

23 Aboriginal heritage

This chapter assesses the potential impacts of the project on Aboriginal heritage, including cultural and archaeological impacts. Full details of the assessment are presented in the Technical working paper: Aboriginal heritage (**Appendix V**) with a summary provided below. The assessment has been prepared to address relevant Secretary's Environmental Assessment Requirements (SEARs) as documented in **Table 23-1**.

Table 23-1 SEARs – Aboriginal heritage

SEARs	Where addressed in the EIS
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:	This chapter and Technical working paper: Aboriginal heritage (Appendix V).
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 (Department of Environment and Conservation, 2005a) and other relevant guidelines and requirements,	Proposed mitigation and management measures are described in Section 23.4 .
be undertaken by a suitably qualified heritage consultant(s),	Technical working paper: Aboriginal heritage (Appendix V).
demonstrate effective consultation with Aboriginal stakeholders in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures),	Consultation with Metropolitan Local Aboriginal Land Council (MLALC) is outlined in Section 23.1.3 .
assess and document the archaeological and cultural heritage significance of affected sites, and	The archaeological and cultural significance of sites potentially impacted by the project are detailed in Section 23.3 .
Undertake appropriate archaeological investigations generally in accordance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (Department of Environment, Climate Change and Water, 2010b), 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 OEH.	Impacts to known Aboriginal objects and PADs are not considered likely as a result of the project. Therefore, further investigation, including archaeological investigations, are not required. The assessment of potential impacts to archaeological and cultural heritage sites is outlined in Section 23.3.

SEARs	Where addressed in the EIS
During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. • local, State and Commonwealth government authorities, including the: • Environment Protection Authority, • Office of Environment and Heritage (including Heritage Division), • The Heritage Council of NSW, • Department of Primary Industries, • NSW Office of Water, • NSW Health (including Local Health Districts), • Roads and Maritime Services, • Transport for NSW, • UrbanGrowth NSW; • Sydney Water, • Canterbury City Council, • Hurstville City Council, • Rockdale City Council, • Marrickville Council, • City of Botany Bay Council, • City of Sydney, • Civil Aviation Safety Authority, and • Air Services Australia; • specialist interest groups, including Local Aboriginal Land Councils, Aboriginal stakeholders, and pedestrian and bicycle user groups; • utilities and service providers; and • the public, including community groups and adjoining and affected landowners.	Consultation with Aboriginal heritage participants / stakeholders is outlined in Section 23.1.3.

23.1 Assessment methodology

The Aboriginal cultural heritage assessment (including cultural and archaeological significance) was conducted in accordance with the:

- *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005a)
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b)
- *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime, 2011a) by a team of suitably qualified heritage consultants.

The PACHCI procedure involves four stages; however projects that can avoid impacts to Aboriginal cultural heritage may only be required to complete some stages of the procedure. The four stages include:

- Stage 1. An initial assessment (desktop) to determine whether the project is likely to harm Aboriginal cultural heritage
- Stage 2. Further assessment and site survey with Aboriginal stakeholders and an archaeologist to assess the project's potential harm to Aboriginal cultural heritage
- Stage 3. Formal consultation and preparation of a cultural heritage assessment report when Stage 1 and Stage 2 have led to the preliminary view that harm to Aboriginal cultural heritage is likely to occur
- Stage 4. Implementation of project mitigation measures based on recommendations in Stage 3 and to obtain an Aboriginal heritage impact permit if required.

The methodology adopted for this assessment was developed in accordance with the requirements of Stage 2 of the PACHCI based on the assessment conclusion that direct or indirect impacts to Aboriginal cultural values are unlikely to occur as a result of the project.

As a result, further archaeological investigations (in accordance with Stage 3 of the PACHCI process) were not warranted. An overview of the stages of this procedure can be found in the Technical working paper: Aboriginal heritage (**Appendix V**).

Aboriginal heritage legislation relevant to the project is described in **Table 23-2**.

