

Woorong Park - Marsden Park

Aboriginal Cultural Heritage Assessment Report



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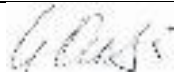
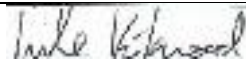
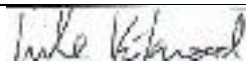
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Executive Summary

AECOM Australia Pty Ltd (AECOM) was commissioned by Woorong Park Pty Ltd (Woorong Park) to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR) to support an application for an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the *National Parks and Wildlife Act 1974* (NPW Act 1974) for a proposed residential development across Lots 4, 5, 7, 8 and 9 on DP1078187, Lot 10 on DP1178982 and Lot 1 on DP262886 (part), west of Richmond Road in Marsden Park, Sydney, NSW. This ACHAR details the results of an Aboriginal cultural heritage assessment of land within the Project area and has been compiled in accordance with the NSW Office of Environment and Heritage's (OEH) *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011). It is intended that this report be read in conjunction with AECOM's Aboriginal Archaeological Report (AAR) for the Project area, attached as **Appendix B**.

Aboriginal community consultation for this assessment was conducted in accordance with OEH's *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010a). A total of 39 Registered Aboriginal Parties (RAPs) were consulted for the assessment. Key consultation activities included the provision of information about the Project as part of the registration process, RAP review of the draft assessment methodology, RAP participation in fieldwork and RAP review of a draft of this ACHAR.

The Project area for this assessment comprises an irregularly-shaped c.419 hectare parcel of land, west of Richmond Rd, in the northwestern Sydney suburb of Marsden Park. Bounded by Stoney Creek Road and South Creek in the west, the Llandilo International Transmitting Station site in the south, undeveloped rural land in the north and a combination of undeveloped rural land and Stockland's residential development 'Elara' in the east, the Project area falls wholly within the Marsden Park Precinct of Sydney's North West Growth Centre (NWGC) and is located within the Local Government Area of Blacktown City Council (Parish of Rooty Hill, County of Cumberland).

The topography of the Project area is typical of the Cumberland Lowlands physiographic region described by Bannerman and Hazelton (2011) and can be broadly described as flat to gently undulating, with level (<1°) to very gently (1-3°) inclined flats (floodplains) associated with locally occurring watercourses giving way to low, variably-dissected ridgelines and/or rises. Floodplain topography within the Project's area two main alluvial valleys (i.e., South Creek and Little Creek) is relatively complex, with remnant alluvial landform elements and features in both valleys indicative of geomorphologically dynamic alluvial environments. Little Creek flows northward through the central portion of the Project area and is the principal watercourse within the site. The creek enters the Project area as a 3rd order stream and exits it as a 5th order stream. Major tributaries within the Project area include two unnamed northwesterly-trending streams, both ≥3rd order. South Creek, a regionally significant perennial watercourse, flows in part along the western boundary of the Project area, with level to very gently inclined terrain in the western and northern portions of the site comprising part of the creek's extensive floodplain.

Searches of the AHIMS database on 19 November 2015 for a 15 x 15 km area centred on the Project area (AHIMS search area) returned 778 site entries. Removal of duplicate, deleted and non-site entries (n = 10) provides a revised total of 768 registered Aboriginal sites. Centroid coordinates for AHIMS registered Aboriginal sites located within 50 m of the Project area (n = 10) place nine sites within the project boundary. However, a review of associated reporting indicates that two of these sites - open artefact sites GROS6 (45-5-2392) and GROS9 (45-5-2395) - are, in fact, located outside of the Project area, bringing the total number of previously recorded sites within the Project area to seven. All previously recorded sites within the Project area are listed as 'Valid' sites on the AHIMS database.

Archaeological survey of the Project area was undertaken over a four day period (20-23 July 2015) by a combined field team of three AECOM archaeologists and three rostered RAP field representatives. The primary aim of the survey was to identify and record any existing surface evidence of past Aboriginal occupation within the Project area, with specific, nested objectives including the relocation of previously recorded Aboriginal sites, the ground-truthing of land disturbances visible in examined historical aerial photographs and an assessment of the subsurface archaeological potential of extant landform elements. All survey was conducted on foot, with a total of 36 transects completed over the course of the survey.

