Appendix V

Technical working paper: Aboriginal heritage

WestConnex

Roads and Maritime Services

WestConnex – M4-M5 Link

Technical working paper: Aboriginal heritage

August 2017

Client: Roads and Maritime Services

ABN: 76 236 371 088

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Glossary of terms and abbreviations

Term	Definition
A	
Aboriginal archaeological site	The present spatial extent of visible Aboriginal archaeological material(s) at a given location
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, song lines and places) cultural practices and traditions associated with past and present day Aboriginal communities
AHIMS	Aboriginal Heritage Information Management System. A register of NSW Aboriginal heritage information maintained by the NSW Office of Environment and Heritage.
Aboriginal object	Any deposit, object or material evidence (not being a handicraft made for sale), including Aboriginal remains, relating to the Aboriginal habitation of NSW
Aboriginal place	Any place declared to be an Aboriginal place under section 94 of the *National Parks and Wildlife Act 1974* (NSW)
ACHMP	Aboriginal Cultural Heritage Management Plan
ADI	Australian Defence Industries
Alignment	The geometric layout (eg of a road) in plan (horizontal) and elevation (vertical)
ALRA	*Aboriginal Lands Right (Northern Territory) Act 1976* (Commonwealth)
AHIP	Aboriginal Heritage Impact Permit. Under the *National Parks and Wildlife Act 1974* (NSW) (NPW Act), a person can apply for an AHIP as a defence to a prosecution for harming Aboriginal objects or Aboriginal places. AHIPs are issued under Part 6 of NPW Act
AMBS	Australian Museum Business Services
Archaeological potential	The likelihood of undetected surface and/or subsurface archaeological materials existing at a location
Artefact	Any object which has been physically modified by humans
ATSIHP Act	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth)
B	
C	
Campbell Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project at St Peters
CBD	Central business district
Concept design	Initial functional layout of a road/road system or other infrastructure. Used to facilitate understanding of a project, establish feasibility and provide basis for estimating and to determine further investigations needed for detailed design
Construction	Includes all physical work required to construct the project
Construction ancillary facilities	Temporary facilities during construction that include, but are not limited to, construction sites (civil and tunnel), sediment basins, temporary water treatment plants, pre-cast yards and material stockpiles, laydown areas, parking, maintenance workshops and offices
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessment considered alone
Cut-and-cover	A method of tunnel construction whereby the structure is built in an open excavation and subsequently covered.

Term	Definition
Cutting	Formation resulting from the construction of the road below existing ground level, the material is cut out or excavated
D	
Darley Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Leichhardt
DECCW	Department of Environment, Climate Change and Water (replaced in 2011 by the NSW Office of Environment and Heritage)
Detailed design	The phase of the project following concept design where the design is refined, and plans, specifications and estimates are produced, suitable for construction
DP&E	NSW Department of Planning and Environment
E	
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EP&A Regulation	Environmental Planning and Assessment Regulation 2000 (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ERS	Eastern Regional Sequence
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
F	
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. 'Feasible' relates to engineering considerations and what is practical to build. 'Reasonable' relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community expectations and nature and extent of potential improvements
G	
GI	Ground integrity
GPS	Global positioning system
GSV	Ground surface visibility. A term used to describe the area of the ground's surface that is visible during archaeological field surveys
H	
Haberfield civil and tunnel site/Haberfield civil site	Construction ancillary facilities for the M4-M5 Link project located at Haberfield
Heritage item	A place, building, work, relic, moveable object or precinct listed on a statutory heritage register
I	
ILUA	Indigenous Land Use Agreement
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment
In situ	In the natural or original position. Applied to a rock, soil, or fossil when occurring in the situation in which it was originally formed or deposited

Term	Definition
Inner West Council/ Inner West LGA	The amalgamation of the former local government areas of Ashfield Leichhardt and Marrickville, proclaimed on 12 May 2016
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways
Iron Cove Link	Around one kilometre of twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge
Iron Cove Link civil site	A construction ancillary facility for the M4-M5 Link project south of Victoria Road at Rozelle, near the eastern abutment of Iron Cove Bridge
J	
K	
King Georges Road Interchange Upgrade	A component of the WestConnex program of works. Upgrade of the King Georges Road interchange between the M5 West and the M5 East at Beverly Hills, in preparation for the New M5 project
L	
LALC	Local Aboriginal Land Council
LEP	Local environmental plan
LGA	Local government area
M	
M4 East Motorway/project	A component of the WestConnex program of works. Extension of the M4 Motorway in tunnels between Homebush and Haberfield via Concord. Includes provision for a future connection to the M4-M5 Link at the Wattle Street interchange
M4 East mainline stub tunnels	Eastbound and westbound extensions of the M4 East mainline tunnel being built as part of the M4 East project (to connect with the M4-M5 Link)
M4 East mainline connection	The underground connection between the M4-M5 Link mainline tunnels and the M4 East mainline stub tunnels
M4 Widening	A component of the WestConnex program of works. Widening of the existing M4 Motorway from Parramatta to Homebush
M4-M5 Link	The project which is the subject of this EIS. A component of the WestConnex program of works
Mainline tunnels	The M4-M5 Link mainline tunnels connecting with the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters
Methodology	The method for analysis and evaluation of the relevant subject matter
Mid-block	Section of road between two intersections
MLALC	Metropolitan Local Aboriginal Land Council
MNES	Matters of National Environmental Significance
Motorway	High-speed, high-volume controlled access roads. May be tolled or untolled
N	
New M5 Motorway/project	A component of the WestConnex program of works. Located from Kingsgrove to St Peters (under construction)
New M5 mainline stub tunnels	Northbound and southbound extensions of the New M5 mainline tunnel being built as part of the New M5 project (to connect with the M4-M5 Link)
New M5 mainline connection	The underground connection between the M4-M5 Link mainline tunnels and the New M5 mainline stub tunnels
Northcote Street civil site	A construction ancillary facility for the M4-M5 Link project located at Haberfield
NPW Act	*National Parks and Wildlife Act 1974* (NSW)

Term	Definition
NT Act	*Native Title Act 1993* (Commonwealth)
NPW Regulation	National Parks and Wildlife Regulation 2009 (NSW)
O	
OEH	NSW Office of Environment and Heritage
P	
PAC	Planning Assessment Commission
PACHCI	*Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (NSW Roads and Maritime Services 2011)
PAD	Potential Archaeological Deposit. 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
Parramatta Road East civil site	A construction ancillary facility for the M4-M5 Link project at Haberfield
Parramatta Road West civil and tunnel site	A construction ancillary facility for the M4-M5 Link project at Ashfield
PJAP	Port Jackson Archaeological Project
Portals	The locations where a tunnel meets a surface road
Project	A new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange
Project footprint	The land required to construct and operate the project. This includes permanent operational infrastructure (including the tunnels), and land required temporarily for construction
Proponent	The person or organisation that proposes to carry out the project or activity. For the purpose of the project, the proponent is NSW Roads and Maritime Services
Pyrmont Bridge Road tunnel site	A construction ancillary facility for the M4-M5 Link project at Annandale
Q	
R	
RAP	Registered Aboriginal parties
REF	Review of environmental factors
RHDA	Rouse Hill Development Area
Roads and Maritime	NSW Roads and Maritime Services
Rozelle civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Lilyfield and Rozelle
Rozelle interchange	A new interchange at Lilyfield and Rozelle that would connect the M4-M5 Link mainline tunnels with City West Link, Anzac Bridge, the Iron Cove Link and the proposed future Western Harbour Tunnel and Beaches Link
Rozelle Rail Yards	The Rozelle Rail Yards is bound by City West Link to the south, Lilyfield Road to the north, Balmain Road to the west, and White Bay to the east. Note that the project only occupies part of the Rozelle Rail Yards site

S	
SEARs	Secretary's Environmental Assessment Requirements. Requirements and specifications for an environmental assessment prepared by the Secretary of the Department of Planning and Environment under section 115Y of the *Environmental Planning and Assessment Act 1979* (NSW)
SEPP	State Environmental Planning Policy
SMC	Sydney Motorway Corporation
St Peters interchange	A component of the New M5 project, located at the former Alexandria Landfill site at St Peters. Approved and under construction as part of the New M5 project. Additional construction works proposed as part of the M4-M5 Link project.
Stone artefact	Any piece of rock modified by human agency
Stub tunnel	Driven tunnels constructed to connect to potential future motorway links
T	
The Crescent civil site	A construction ancillary facility for the M4-M5 Link project located at Annandale
Tunnel portal	The entrance/exit to the tunnel
U	
V	
Ventilation facility	Facility for the mechanical removal of air from the mainline tunnels, or mechanical introduction of air into the tunnels. May comprise one or more ventilation outlets
Ventilation outlet	The location and structure from which air within a tunnel is expelled
Victoria Road civil site	A construction ancillary facility for the M4-M5 Link project located at Rozelle
W	
Waterway	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent)
Wattle Street civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Haberfield
WestConnex program of works	A program of works that includes the M4 Widening, King Georges Road Interchange Upgrade, M4 East, New M5 and M4-M5 Link projects
X	
Y	
Z	

Executive summary

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval to construct and operate the WestConnex M4-M5 Link (the project), which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

As part of the environmental impact statement (EIS) for the project, an Aboriginal heritage assessment has been undertaken to satisfy the relevant requirements of the Secretary's Environmental Assessment Requirements (SEARs) for the project. Specifically, this assessment was undertaken to assess potential impacts of the project on Aboriginal heritage and to support the preparation of an EIS.

The assessment has also been undertaken in accordance with the relevant provisions of the Roads and Maritime *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime 2011). This procedure was developed by Roads and Maritime to guide consultation and investigation of Aboriginal cultural heritage. It sets out an assessment process that incorporates elements of the NSW Office of Environment and Heritage's (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (NSW Department of Environment, Climate Change and Water (DECCW) 2010).

A PACHCI Stage 1 Aboriginal heritage assessment was undertaken by AECOM in May 2016. The findings of that PACHCI Stage 1 assessment concluded that a survey of the study area (PACHCI Stage 2 assessment) was necessary to determine potential impacts (direct and indirect) to Aboriginal heritage values, and to identify appropriate mitigation measures (where required).

The study area (see **Figure 6-2**) for this Aboriginal heritage assessment was based on the project footprint, that comprises the footprint of all temporary (construction) and permanent (operational) project land required for the project, including construction areas and associated ancillary facilities and permanent infrastructure.

A search of the Aboriginal Heritage Information Management System (AHIMS) database for previously recorded Aboriginal sites within the study area was undertaken on 21 September 2016 (search number #246070). No previously recorded Aboriginal sites were identified within the study area. The nearest site, rockshelter with midden (site #45-6-2278), is mapped as occurring about 50 metres to the north of the Rozelle Rail Yards. It is located above an area proposed for subsurface tunnel construction. Access to #45-6-2278 has not been provided due to its location within private property but the area containing it has been subject to a separate study to determine potential vibration and settlement impacts. It was determined that for tunnelling works associated with the project, #45-6-2278 is located beyond the minimum safe working distance for vibration intensive plant, with vibration impacts associated with tunnelling works expected to be negligible.

Aboriginal community consultation for the project has been undertaken in accordance with the Stage 2 PACHCI process, which comprised participation in the archaeological survey by the Metropolitan Local Aboriginal Land Council (MLALC) and a review of the findings contained in this technical working paper. No native title applicants or Aboriginal owners were identified.

An archaeological survey for the project was undertaken by AECOM archaeologist Dr Andrew McLaren accompanied by MLALC Aboriginal Sites Officer, Jay Daley. Survey was targeted, focusing on those portions of the study area that appeared, from the examination of recent aerial photographs, to retain some Aboriginal archaeological potential. Key observations made during the archaeological survey were as follows:

- The study area predominantly consists of highly disturbed terrain that is unlikely to retain Aboriginal archaeological materials in surface or subsurface contexts
- No surface expressions of Aboriginal objects were identified during the survey
- As no AHIMS registered Aboriginal sites occur within the study area, none would be either directly or indirectly impacted by the project. The closest AHIMS site is mapped as occurring about 50 metres to the north of the Rozelle Rail Yards. No direct impacts are anticipated from the project and indirect impacts from vibration are expected to be negligible. As no access has yet been provided to assess this site, its current condition is to be confirmed with a site survey during detailed design, with ongoing observation and monitoring recommended to be undertaken during the construction program, as needed
- At a part of the study area adjacent to Whites Creek, exposed sandstone bedrock was observed on the short but relatively steep slope below the Rozelle Bay light rail stop. However, no grinding grooves or pigment/engraved art were noted during the current survey.

Given the extent of previous disturbance within the study area, no direct or indirect impacts on Aboriginal cultural values are anticipated as a result of the project. As such, it is concluded that further impact assessment in accordance with Stage 3 of the PACHCI is not required. Based on the above findings, the following recommendations are made:

- Should any unexpected finds of Aboriginal places, objects or deposits be identified during the construction of the project, the *Standard Management Procedure for Unexpected Heritage Items* (Roads and Maritime 2015) is to be followed
- Prior to construction and if possible due to property access, a suitably qualified archaeologist is to visit AHIMS site #45-6-2278 to verify the site and confirm its current condition. If verified, a baseline condition assessment and baseline vibration monitoring is to be carried out before construction vibration generating activities start. If the site is verified, vibration levels are to be monitored to ensure they do not to exceed three millimetres per second at AHIMS site #45-6-2278. At the completion of construction, a condition assessment would be completed with recommendations for remediation measures if required.

1 Introduction

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval to construct and operate the WestConnex M4-M5 Link (the project), which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

Together with the other components of the WestConnex program of works and the proposed future Sydney Gateway, the project would facilitate improved connections between western Sydney, Sydney Airport and Port Botany and south and south-western Sydney, as well as better connectivity between the important economic centres along Sydney's Global Economic Corridor and local communities.

Approval is being sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) for the project. A request has been made for the NSW Minister for Planning to specifically declare the project to be State significant infrastructure and also critical State significant infrastructure. An environmental impact statement (EIS) is therefore required.

1.1 Overview of WestConnex and related projects

The M4-M5 Link is part of the WestConnex program of works. Separate planning applications and assessments have been completed for each of the approved WestConnex projects. Roads and Maritime has commissioned Sydney Motorway Corporation (SMC) to deliver WestConnex, on behalf of the NSW Government. However, Roads and Maritime is the proponent for the project.

In addition to linking to other WestConnex projects, the M4-M5 Link would provide connections to the proposed future Western Harbour Tunnel and Beaches Link, the Sydney Gateway (via the St Peters interchange) and the F6 Extension (via the New M5).

The WestConnex program of works, as well as related projects, are shown in **Figure 1-1** and described in **Table 1-1**.

Table 1-1 WestConnex and related projects

Project	Description	Status
WestConnex program of works		
M4 Widening	Widening of the existing M4 Motorway from Parramatta to Homebush.	Planning approval under the EP&A Act granted on 21 December 2014. Open to traffic.
M4 East	Extension of the M4 Motorway in tunnels between Homebush and Haberfield via Concord. Includes provision for a future connection to the M4-M5 Link at the Wattle Street interchange.	Planning approval under the EP&A Act granted on 11 February 2016. Under construction.
King Georges Road Interchange Upgrade	Upgrade of the King Georges Road interchange between the M5 West and the M5 East at Beverly Hills, in preparation for the New M5 project.	Planning approval under the EP&A Act granted on 3 March 2015. Open to traffic.
New M5	Duplication of the M5 East from King Georges Road in Beverly Hills with tunnels from Kingsgrove to a new interchange at St Peters. The St Peters interchange allows for connections to the proposed future Sydney Gateway project and an underground connection to the M4-M5 Link. The New M5 tunnels also include provision for a future connection to the proposed future F6 Extension.	Planning approval under the EP&A Act granted on 20 April 2016. Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) granted on 11 July 2016. Under construction.

Project	Description	Status
M4-M5 Link (the project)	Tunnels connecting to the M4 East at Haberfield (via the Wattle Street interchange) and the New M5 at St Peters (via the St Peters interchange), a new interchange at Rozelle and a link to Victoria Road (the Iron Cove Link). The Rozelle interchange also includes ramps and tunnels for connections to the proposed future Western Harbour Tunnel and Beaches Link project.	The subject of this EIS.
Related projects		
Sydney Gateway	A high-capacity connection between the St Peters interchange (under construction as part of the New M5 project) and the Sydney Airport and Port Botany precinct.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.
Western Harbour Tunnel and Beaches Link	The Western Harbour Tunnel component would connect to the M4-M5 Link at the Rozelle interchange, cross underneath Sydney Harbour between the Birchgrove and Waverton areas, and connect with the Warringah Freeway at North Sydney. The Beaches Link component would comprise a tunnel that would connect to the Warringah Freeway, cross underneath Middle Harbour and connect with the Burnt Bridge Creek Deviation at Balgowlah and Wakehurst Parkway at Seaforth. It would also involve the duplication of the Wakehurst Parkway between Seaforth and Frenchs Forest.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.
F6 Extension	A proposed motorway link between the New M5 at Arncliffe and the existing M1 Princes Highway at Loftus, generally along the alignment known as the F6 corridor.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.

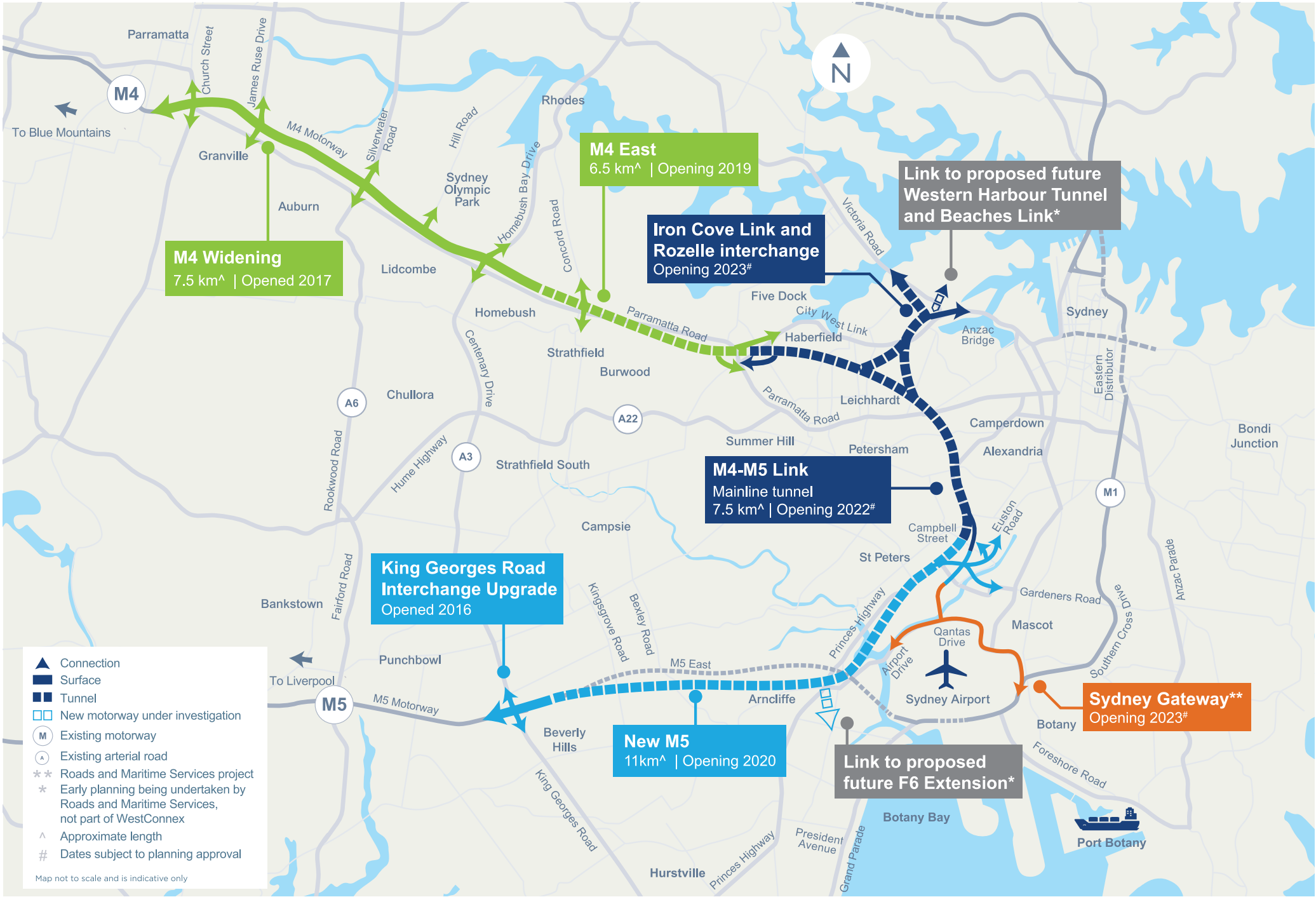


Figure 1-1 Overview of WestConnex and related projects

1.2 Purpose of this report

AECOM has been engaged to undertake an Aboriginal heritage assessment for the project. This assessment forms part of the EIS for the project and has been undertaken in accordance with Roads and Maritime's *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime 2011).

The purpose of this report is to address the Secretary's Environmental Assessment Requirements (SEARs) by identifying any potential Aboriginal cultural heritage values within the study area and provide appropriate recommendations for any further assessment and/or identify appropriate management and mitigations measures.

The PACHCI process was developed by Roads and Maritime to guide consultation and investigation of Aboriginal cultural heritage. It sets out an assessment process that incorporates elements of the NSW Office of Environment and Heritage's (OEH):

- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (NSW Department of Environment, Climate Change and Water (DECCW) 2010)
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010a)
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b)
- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011).

The PACHCI comprises three broad steps:

- Stage 1 – An initial desktop assessment is undertaken by Roads and Maritime, or its consultant, to determine whether consultation with a heritage advisor and a site survey is required
- Stage 2 – A site survey is undertaken by a heritage advisor and representative from the Local Aboriginal Land Council (LALC), Aboriginal archaeological assessment is undertaken and the associated report is prepared
- Stage 3 – A full Aboriginal archaeological assessment in accordance with OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010) is completed. In addition, Aboriginal community consultation is conducted in accordance with OEH's *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010).

The requirement for a Stage 3 assessment is based on whether the Stage 2 assessment identifies Aboriginal sites or areas of archaeological sensitivity that would be impacted by the project. Due to enforced time requirements to allow Registered Aboriginal parties (RAPs) time to provide feedback on the proposed project methodology and report outputs, Stage 3 assessments typically take six months to complete. Consideration should be given during design to avoiding all impacts on Aboriginal sites and areas of archaeological sensitivity to avoid the need for a Stage 3 PACHCI assessment and subsequent project delays.

A PACHCI Stage 1 Aboriginal heritage assessment was undertaken by AECOM in May 2016. Based on the findings of the PACHCI Stage 1 assessment, it was concluded that a survey of the study area (PACHCI Stage 2 assessment) was necessary to determine potential impacts (direct and indirect) to Aboriginal heritage values, and to identify appropriate mitigation measures (where required). This report is the PACHCI Stage 2 assessment. Given the extent of previous disturbance within the study area, no direct or indirect impacts on Aboriginal cultural values are anticipated as a result of the project. As such, it is concluded that further impact assessment in accordance with Stage 3 of the PACHCI is not required.