Table 23-2 Legislation relevant to the project – Aboriginal heritage

Legislation	Relevance to project
<i>National Parks and Wildlife Act 1974</i> (NSW) (NPW Act)	The NPW Act is the primary legislation for the protection of Aboriginal cultural heritage in NSW and provides for the proper care, preservation and protection of 'Aboriginal objects' and 'Aboriginal places', defined under the Act. Under Part 6 of the NPW Act it is an offence to harm or desecrate Aboriginal objects or places. It is a defence to prosecution for such an offence if the harm was authorised by an Aboriginal Heritage Impact Permit issued under section 90 of the NPW Act. As discussed in this chapter, the project would not impact on any known Aboriginal objects or places, and an Aboriginal Heritage Impact Permit would not be required.
<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i> (Commonwealth) (ATSIHP)	The ATSIHP Act provides for the preservation and protection of places, areas and objects of particular significance to Indigenous Australians. Under the ATSIHP Act, the Australian Government Minister for the Environment, in consultation with the State/Territory minister, may make a declaration to protect an Aboriginal area or object.

Broadly, the Aboriginal cultural heritage assessment included:

- A desktop review of background literature, previous investigations and database including the Aboriginal Heritage Information Management System (AHIMS)
- Consultation with relevant Aboriginal representatives to assist with the archaeological field survey
- An archaeological field survey, which was conducted over four days between 24 and 27 November 2014
- Identification of mitigation measures to reduce impacts to Aboriginal heritage based on the results of the investigation and the anticipated impacts of the project on Aboriginal archaeological and culturally sensitive sites.

23.1.1 Desktop review

The desktop review and Aboriginal stakeholder consultation were used to determine if known Aboriginal archaeological and culturally sensitive sites are located in or near potential project surface disturbance areas. The desktop assessment comprised:

- A search of the AHIMS database
- A review of the landscape context of the project alignment and construction footprint
- A review of relevant archaeological and ethno-historic information for the project alignment and construction footprint
- Development of a predictive model for Aboriginal site types and distribution within and in proximity to the project alignment and construction footprint, based on the landscape context review
- Identification of areas of Aboriginal archaeological sensitivity within and adjacent to the project alignment and construction footprint.

Four areas of potential archaeological sensitivity were identified:

- Wolli Creek Valley, a 50 hectare area of bushland and sandstone escarpments bordering Wolli Creek, located between Bexley North and Tempe
- Stotts Reserve, a four hectare area of bushland containing a tributary of Bardwell Creek and sandstone outcrops, located a short distance from Bexley North railway station
- Bardwell Creek Reserve, a six hectare area of remnant bushland featuring sandstone outcrops and Turpentine Forest and Eucalypt woodland, located south of Bardwell Valley Golf Course
- Foreshore zones of estuarine environments such as the Alexandra Canal, Cooks River, Wolli Creek and Botany Bay. Past archaeological assessments demonstrated the potential for Aboriginal midden sites to occur in these environments.

23.1.2 Study Area

Based on the desktop review, a study area (**Figure 23.1**) for the heritage assessment, including the archaeological survey, was developed. A conservative area extending beyond the project alignment and construction footprint for the project was chosen. The study area included the locations of potential ancillary facilities such as construction ancillary facilities and ventilation facilities.

23.1.3 Consultation

In accordance with the project SEARs and Stage 2 of Roads and Maritime's PACHCI process, the following Aboriginal community consultation process has been carried out:

- Identification of key Aboriginal stakeholders through searches of the National Native Title Register and Register of Aboriginal Owners
- Identification of the relevant Local Aboriginal Land Council and engagement of an identified Aboriginal representative to carry out the archaeological survey
- Invitation for the Aboriginal representative(s) to prepare a cultural heritage survey report.

No Aboriginal stakeholders were identified from searches of the National Native Title Register and Register of Aboriginal Owners.

The Metropolitan Local Aboriginal Land Council (MLALC) was identified as the relevant Local Aboriginal Land Council to consult regarding the project. A representative from the MLALC participated in the archaeological survey. The MLALC representative also prepared a cultural heritage survey report for the project (Appendix B of Technical working paper: Aboriginal heritage (**Appendix V**)). Findings from the report were incorporated into the design development as part of an environmental constraints analysis.

A draft copy of the Technical working paper: Aboriginal heritage (**Appendix V**) was provided to the MLALC on 1 November 2015 with an invitation to provide comment. The MLALC representative responded on 6 November 2015, stating that MLALC agreed with the findings and recommended management measures relating to vibration, unanticipated finds, human skeletal remains and the effectiveness of proposed management measures in relation to the potential AHIMS site SR-OVRH-1, as described within the Technical working paper. MLALC also requested that they be contacted immediately, should Aboriginal features be uncovered during future works. A copy of the correspondence from MLALC is provided in Appendix C of **Appendix V**.