A total of 22 individual lithic items, 21 of which satisfied technical criteria for identification as artefacts, were identified during survey. Consideration of the location of identified artefacts against the boundaries of AHIMS registered Aboriginal sites within the Project area indicates that all fall within the mapped boundaries of previously recorded open artefact sites MPP-02 (45-5-4159), MPP-03 (45-5-4160) and WP1 (45-5-4161). Previously recorded artefacts at the four remaining AHIMS registered Aboriginal sites within the Project area - MPP-01 (45-5-4158), MPP-07 (45-5-4170), WP5 (45-5-4166) and WP6 (45-5-4164) - were not relocated during the current

survey. For WP5 and MPP-07, this result was attributed in-field to differences in GSV conditions between the current survey and previous archaeological surveys, as well as intervening erosion activity.

In recognition of generally poor GSV conditions across the Project area and the potential for all non-grossly disturbed portions of the Project area to contain intact subsurface archaeological deposit, albeit of highly variable character, a 21 day program of archaeological test excavation was also completed as part of the archaeological investigation detailed in AECOM's AAR (**Appendix B**). In accordance with Requirement 3.1 of the Code Practice, the overarching objective of the test excavation program was to collect information about the nature and extent of subsurface Aboriginal objects across the Project area. Archaeological test excavation was undertaken in two phases, with Phase 2 testing involving two separate but interrelated components (as detailed below).

Phase 1 of the test excavation program involved the excavation of two hundred 50 x 50 cm (0.25 m²) test pits across the Project area, with test pit locations selected by way of a stratified random sampling design employing identified landform units as the basis of stratification. Phase 2, in contrast, involved small, open plan expansion excavations (2 x 2 m) around three Phase 1 test pits (TP11, TP129 and TP183), as well as subsurface testing of a series of magnetic anomalies (n = 6) identified in the vicinity of TPs129 and 183 as a result of gradiometer surveys at these locations. A gradiometer survey in the vicinity of TP11 failed to identify any anomalies suitable for subsurface testing. Open plan extensions at TPs11, 129 and 183 were undertaken to better characterise what, on a Project area scale, comprised 'high' density concentrations of artefacts (16, 5 and 4 artefacts respectively, representing the three highest artefact totals from Phase 1 test pits).

The overarching pattern of subsurface artefact distribution revealed by Phase 1 testing across the Project area can be characterised as sparse and discontinuous. Most (n = 179, 89.5%) pits contained no artefacts. Artefact-bearing pits (n = 21), meanwhile, were widely but unevenly distributed across the Project area, with the majority located within the western half of the Project area. Densities for artefact-bearing test pits in Phase 1 were near-uniformly low, with only one pit containing more than ten artefacts (range: 1-16). The maximum density of artefacts identified during Phase 1 testing was 16 artefacts per 0.25 m². This occurred in TP11 on a locally prominent residual rise within the South Creek valley. Examination of Phase 1 artefact distribution in relation to various landscape variables, including landform and stream order, suggests an occupational emphasis on low gradient landform elements within the South Creek and Little Creek valleys proper.

Together with the technological and typological profiles of the flaked stone artefact assemblages recovered from them, observed artefact densities within the Phase 2 expansion excavations completed around Phase 1 test pits TP11 and TP183, located within the South Creek and Little Creek valleys respectively, suggest that the current excavation program has - in both instances - intercepted parts of larger moderate-to-high density reduction foci (i.e., knapping floors). The primary purpose of the reduction foci intercepted in the TP11 expansion excavation appears to have been the production of small flakes for on-site backed artefact manufacture. No backed artefacts were recovered from the sampled portion of the reduction foci intercepted in the TP183 expansion excavation. However, a similar purpose seems likely. In contrast to those observed within the TP11 and TP183 expansion excavations, observed 1m² quadrant densities within the TP129 expansion excavation, located on an upper terrace within the flat landform unit, were very low across the board (i.e., <10/artefacts m²) and are consistent with a 'background scatter' of artefactual material.

Test pits advanced to investigate magnetic anomalies in the vicinity of the TP129 expansion excavation (n = 3) failed to intercept any heating features of probable or definite Aboriginal origin (i.e., heat treatment pits or hearths). A single heating feature in magnetic anomaly test pit MA3, located c.9 m to the north of the expansion excavation, was considered to be non-Aboriginal in origin. Test pits advanced to investigate magnetic anomalies in the vicinity of the TP183 expansion excavation (n = 3) failed to intercept any heating features.