1.3 SEARs and agency comments

EISs are prepared to assess the environmental impacts of major projects, including State significant infrastructure projects, under Part 5.1 of the EP&A Act. This Aboriginal heritage assessment forms part of the EIS being prepared for the M4-M5 Link and assesses the potential Aboriginal impacts of the project.

EISs are subject to a range of legislative and policy requirements as set out in the SEARs. **Table 1-2** sets how the requirements relevant to Aboriginal heritage are addressed in this report.

Table 1-2 How SEARs have been addressed in this report

SEARs	
Aboriginal heritage	
Requirement relating to Aboriginal Cultural Heritage	**Section where addressed in EIS**
1. The Proponent must identify and assess any direct and/or indirect impacts (including cumulative impacts) to the heritage significance of listed heritage items inclusive of: (a) Aboriginal places and objects, as defined under the *National Parks and Wildlife Act 1974* and in accordance with the principles and methods of assessment identified in the current guidelines; (b) Aboriginal places of heritage significance, as defined in the Standard Instrument – Principal Local Environmental Plan.	**Chapters 6** and **7** of this technical report.
3. Where archaeological investigations of Aboriginal objects are proposed these must be conducted by a suitably qualified archaeologist, in accordance with section 1.6 of the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010).	**Section 11.2** of this technical report.
4. Where impacts to Aboriginal objects and/or places are proposed, consultation must be undertaken with Aboriginal people in accordance with the current guidelines.	**Section 4.2** of this technical report.
OEH requirement relating to Aboriginal Cultural Heritage	**Section where addressed in EIS**
1.1 The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the project and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW 2011).	**Chapters 6**, **7** and **8** of this technical report.
1.2 Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.	**Section 4.2** of this technical report
1.3 Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.	**Chapters 9**, **10** and **11** of this technical report.

1.4 Assessment team

1.4.1 AECOM

This assessment was led by Dr Darran Jordan. He has a doctorate in archaeology from the University of Sydney, a Bachelor of Arts (Honours, 1st Class) with majors in prehistorical and historical archaeology from the University of Sydney and a Bachelor of Arts from the University of Western Sydney, majoring in Text and Writing, sub-majoring in historical studies. He has also undertaken numerous short courses covering such diverse subjects as Aboriginal cultural consultation, stone tool

identification, archaeological field techniques, and archaeological drawing and writing. He is a senior archaeologist/heritage specialist and team leader at AECOM and has over eleven years of professional experience in Indigenous and non-Indigenous cultural heritage management.

The site inspection was undertaken by Dr Andrew McLaren. He has a doctorate in archaeology from Cambridge University, attained a Master of Cultural Heritage degree at Deakin University and a Bachelor of Arts (Honours, 1st Class) with majors in Anthropology and Archaeology from the University of Queensland. He is a member of the Australian Archaeological Association, the Institute of Field Archaeologists and the Lithic Studies Society. He is also an associate member of the Australian Association of Consulting Archaeologists. He is a senior archaeologist/heritage specialist at AECOM and has over eight years of professional experience in Indigenous and non-Indigenous cultural heritage management.

Dr Darran Jordan was the primary author of this report, which was reviewed by Dr Andrew McLaren.

1.4.2 Aboriginal representation

Assessments for Roads and Maritime are required to utilise the PACHCI. This document outlines a consultation process that is consistent with the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010a) and the National Parks and Wildlife Regulation 2009 (NSW) (NPW Regulation). Consultation guidelines are utilised in heritage assessments to ensure that appropriate consultation is undertaken with representatives of the Aboriginal community. This assessment was undertaken under the PACHCI process, which stipulates that PACHCI Stage 2 assesses a project's potential to harm Aboriginal cultural heritage, and to determine whether formal Aboriginal community consultation is required. Under a Stage 2 assessment, the Roads and Maritime Aboriginal Cultural Heritage Officer is to identify the LALC relevant to the study area and contact the administrator to organise appropriate representation for fieldwork and consultation. For this assessment, Roads and Maritime Aboriginal Cultural Heritage Officer identified that the study area was within the bounds of the Metropolitan Local Aboriginal Land Council (MLALC) and that their Aboriginal Sites Officer was the appropriate representative to attend fieldwork.

MLALC was formed in 1983 when the *Aboriginal Lands Right (Northern Territory) Act 1976* (Commonwealth) (ALRA) was established. It was originally known as the Redfern Land Council, changing its name to MLALC in 1985. The MLALC boundary covers 25 local government areas (LGAs) and the MLALC provide a variety of services including site assessment, Welcome to Country, cultural awareness training, site monitoring, site tours and site protection. Their staff consists of professional, qualified and highly skilled Aboriginal Land and Conservation Management Officers accredited in Conservation and Land Management. The MLALC Cultural Heritage Unit also has access to the cultural knowledge of some of Sydney's most unique Aboriginal sites, many of which were showcased in their book Footprints on Rock, about the Aboriginal art and heritage of the Sydney region. For this assessment, MLALC assigned their trained and accredited Aboriginal Sites Officer, Jay Daley, to attend the fieldwork and provide input into known, potential and intangible Aboriginal cultural heritage values within the study area. Jay Daley was also able to confer with other MLALC staff regarding the assessment in order to draw upon a larger pool of cultural knowledge, as appropriate. Other representatives at MLALC included Gadigal Elder Uncle Charles Madden, Uncle Allen Madden, Uncle Raymond Davison, Larisa Cooper (Land and Culture Officer) and James Smith (Cultural Educator).

MLALC Aboriginal Sites Officer, Jay Daley, was present during all fieldwork for this project and reviewed the findings contained in this technical working paper. These assessment works were conducted under the Stage 2 PACHCI process, in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010) with reference to the SEARs requirement to identify and assess any direct and/or indirect impacts (including cumulative impacts) to the heritage significance of Aboriginal places and objects, as defined under the *National Parks and Wildlife Act 1974* (NSW) (NPW Act) and in accordance with the principles and methods of assessment identified in the SEARs guidelines.

1.5 Study area

The study area for this Aboriginal heritage assessment was based on the project footprint, comprising the footprint of all temporary (construction) and permanent (operational) project infrastructure and associated ancillary facilities. The location of the study area is shown on **Figure 6-2**.

1.6 Structure of this report

This report is the Aboriginal Heritage Assessment for the project and is structured as follows:

Chapter 1 presents the background information on the project

Chapter 2 presents the features of the project

Chapter 3 outlines the legislative requirements

Chapter 4 details the assessment methodology

Chapter 5 contains the landscape context

Chapter 6 contains information on the archaeological context

Chapter 7 contains information on the ethnographic context

Chapter 8 contains the results

Chapter 9 contains the assessment of impacts

Chapter 10 contains the cumulative impact assessment

Chapter 11 summarises the findings and recommendations.

2 The project

2.1 Project location

The project would be generally located within the City of Sydney and Inner West local government areas (LGAs). The project is located about two to seven kilometres south, southwest and west of the Sydney central business district (CBD) and would cross the suburbs of Ashfield, Haberfield, Leichhardt, Lilyfield, Rozelle, Annandale, Stanmore, Camperdown, Newtown and St Peters. The local context of the project is shown in **Figure 2-1**.

2.2 Overview of the project

Key operational features of the project are shown in **Figure 2-1** and would include:

- Twin mainline motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. Each tunnel would be around 7.5 kilometres long and would generally accommodate up to four lanes of traffic in each direction
- Connections of the mainline tunnels to the M4 East project, comprising:
  - A tunnel-to-tunnel connection to the M4 East mainline stub tunnels east of Parramatta Road near Alt Street at Haberfield
  - Entry and exit ramp connections between the mainline tunnels and the Wattle Street interchange at Haberfield (which is currently being constructed as part of the M4 East project)
  - Minor physical integration works with the surface road network at the Wattle Street interchange including road pavement and line marking
- Connections of the mainline tunnels to the New M5 project, comprising:
  - A tunnel-to-tunnel connection to the New M5 mainline stub tunnels north of the Princes Highway near the intersection of Mary Street and Bakers Lane at St Peters
  - Entry and exit ramp connections between the mainline tunnels and the St Peters interchange at St Peters (which is currently being constructed as part of the New M5 project)
  - Minor physical integration works with the surface road network at the St Peters interchange including road pavement and line marking
- An underground interchange at Leichhardt and Annandale (the Inner West subsurface interchange) that would link the mainline tunnels with the Rozelle interchange and the Iron Cove Link (see below)
- A new interchange at Lilyfield and Rozelle (the Rozelle interchange) that would connect the M4-M5 Link mainline tunnels with:
  - City West Link
  - Anzac Bridge
  - The Iron Cove Link (see below)
  - The proposed future Western Harbour Tunnel and Beaches Link
- Construction of connections to the proposed future Western Harbour Tunnel and Beaches Link project as part of the Rozelle interchange, including:
  - Tunnels that would allow for underground mainline connections between the M4 East and New M5 motorways and the proposed future Western Harbour Tunnel and Beaches Link (via the M4-M5 Link mainline tunnels)
  - A dive structure and tunnel portals within the Rozelle Rail Yards, north of the City West Link / The Crescent intersection
  - Entry and exit ramps that would extend north underground from the tunnel portals in the

Rozelle Rail Yards to join the mainline connections to the proposed future Western Harbour Tunnel and Beaches Link

- A ventilation outlet and ancillary facilities as part of the Rozelle ventilation facility (see below)

· Twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge (the Iron Cove Link). Underground entry and exit ramps would also provide a tunnel connection between the Iron Cove Link and the New M5 / St Peters interchange (via the M4-M5 Link mainline tunnels)

· The Rozelle surface works, including:

- Realigning The Crescent at Annandale, including a new bridge over Whites Creek and modifications to the intersection with City West Link

- A new intersection on City West Link around 300 metres west of the realigned position of The Crescent, which would provide a connection to and from the New M5/St Peters interchange (via the M4-M5 Link mainline tunnels)

- Widening and improvement works to the channel and bank of Whites Creek between the light rail bridge and Rozelle Bay at Annandale, to manage flooding and drainage for the surface road network

- Reconstructing the intersection of The Crescent and Victoria Road at Rozelle, including construction of a new bridge at Victoria Road

- New and upgraded pedestrian and cyclist infrastructure

- Landscaping, including the provision of new open space within the Rozelle Rail Yards

· The Iron Cove Link surface works, including:

- Dive structures and tunnel portals between the westbound and eastbound Victoria Road carriageways, to connect Victoria Road east of Iron Cove Bridge with the Iron Cove Link

- Realignment of the westbound (southern) carriageway of Victoria Road between Springside Street and the eastern abutment of Iron Cove Bridge

- Modifications to the existing intersections between Victoria Road and Terry, Clubb, Toelle and Callan streets

- Landscaping and the establishment of pedestrian and cycle infrastructure

· Five motorway operations complexes; one at Leichhardt (MOC1), three at Rozelle (Rozelle West (MOC2), Rozelle East (MOC3) and Iron Cove Link (MOC4)), and one at St Peters (MOC5). The types of facilities that would be contained within the motorway operations complexes would include substations, water treatment plants, ventilation facilities and outlets, offices, on-site storage and parking for employees

· Tunnel ventilation systems, including ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels

· Three new ventilation facilities, including:

- The Rozelle ventilation facility at Rozelle

- The Iron Cove Link ventilation facility at Rozelle

- The Campbell Road ventilation facility at St Peters

· Fitout (mechanical and electrical) of part of the Parramatta Road ventilation facility at Haberfield (which is currently being constructed as part of M4 East project) for use by the M4-M5 Link project

· Drainage infrastructure to collect surface and groundwater for treatment at dedicated facilities. Water treatment would occur at

- Two operational water treatment facilities (at Leichhardt and Rozelle)

- The constructed wetland within the Rozelle Rail Yards

- A bioretention facility for stormwater runoff within the informal car park at King George Park at

Rozelle (adjacent to Manning Street). A section of the existing informal car park would also be upgraded, including sealing the car park surface and landscaping

- Treated water would flow back to existing watercourses via new, upgraded and existing infrastructure
- Ancillary infrastructure and operational facilities for electronic tolling and traffic control and signage (including electronic signage)
- Emergency access and evacuation facilities, including pedestrian and vehicular cross and long passages and fire and life safety systems
- Utility works, including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities. A Utilities Management Strategy has been prepared for the project that identifies management options for utilities, including relocation or adjustment. Refer to **Appendix F** (Utilities Management Strategy) of the EIS.

The project does not include:

- Site management works at the Rozelle Rail Yards. These works were separately assessed and determined by Roads and Maritime through a Review of Environmental Factors under Part 5 of the EP&A Act (refer to **Chapter 2** (Assessment process) of the EIS)
- Ongoing motorway maintenance activities during operation
- Operation of the components of the Rozelle interchange which are the tunnels, ramps and associated infrastructure being constructed to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project.

Temporary construction ancillary facilities and temporary works to facilitate the construction of the project would also be required.

2.2.1 Staged construction and opening of the project

It is anticipated the project would be constructed and opened to traffic in two stages (as shown in **Figure 2-1**).

Stage 1 would include:

- Construction of the mainline tunnels between the M4 East at Haberfield and the New M5 at St Peters, stub tunnels to the Rozelle interchange (at the Inner West subsurface interchange) and ancillary infrastructure at the Darley Road motorway operations complex (MOC1) and Campbell Road motorway operations complex (MOC5)
- These works are anticipated to commence in 2018 with the mainline tunnels open to traffic in 2022. At the completion of Stage 1, the mainline tunnels would operate with two traffic lanes in each direction. This would increase to generally four lanes at the completion of Stage 2, when the full project is operational.

Stage 2 would include:

- Construction of the Rozelle interchange and Iron Cove Link including:
  - Connections to the stub tunnels at the Inner West subsurface interchange (built during Stage 1)
  - Ancillary infrastructure at the Rozelle West motorway operations complex (MOC2), Rozelle East motorway operations complex (MOC3) and Iron Cove Link motorway operations complex (MOC4)
  - Connections to the surface road network at Lilyfield and Rozelle
  - Construction of tunnels, ramps and associated infrastructure as part of the Rozelle interchange to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project
- Stage 2 works are expected to commence in 2019 with these components of the project open to traffic in 2023.

2.3 Construction activities

An overview of the key construction features of the project is shown in **Figure 2-2** and would generally include:

- Enabling and temporary works, including provision of construction power and water supply, ancillary site establishment including establishment of acoustic sheds and construction hoarding, demolition works, property adjustments and public and active transport modifications (if required)
- Construction of the road tunnels, interchanges, intersections and roadside infrastructure
- Haulage of spoil generated during tunnelling and excavation activities
- Fitout of the road tunnels and support infrastructure, including ventilation and emergency response systems
- Construction and fitout of the motorway operations complexes and other ancillary operations buildings
- Realignment, modification or replacement of surface roads, bridges and underpasses
- Implementation of environmental management and pollution control facilities for the project.

A more detailed overview of construction activities is provided in **Table 2-1**.

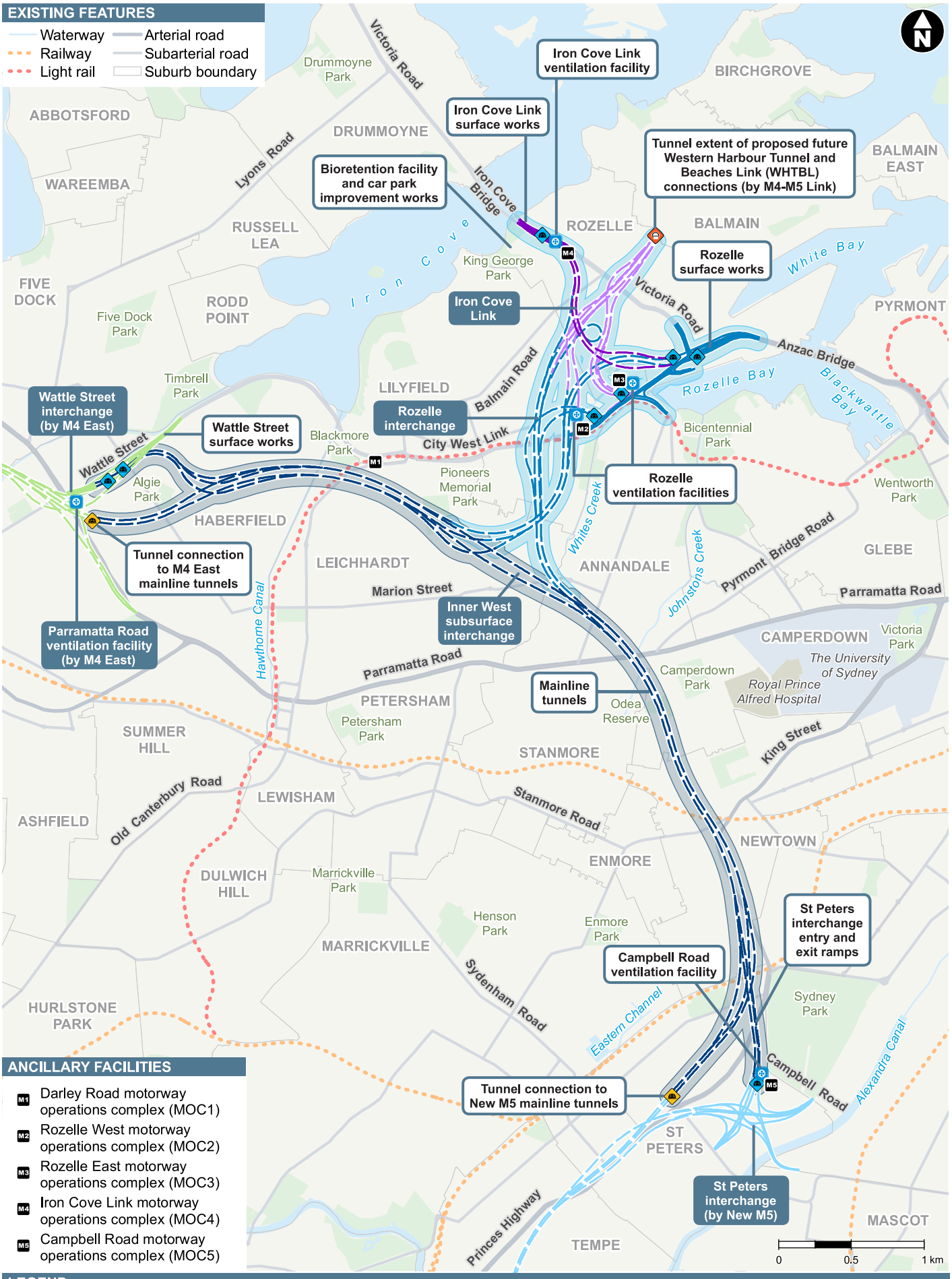


Figure 2-1 Overview of the project

Table 2-1 Overview of construction activities

Component	Typical activities
Site establishment and enabling works	· Vegetation clearing and removal · Utility works · Traffic management measures · Install safety and environmental controls · Install site fencing and hoarding · Establish temporary noise attenuation measures · Demolish buildings and structures · Carry out site clearing · Heritage salvage or conservation works (if required) · Establish construction ancillary facilities and access · Establish acoustic sheds · Supply utilities (including construction power) to construction facilities · Establish temporary pedestrian and cyclist diversions
Tunnelling	· Construct temporary access tunnels · Excavation of mainline tunnels, entry and exit ramps and associated tunnelled infrastructure and install ground support · Spoil management and haulage · Finishing works in tunnel and provision of permanent tunnel services · Test plant and equipment
Surface earthworks and structures	· Vegetation clearing and removal · Topsoil stripping · Excavate new cut and fill areas · Construct dive and cut-and-cover tunnel structures · Install stabilisation and excavation support (retention systems) such as sheet pile walls, diaphragm walls and secant pile walls (where required) · Construct required retaining structures · Excavate new road levels
Bridge works	· Construct piers and abutments · Construct headstock · Construct bridge deck, slabs and girders · Demolish and remove redundant bridges

Component	Typical activities
Drainage	· Construct new pits and pipes · Construct new groundwater drainage system · Connect drainage to existing network · Construct sumps in tunnels as required · Construct water quality basins, constructed wetland and bioretention facility and basin · Construct drainage channels · Construct spill containment basin · Construct onsite detention tanks · Adjustments to existing drainage infrastructure where impacted · Carry out widening and naturalisation of a section of Whites Creek · Demolish and remove redundant drainage
Pavement	· Lay select layers and base · Lay road pavement surfacing · Construct pavement drainage
Operational ancillary facilities	· Install ventilation systems and facilities · Construct water treatment facilities · Construct fire pump rooms and install water tanks · Test and commission plant and equipment · Construct electrical substations to supply permanent power to the project
Finishing works	· Line mark to new road surfaces · Erect directional and other signage and other roadside furniture such as street lighting · Erect toll gantries and other control systems · Construct pedestrian and cycle paths · Carry out earthworks at disturbed areas to establish the finished landform · Carry out landscaping · Closure and backfill of temporary access tunnels (except where these are to be used for inspection and/or maintenance purposes) · Site demobilisation and preparation of the site for a future use

Twelve construction ancillary facilities are described in this EIS (as listed below). To assist in informing the development of a construction methodology that would manage constructability constraints and the need for construction to occur in a safe and efficient manner, while minimising impacts on local communities, the environment, and users of the surrounding road and other transport networks, two possible combinations of construction ancillary facilities at Haberfield and Ashfield have been assessed in this EIS. The construction ancillary facilities that comprise these options have been grouped together in this EIS and are denoted by the suffix a (for Option A) or b (for Option B).

The construction ancillary facilities required to support construction of the project include:

· Construction ancillary facilities at Haberfield (Option A), comprising:
    - Wattle Street civil and tunnel site (C1a)

- Haberfield civil and tunnel site (C2a)
- Northcote Street civil site (C3a)

· Construction ancillary facilities at Ashfield and Haberfield (Option B), comprising:
  - Parramatta Road West civil and tunnel site (C1b)
  - Haberfield civil site (C2b)
  - Parramatta Road East civil site (C3b)
· Darley Road civil and tunnel site (C4)
· Rozelle civil and tunnel site (C5)
· The Crescent civil site (C6)
· Victoria Road civil site (C7)
· Iron Cove Link civil site (C8)
· Pyrmont Bridge Road tunnel site (C9)
· Campbell Road civil and tunnel site (C10).

The number, location and layout of construction ancillary facilities would be finalised as part of detailed construction planning during detailed design and would meet the environmental performance outcomes stated in the EIS and the Submissions and Preferred Infrastructure Report and satisfy criteria identified in any relevant conditions of approval.

The construction ancillary facilities would be used for a mix of civil surface works, tunnelling support, construction workforce parking and administrative purposes. Wherever possible, construction sites would be co-located with the operational footprint to minimise property acquisition and temporary disruption. The layout and access arrangements for the construction ancillary facilities are based on the concept design only and would be confirmed and refined in response to submissions received during the exhibition of this EIS and during detailed design.

2.3.1 Construction program

The total period of construction works for the project is expected to be around five years, with commissioning occurring concurrently with the final stages of construction. An indicative construction program is shown in **Table 2-2**.