The outcomes of the Stage 2 PACHCI process confirmed that a more detailed Stage 3 PACHCI assessment is not required for the project (refer to Technical working paper: Aboriginal heritage (**Appendix V**)). Consequently, identification of, and formal statutory consultation with, registered Aboriginal parties has not been conducted.

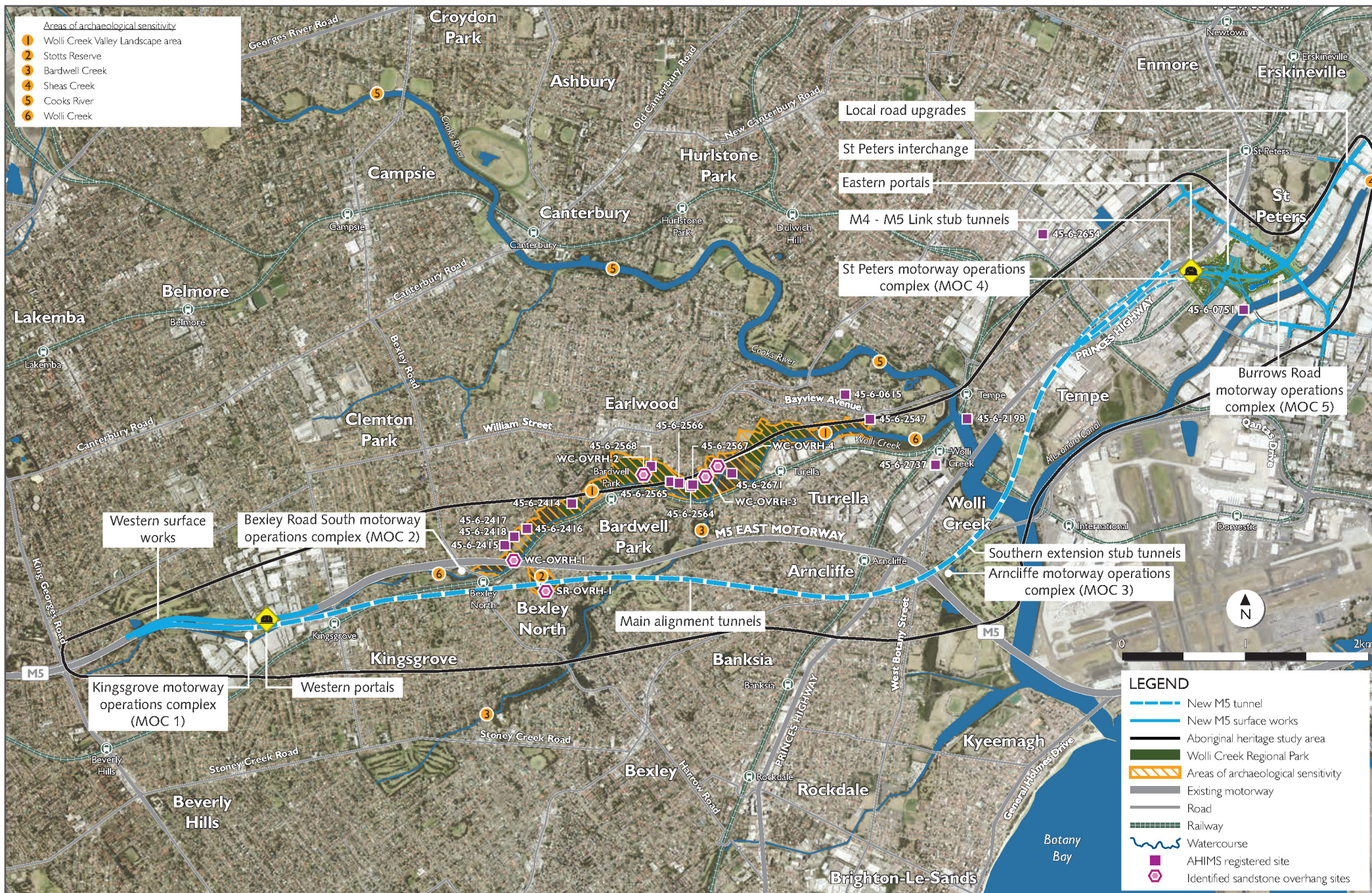


Figure 23-1 Aboriginal heritage study area

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23.1.4 Archaeological field survey

The archaeological field survey:

- Identified and recorded existing surface evidence of past Aboriginal activity
- Identified areas with potential for subsurface archaeology
- Informed the development of strategies for avoiding and / or mitigating potential impacts to Aboriginal heritage.