Taking into account the results of the current survey and test excavation program, a total of 13 Aboriginal sites are recognised within the Project area. With the exception of previously recorded Aboriginal sites WP1 (45-5-4161), WP6 (45-5-4164) and MPP-01 (45-5-4158), all remaining AHIMS registered Aboriginal sites within the Project area (n = 4) have been subsumed within new sites. Site boundaries for the majority (n = 8, 61.5%) of identified sites have been defined on the basis of excavation extent, with remaining boundaries either previously defined by KNC (2010, 2012) or defined on landscape grounds. Three sites (i.e., Woorong Park Residual Rise 1, South Creek Alluvial Landscape and Little Creek Alluvial Landscape) have been assessed as being of moderate scientific significance, with the remaining ten sites assessed as being of low scientific significance. No sites of high scientific significance have been identified within the Project area.

This assessment finds that the Aboriginal heritage values of the Project area rest principally with the Aboriginal archaeological sites that have been identified within it. These sites attest to past Aboriginal occupation and use of the Project area and collectively constitute a landscape of low to moderate scientific significance. RAPs for this assessment have identified the Project area as forming part of a much larger and highly significant cultural landscape for Darug people and have indicated that Aboriginal people will have moved across, utilised and cared for all parts of the subject properties. RAPs have also identified South Creek and the smaller of Project area's two residual rises, in particular, as culturally important landscape features in terms of past Aboriginal occupation and resource exploitation.

Although situated within a broader landscape of high historical significance for contemporary Darug people, including the Blacktown Native Institution and Colebee and Nurragingy Land Grant sites, the Project area itself is assessed as having low historical significance. No evidence of post-contact Aboriginal occupation has been identified within the Project area. In addition, no historical records or oral histories specific to the use of the site by Aboriginal people have been identified as part of this assessment. The Project area is likewise considered to have low aesthetic significance on the grounds that the natural environment of the subject properties has been extensively modified by historical land use practises.

Proposed development activities within the Project area are anticipated to directly impact all thirteen Aboriginal archaeological sites identified within it. Consideration of the location of impacted sites in relation to proposed bulk earthworks and Woorong Park's development plan indicates a total loss of value of all sites.

In order to manage the impacts of the proposed development on the identified Aboriginal heritage values of the Project area, the following recommendations are made:

- 1) Woorong Park Pty Ltd should apply to the Director General of OEH for an "all of area" Aboriginal Heritage Impact Permit (AHIP) for the Project area (the 'AHIP area', shown on **Figure 22** in this report). Subject to Woorong Park Pty Ltd's adherence to any associated conditions, issue of this AHIP would allow impacts to all newly and previously identified Aboriginal sites within the Project area.
- 2) Aboriginal sites Woorong Park Residual Rise 1 (45-5-4703), South Creek Alluvial Landscape (45-5-4704) and Little Creek Alluvial Landscape (45-5-4705) have been assessed as being of moderate scientific significance. In order to mitigate the impact of the proposed development on these sites, an archaeological salvage program incorporating manual open area excavation and mechanical soil sampling is recommended for these sites. Salvage activities can only occur after an AHIP has been obtained from OEH and should be completed in accordance with research design and methodology provided in **Appendix D** of AECOM's AAR for this assessment (**Appendix B**).
- 3) Newly and previously identified Aboriginal sites Woorong Park Isolated Artefact 1 (45-5-4702), Woorong Park Isolated Artefact 2 (45-5-4701), Woorong Park Isolated Artefact 3 (45-5-4694), Woorong Park Isolated Artefact 4 (45-5-4695), Woorong Park Isolated Artefact 5 (45-5-4696), Woorong Park Isolated Artefact 6 (45-5-4697), Woorong Park Artefact Scatter 1 (45-5-4698), Woorong Park Artefact Scatter 2 (45-5-4699), WP1 (45-5-4161), WP6 (45-5-4164) and MPP-01 (45-5-4158) have been assessed as being of low scientific significance. No further management or mitigations actions are recommended for these sites.
- 4) In the event that construction activity reveals potential human skeletal material (remains) with the Project area, the Management of Potential Human Remains procedure outlined in **Section 8.1** of this report should be followed.
- 5) In accordance with Requirement 16B of the Code of Practice, all stone artefacts recovered from the Project area as part of the test excavation program detailed in AECOM's AAR (**Appendix B**) should be stored temporarily at AECOM's head office (Level 8, 420 George Street, Sydney) while options for their long term management are being investigated, as determined through consultation with RAPs. Requirement 26 of the Code of Practice provides standard procedures for the deposition of stone artefacts dealt with under AHIPs and the Code of Practice. These procedures should be strictly adhered to.
- 6) Aboriginal Site Impact Recording (ASIR) forms for all AHIMS registered open artefact sites within the Project area should be completed and submitted to the AHIMS registrar as soon as practicable following completion of AHIP-approved archaeological salvage activities.