Table 2-2 Indicative construction program

Construction activity	Indicative construction timeframe																											
	2018				2019				2020				2021				2022				2023							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Mainline tunnels																												
Site establishment and establishment of construction ancillary facilities																												
Utility works and connections																												
Tunnel construction																												
Portal construction																												
Construction of permanent operational facilities																												
Mechanical and electrical fitout works																												
Establishment of tolling facilities																												
Site rehabilitation and landscaping																												
Surface road works																												
Demobilisation and rehabilitation																												
Testing and commissioning																												
Rozelle interchange and Iron Cove Link																												
Site establishment and establishment of construction ancillary facilities																												
Utility works and connections and site remediation																												
Tunnel construction																												
Portal construction																												
Construction of surface road works																												
Construction of permanent operational facilities																												
Mechanical and electrical fitout works																												
Establishment of tolling facilities																												
Site rehabilitation and landscaping																												
Demobilisation and rehabilitation																												
Testing and commissioning																												

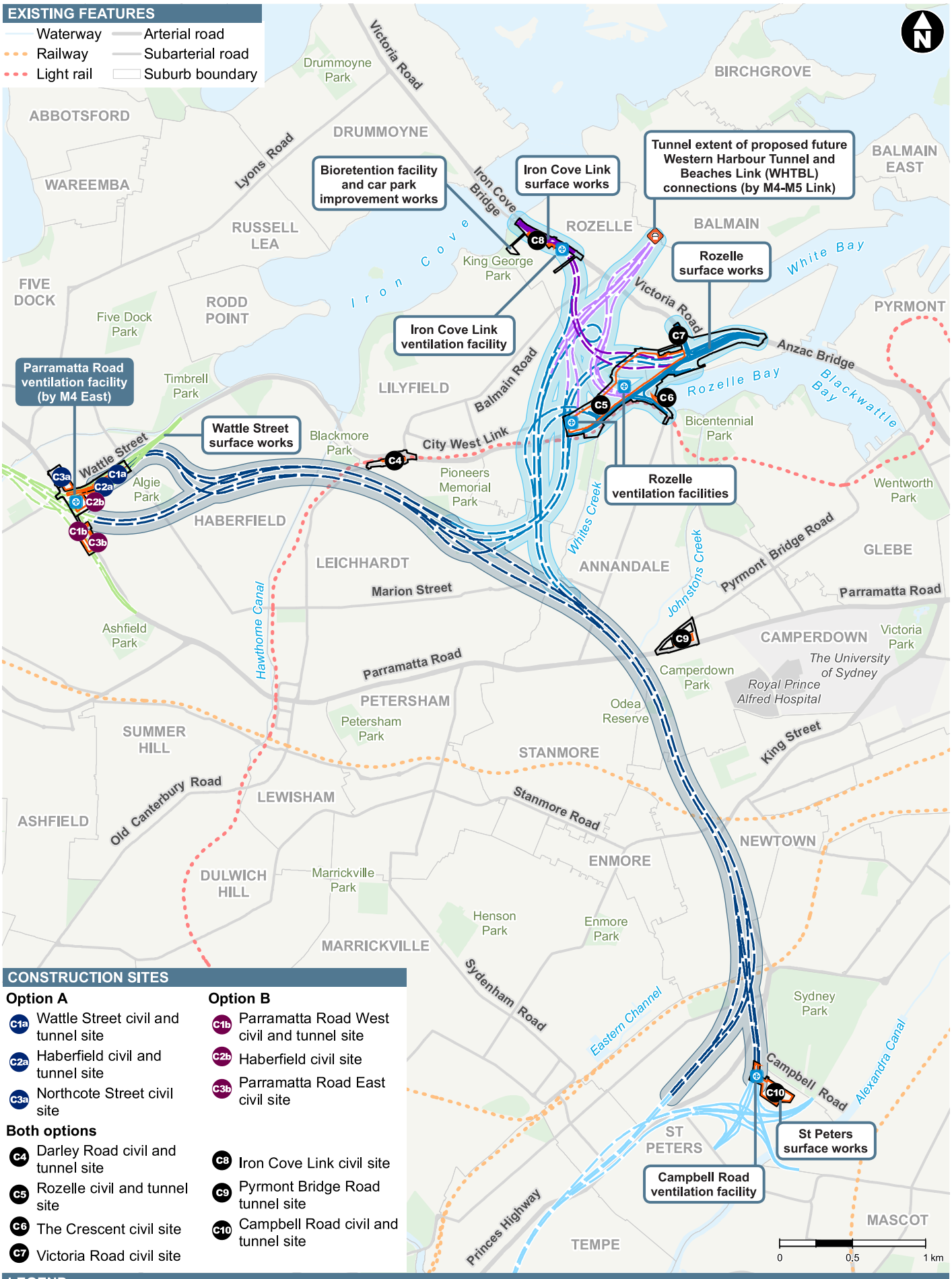


Figure 2-2 Overview of project footprint and ancillary facilities

3 Legislative considerations

3.1 Introduction

A number of planning and legislative documents govern how Aboriginal objects, areas and places are managed in NSW. The following section provides an overview of the requirements under each as they apply to the project.

3.2 NSW legislation

3.2.1 Environmental Planning and Assessment Act 1979 (NSW)

The EP&A Act and the Environmental Planning and Assessment Regulation 2000 (NSW) (EP&A Regulation) provides the framework for environmental planning and assessment in NSW. The EP&A Act and EP&A Regulation also provide opportunity for public involvement in the environmental impact assessment process in most circumstances. In NSW, environmental impacts are interpreted as including impacts on Aboriginal cultural heritage.

As indicated in **Chapter 1**, approval for the project is being sought under Part 5.1 of EP&A Act, with the environmental impact assessment being documented within an EIS. The current Aboriginal heritage assessment has been prepared for inclusion in this EIS. The project is subject to Part 5.1 of the EP&A Act and would be subject to approval by the NSW Minister for Planning. The SEARs for the project require the assessment of the project impacts on Aboriginal cultural heritage.

Pursuant to section 89J of the EP&A Act, Aboriginal Heritage Impact Permits (AHIPs) are not required for projects approved under Division 5.1 of Part 5 of the EP&A Act. Impacts on Aboriginal heritage values associated with approved State significant development and State significant infrastructure projects are typically managed under Aboriginal Cultural Heritage Management Plans (ACHMPs). ACHMPs are statutorily binding once approved by the Planning Assessment Commission (PAC) or the NSW Department of Planning and Environment (DP&E) under delegation from the Secretary.

3.2.2 National Parks and Wildlife Act 1974 (NSW)

The NPW Act, administered by 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:

- An Aboriginal object is any deposit, object or material evidence (that is not a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal extraction (and includes Aboriginal remains)
- 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 and includes a 'strict liability offence' for such harm. A 'strict liability offence' does not require someone to know that it is an Aboriginal object or place they are causing harm to in order to be prosecuted. Defences against the 'strict liability offence' in the NPW Act include the carrying out of certain 'Low Impact Activities', prescribed in clause 80B of the NPW Regulation or the demonstration of due diligence.

An AHIP issued under section 90 of the NPW Act is required if impacts on Aboriginal objects and/or places cannot be avoided. An AHIP is a defence to a prosecution for harming Aboriginal objects and places if the harm was authorised by the AHIP and the conditions of that AHIP were not contravened. 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.

Section 89A of the NPW Act requires notification to the Director-General of the location of identified Aboriginal objects within a reasonable time, with penalties for non-notification. As the project has been declared State significant infrastructure it requires compliance with different parts of the NPW Act.

3.2.3 Standard Instrument – Principal Local Environmental Plan

The SEARs state that Aboriginal places of heritage significance, as defined in the Standard Instrument – Principal Local Environmental Plan, must be considered in relation to the project. The definition contained in the Dictionary included with the plan states:

> *Aboriginal place of heritage significance means an area of land, the general location of which is identified in an Aboriginal heritage study adopted by the Council after public exhibition and that may be shown on the Heritage Map, that is:*
>
> *a) the site of one or more Aboriginal objects or a place that has the physical remains of pre-European occupation by, or is of contemporary significance to, the Aboriginal people. It may (but need not) include items and remnants of the occupation of the land by Aboriginal people, such as burial places, engraving sites, rock art, midden deposits, scarred and sacred trees and sharpening grooves, or*
>
> *b) a natural Aboriginal sacred site or other sacred feature. It includes natural features such as creeks or mountains of long-standing cultural significance, as well as initiation, ceremonial or story places or areas of more contemporary cultural significance.*

Heritage conservation for Aboriginal places of heritage significance is defined in section 5.10 of the Standard Instrument – Principal Local Environmental Plan which states:

> *The consent authority must, before granting consent under this clause to the carrying out of development in an Aboriginal place of heritage significance:*
>
> *a) consider the effect of the proposed development on the heritage significance of the place and any Aboriginal object known or reasonably likely to be located at the place by means of an adequate investigation and assessment (which may involve consideration of a heritage impact statement), and*
>
> *b) notify the local Aboriginal communities, in writing or in such other manner as may be appropriate, about the application and take into consideration any response received within 28 days after the notice is sent.*

In general, section 115ZF(2) of the EP&A Act excludes the application of environmental planning instruments to State significant infrastructure projects (except as those instruments apply to the declaration of State significant infrastructure or critical State significant infrastructure). Regardless of the above, consistent with good environmental assessment practice, the provisions of the State Environmental Planning Policies (SEPPs) and deemed SEPPs have been considered. As the project is subject to Part 5.1 of the EP&A Act and will be submitted for approval by the NSW Minister for Planning, no other environmental planning instruments were relevant to this Aboriginal heritage assessment.

Local environmental plans (LEPs) do not apply to State significant infrastructure projects, but they have been considered here to address the requirement of the SEARs. The project is located within the City of Sydney and Inner West LGAs. The Inner West LGA was formed on 12 May 2016 upon the amalgamation of the former Ashfield, Leichhardt and Marrickville LGAs. Existing LEPs for the former Ashfield, Leichhardt and Marrickville areas remain in force until a combined LEP has been gazetted for the new Inner West LGA. Schedule 5 of each LEP was searched for relevant environmental heritage items.

No Aboriginal sites were listed on the Ashfield Local Environmental Plan 2013. Four Aboriginal midden and rockshelter sites were identified in the suburb of Birchgrove in the Leichhardt Local Environmental Plan 2013 (one on Louisa Road (A4) and three on Numa Street (A6, A7 and A8)), but were determined to be outside the study area.

It was further noted that the King George Park Draft Plan of Management referred to two 'incomplete land claims' lodged by MLALC. These were not deemed relevant to the assessment as the land claims were not complete, and land claims under the *Aboriginal Land Rights Act 1983* (NSW) do not necessarily denote Aboriginal cultural or scientific archaeological values. Land Councils are not required to establish cultural association with lands when making land claims under the *Aboriginal Land Rights Act 1983* (NSW). One of the two land claims referred to has, since preparation of the Draft Plan of Management, been determined by way of refusal.

Kendrick Park, listed on the Marrickville Local Environmental Plan 2011 (I308), contained a shell midden within its bounds; this was also determined to be outside the study area. No Aboriginal sites were listed on the Sydney Local Environmental Plan 2012.

It was concluded that there were no Aboriginal items listed in any relevant LEPs that would be subject to either direct or indirect impacts from the proposed works. Canada Bay Council also identified that there is a shell midden (currently unregistered) in Timbrell Park at Five Dock. No impacts are currently proposed in this area and no direct or indirect impacts are foreseen regarding this midden site.

3.3 Commonwealth legislation

3.3.1 Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth)

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth) (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'* (Part I, 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'* (Part I, 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'* (Part I, 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 ATSIHP Act, an area or object is considered to have been be injured or desecrated if:

a) In the case of an area:

   i. it is used or treated in a manner inconsistent with Aboriginal tradition;

   ii. the use or significance of the area in accordance with Aboriginal tradition is adversely affected; and

   iii. passage through, or over, or entry upon, the area by any person occurs in a manner inconsistent with Aboriginal tradition

b) in the case of an object:

   i. 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 Australian Government Minister for the Environment 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 Minister must consult the appropriate minister of that state or territory (Part 2, section 13).

No declarations relevant to the study area have been made under the ATSIHP Act.

3.3.2 Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

The EPBC Act took effect on 16 July 2000. Under the EPBC Act, proposed 'actions' that have or are likely to have a significant impact on a Matter of National Environmental Significance (MNES) must be referred to the Australian Minister for the Environment. An 'action' is defined as a project, development, undertaking, activity or a series of activities or alteration. An action must also be referred if:

- It is undertaken on Commonwealth land and will have or is likely to have a significant impact on the environment
- It is undertaken outside Commonwealth land and will have or is likely to have a significant impact on the environment on Commonwealth land
- It is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment.

The EPBC Act defines 'environment' as including both natural and cultural environments, and therefore includes Aboriginal and non-Aboriginal heritage. Under the 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. The Register of the National Estate has been suspended and is no longer a statutory list; however, it remains available as an archive.

The heritage registers mandated by the EPBC Act were consulted on 21 September 2016 in relation to this project. No registered Aboriginal heritage items or places with significance to Aboriginal people have been located within the study area.

3.3.3 Native Title Act 1993 (Commonwealth)

The *Native Title Act 1993* (Commonwealth) (NT Act) provides for the recognition and protection of native title for Aboriginal peoples and Torres Strait Islanders. The NT Act recognises native title for land over which native title has not been extinguished and where persons able to establish native title are able to prove continuous use, occupation or other classes of behaviour and actions consistent with a traditional cultural possession of those lands. It also makes provision for Indigenous Land Use Agreements (ILUA) to be formed as well as a framework for notification of Native Title Stakeholders for certain future acts on land where Native Title has not been extinguished.

Initial searches of the *Schedule of Applications (unregistered claimant applications*), *Register of Native Title Claims*, *National Native Title Register*, *Register of Indigenous Land Use Agreements* and *Notified Indigenous Land Use Agreements* were undertaken on 26 May 2016 through the National Native Title Tribunal online search facility as part of the PACHCI Stage 1 assessment. Updated searches were undertaken 10 October 2016 for the Inner West Council LGA and the City of Sydney LGA. No relevant listings were identified within the bounds of the study area.

4 Assessment methodology

The methodology adopted for this assessment was developed in accordance with the requirements of the Stage 2 PACHCI process (refer to **Annexure A**). The steps in the Stage 2 PACHCI process meet the requirements for the project SEARs. Key components of the methodology include:

- Desktop assessment
- Consultation with the LALC
- Archaeological survey of the study area
- Preparation of an Aboriginal heritage assessment report (this report).

4.1 Desktop assessment

The desktop assessment comprised:

- A search of OEH's Aboriginal Heritage Information Management System (AHIMS) database
- A review of the landscape context of the study area
- A review of relevant archaeological and ethnohistoric information for the study area (including a review of the previous EIS documents and Aboriginal heritage assessments for this project and area)
- Identification of areas of potential Aboriginal archaeological sensitivity within the study area.

4.2 Aboriginal community consultation

In accordance with the Stage 2 PACHCI process (refer to **Annexure A**), the following Aboriginal community consultation process was adopted:

- Identification of key Aboriginal stakeholders and the relevant LALC through searches of the National Native Title Register and Registrar of Aboriginal Owners
- Engagement of identified Aboriginal stakeholders to participate in the archaeological survey
- Preparation (by identified Aboriginal stakeholders) of a cultural heritage survey report.

Searches of the National Native Title Register and Register of Aboriginal Owners did not identify any Aboriginal stakeholders.

As is stated in the PACHCI document: "the aim of Stage 2 is to undertake further assessment and a survey with specific Aboriginal stakeholders and an archaeologist to assess a project's potential to harm Aboriginal cultural heritage, and to determine whether formal Aboriginal community consultation and a cultural heritage assessment report is required".

The MLALC was identified as the relevant LALC for this assessment. Jay Daley, a representative from MLALC, participated in the archaeological survey and reviewed the findings of this technical working paper.

4.3 Archaeological survey

The aim of the archaeological survey was to identify and record existing surface evidence of past Aboriginal activity within the study area, as well as areas of subsurface archaeological potential. The study area for this assessment was based on the project footprint (study area) comprising the footprint of all temporary (construction) and permanent (operational) project infrastructure and associated ancillary facilities. An overview of the project footprint and ancillary facilities is shown on **Figure 2-1**.

Archaeological survey for the project was undertaken by AECOM archaeologist Dr Andrew McLaren accompanied by MLALC Aboriginal Sites Officer Jay Daley on 21 September 2016. Owing to levels of past disturbance, survey was targeted, focusing on those portions of the study area that appeared,

from the examination of recent aerial photographs, to retain some Aboriginal archaeological potential. It was determined that these areas included the following construction ancillary facilities:

- Construction ancillary facilities at Haberfield (Option A), comprising:
  - Wattle Street civil and tunnel site (C1a)
  - Haberfield civil and tunnel site (C2a)
  - Northcote Street civil site (C3a)
- Construction ancillary facilities at Ashfield and Haberfield (Option B), comprising:
  - Parramatta Road West civil and tunnel site (C1b)
  - Haberfield civil site (C2b)
  - Parramatta Road East civil site (C3b)
- Darley Road civil and tunnel site (C4)
- Rozelle civil and tunnel site (C5)
- Iron Cove Link civil site (C8)
- Campbell Road civil and tunnel site (C10).

The Crescent civil site (C6), Victoria Road civil site (C7) and Pyrmont Bridge Road tunnel site (C9) were determined to be unlikely to retain Aboriginal archaeological potential due to high levels of past disturbance and impact, and were not subject to further survey.

The archaeological survey was completed by pedestrian transects, walking those parts of the study area determined to be the least disturbed. Notes were taken on the ground surface visibility (GSV), ground integrity (GI) and archaeological sensitivity. GSV is a limiting factor in that it can obscure surface expressions, if any are present. All data was recorded on a hand-held differential global positioning system (GPS). Digital photographs were also taken. The results of the archaeological survey are discussed in **Chapter 8**.

5 Landscape context

Environmental variables such as topography, geology, hydrology and vegetation would have played a critical role in influencing how Aboriginal people moved within and utilised the landscape. Accordingly, any attempt to predict or interpret the character and distribution of Aboriginal sites in a given area must consider such environmental factors.

5.1 Topography

While the natural topography of the study area has been extensively modified through historical land use activities, available soil landscape mapping (Chapman & Murphy, 1989) indicates a varied topography linked to surface geology (**Figure 5-1** and **Figure 5-2**). Sections of the study area have been classified as being Disturbed Terrain (xx), defined as locations where: 'soils have been disturbed to a depth of at least 100 cm. Most of the original soil has either been removed, buried or greatly disturbed'. This is: 'terrain disturbed by human activity. Disturbed areas are often landscaped and artificially drained' (Chapman & Murphy, 1989:132–134). In such areas the Aboriginal archaeological component is usually either highly disturbed or completely destroyed. Outside of areas of Disturbed Terrain (xx), which are concentrated along watercourses (eg Whites Creek, Johnstons Creek, Hawthorne Canal (formerly Long Cove Creek) and Alexandra Canal (formerly Sheas Creek)), the majority of land within the study area has been mapped as belonging to one of two soil landscapes – the shale-based Blacktown (bt) soil landscape and the sandstone-based Gymea (gy) soil landscape. A small area of land adjacent to the duplicated Iron Cove Bridge forms part of the Hawkesbury soil landscape (ha).

Chapman and Murphy (1989: 30) describe the topography of the Blacktown soil landscape as consisting of gently undulating rises with local relief 10–30 metres and slopes generally less than five per cent, but up to 10 per cent. Crests and ridges are broad (200–600 metres) and rounded with convex upper slopes that grade into concave lower slopes. Bedrock outcrops are absent (Chapman & Murphy, 1989: 30-31).

The topography of those portions of the study area mapped as part of the Gymea soil landscape is described as consisting of undulating to rolling rises and low hills with local relief 20–80 metres and slopes of 10–25 per cent. Sideslopes in these areas exhibit narrow to wide (10–100 metres) outcropping sandstone benches, which often form broken scarps of less than five metres (Chapman & Murphy, 1989: 64).

The topography of the Hawkesbury soil landscape is described as consisting of rolling to very steep hills with local relief between 40 and 200 metres and slope gradients from 35 per cent to 70 per cent. Crests and ridges are convex and narrow. Slopes are moderately inclined to precipitous. Sandstone bedrock outcrops occur as horizontal benches and broken scarps up to 10 metres high (Chapman & Murphy, 1989: 45).

5.2 Hydrology

Parts of the study area are located close to Rozelle Bay and Iron Cove, both of which would have provided a range of marine resources in the past. Other named watercourses within and surrounding the study area include Whites Creek, Johnstons Creek, Hawthorne Canal (formerly Long Cove Creek), Dobroyd Canal (Iron Cove Creek) and Alexandra Canal (formerly Sheas Creek). It is likely that the study area would have been well-resourced in the past in terms of both freshwater and marine resources. However, deposits associated with Aboriginal use of these aquatic features are unlikely to have survived within the study area due to historical land use activities (eg channelisation and bank stabilisation works, residential/industrial development).

5.3 Geology & soils

Reference to the Geological Mapsheet for Sydney (9130) indicates that the surface geology of the study area incorporates two natural geological formations and one man-made geological unit, the latter comprising man-made fill (mf) (see **Figure 5-2**). Natural geological formations represented within the study area include the Ashfield Shale component of the Middle Triassic Wianamatta Group and the Hawkesbury Sandstone, also of Middle Triassic antiquity.

The Ashfield Shale is the lowermost of the Wianamatta Group formations and has been described as consisting of a 'sequence of dark-grey to black, sideritic claystone – siltstone which grades upwards into a fine sandstone – siltstone laminate' (Bembrick et al., 1991: 17). A medium to coarse-grained quartz sandstone with minor shale and laminate lenses, Hawkesbury Sandstone weathers cavernously to form overhangs (ie rockshelters) but also occurs as flatted-topped outcrops (platforms) and isolated boulders (McDonald 2008). Utilised rockshelters, grinding grooves and rock art, both engraved and pigment, are common archaeological features of this formation, which also contains stone suitable for the production of flaked stone artefacts in the form of pebbles of white vein quartz, typically less than six millimetres in diameter (Attenbrow 2010: 43; Corkill 1999: 54).

The study area also includes the highly disturbed Rozelle Rail Yards. This area has included extensive quarrying of the sandstone outcrops, excavation and levelling of soil, the laying or asphalt, concrete and rail lines and the construction of associated buildings and other structures. As a result of this past disturbance the rail yards have been classified as Disturbed Terrain (xx) soil landscapes.

Soils within the study area have been mapped as belonging to the Blacktown (bt), Gymea (gy), Hawkesbury (ha) and Disturbed Terrain (xx) soil landscapes.

5.4 Flora and fauna

The study area has been extensively cleared of its original vegetation, with road and residential development activity having significantly altered the area. Plant species present across the study area now are all regrowth. The original native vegetation is likely to have been open sandstone woodland and heathland with such species as flax-leaved wattle (*Acacia linifolia*), myrtle wattle (*Acacia myrtifolia*), smooth-barked apple (*Angophora costata*), heath banksia (*Banksia ericifolia*), blue flax lily (*Dianella caerulea*), Sydney peppermint (*Eucalyptus piperita*), scribbly gum (*Eucalyptus racemose*), prickly-leaved paperbark (*Melaleuca stypheloides*), thyme-leaved paperbark (*Melaleuca thymifolia*), basket grass (*Oplismenus aemula*) and Kangaroo grass (*Themeda australis*), with multiple types of Aboriginal use in food, medicine and manufacture (Leichhardt Council, 2012: 24). The previously disturbed Rozelle Rail Yards had become extensively overgrown with a variety of vegetation since the diminished use of the area. This necessitated the implementation of site management works to clear the vegetation in this area (see **section 6.4.2**).