The archaeological survey was carried out between 24 and 27 November 2014, in the presence of a MLALC representative.

During the archaeological survey, AHIMS sites that had been previously recorded within the study area were visited. The survey was conducted on foot and by vehicle, during which details of the ground surface visibility, integrity (land condition) and archaeological sensitivity were noted. Data was recorded on a hand-held GPS and photographs were taken.

Aboriginal archaeological sites/ objects identified during the survey were recorded in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b). Individual site boundaries were captured by differential GPS. The survey findings are provided in the following sections.

Further details of the methodology, timing and extent of the archaeological survey are provided in Technical working paper: Aboriginal heritage (**Appendix V**).

23.2 Existing environment

The existing environment for Aboriginal cultural heritage is presented in terms of the:

- Pre-European occupation of the land
- The landscape context and the way in which it influenced Aboriginal occupation
- Records of Aboriginal objects recorded in AHIMS
- Previous Aboriginal heritage investigations
- Findings and recommendations of the field survey/ Stage 2 PACHI.

23.2.1 Pre-European occupation of land

The project would be located within the boundaries of the Darug (also spelt Dhaŋ-rook, Dharrook, Dhaŋrook, Dharruk and Dharug) linguistic group. The boundaries of the Darug linguistic group stretched from the Hawkesbury River in the north, to Appin in the south, and from the coast west across the Cumberland Plain into the Blue Mountains. Two dialects of Darug; a coastal and a hinterland dialect; were spoken at the time of European contact.

The primary unit of social organisation amongst the Darug was the clan consisting of around 50 to 60 people and taking its name from the place where its members resided. Records indicate that a wide range of marine, freshwater, terrestrial and avian fauna were exploited by Darug-speaking peoples for food (Attenbrow, 2010). Fish and shellfish were principally exploited in coastal areas and land mammals such as kangaroos, wallabies, possums and koalas among others were hunted further inland.

Hunting and gathering tools were employed by men and women (McDonald, 2008). Men used spears (including barbed spears), clubs, spear throwers, 'swords', boomerangs, shields and hafted stone hatchets (known as mogo). Women used fishing hooks, lines and sinkers, digging sticks and various containers (shell and wood). Net bags made from plaited wood fibre and bark canoes were also widely used (Attenbrow, 2010).

Two major forms of shelter appear to have been utilised by Darug speaking peoples at the time of European contact: rockshelters and small huts built from sheets of bark, branches and bushes (Barrington, 1802; Collins, 1798, 1802; Trench, 1793). Evidence for ceremonial or ritual behaviour amongst Darug-speaking peoples can be found in the writings of a number of early observers (for example, Collins, 1798; Phillip, 1788 in Hunter 1793 [1968]; Trench, 1793), with documented activities including corroborees, male initiation ceremonies, ritual combats and various burial, body adornment and personal decoration practices.

23.2.2 Landscape context

The study area is located across the physiographic regions of the Botany Lowlands and Cumberland Lowlands. The topography of Botany Lowlands region, in the east is characterised by deep sand dunes and patches of swampland found to the north and west of Botany Bay broadly encircling it. In the western portion of the study area, the topography of the Cumberland Lowlands varies, including ranges from undulating low hills to very steep hills associated with Hawkesbury Sandstone outcrops bordering the Wolli Creek Valley.

The surface geology within the study area comprises a mixture of Quaternary alluvium and sands associated with watercourses, and Wianamatta Group shales and Hawkesbury Sandstone away from watercourses. The geological context of the project is described in **Chapter 17** (Geology and groundwater).

Vegetation within the study area has been extensively cleared with the exception of some isolated pockets in reserves and parklands. Large areas of reclaimed land are found around the lower reaches of the Cooks River and Botany Bay. Relatively undisturbed remnant landscapes are found in three locations within the study area: Wolli Creek Valley (referred to as Wolli Creek Valley Landscape Area), Stotts Reserve and Bardwell Creek Reserve.

The Wolli Creek Valley is one of the few remnant landscapes within the study area that has been not subjected to significant landscape modification due to urban development. From an Aboriginal heritage perspective, it is unique in the inner city area, containing an archaeological resource comprising of rockshelters and artefact scatters linked to relatively undisturbed key landscape features of Wolli Creek and the escarpments of Hawkesbury Sandstone. There is potential for additional sites to be present within this landscape area, both in surface and subsurface contexts. Taken as a whole, this area is considered highly significant, both archaeologically and culturally (refer to **Appendix V** for a cultural assessment from the MLALC representative).