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Woorong Park Pty Ltd (Woorong Park) to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR) to support an application for an “all of area” Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the *National Parks and Wildlife Act 1974* (NPW Act 1974) for a proposed residential development across residential development across Lots 4, 5, 7, 8 and 9 on DP1078187, Lot 10 on DP1178982 and Lot 1 on DP262886 (part), west of Richmond Road, in Marsden Park, Sydney, NSW (the ‘Project area’) (**Figure 1** and **Figure 2**).

This ACHAR details the results of AECOM’s Aboriginal cultural heritage assessment of land within the Project area and has been compiled in accordance with Section 3.1 of the NSW Office of Environment and Heritage’s (OEH) *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011). It is intended that this report be read in conjunction with AECOM’s Aboriginal Archaeological Report (AAR) for the Project area, which satisfies the requirements of OEH’s *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW, 2010) and is attached as **Appendix B**.

1.1 The Proponent

The proponent for this investigation is Woorong Park Pty Ltd, a registered Australian company (ABN: 51094493428) based in Milsons Point, Sydney, NSW.

1.2 Proposed Development

Woorong Park propose to develop the Project area for residential purposes and have lodged a Development Approval (DA) application with Blacktown City Council for bulk earthworks across the Project area (DA-15-2273) (**Figure 3**). Further DAs relating to the proposed residential development will be submitted in due course. A development plan is shown on **Figure 4**.

1.3 Planning Context and Land Zoning

The Project area for this assessment, shown on **Figure 2**, falls wholly within the Marsden Park Precinct of Sydney’s North West Growth Centre (NWGC), which was rezoned for development on 4 October 2013. Reference to the North West Growth Centre Land Zoning Map indicates that land within the Project area has been zoned for low and medium density residential development (R2 and R3), a local centre (B2), transitional land uses (RU6), public recreation (RE1), environmental conservation (E2) and infrastructure (SP2) ().

1.4 Previous AHIPs

No AHIPs have been previously issued, or applied for, for land within the Project area.

1.5 Statutory Controls

The following statutory controls are of relevance to this Aboriginal cultural heritage assessment:

1.5.1 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (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 Aboriginal habitation of NSW, before or during 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 *National Parks and Wildlife Amendment Regulation 2010* (NPW Regulation), and the demonstration of due diligence.

An Aboriginal Heritage Impact Permit (AHIP) issued under Section 90 of the NPW Act is required if impacts to 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 of the location of Aboriginal sites within a reasonable time, with penalties for non-notification.

1.5.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act), administered by the NSW Department of Planning and Infrastructure (DP&I), requires that consideration be given to environmental impacts as part of the land use planning process in NSW. In NSW, environmental impacts are interpreted as including impacts to Aboriginal and non-Aboriginal cultural heritage.

Development approval for the current development is being sought under Part 4 of the EP&A Act, with Blacktown City Council as the relevant consent authority.

1.5.3 Blacktown Local Environmental Plan (LEP) 1988

The proposed development is located wholly within the Blacktown City LGA, in which the relevant Environmental Planning Instrument (EPI) is the Blacktown Local Environmental Plan (LEP) 1988. Division 3 of the Blacktown LEP provides specific provisions for the protection of heritage items and relics within the Blacktown City LGA, defined in the LEP as follows:

- A *heritage item* means any building, work, archaeological site, tree or place specified in an inventory of heritage items that is available at the office of the council and the site of which is described in Schedule 2.
- A *relic* means:
 - a) any deposit, object or material (which may consist of human remains that is more than 50 years old relating to the use or settlement, not being Aboriginal habitation, of the City of Blacktown and that is a fixture or is wholly or partly within the ground
 - b) any deposit, object or material (which may consist of human remains) of any age relating to Aboriginal habitation of the City of Blacktown.

Under the Blacktown LEP, development consent is required for any of the following:

- a) demolishing or moving a heritage item;
- b) altering a heritage item or relic by making structural or non-structural changes to its exterior, such as to its detail, fabric, finish or appearance;
- c) altering a heritage item by making structural changes to its interior;
- d) moving any relic, or excavating land and discovering, exposing or moving a relic; and
- e) erecting a building on, or subdividing, land on which a heritage item is located.