Fauna species that may have been present in the area in the past include the Superb Fairy Wren (*Malurus cyaneus*), Tawny Frogmouth (*Podargus strigoides*), Southern Boobook (*Ninox boobook*), Spotted Pardalote (*Pardalotus punctatus*), Yellow Thornbill (*Acanthiza nana*), Eastern Spinebill (*Acanthorhynchus tenuirostris*), Eastern Yellow Robin (*Eopsaltria australis*), Grey Fantail (*Rhipidura albiscapa*), Red-Browed Finch (*Neochmia temporalis*), Blue-tongued Lizard (*Tiliqua Scincidae*), Eastern Banjo Frog (*Limnodynastes dumerilii*), Common Eastern Froglet (*Crinia signifera*), Peron's Tree Frog (*Litoria peronii*), Dwarf Tree Frog (*Litoria fallax*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Pied Oystercatcher (*Haematopus longirostris*) and the Eastern Bentwing-bat (*Miniopterus fuliginosus*) (Leichhardt Council, 2012: 11). Although the current area is only an indication of what species may have been in this vicinity in the Aboriginal past, it does indicate that faunal species for food and other resources would have been present. It is likely that the area was well resourced in terms of both flora and fauna in the Aboriginal past, with both land animals and marine resources accessible.

5.5 Land use

The study area has been highly disturbed throughout the process of urban development for roads, commercial/industrial development for businesses and rail, and residential areas. This includes high levels of past impact in the development and use of the Rozelle Rail Yards. This has included extensive vegetation clearance, landscape modification, channelising of creek channels, road development and the installation of related infrastructure. The level of disturbance means that any Aboriginal deposits that were present are likely to have been destroyed if they were present within the highly disturbed sections of the study area. The purpose of survey undertaken for this assessment was to ground truth any remnant areas that are less disturbed and have the potential to contain intact subsurface cultural deposits.

5.6 Key observations

Key observations from the background review of the landscape context of the study area are as follows:

- While the natural topography of the study area has been extensively modified through historical land use activities, available soil landscape mapping (Chapman & Murphy, 1989) indicates a varied topography linked to surface geology. In general, the topography of the study area can be described as undulating
- Parts of the study area are located close to Rozelle Bay and Iron Cove, both of which would have provided a range of marine resources in the past. Other named watercourses within and surrounding the study area include Whites Creek, Johnstons Creek, Hawthorne Canal (formerly Long Cove Creek), Dobroyd Canal (Iron Cove Creek) and Alexandra Canal (formerly Sheas Creek). It is likely that the study area would have been well-resourced in the past in terms of both freshwater and marine resources
- Natural geological formations represented within the study area include the Ashfield Shale component of the Middle Triassic Wianamatta Group and the Hawkesbury Sandstone, also of Middle Triassic antiquity. Utilised rockshelters, grinding grooves and rock art, both engraved and pigment, are common archaeological features of the Hawkesbury Sandstone, which also contains stone suitable for the production of flaked stone artefacts in the form of pebbles of white vein quartz, typically less than six millimetres in diameter
- The study area has been highly disturbed throughout the process of urban development for roads, commercial/industrial development for businesses and rail, and residential areas. This has included extensive vegetation clearance, landscape modification, channelising of creek channels, road development and the installation of related infrastructure. Aboriginal archaeological materials are unlikely to survive in highly disturbed areas.

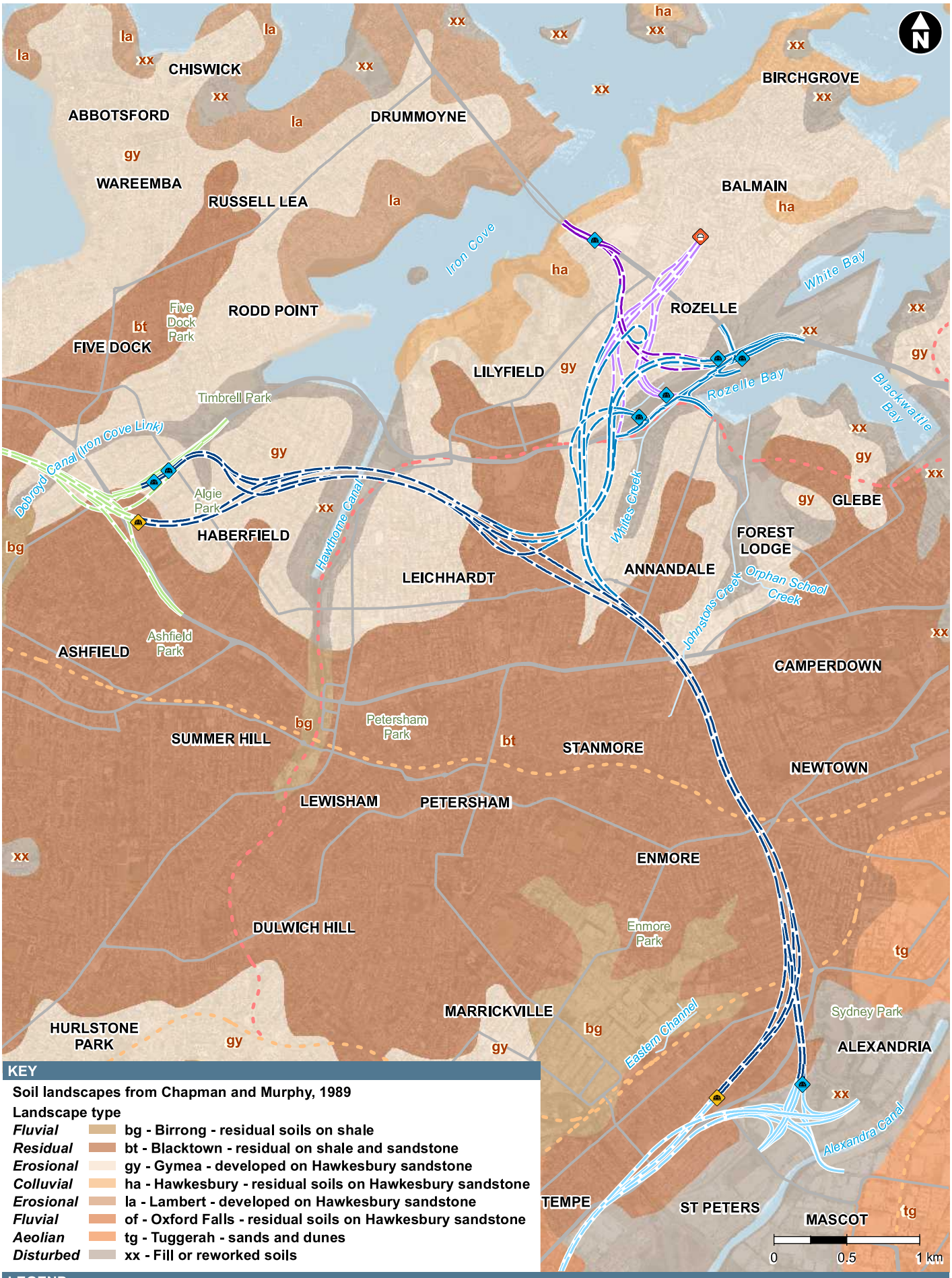
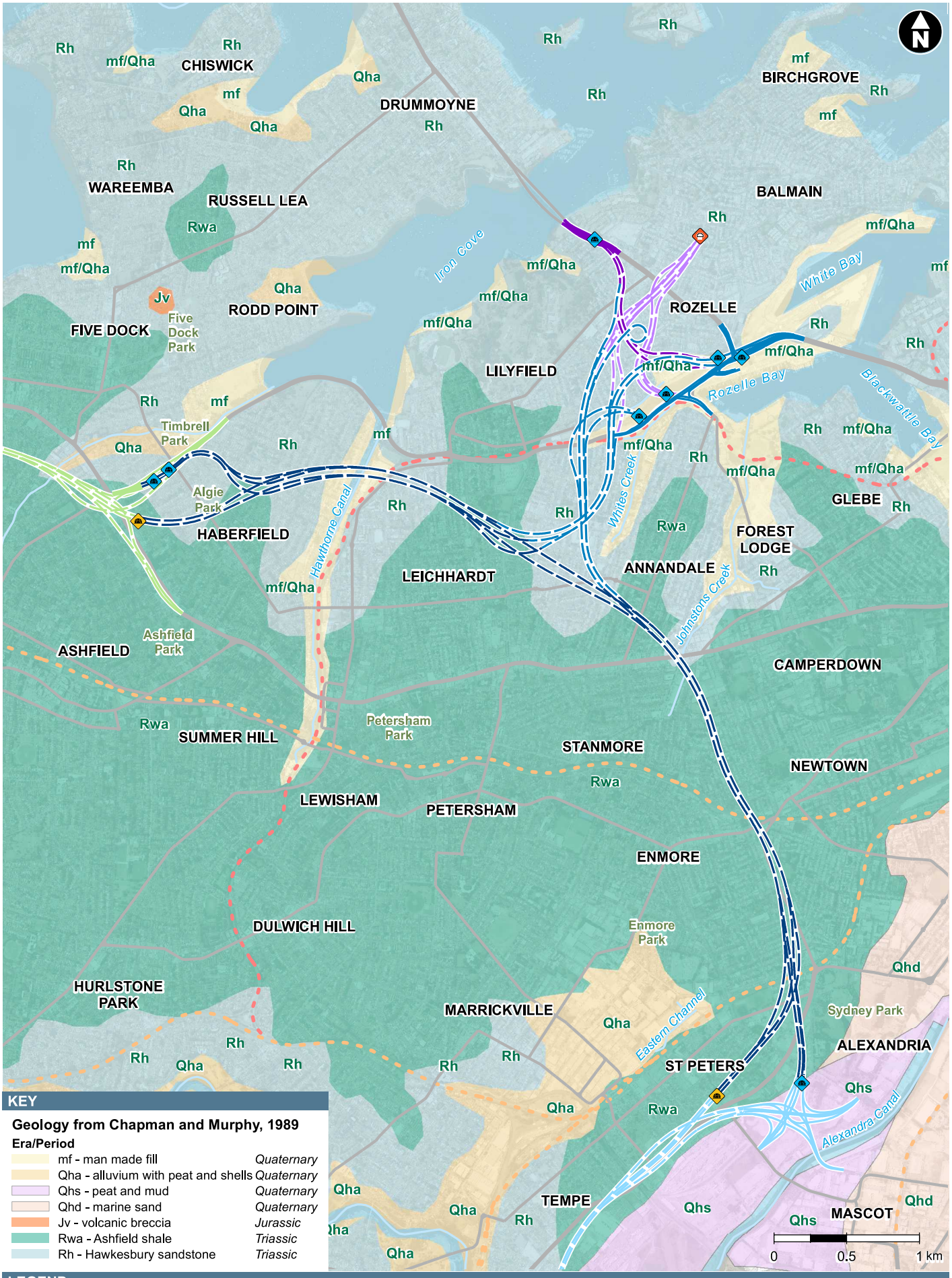


Figure 5-1 Soil landscapes



KEY

Geology from Chapman and Murphy, 1989

Era/Period	
mf - man made fill	*Quaternary*
Qha - alluvium with peat and shells	*Quaternary*
Qhs - peat and mud	*Quaternary*
Qhd - marine sand	*Quaternary*
Jv - volcanic breccia	*Jurassic*
Rwa - Ashfield shale	*Triassic*
Rh - Hawkesbury sandstone	*Triassic*

LEGEND

Existing features
- Waterway
- Railway
- Light rail
- Arterial road
- Subarterial road

Project features
- Tunnel portal
- Tunnel extent
- Tunnel connection

M4 East
- Surface road
- Tunnel

New M5
- Surface road
- Tunnel

M4-M5 Link

Mainline
- Surface road
- Tunnel

Rozelle interchange
- Surface road
- Tunnel

Iron Cove Link
- Surface road
- Tunnel

Proposed future WHTBL connections (civil construction only)
- Surface road
- Tunnel

Figure 5-2 Regional geology

6 Archaeological context

6.1 The Sydney region

Available archaeological data indicate that Aboriginal people have occupied the Sydney region[1] for at least 36,000 years (Jo McDonald CHM 2005b; Williams et al. 2014). Late Pleistocene/early Holocene occupation of the region is evidenced by radiometric dates from both coastal and hinterland sites (see Attenbrow, 2010: 18, Table 3.1). Excavated material culture assemblages from these periods have been interpreted as evidence of relatively small populations of Aboriginal people employing settlement patterns of high residential and low logistical mobility (Attenbrow 2010: 152-154; McDonald 2008: 39). Late Pleistocene/early Holocene chipped stone assemblages attest to a preference for silicified tuff sourced from secondary geological sources such as the Hawkesbury-Nepean River gravels (McDonald 2008; Williams et al. 2014). However, they also indicate the exploitation of other raw material types such as silcrete, quartzite, petrified wood and quartz. Direct freehand percussion appears to have been the dominant reduction technique employed by Late Pleistocene/early Holocene Aboriginals knappers, with bipolar flaking comparatively poorly represented in available assemblages. Retouched 'tools' include unifacially-flaked pebble implements, dentated saws, burins and a variety of scrapers, with unmodified utilised flakes also well represented (Kohen et al. 1984; Williams et al. 2014). Stone tools such as these will have been complemented by a range of organic implements such as wooden digging sticks, spears and boomerangs. However, these do not survive archaeologically (Attenbrow 2010: 154).

Compared with the late Pleistocene/early Holocene, archaeological evidence for mid-to-late Holocene Aboriginal occupation of the Sydney Region abounds (for recent syntheses see Attenbrow 2010; McDonald 2008). In keeping with broader Australian developments (eg Allen and O'Connell 1995; Beaton 1985; Brumm and Moore 2005; Attenbrow et al. 2009; Lourandos 1983, 1997; Lourandos and Ross 1994), the social and economic systems of Aboriginal groups living in the region during this period appear to have become increasingly complex. Available archaeological data, for example, suggest a significant increase in site establishment and population densities over time, as well as a concomitant growth in the size and complexity of social aggregation (but see Attenbrow (2012) and Hiscock (2008) for cautionary notes on the interpretive significance of radiometric date graphs). Growing economic specialisation is indicated by the emergence and/or proliferation of complex fishing and stoneworking technologies, with the latter linked variously to increased foraging risk associated with greater climatic variability as well as other variables such as redefinition of social space, reduction of resources and increased logistical pre-equipping (Attenbrow et al. 2009; McDonald 2008: 40). Complex, long-distance exchange networks are also attested archaeologically (eg Attenbrow et al. 2012; Grave et al. 2012) as are important developments in artistic activities (McDonald 2008). Higher levels of stylistic heterogeneity in pigment and engraved art across the region, for example, have been linked to increasing territoriality (McDonald 2008: 42).

With some modification, McCarthy's (1967) *Eastern Regional Sequence* (ERS) of stone artefact assemblages remains the dominant chronological framework for Aboriginal occupation of the region. Based on appreciable changes in the composition of chipped stone artefact assemblages over time, the ERS hypothesises a three phase sequence of 'Capertian' (earliest), 'Bondaian' and 'Eloueran' (most recent) assemblages and was developed on the basis of McCarthy's (1948, 1964) pioneering analyses of stratified flaked stone assemblages from Lapstone Creek rockshelter, on the lower slopes of the Blue Mountains eastern escarpment, and Capertee 3 rockshelter in the Capertee Valley north of Lithgow. At present, the most widely cited characterisation of the ERS in the Sydney region is that of a four-phase sequence beginning with the *Pre-Bondaian* (McCarthy's *Capertian*) and moving successively through the Early, Middle and Late phases of the *Bondaian*, the last of which equates to McCarthy's (1967) *Eloueran* phase. The tripartite division of the Bondaian is based principally on the presence/absence and relative abundance of backed artefacts (Attenbrow 2010: 101). However, other factors, such as changes in the abundance of bipolar artefacts and different stone materials, as well as the presence/absence of edge-ground hatchet-heads are also relevant.

[1] Following Attenbrow (2012a), the land bounded by the coast on the east, by the Hawkesbury-Nepean River on the north and west, and by a line running east–west through Picton and Stanwell Park in the south.

Table 6-1 MCarthy's (1967) Eastern Regional Sequence (ESR) of stone artefact assemblages

Current phasing	McCarthy's (1967) phasing	Approximate date range	Backed artefact frequency	Bipolar artefacts	Edge-ground hatchet heads
Pre-Bondaian	Capertian	40,000-8,000 BP	Absent	Rare	Absent
Early Bondaian	Bondaian	8,000-4,000 BP	Very low	Rare	Absent
Middle Bondaian		4,000-1,000 BP	Very high	Increasingly common	Present
Late Bondaian	Eloueran	1,000 BP to European contact	Low	Very common	Present

6.2 The Port Jackson Archaeological Project

The Port Jackson Archaeological Project (PJAP) was initiated by Val Attenbrow (Senior Fellow, Australian Museum) as a vehicle for investigating pre-colonial Aboriginal land and resource use patterns in the Port Jackson catchment (Attenbrow 1990, 1991, 1992a, 1992b, 1994). Still ongoing, the PJAP has generated a substantial body of data concerning pre-contact Aboriginal occupation of the catchment and remains one of the comprehensive sources of data on Aboriginal archaeological site distribution within it. Alongside desktop analyses of AHIMS and privately-held site data, the PJAP has involved the relocation and re-recording of numerous previously identified (but poorly described) sites as well as targeted survey in parts of the catchment with few, if any, sites. Archaeological excavations have also been undertaken at several sites (eg Attenbrow et al. 2008; Attenbrow 1992a), with analysis of recovered cultural materials completed for some sites but not others. Of particular interest here are the results of Attenbrow's (1990, 1991) analysis of the distribution of then known shell middens and open archaeological deposits within the catchment (n = 369, with 335 middens and 34 open deposits respectively), with eight sub-catchments recognised on the basis of major rivers and creeks and further subdivided into freshwater, estuarine and ocean zones (**Figure 6-1**).

Key patterns to emerge from Attenbrow's analysis were as follows:

- Shell middens occur only in sub-catchments with estuarine and/or ocean zones. Shell is present in freshwater zone sites but in quantities insufficient for their classification as middens (**Figure 6-1**)
- Archaeological deposits tend to occur in freshwater zones (**Figure 6-1**)
- The majority of sites are located in areas underlain by Hawkesbury sandstone, with comparatively few sites located in areas underlain by Wianamatta Shale
- Most sites occur within council reserves or on undeveloped Crown Land
- Middens and deposits occur in higher densities in sub-catchments that include estuary mouths
- Most middens and deposits occur in rockshelters as opposed to 'open' contexts
- Most middens and deposits occur on landform elements within 10 metres of high water level (ie in foreshore zones)
- Ridgetops and ridge-side sites are comparatively poorly represented.

The distributional patterning revealed by Attenbrow's (1991) analysis can be interpreted in a number of ways. Taken at face value, site distribution patterns suggest an occupational emphasis on coastal/estuarine environments and the Hawkesbury Sandstone, with hinterland/freshwater environments and areas underlain by Wianamatta shales less intensively utilised. Greater numbers of people living in these areas can also be inferred. However, as Attenbrow (2010: 51) has cautioned, equating larger numbers of sites with increased activity and/or populations without taking into

consideration the size and contents of these sites, as well as the effects of natural and anthropogenic processes is, at best, problematic. Variations in the numbers and densities of Aboriginal sites between aquatic zones and geological formations must be interpreted with due reference to such variables. Key issues for the Port Jackson catchment include marked differences in levels of archaeological site visibility and preservation potential between areas, variable urban and industrial development pressures and archaeological sampling bias (Attenbrow 2010: 52). Whilst recognising the distributional biases introduced by such variables, reference to the results of large scale surveys in comparatively undisturbed estuarine areas to the north of the Hawkesbury River (eg Vinnicombe 1980) suggest that the general trends in site distribution revealed by the PJAP may, at least in part, reflect the original distribution of these sites (ie more sites and deposits along shores compared with slopes and very few sites on ridgetops). As Attenbrow (2010: 53) has suggested, it seems reasonable to conclude that 'many activities, including those relating to tool-making which probably happened at base campsites, took place close to the estuarine and freshwater waterways as well as the marine shorelines'.

Table 6-2 Port Jackson catchment: number of shell middens and archaeological deposits in each sub-catchment (after Attenbrow 2010: 51, Table 5.1)

Sub-catchment	Area (km2)	Aquatic zone(s)	No. of middens	No. of arch. deposits	Density (no./sq km)
1. Middle Harbour	92.5	F; Est; O	171	7	1.9
2. Lane Cove River	96.5	F; Est	86	9	0.98
3. Vineyard Creek	41	F; Est	36	2	0.92
4. Darling Mills Creek	32.5	F	0	10	0.3
5. Upper Parramatta River	71	F	0	3	0.04
6. Duck River	81	F; Est	0	3	0.04
7. Concord to Sydney Harbour Bridge	50	F; Est	20	0	0.4
8. Sydney Harbour Bridge to South Head	20.5	F; Est; O	22	0	1.1
Total	**485**	**-**	**335**	**34**	**-**

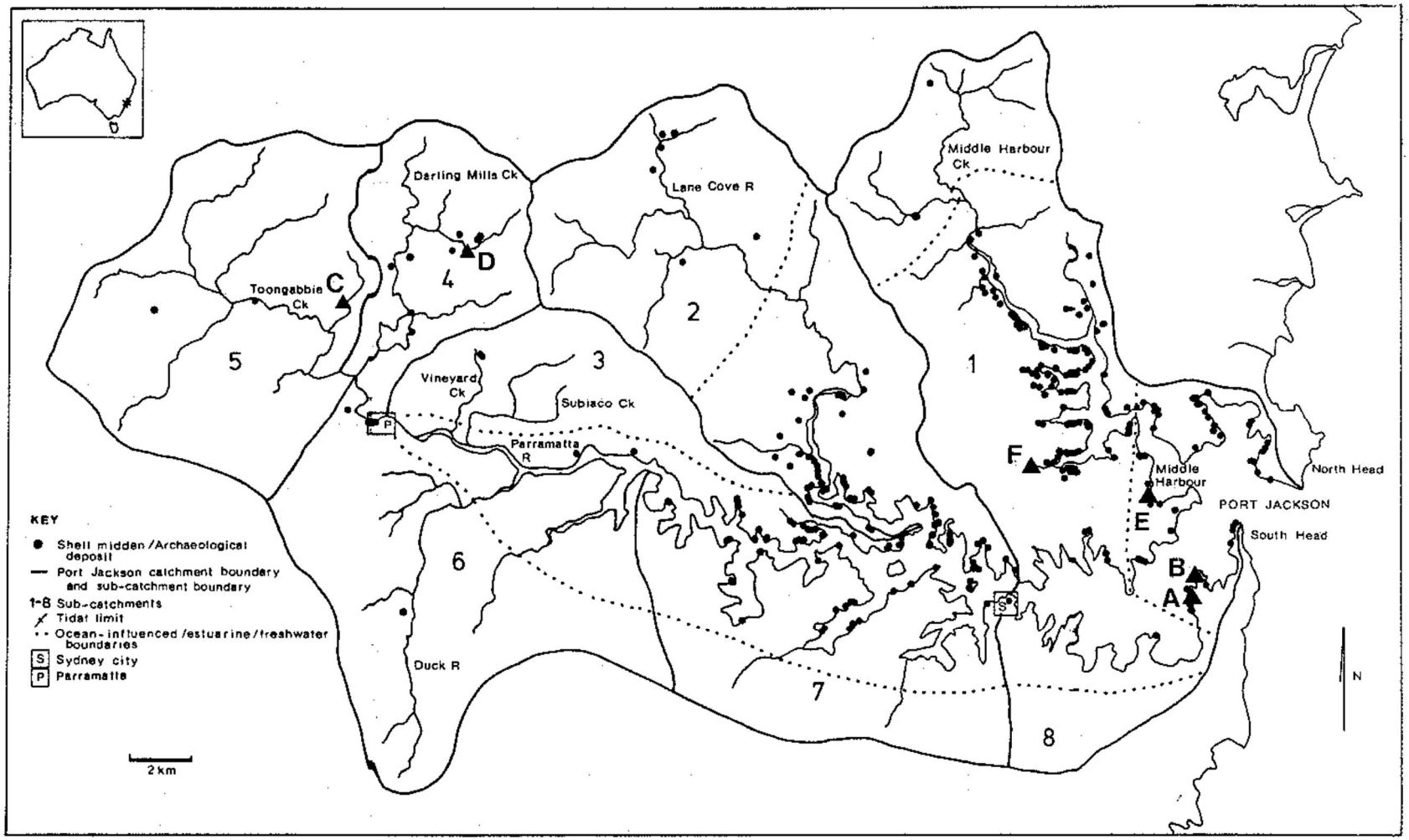


Figure 6-1 Map of the Port Jackson catchment

Map of the Port Jackson catchment showing Attenbrow's (1991) sub-catchments and zones, previously recorded shell middens and archaeological deposits (as at 1994) and the location of excavated rockshelter sites (A = Mt Trefle; B = Hydrofoil; C = John Curtain Reserve; D = Darling Mills Creek; E = Balmoral Beach; and F = Cammeray) (after Attenbrow 1994: 3, Fig. 1)

6.3 The Cumberland Plain

Concentrated archaeological investigation of the Aboriginal archaeological record of Sydney's Cumberland Plain can be traced to the early-to-mid 1980s, a period marked by a rapid growth in residential and other forms of development across the Plain. Intensive development activities since this time have secured the Cumberland Plain's place as one of the most intensively investigated archaeological regions in Australia, with hundreds, if not thousands, of Aboriginal archaeological investigations involving survey and/or excavation having now been undertaken, the majority as part of larger environmental impact assessments associated with residential development and affiliated infrastructure projects. Unsurprisingly, these investigations have varied significantly in scale and scope, ranging from targeted small-scale surveys to complex, multi-phase survey and excavation projects over large areas. Nonetheless, together they have revealed a rich and diverse record of past Aboriginal occupation, with thousands of Aboriginal archaeological sites now registered on OEH's AHIMS database. Key investigation themes are detailed in brief below.