Stotts Reserve comprises of about four hectares of bushland and is located about 370 metres east of Bexley North railway station. The reserve contains a tributary of Bardwell Creek and sandstone outcrops. Reference to 1943 historic aerials suggests this bushland area has remained relatively undisturbed over the past 70 years (refer to **Appendix V** for aerial photo). Bardwell Creek Reserve, located south of Bardwell Valley Golf Course, covers around six hectares and includes remnant bushland featuring sandstone outcrops, Turpentine forest and Eucalypt woodland.

The remainder of land within the study area has been subjected to varying degrees of landscape disturbance and is unlikely to contain in-situ evidence of past Aboriginal activity.

23.2.3 New South Wales Aboriginal Heritage Information Management System (AHIMS)

The AHIMS database contains records of Aboriginal objects reported in accordance with section 89A of the NPW Act. It also contains information about Aboriginal places which have been declared by the Minister for the Environment 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'.

A search of the AHIMS database for previously recorded Aboriginal sites within and surrounding the study area (being areas within one kilometre of the study area) was lodged with the NSW Office of Environment and Heritage (OEH) on 7 November 2014. A total of 17 sites were initially identified within the search area comprising:

- Eleven rockshelters
- Three open artefact sites (artefact scatters and isolated artefacts)
- One shell midden
- One Potential Archaeological Deposit (PAD)
- A site containing an artefact scatter, edge ground axe head and dugong bones (referred to as the Sheas Creek site)

The AHIMS database identified the Sheas Creek (#45-6-0751) site as being located within the study area near the Alexandra Canal. The site was identified during construction of the canal in 1896 and comprised dugong bones and axe heads located within a layer of unctuous plastic dark bluish grey sandy clay with marine shells, five metres below the current ground surface. The excavated material was collected and retained by the Australian Museum. AHIMS currently lists the site as valid however the site card identifies that the site was actually excavated and destroyed.

23.2.4 Previous Aboriginal heritage investigations

Previous archaeological assessments involving survey, excavation and / or salvaging have been carried out in the region by others over the past three decades, relating to known sites and past development projects. Eight of these assessments are relevant to the Aboriginal heritage study area and have been used to inform the development of Aboriginal site predictions and the scope of field surveys.

A summary of the relevant past archaeological assessments is provided in the Technical working paper: Aboriginal heritage (**Appendix V**).

23.2.5 Field survey / Stage 2 PACHCI findings and recommendations

Combined, the archaeological field survey conducted for the project and the desktop review identified the following within one kilometre of the study area:

- Five newly identified potential Aboriginal sites
- Seventeen previously recorded Aboriginal site
- Twenty-one verified Aboriginal sites
- One landscape area, being the Wolli Creek Valley Area.

A summary of verified AHIMS sites and additional newly recorded Aboriginal sites within the study area is provided in **Table 23-3**. A map showing their respective locations is provided in **Figure 23-1**.

The archaeological survey identified five sandstone overhangs that are considered to be PAD based on habitation area size and presence of potential deposits. Aboriginal rockshelter sites and sandstone overhangs have the potential to be impacted by vibration and settlement, both as a result of tunnelling or carrying out construction activities below or nearby the sites.

No Aboriginal sites have been identified within areas that would be disturbed by the surface works as part of the project.