Schedule 2 of the Blacktown LEP provides a list of heritage items within the Blacktown City LGA. There are no Aboriginal heritage items listed in this schedule that fall within the Project area.

1.5.4 Blacktown City Council Growth Centre Precincts Development Control Plan 2010

The *Blacktown City Council Growth Centre Precincts Development Control Plan 2010* (BCC Growth Centre DCP) provides detailed planning controls for development in the NWGC's Alex Avenue, Riverstone, Marsden Park Industrial, Area 20, Schofields and Marsden Park precincts, with Schedule 6 of the DCP giving effect to the provisions of the BCC Growth Centre DCP for land within the Marsden Park Precinct. The BCC Growth Centre DCP was adopted by the Deputy Director General Strategies and Land Release (or delegate) of the NSW Department of Planning and Environment (DP&E) on 14 May 2010 and came into force on 19 May 2010. Section 2.3.3 of the BCC Growth Centre DCP pertains specifically to Aboriginal and European heritage and contains a

series of development controls for protecting and managing the known and potential Aboriginal and European heritage values of these precincts.

Schedule 6 of the BCC Growth Centre DCP was adopted by the Director General of the NSW Department of Planning and Environment (DP&E) on 4 October 2013. Aboriginal heritage constraints identified within the Marsden Park Industrial Precinct up to 2013 are shown on Figure 3.5 within Schedule 6.

1.6 Assessment Objectives

The overarching objectives of the Aboriginal cultural heritage assessment detailed in this report were as follows:

- to identify the Aboriginal cultural heritage values of the Project area using a combination of background research, archaeological survey and test excavation and Aboriginal community consultation;
- to provide, on the basis of significance and impact assessments, an appropriate management strategy for the identified values of the Project area; and
- to compile an Aboriginal archaeological report that will assist the Director General of OEHS in his/her assessment of an AHIP application for the proposed development.

1.7 Report Structure

This report contains nine sections. This section - **Section 1.0** - has provided background information on the assessment undertaken. The remainder of the report is structured as follows:

- **Section 2.0** provides a description of the Project area;
- **Section 3.0** documents the Aboriginal community consultation process undertaken for this assessment;
- **Section 4.0** summarises relevant archaeological and ethnohistoric information for the Project area;
- **Section 5.0** describes the identified cultural heritage values of Project area;
- **Section 6.0** discusses the proposed activity and its associated impacts;
- **Section 7.0** discusses avoidance and mitigation of harm strategies for identified values;
- **Section 8.9** outlines for the management recommendations for the Project Area; and
- **Section 9.0** lists the references cited in-text.

Details of where to locate the report content stipulated by OEHS in the Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEHS 2011) are provided in **Table 1**.

