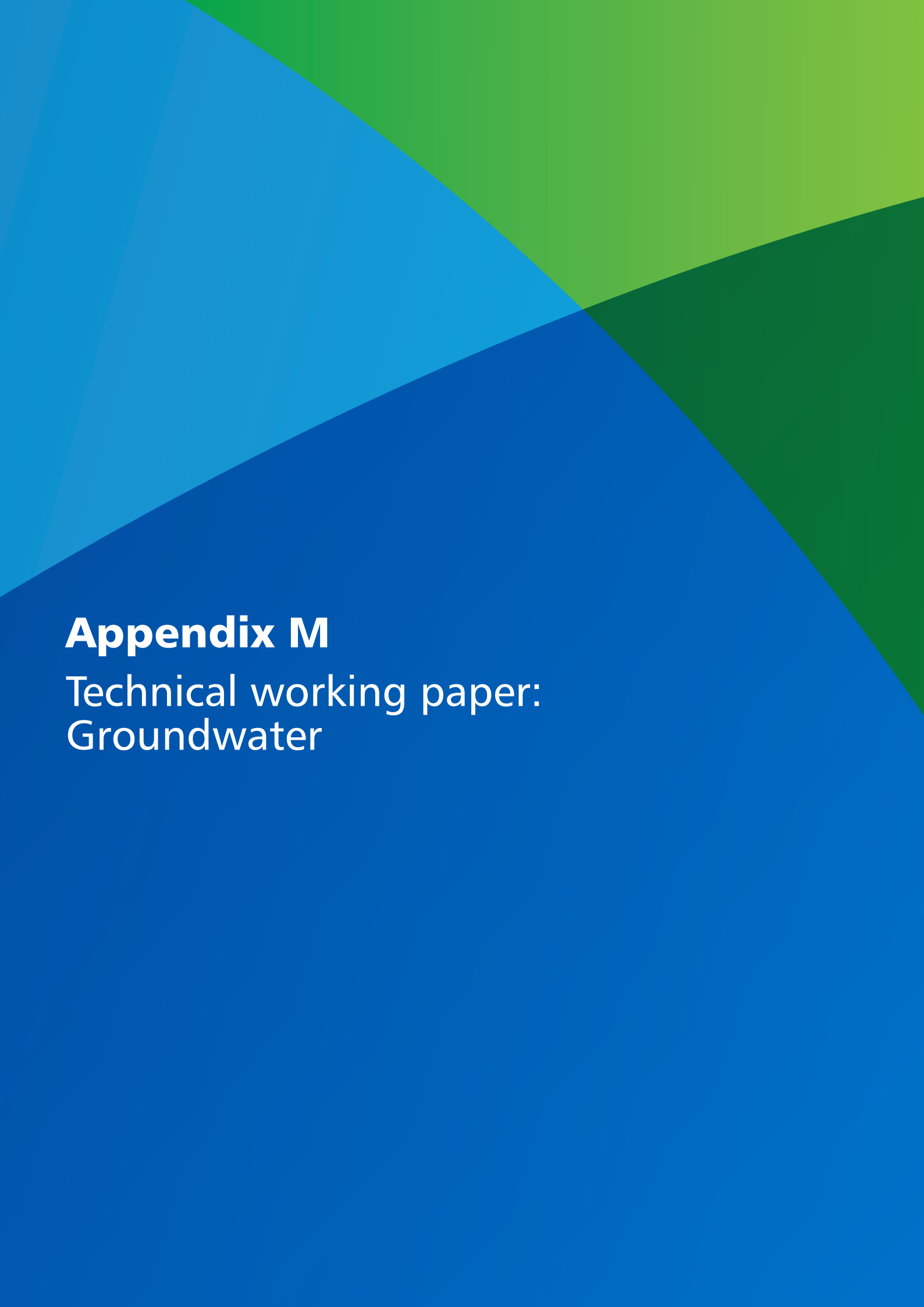
- The closures and changes in access to Old Mans Valley.
- The best ways for the project team to reach the members of these groups. This feedback would then be incorporated into the communication activities for the project.

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.

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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

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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.

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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 of 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 conveyor is still being constructed.
Spoil emplacement	Once the conveyor 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**.

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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.

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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.

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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.

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6 References

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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.

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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

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
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 da	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, overcast	dry		n		n		n		n	
2011 85 21	7.4	0.44	overcast	dry	2mm overnight	n		n		n		n	
2011 85 23	8.3	0.4	overcast	dry	6mm rain over	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 smell	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 odour	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 turbulent	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 concrete	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 line	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 overnight	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				

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)
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													



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