Table 23-3 AHIMS sites identified within the Aboriginal heritage study area

Site name	AHIMS reference	Site type	Site features	Location / description
Previously recorded AHIMS sites^				
Undercliffe Road	45-6-0615	Rockshelter	Art; Midden	Site location confirmed.
Sheas Creek*	45-6-0751	Includes artefact scatter, edge ground axes and dugong bones	Artefacts, shell and bones	Site salvaged and is likely to have been destroyed during construction of the Alexandra Canal.
View Street	45-6-2198	Midden	Shell; artefacts	Site inspected and partially destroyed. The AHIMS coordinates are incorrect and require updating.
4 Wolli_Creek 1.6	45-6-2414	Rockshelter	Deposit; artefacts	Site inspected and in good condition. The AHIMS coordinates are incorrect and require updating. No artefacts were observed.
Wolli_Creek 1.4	45-6-2415	Rockshelter	Deposit; artefacts	Site not located.
Wolli_Creek 1.3	45-6-2416	Rockshelter	Deposit; shell	Site inspected and in good condition. The AHIMS coordinate are incorrect and require updating. No shell deposits were observed.
Wolli_Creek 1.2	45-6-2417	Rockshelter	Shell; artefacts	Site not located. Possibly built over by houses along Sutton Avenue.
Wolli_Creek 1.1	45-6-2418	Rockshelter	Deposit; artefacts	Site not located. Possibly built over by houses along Sutton Avenue.
Nanny Goat Hill 1;NGH 1	45-6-2547	Open artefact site	Artefacts	Site inspected and no artefacts were observed.
Wolli Creek 2.5	45-6-2564	Rockshelter	Shell; artefacts	Site inspected and in good condition. The AHIMS coordinates are incorrect and require updating. No shell or artefacts were observed.
Wolli Creek 2.4	45-6-2565	Rockshelter	Deposit; artefacts	Site inspected and in good condition. The AHIMS coordinates are incorrect and require updating. No artefacts were observed.
Wolli Creek 2.1	45-6-2566	Rockshelter	Deposit; artefacts	Site inspected and in good condition. The AHIMS coordinates are incorrect and require updating. No artefacts were observed.
Wolli Creek	45-6-2567	Rockshelter	Shell; artefacts	Site inspected and in poor condition due to contemporary use as a rock-climbing wall. No artefacts were observed, however small bone animal fragments were identified.

Site name	AHIMS reference	Site type	Site features	Location / description
Wolli Creek	45-6-2568	Rockshelter	Deposit; artefacts	Site inspected and in good condition. The AHIMS coordinates are incorrect and require updating. No artefacts were observed.
Fraser Park PAD	45-6-2654	PAD	PAD	Site not located.
Wolli Creek 3	45-6-2671	Open artefact site	Artefacts	Site inspected. No artefacts were observed, possibly removed or washed away during rain / flooding.
Tempe House 1	45-6-2737	Open artefact site	Artefacts; PAD	Site partially destroyed and comprises of a subsurface deposit. No surface artefacts identifiable.
Newly recorded potential Aboriginal sites				
Pending	SR-OVRH-1	Sandstone overhang	PAD	Site located on an upper slope overlooking an unnamed tributary of Wolli Creek in Stotts Reserve
Pending	WC-OVRH-1	Sandstone overhang	PAD	Site located on a lower slope 20 metres from Wolli Creek.
Pending	WC-OVRH-2	Sandstone overhang	PAD	Site located on a middle slope PAD in the Wolli Creek area.
Pending	WC-OVRH-3	Sandstone overhang	PAD	Site located on a middle slope 100 metres from Wolli Creek.
Pending	WC-OVRH-4	Sandstone overhang	PAD	Site located on a middle slope 60 metres from Wolli Creek.

^The field survey identified site # 45-6-1496 in the AHIMS database was determined not to be a site.

* This site was documented in the late 19th century during construction of the Alexandra Canal at a time when archaeological reporting requirements were poor. Stone artefacts and a dugong skeleton were recovered from the site, and while suspected based on known impacts, it is unclear from available documentation whether the site was subsequently completely destroyed during construction.

23.3 Assessment of potential impacts

The Technical working paper: Aboriginal heritage (**Appendix V**) identifies three broad areas of Aboriginal archaeological and / or cultural heritage significance relevant to the project:

- The Wolli Creek Valley Landscape Area, an area of archaeological sensitivity and registered AHIMS sites
- Alexandra Canal / Sheas Creek, an area that may contain artefact bearing deposits
- Newly identified potential Aboriginal sites.

23.3.1 Construction

Construction works have the potential to directly and indirectly impact on Aboriginal cultural heritage as a result of surface and tunnel works:

- Direct impacts - direct impacts are those with the potential to damage or destroy Aboriginal sites within the proposed disturbance footprint of the project. No direct impacts have been identified for this project
- Indirect impacts - the potential for the project to indirectly damage Aboriginal sites is low. Indirect impacts include those resulting from vibration during construction, as well as blasting activities, and settlement from tunnelling.

The potential for impacts to occur at the areas of Aboriginal archaeological and / or cultural heritage significance identified is discussed below.

Wolli Creek Valley Landscape Area

The Wolli Creek Valley Landscape Area is located immediately east of the Bexley Road East construction compound (C6). The project would not directly impact the Wolli Creek Landscape Area.