6.3.1 Open artefact sites: Distribution, contents and definition

Surface and subsurface distributions of stone artefacts, variously referred to as open artefact sites, open sites and open camp sites are the most common and widely distributed form of Aboriginal archaeological site on the Cumberland Plain (see Attenbrow 2010: Plate 12; Przywolnik 2007: 46, Table 4.2). Other site types, such as scarred trees, quarries, grinding grooves and rock shelters with deposit and/or art or Potential Archaeological Deposits (PAD), have also been identified but are comparatively rare. Accordingly, open artefact sites remain the most intensively investigated component of the Aboriginal archaeological record of the Cumberland Plain, with site distribution and the technology of associated flaked stone artefact assemblages, in particular, comprising key research topics (eg Australian Museum Business Services (AMBS) 2000; Craib et al. 1999; Jo McDonald CHM 2001, 2003, 2005a, 2006a, 2006b, 2006c, 2007, 2009a, 2009b; Kohen 1986; White & McDonald 2010).

Existing archaeological survey data for the Cumberland Plain indicate a strong trend for the presence of open artefact sites along watercourses, specifically, on creek banks and 'flats' (ie flood/drainage plains), terraces and bordering lower slopes. Although this distribution pattern can be attributed in part to geomorphic dynamics and archaeological sampling bias, with extensive fluvial erosion activity along watercourses resulting in higher levels of surface visibility and, by extension, concentrated survey effort, an occupational emphasis on watercourses is supported by the results of numerous subsurface investigations (eg AECOM 2013b, 2015; AMBS 2000; Craib et al. 1999; GML 2012; Jo McDonald CHM 2001, 2003, 2005a, 2006a, 2006b, 2007, 2009a, 2009b). Collectively, these investigations have demonstrated that assemblage size and complexity tend to vary significantly in relation to stream order and landform, with larger, more complex[2] assemblages concentrated on elevated, low gradient landform elements adjacent to higher order watercourses. Outside of these contexts, surface and subsurface artefact distributions have typically been found to be sparse and discontinuous and are often referred to as 'background scatter', being 'artefactual material which is insufficient in number or in association with other material to suggest focussed activity in a particular location' (Douglas and McDonald 1993).

Flaked stone artefacts dominate archaeological finds assemblages from recorded open artefact sites on the Cumberland Plain, with heat shattered rock also well represented. Items such as complete and broken grindstones, hammerstones and edge-ground hatchet heads have also been recorded though comparatively infrequently. With the notable exception of 'knapping floors', a relatively common component of the Aboriginal archaeological record of the Cumberland Plain, associated archaeological features (eg hearths and heat treatment pits) have likewise proven elusive (but see AHMS 2013; McDonald and Rich 1994; Jo McDonald CHM 2009a for examples). Investigated knapping floors across the Plain have varied considerably in size and complexity, with the largest and most complex examples identified through excavation as opposed to surface survey (eg Jo McDonald CHM 2001, 2005a, 2006b, 2007). Backed artefacts (ie Bondi points, geometric microliths and elouera)

[2] Those containing a wider variety of raw materials and technological types and/or higher mean artefact densities and features such as knapping floors.

are a common feature of knapping floors and most of these features were likely specifically associated with their production. As in other NSW contexts, most notably the Hunter Valley (eg Hiscock 1993; Moore 2000), available evidence supports the suggestion that backed artefact manufacture on the Cumberland Plain was a highly structured or systematic activity.

Although relevant to a variety of site types, geomorphic processes such as soil erosion and colluvial/fluvial aggradation are of particular relevance to the identification and definition of open artefact sites. As in other archaeological contexts (eg Dean-Jones & Mitchell 1993; Fanning & Holdaway 2004; Fanning et al. 2009; Holdaway et al. 2000), it is now widely accepted by archaeologists working on the Cumberland Plain that the visibility of open artefact sites across the Plain can, for the most part, be attributed to contemporary and/or historical geomorphic processes which have variously exposed or obscured them. As demonstrated by numerous large scale salvage projects across the Cumberland Plain, surface artefacts invariably represent only a fraction of the total number of artefacts present within recorded surface open artefact sites, with a typical surface to subsurface artefact ratio of 1:25 proposed (Jo McDonald CHM 2005b: 35). Artefact exposure, unsurprisingly, is highest on erosional surfaces and lowest on depositional ones. At the same time, in many areas, surface artefacts have been shown through dispersed testing to form part of more-or-less continuous subsurface distributions of artefacts, albeit with highly variable artefact densities linked to environmental variables such as distance to water, stream order and landform (eg White & McDonald 2010). Critically, the presence or absence of surface artefacts on the Cumberland Plain is not a reliable indicator of Aboriginal archaeological sensitivity.

6.3.2 Flaked stone artefact technology

Virtually indestructible, flaked stone artefacts are a ubiquitous element of the Aboriginal archaeological record of the Cumberland Plain and have assumed a prominent position in archaeological reconstructions of past Aboriginal land use across the region. To date, hundreds, if not thousands, of surface-collected and excavated flaked stone assemblages from across the Cumberland Plain have been analysed, with individual assemblage sizes, research questions, aims, analytical methodologies and terminological schemes varying significantly between researchers and projects. Studies to date have ranged from basic descriptive accounts of assemblage composition in typological terms to detailed reconstructions of past stone reduction and quarrying behaviours through rigorous technological analyses. Particularly informative analyses in the context of the Cumberland Plain include those conducted by Jo McDonald CHM (2001, 2003, 2005a, 2006a, 2006b, 2006c, 2007, 2009a, 2009b) as part of archaeological salvage projects associated with development activities within the Rouse Hill Development Area (RHDA), the former Australian Defence Industries (ADI) site at St Marys and the Colebee Release Area. Technological analyses of stone artefact assemblages recovered from fluvial sand bodies adjacent to the Parramatta (Jo McDonald CHM, 2005b, 2005c, 2006b) and Hawkesbury Rivers (AHMS 2013; Williams et al. 2012) have likewise proven highly informative, particularly with respect to the documentation of diachronic changes in raw material use and stone artefact technologies.

Available technological and typological data for surface collected and excavated flaked stone artefact assemblages from the Cumberland Plain suggest that the majority of these assemblages belong to what is known as the 'Australian small-tool tradition', a term coined by Gould (1969) to describe what was then thought to be the first appearance, in the mid-Holocene[3], of a new suite of flaked stone tool forms in the Aboriginal archaeological record of Australia, including backed artefacts, adzes and points (both unifacially and bifacially flaked). Complex, hierarchically-organised reduction sequences associated with the production of these tools contrast markedly with the simple sequences of earlier periods (Moore 2011). Tools of the Australian small-tool tradition, it has been suggested, formed part of a portable, standardised and multifunctional tool kit aimed specifically at risk reduction (Hiscock 1994, 2002, 2006). Stone artefact assemblages from late Pleistocene and early Holocene contexts, in contrast, are described by archaeologists as belonging to the 'Australian core tool and scraper tradition', a term first used by Bowler et al. (1970) to describe the Pleistocene assemblages recovered

[3] More recent research into the chronology of backed artefacts and points in Australia (eg Hiscock & Attenbrow 1998, 2004; Hiscock 1993b) has demonstrated a long history of production and use for these implement types, with both types now known to have been produced, albeit in small numbers, in the early Holocene and likely in the late Pleistocene as well.

from Lake Mungo in western New South Wales. Bowler et al. (1970) saw the main components of these assemblages – core tools, steep-edged scrapers and flat scrapers – as characteristic of early Australian Aboriginal assemblages and as being of a distinctly different character to those associated with the proceeding small-tool tradition. In south-eastern Australia, including the Cumberland Plain, the Australian 'small-tool' and 'core tool and scraper' traditions are most commonly described in terms of McCarthy's (1967) ERS, with 'Capertian' assemblages assigned to the latter tradition and 'Bondaian' assemblages, the former.

Flaked stone artefact assemblages from excavated and surface collected open artefact sites on the Cumberland Plain attest to the exploitation of a diverse range of lithic raw materials (Corkill 1999, 2005). However, two rock types – silcrete and silicified tuff (also known as indurated mudstone) – dominate the region's existing stone artefact record. Other, less commonly exploited raw materials represented in excavated and surface collected assemblages include quartz, quartzite, petrified wood, chert and various fine-grained volcanics. Alongside silcrete and silicified tuff, these materials occur variously in a number of geological formations and units across the Cumberland Plain (for a detailed review see Corkill 1999). Oft-cited sources, for example, include the Tertiary St Marys (Ts) and Rickabys Creek Gravel (Tr) formations, as well as the various unconsolidated Pleistocene units that line as terraces the present day and abandoned channels of the Nepean-Hawkesbury River (eg Agnes Bank Sand (Qpa) and Cranebrook Formation (Qpc)).

In common with the Sydney region as a whole (Attenbrow 2010: 120-121), various excavated assemblages from the body and peripheries of the Cumberland Plain (eg Jo McDonald CHM 2001a, 2005a; Williams et al. 2012; Williams et al. 2014) attest to a shift, over time, in the relative significance of particular raw materials for flaked stone artefact manufacture, principally silcrete and silicified tuff but also quartz. An 'early' (ie Pre-Bondaian) emphasis on the procurement and reduction of silicified tuff, for example, appears to have given way to a 'later' (ie Bondaian) emphasis on silcrete. Quartz use, meanwhile, appears to have peaked in the late Holocene. For the Cumberland Plain, these changes have been linked, in particular, to broader changes in settlement organisation, with a decline in levels of residential mobility over time prompting more intensive use of locally available stone (Jo McDonald CHM 2005a).

In the northwestern portion of the Cumberland Plain, the Tertiary St Marys Formation has been singled out as a particularly important source of silcrete for stone artefact manufacture. Mapped at various localities across the Mulgoa Creek, South Creek and Eastern Creek catchments, the best known and most intensively investigated outcrops of this formation occur on Plumpton Ridge, a low but locally prominent ridgeline separating the floodplains of Eastern and Bells Creek between the suburbs of Plumpton and Riverstone. The subject of numerous archaeological investigations since the early 1980s (eg AMBS 2002b; Baker 1996; McDonald 1986), recent large-scale archaeological salvage works across what is now Stonecutters Ridge Golf Club have unequivocally identified Plumpton Ridge as a major Aboriginal quarry site (Jo McDonald CHM 2006c). At the same time, they have highlighted a number of important trends in relation to the procurement and reduction of silcrete obtained from this source. Trends in the relative frequencies of raw material types, artefact types and the size of silcrete artefacts in local excavated assemblages, for example, have been attributed to a process of 'distance-decay'. As one of only three systematically investigated Aboriginal quarry sites on the Cumberland Plain, the other two being the ADI-EPI and ADI-FF22 sites within the former ADI site at St Marys (Jo McDonald CHM 2006a, 2008a), Plumpton Ridge is widely regarded as a feature of high scientific and cultural significance.

Backed artefacts dominate the retouched components of the majority of dated and undated Bondaian assemblages from the Plain and, as such, the technology of their manufacture has received considerable analytical and interpretive attention. Studies by Jo McDonald CHM (2001, 2003, 2005a, 2006a, 2006b, 2007, 2009a, 2009b), in particular, have demonstrated that backed artefact manufacture on the Cumberland Plain was a highly structured or systematic activity involving a complex system of raw material procurement, transportation, preparation and reduction. Differences in the technological character of recovered cores across the region attest to a significant degree of variability in the methods used by Aboriginal knappers to produce flakes for backed artefact manufacture. However, certain techniques (eg asymmetric alternating flaking and Hiscock's (1993) 'tranchet technique') are particularly well represented. Evidence for the deliberate heat treatment of silcrete blanks, both as part of systematic backed artefact manufacture activities and other reduction activities, is abundant and widespread, with excavated and surface collected assemblages attesting to the use of heat at various points in the reduction process. As in other contexts (eg Hiscock 1993),

the thermal alteration of Cumberland Plain silcrete appears to have significantly improved the flaking quality of the stone, increasing the lustre and smoothness of fracture surfaces.

6.3.3 Chronology of occupation

In common with the Sydney region as a whole, evidence for late Pleistocene/early Holocene (ie Pre-Bondaian/Early Bondaian) Aboriginal occupation of the Cumberland Plain is sparse, with confirmed or potential evidence from these periods obtained from a limited (less than 15) number of sites. Examples include Rouse Hill sites RH/CC2 (Jo McDonald CHM 2001), RH/SC5 (Jo McDonald CHM 2002b), RH/CD12 (Jo McDonald CHM 2002a) and RHCD7 (Jo McDonald CHM 2007); Richmond site RMI (Jo McDonald CHM 1997a); PT12 near Pitt Town (Williams et al. 2012; Williams et al. 2014); Power Street Bridge 2, Doonside (McDonald 1993), Regentville RS1, Regentville (Koettig & Hughes 1995; McDonald et al. 1996), the Parramatta CBD (AHMS 2013; Austral Archaeology, 2007; Jo McDonald CHM, 2005b, 2005c, 2006b) and the Windsor Museum site (Austral Archaeology 2011; Williams et al. 2012; Williams et al. 2014). Claims of a c.40 ka year old date for five 'flaked pebbles' recovered from a gravel pit associated with the Cranebrook Terrace near Penrith (Nanson et al. 1987) have been widely questioned, with legitimate concerns raised over the artefactual status of these pebbles, their provenance and association with available dates. For most sites, late Pleistocene/early Holocene occupation has been inferred on the basis of the technological and typological characteristics of recovered flaked stone artefact assemblages as opposed to radiometric dates.

At present, the oldest securely dated archaeological site on the Cumberland Plain is the PT12 site at Pitt Town, with compliance-based archaeological excavations across a source-bordering dune at this site, which overlooks the Hawkesbury River, producing a suite of OSL dates suggestive of Aboriginal occupation from at least 36,000 years ago (and potentially earlier) (Williams et al. 2012; Williams et al. 2014). Closer to the coast, Late Pleistocene/early Holocene occupation of a sandy fluvial terrace adjacent to the Parramatta River (ie the Parramatta Sand Sheet) has been by proposed by Jo McDonald CHM (2005b, 2005c, 2006b) and seems likely on the basis of available radiometric dates and assemblage characteristics.

In stark contrast to the late Pleistocene/early Holocene, evidence for mid-to-late Holocene (ie Middle to Late Bondaian) Aboriginal occupation of the Cumberland Plain abounds, with numerous excavated sites producing assemblages that can be confidently assigned to these periods on the basis of radiometric dates and/or their typological/technological profiles. Available radiometric dates indicate a steady increase in the number of sites occupied over the course of the Holocene, with a peak in the 2nd millennium BP (see, for example, Przywolnik 2007: 53, Fig. 4.6). Taken at face value, these data suggest a progressive increase in the Aboriginal population of the Cumberland Plain over the course of the Holocene. However, as argued by Hiscock (2008), albeit on a national scale, it seems likely that the directional population growth suggested by such data is, to a certain extent at least, a product of differential site preservation, with younger sites better preserved than older ones. Other factors, such as the burial of older sites through sediment deposition and bias in the location of archaeological surveys and excavations, may also be relevant.

Critical to any discussion concerning the antiquity of Aboriginal occupation across the Cumberland Plain are the well-documented difficulties surrounding the dating of open artefact sites with active 'biomantles' (sensu Paton et al. 1995; see Dean-Jones & Mitchell, 1993; Balek 2002; Hofman 1986; Johnson et al. 2005; Johnson 1989; Paton et al. 1995; Peacock & Fant 2002; Stein 1983). On the Cumberland Plain, the term biomantle is typically used as a collective descriptor for the 'A' soil horizons of the Plain's dominant texture contrast or duplex soil profiles[4], which tend to be relatively thin (less than 30 centimetres), and exhibit extensive evidence of bioturbation in the form of roots, open/infilled burrows, live insects and/or earthworms and stone lines[5]. However, the uppermost portions of underlying 'B' soil horizons can also exhibit such evidence and form part of the biomantle (eg AECOM 2015). As highlighted by Dean-Jones & Mitchell (1993) and others (eg Balek 2002;

[4] Such profiles are characterised by loamy topsoils and silty clay to clay subsoils, with boundaries between these two units typically clear to abrupt. Clayey subsoils have formed by *in situ* weathering of the parent material, while topsoils are derived from a combination of *in situ* weathering and the deposition of colluvially and/or fluvially transported materials.

[5] Stone lines, where present, typically occur at the interface between the A and B horizons.

Johnson 1989), excavated finds assemblages from archaeological sites with active biomantles are subject to a range of interpretive constraints, with intact depositional stratigraphy unlikely to be preserved and inset archaeological features (eg hearths and heat treatment pits) representing the only reliable means of dating (with any specificity) intercepted archaeological events (Mitchell 2009: 4). Any stone artefacts discarded at the surface in landscapes with active biomantles are likely, over time, to have been incorporated into the soil profile through bioturbation, with depth of artefact burial ultimately corresponding to the base of major biological activity (ie the base of the biomantle). Where biomantles remain relatively undisturbed, patterns of artefact discard may be preserved. However, in heavily disturbed contexts, the preservation of such patterning is unlikely (Mitchell 2009: 4).

For archaeologists working on the Cumberland Plain, the analytical and interpretive constraints posed by intensive bioturbation have, in combination with a real paucity of dateable features, led to a reliance on the dating of excavated archaeological finds assemblages through relative means, specifically, through consideration of the typological and technological composition of associated flaked stone artefact assemblages and reference to a modified version of McCarthy's (1967) ESR, the broad temporal parameters of which are now well established. While offering a useful chronological framework within which to assess diachronic changes in the stone artefact technologies and raw material use, the largely undated and palimpsest character of the Plain's lithic record represents a significant analytical and interpretive obstacle for period-specific reconstructions of Aboriginal mobility regimes (cf. Cowan 1999). Well dated assemblages from sites retaining stratified deposit(s) are rare, with the most comprehensively dated sequences to date coming from deep fluvial sand bodies adjacent to the Hawkesbury and Parramatta Rivers (ie AHMS 2013; Jo McDonald CHM 2005c; Williams et al. 2012, 2014). While the preservation and dating potential offered by such bodies has been amply demonstrated, the same cannot be said of alluvial valley fill sequences outside of these major river valley contexts, with comparatively little research directed towards investigating the age, genesis or evolution of alluvial valley fill sequences within the Cumberland Plain's numerous creek valleys, nor their potential for preserving at depth (ie within buried paleosols) Aboriginal archaeological materials of varying ages, including those of Late Pleistocene/Early Holocene antiquity (but see AHMS 2015; Barham 2005, 2007; Jo McDonald CHM 2005a for notable exceptions). Nonetheless, the limited work that has been conducted in this regard suggests considerable research potential, particularly with respect with the development of chronological frameworks for contextualising and interpreting flaked stone artefact assemblages recovered from such sequences.

6.3.4 Site distribution and occupation models

A number of Aboriginal site distribution and occupations models have been proposed for the Cumberland Plain over the past four decades, with early models (eg Kohen 1986; Smith 1989) based almost exclusively on surface evidence and more recent models (eg AMBS 2000; Jo McDonald CHM 1997b) taking into account both surface and excavated evidence. As indicated in **Table 6-3**, Aboriginal site distribution on the Cumberland Plain has been linked to a variety of environmental factors, with proximity to water, stream order, landform and geology (including proximity to known stone sources) variously highlighted as key determinants.