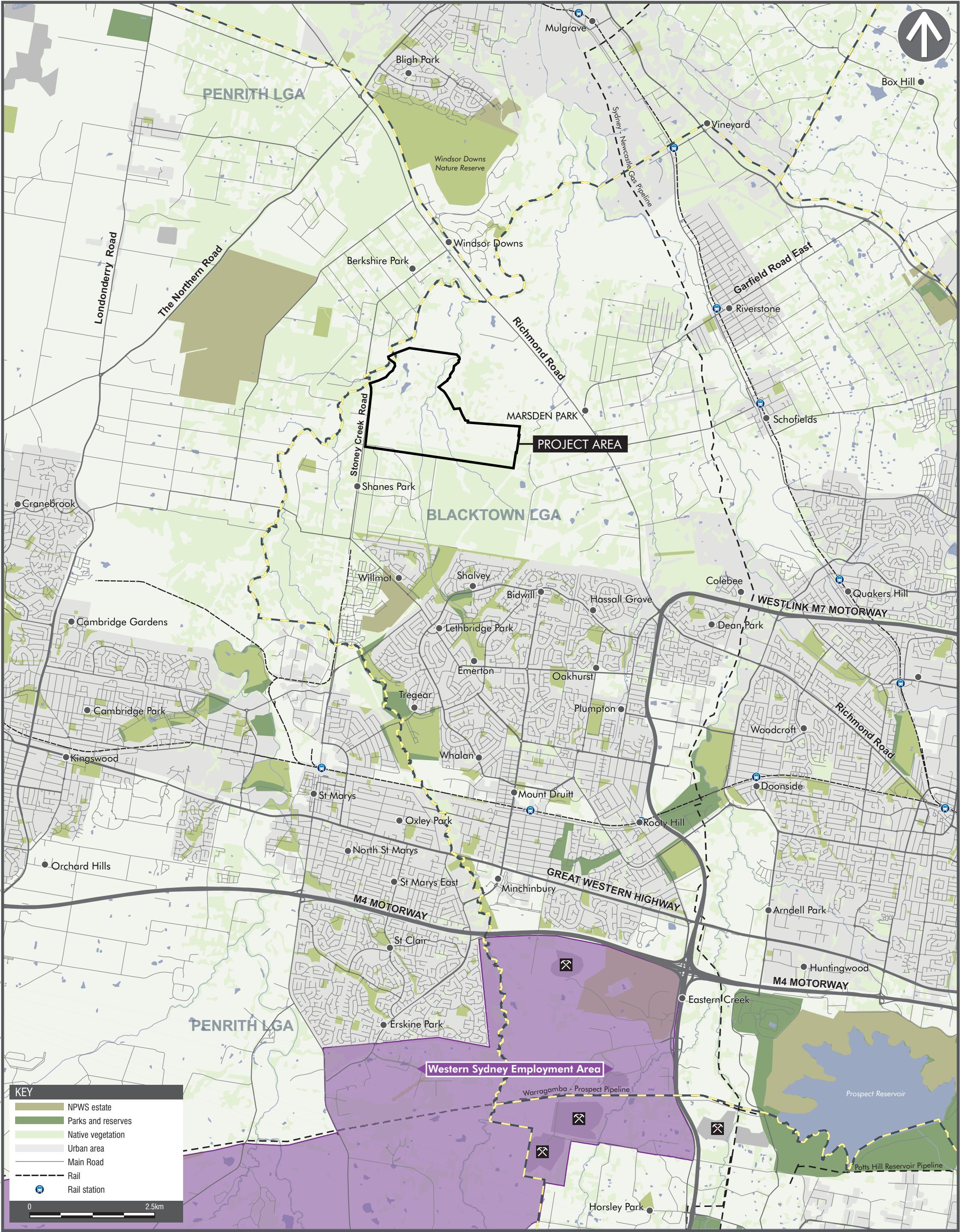
Table 1 OEHS requirements reference table

OEHS Requirement	Refer to
A description of the Aboriginal objects and declared Aboriginal places located within the area of the proposed activity	Section 2.2 and Appendix B
A description of the cultural heritage values, including the significance of the Aboriginal objects and declared Aboriginal places, that exist across the whole area that will be affected by the proposed activity and the significance of these values for the Aboriginal people who have a cultural association with the land	Section 5.0
How the requirements for consultation with Aboriginal people have been met (as specified in clause 80C of the NPW Regulation)	Section 3.0
The views of those Aboriginal people regarding the likely impact of the proposed activity on their cultural heritage (if any submissions have been received as a part of the consultation requirements, the report must include a copy of each submission and your response)	Section 3.0 and Appendix H
Actual or likely harm posed to the Aboriginal objects or declared Aboriginal places from the proposed activity, with reference to the cultural heritage values identified	Section 6.0
Any practical measures that may be taken to protect and conserve those Aboriginal objects or declared Aboriginal places	Section 7.0

OEH Requirement	Refer to
Any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm or, if this is not possible, to manage (minimise) harm	Section 8.0

1.8 Copyright

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AECOM REGIONAL CONTEXT
Aboriginal Cultural Heritage Assessment Report
Lots 4, 5, 7, 8 and 9 DP1078187, Lot 10 DP 1178982 and Lot 1 DP262886 (part)
Marsden Park