Indirect impacts the Wolli Creek Valley Landscape Area from noise, vibration, visual and dust are unlikely to cause significant landscape modifications or impact on undisturbed key landscape features. As such, the likelihood that the project would create indirect impacts to the Wolli Creek Valley Landscape Area is low.

Nonetheless and to further reduce the likelihood of indirect impacts, appropriate mitigation measures have been identified in **Table 23-6**.

Rockshelters

The closest valid site to areas of surface distance is Aboriginal rockshelter Wolli Creek 4.1 (#45-6-2415), located about 250 metres north-west of the Bexley Road East construction compound (C6). This site would not be directly impacted by the project. Given the distance between the valid site and construction activities, the potential for indirect impacts is low.

Alexandra Canal

The AHIMS registered artefact scatter site Sheas Creek (#45-6-0751) was destroyed during construction of Alexandra Canal (refer to **Section 23.2.3**). Archaeological data indicates that should other objects of Aboriginal heritage be present within Alexandra Canal these would be located around five metres below the current ground surface.

Most of the construction works for the local road upgrades adjacent to the canal are unlikely to extend to five metres below the ground surface. However, the proposed bridges over Alexandra Canal would be supported by two piers either side of the canal each supported by eight piles each measuring 900 millimetres in diameter, bored about 18 metres below the ground surface. Given the restricted subsurface footprint of the project, the likelihood of disturbing any artefact bearing deposits associated with site #45-6-0751 is considered low.

A procedure for the management of any unanticipated Aboriginal objects identified during the construction of the Campbell Road bridge, pedestrian and cycle bridge and Gardeners Road bridge is provided in **Table 23-6**.

Sandstone overhang sites

Several archaeologically sensitive sandstone overhang sites are located in the study area. The closest archaeologically sensitive site to the project alignment that may have had past Aboriginal use is a sandstone overhang (SR-OVRH-1). However, no direct evidence of use has been identified. This sandstone overhang is located within Stotts Reserve.

Direct impacts to sandstone overhang sites would not occur as the project would be underground at this location. However, indirect impacts to the sandstone overhang could occur due to tunnelling activities.

Tunnelling has the potential to cause indirect impacts to Aboriginal heritage sites through subsidence as a result of settlement and vibration. Subsidence, in the context of the current project refers to the vertical and horizontal displacement of the ground surface as a result of tunnelling or groundwater drawdown.

Table 23-4 identifies the criteria used for assessing settlement damage to standing structures and is found in existing studies (Burland et al., 1977 and Boscardin and Cording, 1989).

Settlement beneath and around the sandstone overhang site (# SR-OVRH-1) would be less than five millimetres (refer to **Chapter 13** (Land use and property)). This low settlement value, and the relatively small size of the site (21 cubic metres), indicates that settlement-related impacts are unlikely. Settlement-related impacts to other known Aboriginal sites and areas of archaeological sensitivity found within the study area are unlikely given the distance to the project alignment.

Table 23-4 Criteria for assessing settlement damage

Maximum settlement (mm)	Degree of damage	Description of potential damage	Approximate crack width (mm)
<5	Negligible	Hairline cracks	<0.1
<10	Very slight	Fine cracks	<0.1 to 1.0
10-50	Slight	Potential fractures	5 – 15

In order to assess potential impacts to Aboriginal rockshelters from vibration caused from construction (including blasting) and during operation of the project, the German Standard (DIN 4150 Group 3) guidelines have been applied (see **Table 23-5**). These standards are commonly used in Aboriginal heritage assessments to assess impacts to Aboriginal rockshelter sites. Group 3 represents the most sensitive safe limit for vibration impacts on structures and has been adopted here as it represents a conservative approach.

Table 23-5 Criteria for assessing vibration: DIN 4150: Structural damage safe limits for building vibration

Group	Type of Structure	Vibration Velocity in mm/s			Vibration at the Horizontal Plane of the Highest Floor All Frequencies
		At Foundation at a Frequency of	Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order).	3	3 to 8	8 to 10	8

Maximum predicted surface, tunnelling and blasting vibration intensities at the sandstone overhang (SR-OVRH-1) is below the Group 3 safety limit of three millimetres per second for all identified Aboriginal sites (**Chapter 12** (Noise and vibration)).

Based on this, vibration related impacts on SR-OVRH-1 would be unlikely. Other known Aboriginal sites and areas of archaeological sensitivity found within the study area are unlikely given the distance to the project alignment.