Table 6-3 Aboriginal site distribution and occupation models for the Cumberland Plain

Researcher(s)	Year	Summary of model
Dallas and Witter	1983	· Sites closer to silcrete and other raw material sources will tend to contain more cores and waste chips and less utilised material than sites which are located further away. They will also contain more block fractured pieces, a higher frequency of cortex, and the artefacts will generally be larger than those at sites not associated with raw material sources · In areas of raw material abundance, artefacts will be discarded earlier in the reduction sequence and will generally be larger and occur in a variety of forms · Raw material abundance, quality and size will influence assemblage variability · Sites located away from raw material sources will exhibit a wider variety of activities and a higher number of utilised pieces than those closer to them.
Kohen	1986	· Proximity to water and geological context key determinants for site location · Sites can be categorised as one of three types according to their function: · camping sites, which have a wide range of activities represented in the archaeological record · woodworking sites, where there is a high proportion of implements to debitage present · hunting sites, which contain a relatively small number of unworked flakes and are sometimes associated with backed blades · Greatest proportion of sites located on Wianamatta Shale substrates · Number of artefacts found at a site and site size more closely correlated to the nature and degree of disturbance at a site than any behavioural factors. The more disturbed the site, the greater the visibility and hence the greater quantity of artefacts recorded · Sites with high artefact densities tend to be found within 100 metres of permanent water sources.
Smith	1989	· Sites are most likely to occur in association with water sources. Permanency of the water source, however, is not a determining factor for site location, with a significant quantity of sites found along temporary creek lines · Sites on the Londonderry Clay/Rickabys Creek Formation are likely to be found in association with gravel exposures · Sites dominated by silcrete are less likely to be found west of Marsden Park and South Creek than east of those areas. Isolated finds in these areas are also less likely to be made from silcrete · Sites east of South Creek are likely to be principally stone tool and silcrete manufacturing and processing sites · Sites in the northern Cumberland Plain are expected to have a lower frequency of implements than those in the south · Woodland areas will typically contain sites at lower densities than open forest areas

Researcher(s)	Year	Summary of model
		· Surface sites appear to be more common than subsurface sites, and undisturbed stratified sites are rare due to the degree of disturbance · Sites with over 50 artefacts are rare, although very large sites (500+ artefacts) do occur. There is no apparent patterning to the occurrence of these large sites. The pattern of distribution of site size appears to be determined predominantly by visibility · Sites cannot be divided neatly into 'single use' categories, as most sites were the location of numerous activities.
Jo McDonald CHM	1997b	· Open sites with subsurface archaeological deposits are the most commonly occurring sites · Sites cannot be adequately characterized on the basis of surface evidence alone · Where open sites are found in stable and aggrading landscapes, many will be intact and have the potential for internal structural integrity, with sites in alluvium and other depositional environments containing the best potential for intact archaeological remains and stratification · Many sites contain extremely high artefact densities, with variability depending on the range of activity areas and site types present · Artefacts are not evenly distributed across the landscape. Site patterning can be related to broad environmental factors, with sites on permanent water being more complex than those situated on ephemeral or temporary water lines. However, there is not always a direct correlation between site location and the environment · Major confluences, particularly along major creeks, are prime site locations · Proximity to water and underlying geological units are key factors in site distribution. However, distribution can be further measured according to stream order, with sites located in close proximity to established, permanent, and resource rich drainage channels (eg 3rd and 4th order creeks) are more likely to have higher artefact densities and a greater diversity of tools than sites associated with lower order water courses · Temporary water sources and minor gullies tend to have single-use or occasionally repeated visits and hence lower density sites · Locations between creeks, such as ridge-tops and spurs, may possibly contain archaeological evidence, which may vary according to proximity to water sources · Sites in close proximity to an identified stone source will contain a range of size and cortex characteristics in their assemblages. As distance increases from the source, artefact size and percentage of cortex in the assemblage will decrease.
AMBS	2000	· Spatial patterning in chipped stone artefact distributions adjacent to major creek lines can – in certain instances – be accommodated under a three-tiered model of 'Activity Overprint Zones' incorporating 'complex', 'dispersed' and 'sparse' zones · Complex zones will exhibit overlapping knapping floors and high density concentrations of artefacts indicative of repeated, long-term occupation events · Dispersed zones may include knapping floors. However, these are

Researcher(s)	Year	Summary of model
		typically spatially discrete due to less frequent occupation · Sparse zones will exhibit consistently low frequencies/densities of artefacts. Artefact discard in these zones is likely to have resulted from discard in the context of use or loss rather than manufacture · Flaked stone artefact production and maintenance will leave a more obtrusive archaeological signature than resource extraction (eg food collection and processing). These activities will also occur closer to the residential core while resource extraction will typically occur away from it.

White and McDonald's (2010) analysis of lithic artefact distribution in the RHDA provides a suitably robust dataset for assessing the validity of some of the key predictions of the models outlined above. Based on the results of over a decade of intensive test excavation in the RHDA, this study remains the most comprehensive of its type currently available for the Cumberland Plain. As indicated, Aboriginal site distribution on the Cumberland Plain has been linked to a variety of environmental factors, with distance to water, stream order, landform and geology (including proximity to known stone sources) variously highlighted as important influences. White and McDonald's (2010) analysis both supports and negates various aspects of the postulated relationships between these factors and Aboriginal site patterning on the Cumberland Plain. Key findings can be summarised as follows:

- Artefact distributions do not, as implied by the models of Kohen (1986) and Smith (1989), form bounded 'sites' but rather 'landscapes'
- Artefact distribution does, as variably expressed by AMBS (2000), Kohen (1986), Jo McDonald CHM (1997b) and Smith (1989), appear to vary with proximity to water, albeit to different extents based on stream order
- Artefact density does, as suggested by Jo McDonald CHM (1997b), appear to vary significantly with stream order
- Artefact density does, as suggested by Jo McDonald CHM (1997b), appear to vary significantly with landform
- Aboriginal archaeological sites on the Cumberland Plain cannot, as proposed by Jo McDonald CHM (1997b), be adequately characterised on the basis of surface evidence alone. Most areas, regardless of surface indications, contain subsurface archaeological deposit(s)
- The orientation of open land surfaces appears to have influenced the selection of artefact discard locations in the lower portions of valleys, with generally higher densities on lower slopes facing north and north-east
- Distance from known silcrete sources does not, on present evidence at least, appear to have influenced intensity of artefact discard (cf. Dallas & Witter 1983)
- Trends in artefact density and distribution indicate long-term, large scale patterns. Short term models of settlement organisation are insufficient to account for these artefact distributions.
- Social and/or symbolic factors may have influenced site selection along with the distributions of economic and other resources.

6.4 Local context

6.4.1 Aboriginal Heritage Information Management System

A search of the AHIMS database was undertaken on 21 September 2016 (search number #246070) (search results are included in **Annexure B**). The search area was a rectangular shape containing the study area centred within its bounds. The reason for the larger search area was to provide a buffer around the study area and ascertain the spread of previously recorded Aboriginal sites across the wider region. The search results identified that there were no previously recorded sites within the bounds of the study area (see **Figure 6-2**).

Within the search area (an 11 kilometre by nine kilometre area centred on the study area), a total of 49 AHIMS sites were identified. These predominantly occur in coastal fringe areas and were most commonly midden and rockshelter sites.

Consideration of the location of previously recorded sites indicates that none are located within the study area, with the closest site – rockshelter with midden #45-6-2278 – mapped as occurring about 50 metres to the north of the Rozelle Rail Yards. The site is located above an area proposed for subsurface tunnel construction. Access to AHIMS site #45-6-2278 has not been provided due to its location within private property but the area containing it has been subject to a separate study to determine potential vibration and settlement impacts.

It was determined that for tunnelling works associated with the project, site #45-6-2278 is located beyond the minimum safe working distance for vibration intensive plant, with vibration impacts associated with tunnelling works expected to be negligible. Works were specifically designed to reduce the magnitude of settlement in the upper soil profiles. As the degree of movement experienced by a structure is dependent on its foundation type and how a structure responds to ground movements depends on its size, design and materials, ongoing observation and monitoring have been proposed during the construction program. The current condition of the site should be confirmed with a site survey, if possible, during detailed design and with ongoing observation and monitoring recommended to be undertaken during the construction program.

The details of the search results are summarised in **Table 6-4** and shown in **Figure 6-2**. The designation 'Not a Site' refers to areas that had been registered in AHIMS but later proved not to be legitimate Aboriginal sites (eg PADs found upon test excavation to not contain cultural deposits, Modified Trees found to be naturally rather than culturally scarred or grinding grooves found to be of non-Aboriginal origin). Once a registered location is verified not to be of Aboriginal origin its site type is renamed 'Not a Site' in the AHIMS register.

Table 6-4 AHIMS search results for the search area

Site type	Number	Per cent of total sites (%)
Midden	12	24.5
Rockshelter	12	24.5
PAD	8	16.3
Art site	8	16.3
Engraving	4	8.2
Artefact scatter	3	6.2
Not a site	1	2
Resource & gathering	1	2
Total	**49**	**100**

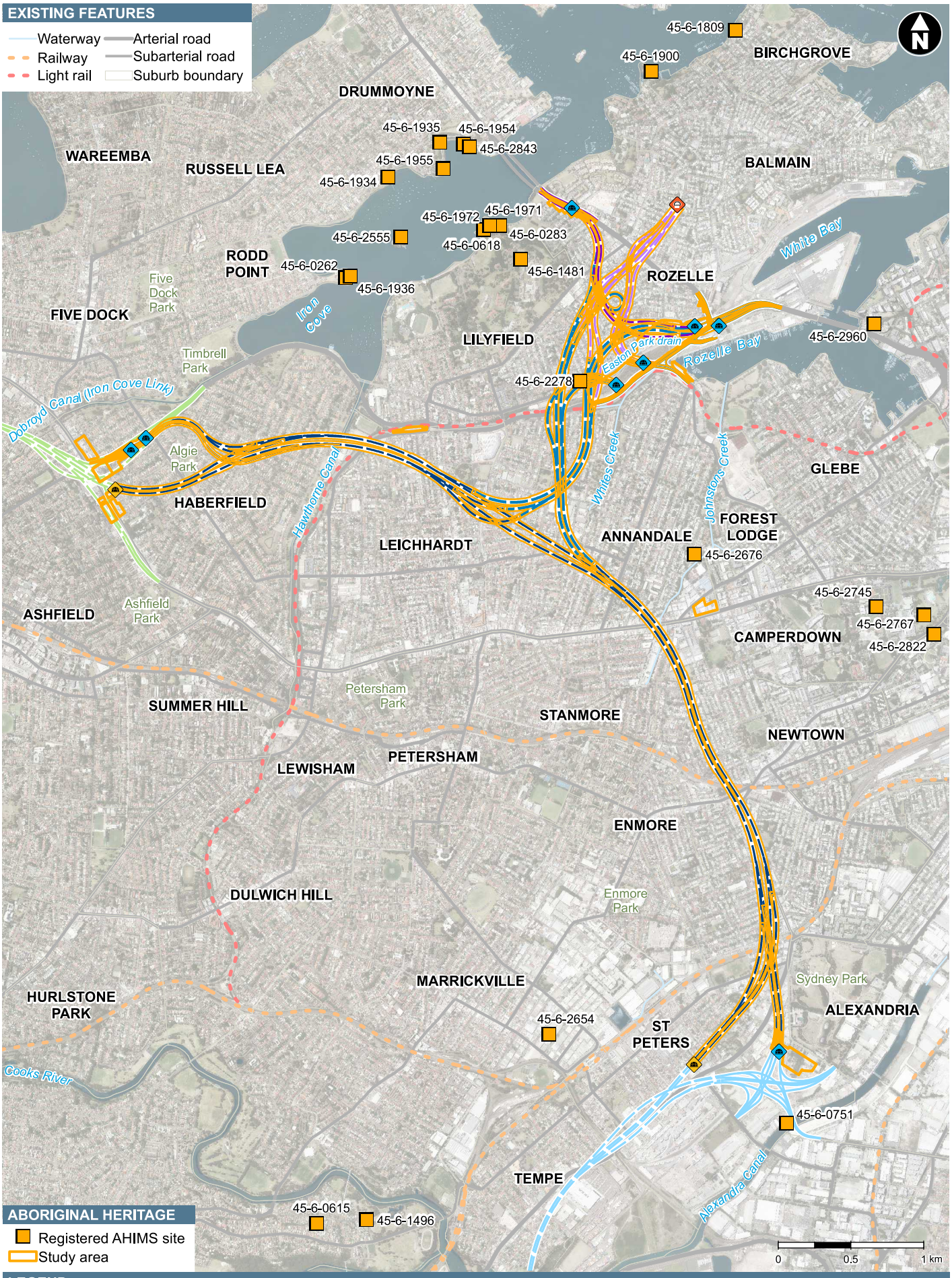


Figure 6-2 Study area AHIMS sites

6.4.2 Previous Aboriginal heritage investigations

Multiple Aboriginal archaeological investigations incorporating survey and/or excavation have been carried out in the larger region containing the study area. The results of some select examples of these investigations are summarised in **Table 6-5**.

Table 6-5 Relevant previous archaeological investigations within 10 kilometres of the study area

Author	Year	Key findings	Distance to study area
Rich	1985	An archaeological survey was undertaken at the Homebush Bay area as part of the development of conservation measures. A shell midden with an associated artefact scatter was identified at Charity Point. This site was recommended for protective measures. Other isolated artefacts were also identified, which were recommended for destruction under the conditions of a Consent to Destroy permit.	8.5 km
Don Godden & Associates	1986	A Conservation Plan was produced for heritage items at the Homebush area, being the State Brickworks and State Abattoir. No Aboriginal cultural heritage items or areas of PAD were identified in association with these items, most likely due to the associated historical past disturbance.	8.5 km
NSW Department of Planning	1994	An environmental plan was produced by the NSW Department of Planning in 1994. It was designed to manage the Homebush Bay area. The plan did not identify any issues with Aboriginal archaeology within the study area.	8.5 km
Newell	1997	An archaeological assessment was undertaken for 95 Ramsay Street at Haberfield, NSW. This study area was located at Lot 1 DP 180 212 and Lot 1 DP 926 992. No Aboriginal sites were identified.	3 km
Stuart	2000	A heritage impact statement was produced for a proposed Telecommunications Facility at 169–173 Parramatta Road, Haberfield. No Aboriginal sites were identified.	1.8 km
McLoughlin	2000	Using available data, McLoughlin produced a study of Estuarine wetlands distribution along the Parramatta River between 1788 and 1940. The conclusion was that mangroves were more limited to creek fringes in the past, with saltmarsh communities dominating the inter-tidal zone. From the late 19th century onwards the mangroves had been expanding into the saltmarsh areas, resulting in the landscape being as it is today.	8.3 km
Mary Dallas Consulting Archaeologists	2000	An Aboriginal Heritage Management Plan was produced for the public area at Callan Point. Four midden sites were identified here in close proximity to Rozelle Hospital.	1.3 km
Newell	2002	An updated archaeological assessment was undertaken for 95 Ramsay Street at Haberfield (Lot 1 DP 180 212 & Lot 1 DP 926 992). No Aboriginal sites were identified.	3 km

Author	Year	Key findings	Distance to study area
Navin Officer Heritage Consultants	2005	An inspection was undertaken of an area proposed for a turnback with other rail facilities at Homebush Railway Station. No Aboriginal sites areas of PAD were identified. The project was recommended to proceed.	8 km
Comber Consultants Pty Ltd	2011	An Aboriginal archaeological cultural heritage assessment was undertaken for a proposed shared pathway project along the Johnstons Stormwater Canal in the Glebe area. The canal, once a natural creek line (Johnstons Creek) was found to be highly channelised with concrete sides and base. No Aboriginal sites were registered along its extent.	0.4 km
Burwood Council	2013	A Plan of Management document was produced for the Wangal Park area. Due to the highly disturbed nature of the site, it was concluded that there was almost no potential for re-establishing self-sustaining vegetation communities, noting that revegetation and ongoing management were required.	4.8 km
AECOM Australia Pty Ltd	2015b	PACHCI Stage 1 WestConnex M4 East Aboriginal heritage assessment identified that although there was widespread disturbance across the area, where there were coastal areas and waterways that had not been highly disturbed there was a potential for intact deposits.	3.8 km
AECOM Australia Pty Ltd	2015c	PACHCI Stage 2 WestConnex New M5 Aboriginal heritage assessment identified widespread high levels of disturbance and did not identify any Aboriginal sites.	Adjacent to study area
AECOM Australia Pty Ltd 2016	2016	PACHCI Stage 2 Aboriginal heritage assessment undertaken as part of a review of environmental factors (REF) for site management works identified high levels of disturbance within the Rozelle Rail Yards and did not identify any Aboriginal sites.	Within study area

Rozelle Rail Yards – Site management works review of environmental factors

As mentioned above in **Table 6-5**, a review of environmental factors (REF) under Part 5 of the EP&A Act was prepared for a suite of site management works on part of the former Rozelle Rail Yards. To support this REF, a Stage 2 PACHCI Assessment was undertaken in November 2016 by AECOM (2016). The assessment included desktop review, Aboriginal community consultation and an archaeological survey. The targeted archaeological survey was undertaken on 27 May 2016.

The assessment described the site as a highly developed rail yard area with sections of regrowth vegetation due to disuse. Following the survey these key observations were made:

- The study area (which comprised of part of the Rozelle Rail Yards only) consists of highly disturbed terrain that is unlikely to retain Aboriginal archaeological materials in surface or subsurface contexts
- No surface expressions of Aboriginal objects or areas of Aboriginal archaeological sensitivity/PAD were identified
- No AHIMS registered Aboriginal sites occur within the study area and none are likely to be either directly or indirectly impacted by the proposal
- To manage potential impacts during the site management works, management measures were recommended to be implemented, including:

- Should additional study areas be proposed that are outside the curtilage of the study area as it is defined for this assessment, then these areas should also be subject to a PACHCI Stage 2 assessment
- Should any unexpected finds of Aboriginal places, objects or deposits be identified during the proposed works, then the Roads and Maritime *Unexpected Heritage Items Procedure, Standard Management Procedure* (2015) should be followed.

The Rozelle Rail Yards assessment findings were that the area had been subject to high levels of disturbance in the past and that intact in situ subsurface deposits were not likely to occur. No surface expression of artefacts or other Aboriginal site types were identified (AECOM Australia Pty Ltd 2016).

6.5 Aboriginal site predictions

With regard to the archaeological context of the study area, the assessment made the following predictions about the Aboriginal archaeological record in the area:

· Aboriginal shell midden sites are the most likely to occur in this general area, usually occurring in tidal estuarine foreshore zones (that is, within 10 metres of high water level). It is unlikely that any shell midden sites will occur within the study area, because of the high levels of disturbance of those areas where they may once have occurred

· Rockshelters are another common site type in the wider region and could occur in areas where in situ natural overhangs are extant

· Any Aboriginal archaeological sites are highly unlikely to occur in areas previously subjected to high levels of landscape modification and disturbance.

In order to test these site predictions a targeted survey was undertaken of the study area. Areas of known high levels of disturbance were not surveyed in detail, with a vehicle inspection used to cover these. Areas of fewer disturbances, such as public parks, were surveyed for both surface material and any subsurface archaeological potential. The results of the investigation of these areas are provided in **Chapter 8**.

7 Ethnographic context

7.1 Introduction

Information regarding the ways in which Aboriginal people likely used pre-contact landscapes is available to archaeologists through two primary sources: archaeological (ie survey and excavation) data and historical records. **Chapter 6** has summarised the Aboriginal archaeological context of the study area on a regional and local scale. This section builds on this foundation by summarising relevant ethnohistoric information for the study area. As in other parts of NSW and Australia more broadly, non-Aboriginal people occupying the Sydney Region began to document Aboriginal culture from first contact, with explorers, missionaries, settlers and the like recording their observations of Aboriginal people and/or their material culture in letters, journals and official reports. Many of these accounts are overtly Eurocentric in tone and the content and veracity of some is, at best, questionable. Nonetheless, taken together, they form an important source of information on Aboriginal lifeways at the time of British colonisation and can, in conjunction with available archaeological data, be used to generate working predictive models of prehistoric Aboriginal land use.

Key sources, both primary and secondary, for the post-contact languages and lifeways of the Aboriginal people occupying the Sydney region at the time of British colonisation include: Attenbrow (2010); Barrallier (1802 [1975]); Bradley (1792 [1961]); Brook & Kohen (1991); Collins (1798 [1975], 1802 [1971]; Dawes (1790a, 1790b); Flynn (1994, 1995a, 1995b); Hunter (1793 [1968]); Kohen (1985, 1986, 1988, 1993); Kohen and Lampert (1987); Kohen et al. (1999); Matthews (1903); McDonald (2008); Phillip (1789 [1970], 1791[1963]); Tench (1793 [1979]); Troy (1994); White (1790 [1962]) and Worgan (1788). While a detailed review of these sources is beyond the scope of this assessment, salient information is summarised below.

7.2 The Darug language and people

Available sources indicate that study area falls within the traditional country of the Darug people, who spoke the Darug (also spelt Dhaŕ-rook, Dharrook, Dhaŕook, Dharruk and Dharug) language. Darug is believed to have been spoken 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. Early sources (eg Collins 1798 [1975]; 1802 [1971]; Tench 1793 [1961]; Dawes 1790a, 1790b; Phillip in Hunter 1793 [1961]) and more recent linguistic research (eg Troy 1994) indicates that two distinct dialects of Darug were spoken at the time of European contact, a coastal dialect, spoken on the Sydney peninsula and the country to the north of Port Jackson, and a hinterland dialect, spoken on the Cumberland Plain from Appin in the south to the Hawkesbury River in the north (Attenbrow 2010: 34). This linguistic division is thought to correspond to a broader economic division between 'coastal' and 'hinterland' Darug-speaking peoples, with the accounts of several early observers (eg Bradley 1792 [1961]; Collins 1798 [1975], 1802 [1971]; Phillip 1788 in Attenbrow 2010: 63; Tench 1793 [1979]) suggestive of a 'coastal', marine-oriented subsistence economy[6] and contrasting 'inland' economy focused on the exploitation of land mammals, plant foods and freshwater faunal resources. Notably, early sources (eg Barrallier 1802 [1975]; Collins 1798 [1975]; Tench 1793 [1961]) suggest that there was little contact between coastal and hinterland groups.

Some idea of population size for the coastal Darug at contact is provided by Attenbrow (2010), who suggests that the area around Port Jackson likely supported a minimum population density of 0.75 persons/one square kilometre (ie one person per 1.3 cubic kilometres). Attenbrow's estimate is based Governor Phillip's own estimate of the Aboriginal population of this area, made in 1788. Phillip, reporting to Lord Sydney on 15 May 1788, estimated a total population of not 'less than one thousand five hundred' (Phillip 1788 in Attenbrow 2010: 17). Attenbrow (2010:17), citing Hunter (1793 [1968]: 62), notes that 'population densities for the hinterland (west of Parramatta) were initially assessed by the colonists as being less than those along the coast' but implicitly urges interpretive caution given

[6] Note that available archaeological evidence suggests that the historically documented seafood bias in the diets of coastal Darug speaking peoples has been overemphasised, with excavated bone assemblages from coastal rockshelter sites (eg Balmoral Beach, Angophora Reserve) attesting to the importance of terrestrial and avian fauna in coastal diets.

the deleterious effects of 1789 smallpox epidemic, which 'had killed many people living to the west of Rose Hill before Phillip's 1791 expedition crossed the Cumberland Plain to the Hawkesbury-Nepean River'. More recently, Kohen (1995) has estimated a minimum overall density of around 0.5 persons per square kilometre for the hinterland zone.

In common with other regions of New South Wales (eg Attenbrow 2010) and Australia more broadly (Peterson, 1976), available historical records suggest that the primary units of social organisation amongst the Darug were the clan and band. Kohen (1993: 15) equates the term 'clan' with 'band', defining both as 'groups of people who lived together and hunted together'. However, Attenbrow (2010) draws a distinction between the two, with clans comprising local descent groups and bands, land-using groups who, though not necessarily all of the same clan[7], camped together and cooperated daily in hunting, fishing and gathering activities. Individual bands will have habitually occupied and exploited the resources of particular tracts of land within the overall territory of their clan. However, the territorial boundaries of each band will have been permeable or elastic in the sense of complex kinship ties facilitating inter-band territorial movements and the reciprocal use and/or exchange of resources. Early accounts (eg Collins 1798 [1975: 453]; Tench 1793 [1979: 292]) indicate that clan names were derived from the country on which the members of the clan lived.

The size of the individual bands occupying the Cumberland Plain at contact was no doubt activity and season dependent. However, an upper limit of around 50 individuals, consisting of several nuclear families, has been suggested (Kohen 1988: 239). Individual band sizes notwithstanding, much larger groups of Aboriginal people, numbering in the hundreds, are known to have come together for events such as corroborees, ritual combats and feasts (Attenbrow 2010; Kohen et al. 1999). Unlike many Australian Aboriginal groups, social organisation amongst the Darug did not comprise a class system based on moieties or sections but rather was based on clan membership attained through patrilineal descent (Attenbrow 2010: 57; Kohen 1993: 35). Totemic affiliations were inherited from a person's father and, along with clan membership, were the basis upon which marriages were arranged and initiations carried out.

Available historical records indicate that a wide range of marine and freshwater fauna were exploited by Darug-speaking peoples for food and other resources (for a detailed discussion see Attenbrow 2010: 62-84). Along the coast, an emphasis on the exploitation of marine resources, principally fish and shellfish, is attested in the writings of several early observers (eg Bradley 1792 [1969: 133]; Collins 1798 [1975: 456, 461, 495]; Phillip 1788 in Attenbrow 2010: 63; Tench 1793: 125, 195 [1979]: 233, 287). Further inland, historical records suggest an emphasis on the hunting of land mammals (eg Barrallier 1802 [1975:2 n4]; Collins 1798 [1975: 456]; Tench 1793: 121 [1979: 230]), with kangaroos, wallabies, possums, gliders, fruit bats (ie flying foxes), dingos, koalas and wombats variously reported as having been either hunted and/or eaten (Attenbrow 2010: 71). Possums, in particular, appear to have been major food source in the hinterland, with a number of early observers remarking on the tree climbing skills of the 'woods people' and detailing procurement techniques (eg Hunter 1793 [1968]; Tench 1793 [1979]; Collins 1798 [1975]; Barrallier 1802 [1975]). Freshwater fish, shellfish and eels, as well as platypus, are also known to have been exploited by hinterland groups (eg Barrallier 1802 [1975: 2]; Collins 1798 [1975: 461-63], 1802 [1971: 321-22]; Phillip in Hunter 1793 [1968: 523]; Tench 1793 [1979: 230]), as are birds.

Compared with their faunal counterparts, the plant food resources of coastal and hinterland Darug-speaking peoples are poorly represented in the writings of early colonial observers. Nonetheless, available descriptions do suggest that plants formed a regular part of the diets of groups in both areas (see Attenbrow 2010: 77-8). Along from the coast, a 'vegetable catalogue' consisting of 'a few berries, the yam and fern root, the flowers of the different Banksia, and at times some honey' is reported by Collins (1798 [1975: 462-63]). Along the Hawkesbury-Nepean River, yams appear to have been particularly important food item (see, for example, Hunter 1793 [1968: 153]) and it has been suggested that the establishment of European farms along the banks of the river, which resulted in the widespread destruction of traditional yam beds, was an important contributing factor to the significant Aboriginal-Settler hostilities that occurred in this area (Kohen 1985).

[7] Some individuals may have been related through marriage.

A wide range of hunting and gathering 'gear' was employed by Darug speaking peoples, with distinctive repertoires for men and women (McDonald 2008: 24). Men's gear included several different forms of spears (variously barbed), spear throwers, clubs, 'swords', boomerangs, shields and hafted stone hatchets known as mogo. Women's toolkits, in contrast, included fishing hooks, lines and sinkers, digging sticks and various containers (shell and wood). Net bags made from plaited wood fibre appear to have been used both men and women (see Attenbrow 2010: 91). Bark canoes were also widely used (Attenbrow 2010: 87).

Two principal 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. In keeping with the linguistic division of the Darug language into coastal and hinterland dialects, differences in the nature of huts built along the coast and in the hinterland are attested in early colonial writings, with the former reportedly larger and 'formed of pieces of bark from several trees put together in the form of an oven with an entrance, and large enough to hold six or eight people' (Collins 1798 [1975: 460]). Unlike those living along the coast, Darug-speaking peoples occupying the Cumberland Plain appear to have relied heavily on bark huts (Hunter 1793 [1968]: 60-61). Regarding settlement duration, as Attenbrow (2010: 54) has observed, 'there is little direct historical evidence for the length of time people stayed at any one campsite (be it a rockshelter or bark hut), how often they moved, or what motivated them to move to another campsite'. Kohen and Lampert (1987), for their part, have argued that 'some bands probably lived at one campsite for months of each year and regularly returned to it'. However, this argument is not universally accepted (eg Attenbrow 2010: 55; McDonald 2008).

Evidence for ceremonial or ritual behaviour amongst Darug-speaking peoples can be found in the writings of a number early observers, with documented 'ceremonial' activities including corroborees, male initiation ceremonies, ritual combats and various burial, body adornment and personal decoration practices (Attenbrow 2010: 126-42). While available colonial records provide only scant information on the belief systems of Darug-speaking peoples, reference to the 19th century writings of people such as L.E Threlkeld, A.W Howitt, R.H Matthews, W. Ridley and W.J Enright, suggest that spiritual authority amongst Darug clans was likely vested in a number of ancestral beings, with Baiame or Daramulan – the supreme creative being – a central figure (Attenbrow 2010: 127).

In common with other parts of NSW and Australia more generally, the post-contact history of the Darug-speaking peoples of the Sydney region is primarily one of dispossession and loss, with groups alienated from their traditional hunting, gathering and camping grounds, populations decimated by a combination of introduced diseases[8] and frontier violence (Attenbrow 2010: 14-15, 21-22) and surviving groups subject to various colonial initiatives aimed at assimilating them into an ostensibly superior European way of life. Nonetheless, active resistance and friendly relations are also attested in available records.

[8] As highlighted by Attenbrow (2010: 21-22), a major initial cause of depopulation amongst the Darug was the April 1789 smallpox epidemic, which 'hit the local [Aboriginal] population horrific effect' and is estimated to have killed 'well over half' of Sydney's Aboriginal population (Attenbrow 2010: 21).

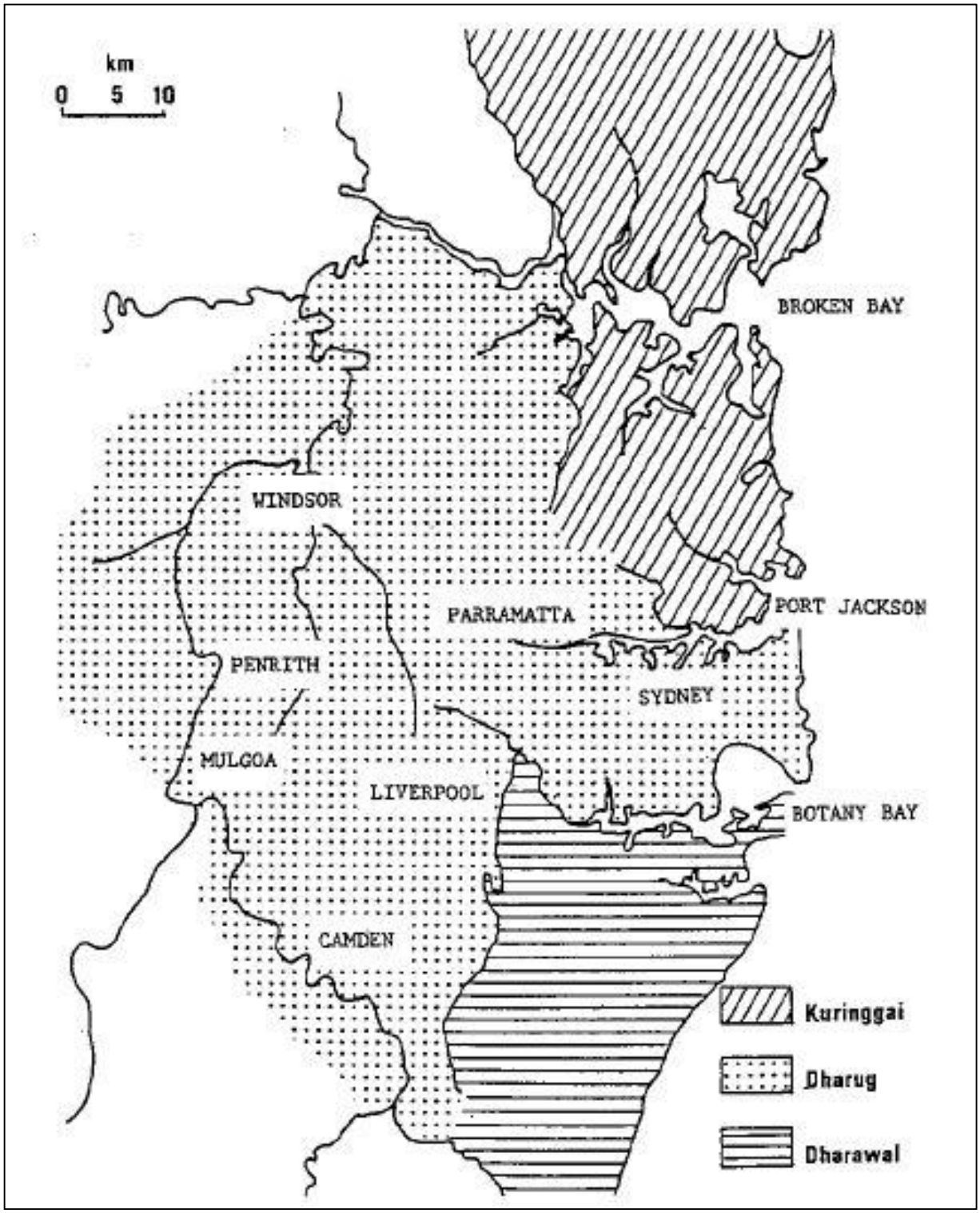


Figure 7-1 Aboriginal language group boundaries in the Sydney region (from Kohen 1993: 241, Fig. 1)

8 Survey and results

8.1 Overview

A targeted archaeological survey of the study area was undertaken by AECOM archaeologist Dr Andrew McLaren and MLALC representative Jay Daley on 21 September 2016. No native title owners or claimants were identified. These works followed on from a previous AECOM assessment for site management works for the Rozelle Rail Yards which included a survey undertaken by AECOM archaeologist Dr Darran Jordan and MLALC representative Jay Daley on 27 May 2016. The area subject to that assessment was determined to be highly disturbed. No sites or areas of archaeological sensitivity were noted in that assessment (AECOM Australia Pty Ltd 2016). It was considered likely that similar areas of disturbance would be identified in the larger project area during the site survey component of this assessment. This proved to be accurate, the results of which are outlined further in the following sections.

8.2 Site survey methodology

Pedestrian transects were walked across those parts of the study area determined to be least disturbed on the basis of aerial photographs (C2a/b, C3a, C4, C5, C6, C8 and C10 as previously described in **section 4.3**). Other disturbed areas were ground-truthed through a vehicle survey (C1a, C1b, C3b, C7 and C9). All mature remnant trees and sandstone outcrops within the study area were inspected for signs of cultural modification. All areas of exposure within the study area were inspected for surface expressions of Aboriginal artefacts. Notes were taken during the inspection and photographic recordings made of each inspected location.

8.3 Site survey findings

Field inspection focused on vegetated areas identified on 2016 aerials as being potentially undisturbed. Despite some reduced ground surface visibility during the survey, evidence of high levels of past ground disturbance were identified throughout the study area. The following sections describe the results of the survey in each area, as shown on **Figure 2-2**. This survey continued on from earlier assessments undertaken for the M4 East project and the site management works at the Rozelle Rail Yards, both of which have since commenced construction.

The M4 East project had a broader survey undertaken for it, which targeted areas of known sites and archaeological potential across a wider area that was located to the north and south of the existing M4 and Parramatta Road corridor, between Homebush and Haberfield/Ashfield. The survey for this assessment targeted those areas that had been specified for impacts, which included areas within the broader project boundary already assessed for the M4 East project. Other areas of the project that are not compounds but are proposed to be disturbed by the project, such as local road works, were assessed as part of the desktop research and through vehicle survey as extensive impacts in existing road corridor and highly developed areas would have destroyed any Aboriginal heritage that was once located there.

8.3.1 Wattle Street civil and tunnel site (C1a), Haberfield civil and tunnel site (C2a), Haberfield civil site (C2b) and Northcote Street civil site (C3a) at Haberfield

This area has been subject to previous Aboriginal heritage assessment as part of the M4 East project, and is now under construction. During this previous assessment for M4 East, no Aboriginal archaeological sites or areas of PAD or intangible cultural heritage values were identified.

A pedestrian survey was undertaken of this area at the corner of Wattle Street and Parramatta Road as part of this project to inspect and verify the findings for areas not yet cleared by M4 East. The vegetated area that was visible at the intersection of Wattle Street and Parramatta Road could be described as a ‘vegetated traffic island’. The visual inspection suggested that this island was likely highly disturbed (artificially levelled) during the construction of Wattle Street and/or Parramatta Road. No mature trees were present (ie no trees with the potential for cultural scarring) nor were any Aboriginal objects identified during the field inspection. GSV across the ‘island’ was generally very poor due to fallen tree matter.

No known, potential or intangible cultural heritage values were identified.

8.3.2 Parramatta Road West civil and tunnel site (C1b) and Parramatta Road East civil site (C3b) at Haberfield/Ashfield

A vehicle survey of this area confirmed that it was heavily impacted by past road, residential, commercial and industrial developments with high levels of disturbance noted. No known, potential or intangible cultural heritage values were identified.

8.3.3 Darley Road civil and tunnel site (C4) at Leichhardt

A pedestrian survey was undertaken of two areas. At the time of the survey, the site consisted of a disused building which has subsequently been adapted for a commercial purpose. Notwithstanding the change in land use, this area is highly developed and contains no sites or subsurface potential. The second portion surveyed was a cleared area bordered to the west by Darley Road and to the east by Norton Street which was determined to be a landscaped road verge. The verge is separated from Darley Road/City West Link by a concrete footpath. Localised subsurface disturbances were noted during the field inspection, including a grated storm drain and capped geotechnical drill hole at the western end of the road verge. This land is outside of the project footprint and would not be affected by the project.

An east-west oriented concrete stormwater pipe was observed in the vegetated area at the eastern end of the Leichhardt North light rail stop, which suggests that the road verge has been highly disturbed through pipeline installation at some point in the past (assuming that the pipe continues through the verge on its observable east-west trajectory).

This area at the eastern end of the Leichhardt North light rail stop has been highly disturbed by the installation of a stormwater pipe. No known, potential or intangible cultural heritage values were identified.

8.3.4 Rozelle civil and tunnel site (C5) at Rozelle

A pedestrian survey was previously undertaken of this area through the Rozelle Rail Yards site (as part of a REF for site management works). The site consists of highly disturbed terrain that is unlikely to retain Aboriginal archaeological materials in surface or subsurface contexts. No surface expressions of Aboriginal objects or areas of Aboriginal archaeological sensitivity/PAD were identified. The potential for intact in situ subsurface Aboriginal cultural deposits to be present here was assessed as low due to the level of past disturbance which is likely to have destroyed any sites that may have been in this area in the past. This area is defined as Disturbed Terrain (xx) (Chapman & Murphy, 1989:132–134) and past impacts have included cut and fill, as well as excavation to depths below current ground level for the installation of drainage, infrastructure and levelling. Based on past impacts known in this area, it was assessed that the proposed site management works in the disturbance area, where it was proposed to impact deeper than 500 millimetre depths in Disturbed Terrain (xx), would be unlikely to impact upon intact in situ subsurface Aboriginal cultural deposits.

No known, potential or intangible cultural heritage values were identified. This area has low subsurface archaeological potential.

Surface works at Rozelle (around Whites Creek)

This site is associated with the widening and improvement works to Whites Creek around The Crescent and Rozelle Bay at Annandale, and includes an area of land adjacent to Whites Creek and Brenan Street.

A pedestrian survey was undertaken of this area from the shared path through Buruwan Park, along Whites Creek and through the areas around The Crescent and Johnston Street. Whites Creek and the adjacent bank have been highly modified through concrete channelisation and earthworks/landscaping respectively. Outcropping sandstone bedrock was noted to the south of the shared path in Buruwan Park, occurring on a short but relatively steep sideslope below the Rozelle Bay light rail stop. No grinding grooves or pigment/engraved art were noted on exposed portions of the bedrock during the current survey.

Key disturbances in this inspection area included creek channelisation, creek bank modification, landscaping, path construction, the installation of park benches and telephone poles. Based on the level of past impacts, no subsurface archaeological potential was identified for this area. No known, potential or intangible cultural heritage values were identified.

8.3.5 The Crescent civil site (C6) at Annandale

A pedestrian survey was undertaken of the area. This area has been subject to high levels of past disturbance with earthworks, building construction, subsurface infrastructure and ground levelling for boating facilities, roadways and carparks. Based on the level of past impacts, no subsurface archaeological potential was identified for this area. No known, potential or intangible cultural heritage values were identified.

8.3.6 Victoria Road civil site (C7) at Rozelle

This site was assessed as highly disturbed areas and was ground-truthed through a vehicle survey. It was confirmed as being highly disturbed. Based on the level of past impacts, no subsurface archaeological potential was identified for this area. No known, potential or intangible cultural heritage values were identified.

8.3.7 Iron Cove civil site (C8) at Rozelle

A pedestrian survey was undertaken of this area. The visual inspection indicated that the grassed area to the south of Victoria Road, which forms part of King George Park, comprised an artificial, landscaped landform associated with the eastern approach to the duplicated Iron Cove Bridge. The location for the bioretention facility and improved car park works at King George Park (adjacent to Manning Street) comprised a mixture of hardstand and grassed areas.

This area was assessed as a highly disturbed, modified landform. Based on the level of past impacts no subsurface archaeological potential was identified for this area. No known, potential or intangible cultural heritage values were identified.

8.3.8 Pyrmont Bridge Road tunnel site (C9) at Annandale

This site was assessed as highly disturbed areas and was ground-truthed through a vehicle survey. It was confirmed as being highly disturbed. Based on the level of past impacts no subsurface archaeological potential was identified for this area. No known, potential or intangible cultural heritage values were identified.

8.3.9 Campbell Road civil and tunnel site (C10) at St Peters

A pedestrian survey was undertaken of this area from Woodley and Holland streets, as well as Campbell Lane. The visual inspection confirmed that the vegetated areas adjacent to Woodley and Holland Streets, as well as Campbell Lane, consisted exclusively of one or more revegetated deposits of historical fill, with the deposit adjacent to Woodley and Holland streets being several metres high. Sandstone boulders were common in this area and were readily visible from the street.

Vegetation included a mixture of introduced and exotic species. A heavily degraded brick wall (possibly a retaining wall) abutted and underlay the fill material along Woodley Street and Campbell Lane, which had been reinforced more recently, presumably to prevent further collapse, and fenced off. This area was assessed in the field as highly disturbed. Based on the level of past impacts no subsurface archaeological potential was identified for this area. No known, potential or intangible cultural heritage values were identified.

8.3.10 Summary

No surface Aboriginal objects or places were identified within the study area. MLALC representative, Jay Daley, did not identify any specific areas of Aboriginal cultural attachment or intangible cultural heritage values, although he noted that Aboriginal people would have been present in the wider area in the past. No issues were raised by the MLALC representative regarding the proposed works having an impact on known or potential Aboriginal sites or deposits or intangible cultural heritage values. Results of the archaeological survey of the investigation areas are provided in **Table 8-1**, with photos in **Annexure C**. Rating scales used for GSV and GI are provided in **Annexure D**.

Outcropping sandstone bedrock was noted to the south of the shared path through Buruwan Park, linking Railway Parade to The Crescent at Annandale, occurring on a short but relatively steep side slope below the Rozelle Bay light rail stop. No grinding grooves or pigment/engraved art were noted on exposed portions of the bedrock during the current survey.

Table 8-1 Investigation area results

Investigation area	Approximate length of transect	Description	Average GSV (%)	Average GI	Key disturbance factors	Findings
Wattle Street civil and tunnel site (C1a), Haberfield civil and tunnel site (C2a), Haberfield civil site (C2b) and Northcote Street civil site (C3a)	100 m	Highly disturbed	5	Low	Earthworks, levelling, creation of traffic island	Retains no subsurface archaeological potential
Parramatta Road West civil and tunnel site (C1b) and Parramatta Road East civil site (C3b)	360 m	Highly disturbed	5	Low	Development of roads, residential and industrial structures and related infrastructure	Retains no subsurface archaeological potential
Darley Road civil and tunnel site (C4)	100 m	Highly disturbed	40	Low	Pipeline, earthworks	Retains no subsurface archaeological potential
Rozelle civil and tunnel site (C5) and The Crescent civil site (C6)	1.5 km	Highly developed rail yard area with sections of regrowth vegetation due to disuse	20	Low	Earthworks, fill, drainage works, ventilation outlet, and other general development.	Retains no subsurface archaeological potential
Surface works at Rozelle (around Whites Creek)	100 m	Majority highly disturbed with small undisturbed section	5	Low to Moderate	Concrete channelisation, earthworks/landscaping, bike/footpath	Retains no subsurface archaeological potential. Natural sandstone benches were noted but no grinding grooves and/or engraved/pigment art were observed on exposed sections of bedrock.
Victoria Road civil site (C7)	200 m	Highly disturbed	5	Low	Development of roads, buildings and associated infrastructure	Retains no subsurface archaeological potential

Investigation area	Approximate length of transect	Description	Average GSV (%)	Average GI	Key disturbance factors	Findings
Iron Cove Link civil site (C8)	100 m	Highly disturbed	10	Low	Landscaping	Retains no subsurface archaeological potential
Pyrmont Bridge Road tunnel site (C9)	200 m	Highly disturbed	5	Low	Development of roads, buildings and associated infrastructure	Retains no subsurface archaeological potential
Campbell Road civil and tunnel site (C10)	100 m	Highly disturbed	5	Low	Earthworks, fill, development of path and wall	Retains no subsurface archaeological potential

9 Assessment of impacts

9.1 Direct impacts

Direct impacts are those that would result from the construction of tunnelling, surface roads, interchanges, ancillary and operational facilities, utilities, upgrades of existing roads and construction compounds. Direct impacts have the potential to damage or destroy Aboriginal sites where the sites are located within the project footprint.

As no Aboriginal sites or areas of archaeological sensitivity or intangible cultural heritage values were identified within the project footprint, no direct impacts on Aboriginal heritage values are anticipated as a result of the project.

9.2 Indirect impacts

Indirect impacts are those that would result from vibration during construction and blasting activities, and settlement-related impacts from tunnelling. Indirect impacts have the potential to damage or destroy Aboriginal sites where the sites are located within impact zones.

Consideration of the location of previously recorded sites indicates that rockshelter with midden site #45-6-2278 is located about 50 metres to the north of the Rozelle Rail Yards site. As there will be underground tunnels excavated in the general area beneath site #45-6-2278 indirect impacts could potentially be caused by vibration and settlement.

The noise and vibration assessment undertaken for the project (SLR 2017) assessed the potential vibration impacts from mainline tunnelling works (refer to **Appendix J** (Technical working paper: Noise and vibration)) of the EIS. The assessment identified criteria to be applied to certain structures in accordance with the guideline: DIN 4150: Part 3-1999 *Structural vibration – Effects of vibration on structures* (Deutsches Institute fur Normung 1999). The guideline identifies the minimum 'safe limit' of peak vibration velocity at low frequencies for structures which may be particularly sensitive to ground vibration (such as heritage buildings), as three millimetres per second. It is also accepted that this criterion could also be applied to buried archaeological artefacts. The noise and vibration assessment determined that AHIMS site #45-6-2278 is outside the minimum safe working distance for vibration intensive plant, and vibration impacts associated with tunnelling works are expected to be negligible.