Nevertheless as a precaution, management of SR-OVRH-1 would include:

- Vibration monitoring for vibration intensive works within 50 metres of SR-OVRH-1. The need for vibration monitoring would be informed by a preliminary screening of activities that have the potential for vibration. Details would be contained within the construction environmental management plan
- A condition assessment prior to the commencement of construction, following vibration intensive works within 50 metres of SR-OVRH-1 and at the completion of construction.

23.3.2 Operation

Potential indirect and direct impacts to Aboriginal heritage during operation of the project relate to impacts associated with urban design, landscape character and visual amenity impacts. The project has been designed to integrate with the visual appearance of existing infrastructure and to be sympathetic to the surrounding landscape context.

A summary of changes to the landscape or scenic context in relation to the urban design of the project is provided in **Chapter 14** (Visual impacts and urban design).

23.4 Environmental management measures

Direct impacts to sites and items of known Aboriginal heritage items and areas of archaeological and cultural heritage significance have been avoided through the design of the project. The archaeologically sensitive Wolli Creek Valley Landscape Area is located adjacent to the Bexley Road East construction compound. No indirect impacts (including vibration) on areas of Aboriginal cultural significance are anticipated as a result of the project.

Despite this and to further reduce the potential for impacts to Aboriginal heritage, environmental management measures relating to Aboriginal heritage during construction are provided in **Table 23-6**.

The recommended management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. All measures are expected to be effective avoid in Aboriginal heritage impacts. No operational mitigation measures relating to Aboriginal heritage are necessary.

Table 23-6 Environmental management measures – Aboriginal heritage

Impact	No.	Environmental management measure	Timing
Construction			
Impacts on culturally sensitive Aboriginal sites	AH 1	Vibration generating activities, including blasting would be conducted in a manner to ensure vibration levels do not exceed three millimetres per second at potential Aboriginal heritage site SR-OVRH-1.	Construction
Indirect impacts on sandstone rock overhang site	AH 2	Vibration monitoring would be carried out during vibration intensive works within 50 metres of SR-OVRH-1. The need for vibration monitoring would be informed by a preliminary screening of activities at this location to identify what activities have the potential for vibration at this location. The preliminary screening and works requiring monitoring would be contained within the construction environmental management plan.	Pre-construction and construction

Impact	No.	Environmental management measure	Timing
	AH 3	A baseline condition assessment would be completed by a qualified structural engineer for Aboriginal site SR-OVR-1 before construction commences, followed by a condition assessment immediately following significant vibration and with recommendations for remediation measures if required.	Pre-construction and construction
Unexpected discovery of Aboriginal objects (Project wide)	AH 4	If an Aboriginal object(s) is discovered during construction it would be managed in accordance with the <i>Standard Management Procedure: Unexpected Heritage Items</i> (Roads and Maritime Services, 2015), including: • Ceasing works in the vicinity of the object(s), where there is the potential to directly or indirectly impact on the object(s) • Notifying the construction Environmental Representative and OEH of the discovery • Engaging a qualified archaeologist to determine the nature, extent and scientific significance of the object(s) • Developing management recommendations in consultation with the qualified archaeologist, OEH and RAPs.	Construction
Unexpected discovery of Aboriginal objects (Alexandra Canal)	AH 5	In order to manage the potential discovery of an Aboriginal object(s) during pile installation adjacent to Alexandra Canal the following strategy would be implemented: • Geotechnical coring at each pile location by a geotechnical engineer to obtain intact sediment samples to a depth of around seven metres • Inspection of obtained sediment samples by a qualified archaeologist in consultation with the geotechnical engineer in order to characterise the soil profile and identify any Aboriginal archaeological materials Should Aboriginal archaeological material be present within one or more core samples, management would occur in accordance with the <i>Standard Management Procedure: Unexpected Heritage Items</i> (Roads and Maritime, 2015).	
Unexpected discovery of human remains	AH 6	If human remains are discovered during construction would be managed in accordance with the <i>Standard Management Procedure: Unexpected Heritage Items</i> (Roads and Maritime Services, 2015), including: • Ceasing works in the vicinity of the remains, with the potential to directly or indirectly impact on the remains • Notifying the construction Environmental Representative, OEH and NSW Police of the discovery • Following directions from the NSW Police and / or OEH, as relevant, depending on the nature of the remains and the outcomes of forensic investigations.	Construction

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