Although indirect impacts are not anticipated, during construction, as a precaution, vibration and settlement monitoring are recommended.

10 Assessment of cumulative impacts

10.1 Other WestConnex projects

10.1.1 M4 East

The M4 East project involves the construction and operation of an upgrade and extension of the M4 Motorway from Homebush Bay Drive at Homebush to City West Link at Haberfield (Wattle Street and Parramatta Road). This includes twin tunnels about 5.5 kilometres long and associated surface works to connect to the existing road network.

The Aboriginal heritage assessment undertaken for M4 East involved consultation with MLALC and an archaeological survey as per the PACHCI Stage 2 process. The targeted archaeological survey was undertaken over two days on 8 and 9 April 2015 as part of the M4 East Aboriginal archaeological assessment.

Following the survey these key observations were made:

- Areas of highly disturbed terrain are unlikely to retain Aboriginal archaeological materials in surface or subsurface contexts
- No surface expressions of Aboriginal objects or places were identified
- The closest AHIMS registered site was #45-6-2339, located at Phillips Park at Lidcombe, 1.6 kilometres to the west of the project corridor. Although outside the bounds of the project and not proposed for direct or indirect impacts, it was inspected during the current survey. The site card for #45-6-2339 lists 10 artefacts and shell fragments. Shell fragments in a disturbed context were present but no artefacts were identified during this inspection
- Two areas of potential Aboriginal heritage sensitivity were identified:
    - Mason Park, off Underwood Road at Homebush
    - Queen Elizabeth Park, between Broughton Street and Addison Avenue at Concord.

The M4-M5 Link project overlaps with the M4 East project at Haberfield (at Wattle Street and Parramatta Road), with the M4-M5 Link project utilising land within or potentially beyond the existing civil and tunnel sites (depending if Option B at Haberfield/Ashfield is selected) during construction and connecting into underground stub tunnels being constructed as part of the M4 East project.

In the areas of overlap, there are no potential sites or features at the Wattle Street or Parramatta Road locations. The M4-M5 Link would therefore not impact any of the previously identified AHIMS sites or areas of identified potential Aboriginal heritage sensitivity assessed and managed as part of the M4 East project. Management measures adopted for the M4 East project for Aboriginal heritage will be carried over for the M4-M5 Link project to ensure consistency.

No significant impacts on Aboriginal heritage are anticipated as a result of the M4-M5 Link project as described in the findings of this current assessment (refer to **Chapter 8**). Cumulative impacts on Aboriginal heritage are therefore not anticipated as a result of the M4-M5 Link project's interaction with the M4 East project.

10.1.2 New M5

The New M5 project involves the construction and operation of a new multi-lane road link tunnel between the existing M5 East Motorway, east of King Georges Road, and St Peters. The project also includes an interchange at St Peters and connections to the existing road network.

The Aboriginal heritage assessment undertaken for the New M5 EIS involved consultation with MLALC and an archaeological survey as per the PACHCI Stage 2 process. The targeted archaeological survey was undertaken over four days in November 2014.

During the survey, five sandstone rock overhangs were identified as PADs based on habitation area size and presence of potential deposit. Four of these were located within the Wolli Creek Valley, and one was located at Stotts Reserve, Bardwell Park. The sites were registered with AHIMS.

Given the extent of previous disturbance within the project footprint, as well as the proposed construction activities, it was concluded unlikely that direct or indirect impacts on Aboriginal cultural values would occur as a result of the project.

The M4-M5 Link project overlaps with the New M5 project at St Peters only (within the St Peters interchange). None of the areas previously identified as potential archaeological deposits are within the M4-M5 Link project footprint and would therefore not be impacted by this project.

No significant impacts on Aboriginal heritage are anticipated as a result of the M4-M5 Link project as described in the findings of this current assessment (refer to **Chapter 8**). Cumulative impacts on Aboriginal heritage are therefore not anticipated as a result of the M4-M5 Link project's interaction with the New M5 project.

10.1.3 Other WestConnex projects

The proposed works and previous heritage assessment for King Georges Road Intersection Upgrade and M4 Widening were also considered. However, impacts in relation to Aboriginal heritage were considered to be negligible. These projects do not interface with the M4-M5 Link project.

10.1.4 Summary of the WestConnex scheme

PACHCI Stage 2 assessments have been completed for each stage of WestConnex. Management measures have been identified for each stage of WestConnex to mitigate potential impacts. Across the WestConnex scheme it is considered that direct or indirect impacts on Aboriginal cultural values are unlikely provided these measures are implemented. Consistent management measures include:

- Should a scope change for this project be proposed and new areas outside the curtilage of the study area be proposed for impact, then these areas should also be subject to a PACHCI Stage 2 assessment
- Should any unexpected finds of Aboriginal places, objects or deposits be identified during the project, then the Roads and Maritime *Standard Management Procedure for Unexpected Heritage Items* (Roads and Maritime 2015) should be followed.

10.2 Other projects

10.2.1 Rozelle Rail Yards site management works

The Rozelle Rail Yards site management works assessed for Aboriginal sites, cultural significance and subsurface potential and the findings included in the REF. This involved a site inspection, reference to aerials and maps, as well as consideration of the history of the area. The resulting findings were that the area had been subject to high levels of disturbance in the past and that intact in situ subsurface deposits were not likely to occur. No surface expression of artefacts or other Aboriginal site types were identified (AECOM Australia Pty Ltd 2016). Stop work procedures are to be followed should any unexpected finds be identified during works.

10.2.2 CBD and Southeast Light Rail Project

The CBD and South East Light Rail Project (CSELR) involves the construction of about 13 kilometres of new light rail track from circular quay to central, Kingsford and Randwick by Surry Hills and Moore Park and maintenance and stabling facilities. Of relevance to the M4-M5 Link project, the CSELR Rozelle maintenance depot will be located next to the existing Lilyfield light rail stop, west of the rockshelter with midden Aboriginal site (AHIMS #45-6-2278) adjacent to the western portion of the Rozelle Rail Yards.

Works have begun for the CSELR Rozelle maintenance depot and construction is expected to be completed in 2018 (operational in 2019). The construction of the facility would therefore potentially coincide for a limited period with the M4-M5 Link project.

Aboriginal heritage was assessed as part of the CSELR EIS with the Rozelle maintenance depot, with the majority of the site identified as within Zone 3 archaeological potential, where Aboriginal archaeological evidence may be present; however due to nature and extent of modern land use it is likely to be disturbed.

Construction of the CSELR within Zone 3 may impact on Aboriginal archaeological evidence where excavation is proposed. Areas defined as having the potential to contain Aboriginal objects will be managed in accordance with the archaeological investigation and salvage recommendations. The M4-M5 Link project is located adjacent to the CSELR project (Rozelle maintenance depot) at Rozelle. The CSELR did not identify areas of potential archaeological deposits and identified that any potential archaeology, if present, would be highly disturbed.

No significant impacts on Aboriginal heritage are anticipated as a result of the M4-M5 Link project as described in the findings of this current assessment (refer to **Chapter 8**). Cumulative impacts on Aboriginal heritage are therefore not anticipated as a result of the M4-M5 Link project's interaction with the CSELR project. Both projects would be managed through unexpected finds protocols.

10.2.3 Western Harbour Tunnel

The construction footprint for the proposed future Western Harbour Tunnel and Beaches Link would extend into the Rozelle Rail Yards, and the area assessed as part of the M4-M5 Link project. This area has therefore already been assessed in **section 10.2.1**.

11 Summary of findings and recommendations

11.1 Summary of findings

Following the survey these key observations were made:

- The study area predominantly consists of highly disturbed terrain that is unlikely to retain Aboriginal archaeological materials in surface or subsurface contexts
- No surface expressions of Aboriginal objects were identified during the survey and no intangible cultural heritage values were identified by the MLALC representative
- As no AHIMS registered Aboriginal sites occur within the study area, none would be either directly or indirectly impacted by the project. The closest AHIMS site is mapped as occurring about 50 metres to the north of the Rozelle Rail Yards. No direct impacts are anticipated from the project and indirect impacts from vibration are expected to be negligible. Its current condition is to be confirmed with a site survey during detailed design, with ongoing observation and monitoring recommended to be undertaken during the construction program
- At a part of the study area adjacent to Whites Creek, exposed sandstone bedrock was observed on the short but relatively steep slope below the Rozelle Bay light rail stop. However, no grinding grooves or pigment/engraved art were noted during the current survey.

11.2 Management recommendations

Given the extent of previous disturbance within the study area, no direct or indirect impacts on Aboriginal cultural values are anticipated as a result of the project. As such, it is concluded that further impact assessment in accordance with Stage 3 of the PACHCI is not required.

Based on the above key findings, management measures are recommended as outlined in **Table 11-1**.

Table 11-1 Recommended environmental management measures

Impact	No.	Environmental management measure	Timing
Construction			
Impacts on unexpected finds of Aboriginal places, objects or deposits	AH1	Any items of potential Aboriginal archaeological or cultural heritage conservation significance or human remains discovered during construction will be managed in accordance with the Unexpected Heritage Finds and Humans Remains Procedure developed for the project.	Construction
Impacts of vibration on Aboriginal places, objects or deposits	AH2	Subject to gaining access from the relevant landholder, a suitably qualified archaeologist would visit AHIMS site #45-6-2278 prior to the commencement of any vibration intensive construction activities in the vicinity to verify the site to confirm and record its current condition.	Construction
	AH3	If the AHIMS site #45-6-2278 is verified, an assessment will be completed by a suitably qualified and experienced person prior to the commencement of any vibration intensive construction activities in the vicinity. The assessment will consider all vibration intensive activities that will occur in the vicinity, the likely vibration levels and relevant vibration criteria and identify the management measures, including monitoring, that will be implemented to prevent and reduce potential impacts. A final condition assessment will be carried out at the completion of construction detailing recommendations for remediation measures if required.	Construction

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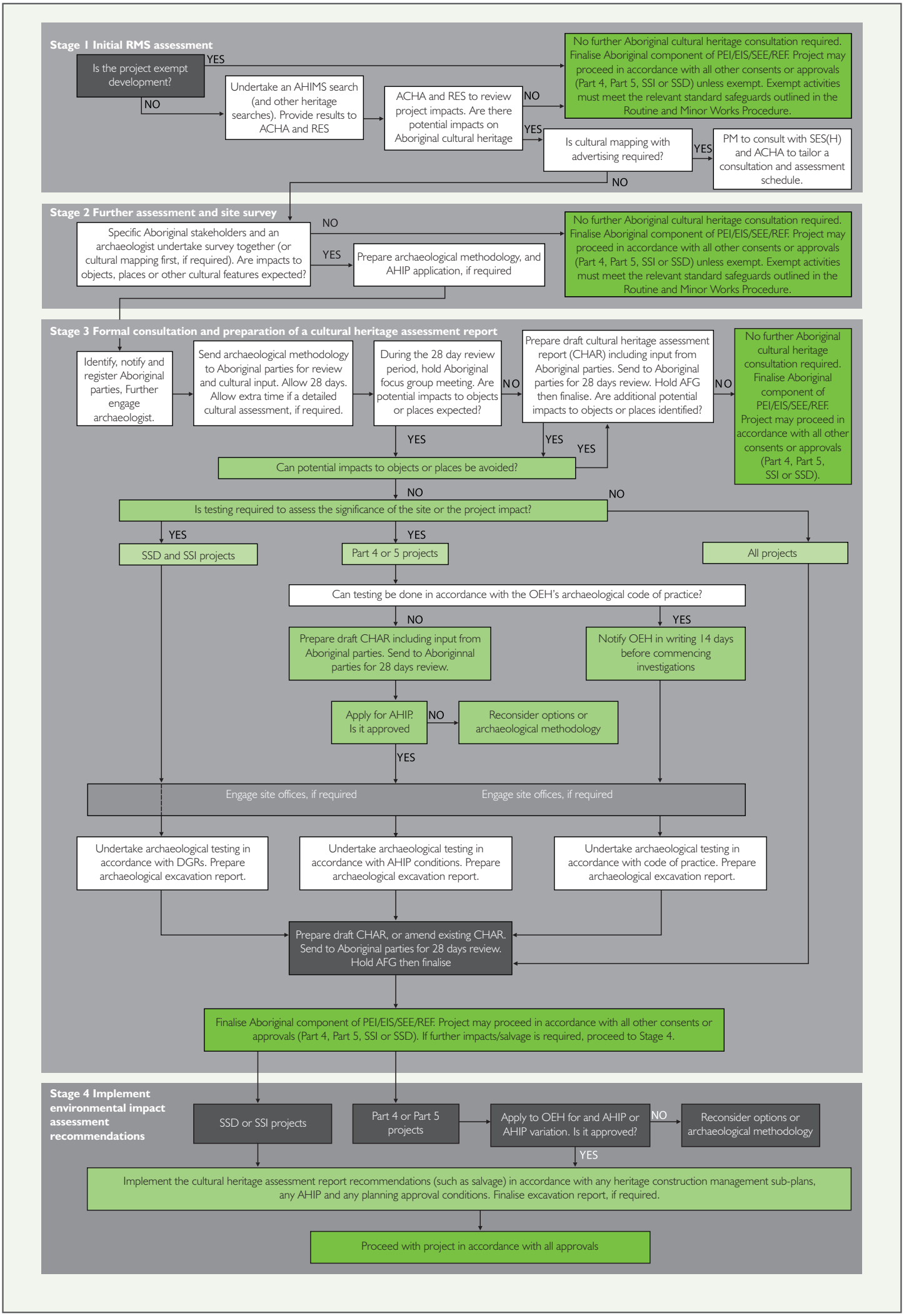
Annexures

Annexure A PACHCI process



The PACHCI process (Roads and Maritime Services, 2011)

Annexure B Search results

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 60491677, 1.1

Client Service ID : 246070

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-2382	Goat Island 2	AGD	56	333100	6252480	Closed site	Valid	Artefact : -, Shell : -, Aboriginal Ceremony and Dreaming : -		
	Contact	**Recorders**	Klim Gollan					**Permits**		
45-6-2278	Lilyfield Cave	AGD	56	330310	6250290	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	102201
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-2287	Yerroulbin Cave	AGD	56	332010	6253210	Closed site	Valid	Shell : -, Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-0535	Quarantine Park	AGD	56	326210	6252970	Open site	Not a Site	Earth Mound : -	Not an Aboriginal Site	1308,1809
	Contact	**Recorders**	Val Attenbrow,Val Attenbrow,Laura-Jane Smith					**Permits**		
45-6-2145	France/Exile Bay, Concord.	AGD	56	325900	6252400	Open site	Valid	Shell : -, Artefact : -	Midden	1809,1911
	Contact	**Recorders**	Mr.R Taplin					**Permits**		
45-6-0262	Rodd Point;Rodd Park;	AGD	56	328700	6251000	Open site	Valid	Shell : -, Artefact : -	Midden	2047
	Contact	**Recorders**	Val Attenbrow,Michael Guider					**Permits**		
45-6-0266	Chiswick;Drummoyne;	AGD	56	327674	6252823	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-0283	Rozelle Hospital 1;Rozelle Ho5555;	AGD	56	329760	6251360	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Val Attenbrow					**Permits**		
45-6-0615	Undercliffe Road	AGD	56	328500	6244500	Closed site	Valid	Shell : -, Artefact : -, Art (Pigment or Engraved) : -	Midden,Shelter with Art	99514
	Contact	**Recorders**	Ms.Bronwyn Conyers,D Burns					**Permits**		
45-6-1268	Balls Head Reserve;	AGD	56	332786	6253288	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1900	White Horse Pt.	AGD	56	330800	6252420	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1901	Long Nose Point 1.;Birchgrove;9 Numa Street;	AGD	56	332000	6253030	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1481	Rozelle Hospital 3	AGD	56	329902	6251129	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Val Attenbrow,Michael Guider					**Permits**		
45-6-2555	Rodd Island	AGD	56	329080	6251280	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-0618	Rozelle Hospital 2, Rozelle Hospital 1	AGD	56	329650	6251330	Open site	Valid	Shell : -, Artefact : -, Art (Pigment or Engraved) : -	Midden,Rock Engraving	
	Contact	**Recorders**	Val Attenbrow,Michael Guider					**Permits**		
45-6-0628	Balls Head Reserve Waverton	GDA	56	333129	6253420	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	**Recorders**	Michael Guider,D Lautrec,Mr.R Taplin,Aboriginal Heritage Office					**Permits**		
45-6-2142	Hen & Chicken Bay, Five Dock.;	AGD	56	326200	6251250	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Mr.R Taplin					**Permits**		
45-6-1232	Balls Head Unbelievable Cave	GDA	56	332839	6253390	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	**Recorders**	Michael Guider,D Lautrec,Aboriginal Heritage Office					**Permits**		
45-6-1142	Abbotsford;Kangaroo Feet Cave;	AGD	56	326670	6252712	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	**Recorders**	ASRSYS					**Permits**		
45-6-1143	Mortdale;Tide Floor Cave;	AGD	56	325932	6253064	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	**Recorders**	ASRSYS					**Permits**		
45-6-1934	Half Moon Bay Cave;	AGD	56	328990	6251690	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1935	Sisters Bay Cave	AGD	56	329350	6251930	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1936	Rodd Point Cave;	AGD	56	328730	6251010	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-0751	Shea's Creek Dugong	GDA	56	331839	6245378	Open site	Destroyed	Artefact : -, Aboriginal Resource and Gathering : -, Non-Human Bone and Organic Material : -	Open Camp Site	
	Contact	**Recorders**	ASRSYS,AECOM Australia Pty Ltd (previously HLA-Envirosciences),Mr.Luke Kirkw(					**Permits**		
45-6-1496	Shea's Creek	AGD	56	328842	6244524	Open site	Valid	Shell : -, Artefact : -	Midden	30,591,940
	Contact	**Recorders**	ASRSYS					**Permits**		
45-6-0891	Balls Head Reserve 5 Hands Cave	GDA	56	333139	6253455	Closed site	Valid	Shell : -, Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Midden	
	Contact	**Recorders**	Michael Guider,D Lautrec,Aboriginal Heritage Office					**Permits**		

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-1954	Sisters Bay Cave 2	AGD	56	329510	6251920	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1955	Sisters Bay 3;	AGD	56	329370	6251750	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**	3653,3690	
45-6-1956	Five Dock Bay Cave	AGD	56	328430	6253220	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1957	Goat Island Cave;	AGD	56	333010	6252710	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-1971	Rozelle Hospital 5, Rozelle Hospital 3	AGD	56	329740	6251360	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Val Attenbrow,Michael Guider					**Permits**		
45-6-1972	Rozelle Hospital 4	AGD	56	329690	6251360	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	**Recorders**	Val Attenbrow,Michael Guider					**Permits**		
45-6-1809	Birchgrove	AGD	56	331380	6252700	Closed site	Valid	Shell : -, Artefact : -, Art (Pigment or Engraved) : -	Midden,Shelter with Art	
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-0026	Whale rock	AGD	56	332800	6253300	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	**Recorders**	D Earle,Michael Guider,D Lautrec					**Permits**	2885	
45-6-0027	Balls Head Berry Island	GDA	56	333214	6253390	Closed site	Valid	Art (Pigment or Engraved) : -, Shell : -, Artefact : -, Burial : -	Burial/s,Shelter with Art,Shelter with Midden	
	Contact	**Recorders**	Michael Guider,Aboriginal Heritage Office					**Permits**		
45-6-2629	Broadway 1	AGD	56	333060	6249100	Open site	Valid	Artefact : -		102494,102763,102765
	Contact	**Recorders**	Dominic Steele Archaeological Consulting					**Permits**	1299	
45-6-2654	Fraser Park PAD	AGD	56	330100	6245800	Open site	Valid	Potential Archaeological Deposit (PAD) : -		98669
	Contact	**Recorders**	Navin Officer Heritage Consultants Pty Ltd					**Permits**	1639	
45-6-2676	Johnstons Creek	AGD	56	331100	6249100	Closed site	Valid	Art (Pigment or Engraved) : 2, Artefact : 5		102142,102763

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	Contact	**Recorders**	Michael Guider					**Permits**		
45-6-2666	Wattle Street PAD 1	AGD	56	333150	6249450	Open site	Valid	Potential Archaeological Deposit (PAD) : -		102494,102763,102765
	Contact	**Recorders**	Dominic Steele Archaeological Consulting					**Permits**	1738	
45-6-2680	Broadway Picture Theatre PAD 1	AGD	56	333150	6249000	Open site	Valid	Potential Archaeological Deposit (PAD) : -		102142,102494,102763,102765
	Contact	**Recorders**	Jim Wheeler					**Permits**	1854	
45-6-2745	University of Sydney Law Building PAD	AGD	56	332350	6248740	Open site	Valid	Potential Archaeological Deposit (PAD) : -		102201,102494,102763,102765
	Contact	**Recorders**	Doctor.Jo McDonald					**Permits**	2153,2320,2443	
45-6-2767	Tent Embassy	AGD	56	332680	6248680	Open site	Valid	Aboriginal Resource and Gathering : 1		102494,102763,102765
	Contact T Russell	**Recorders**	Bill Lord					**Permits**		
45-6-2822	USYD: Central	AGD	56	332750	6248550	Open site	Valid	Artefact : -		100302,102494,102763,102765
	Contact	**Recorders**	Jo McDonald Cultural Heritage Management					**Permits**	2554	
45-6-2843	Canada Bay Midden	AGD	56	329550	6251900	Closed site	Valid	Shell : -		100436
	Contact T Russell	**Recorders**	Kate Sullivan					**Permits**	3075	
45-6-2960	Jackson Landing Shelter	GDA	56	332442	6250870	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		102494,102763,102765
	Contact	**Recorders**	Mary Dallas Consulting Archaeologists,Mr.Paul Irish					**Permits**		
45-6-2966	Balls Head shelter NSC-073	GDA	56	332879	6253500	Open site	Valid	Potential Archaeological Deposit (PAD) : -, Shell : -		
	Contact	**Recorders**	Mr.Phil Hunt,Aboriginal Heritage Office					**Permits**		
45-6-2967	5 Hands Shelter B NSC-074	GDA	56	332134	6253455	Open site	Valid	Shell : -		
	Contact	**Recorders**	Mr.Phil Hunt,Aboriginal Heritage Office					**Permits**		
45-6-3071	445-473 Wattle Street PAD	GDA	56	333285	6249412	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	**Recorders**	Biosis Pty Ltd - Sydney					**Permits**		
45-6-3064	445-473 WATTLE ST PAD	GDA	56	333285	6249412	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		102763

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 60491677, 1.1

Client Service ID : 246070

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
Contact		Recorders	Biosis Pty Ltd - Sydney					Permits		

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Annexure C Site photos

Plate 1 Campbell Road civil and tunnel site (C10)

Plate 2 Darley Road civil and tunnel site (C4)

Plate 3 Rozelle civil and tunnel site (C5)

Plate 4 Buruwan Park, adjacent to Whites Creek in Annandale

Plate 5 Iron Cove Link civil site (C8)

Plate 6 Campbell Road civil and tunnel site (C10)

Annexure D Rating schemes

Table D.1 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 D.2 Ground Integrity (GI) rating scheme

GI rating	Definition
Low	Area has been subject to significant disturbance through natural and/or anthropogenic processes (eg heavy earthworks).
Moderate	Area has been subject to moderate disturbance (eg native vegetation clearance) but retains a reasonable degree of integrity.
High	Area remains in a natural or near-natural state.

Table D.3 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.