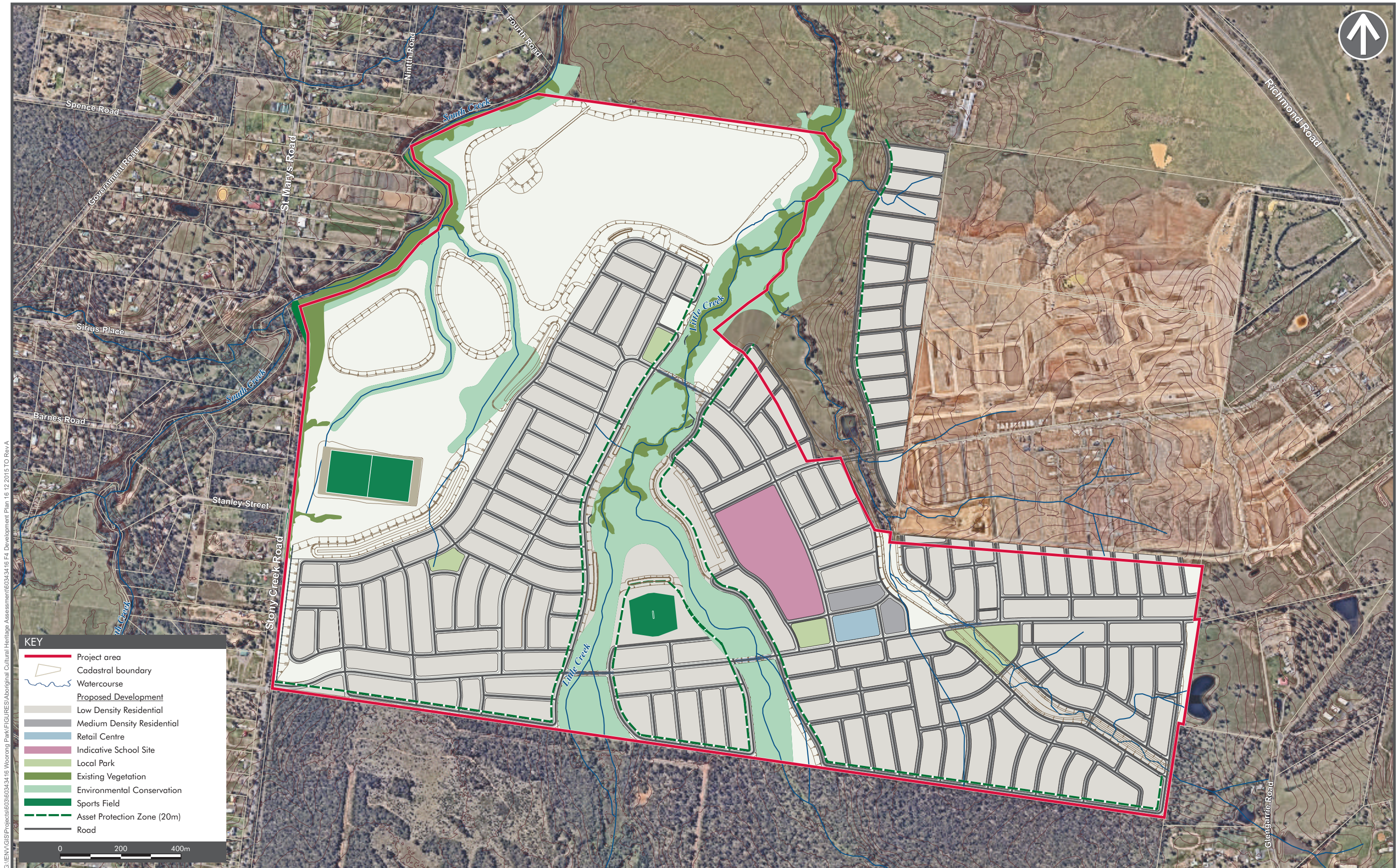
FIGURE 1



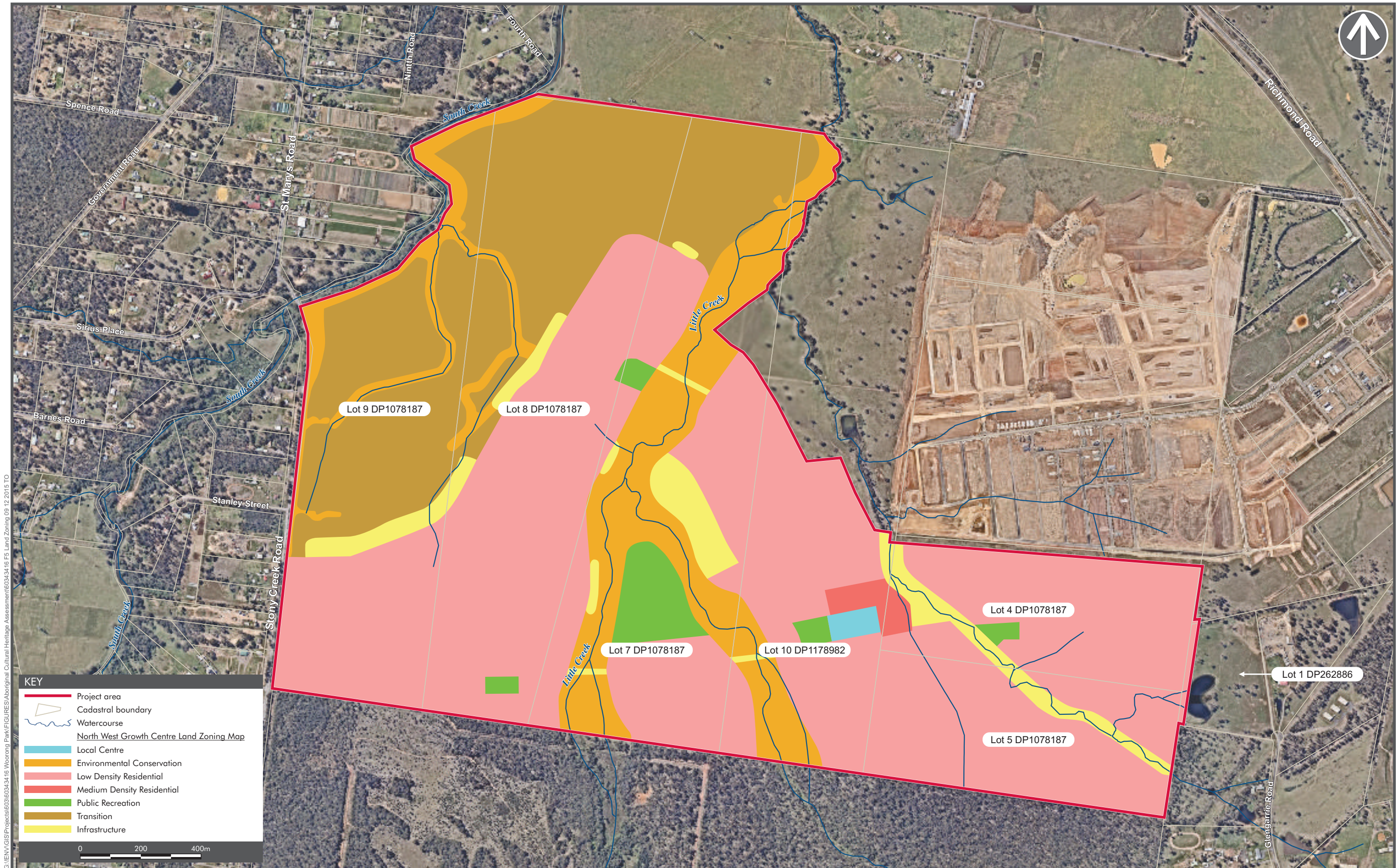
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2.0 Description of the Project Area

2.1 The Project Area

The Project area for this assessment, shown on **Figure 2**, comprises an irregularly-shaped c.419 hectare parcel of land, west of Richmond Road, in the northwestern Sydney suburb of Marsden Park.

Registered as Lots 4, 5, 7, 8 and 9 on DP1078187, Lot 10 on DP1178982 and Lot 1 on DP262886 (part), the Project area makes up a significant proportion (c.23%) of the Marsden Park Precinct of Sydney's NWGC and is bounded by Stoney Creek Road and South Creek in the west, the Llandilo International Transmitting Station site in the south, undeveloped rural land in the north and a combination of undeveloped rural land and Stockland's residential development 'Elara' in the east.

Reference to the NSW Geographical Name Register (GNR) indicates that the Project area is located within Blacktown City Local Government Area (Blacktown LGA) and falls wholly within the Parish of Rooty Hill in the County of Cumberland.

2.2 Previously Recorded Aboriginal Sites

Previously recorded Aboriginal sites within the Project area are listed in **Table 2**, with site locations shown on **Figure 17**. All comprise open artefact sites (i.e., artefact scatters and isolated artefacts) identified during previous archaeological surveys of the Woorong Park property (KNC 2010, 2012). Further information on these sites is provided in **Table 11** in **Section 4.2.1**.

Table 2 Previously recorded Aboriginal sites within Project area

AHIMS Site ID	Site name	AHIMS Centroid Coordinates		Site type	Current AHIMS status	Recorder (Reference)
		MGAE	MGAN			
45-5-4158	MPP-01	296099	6268407	Open artefact site (isolated artefact)	Valid	Kelleher Nightingale Consulting (KNC 2012)
45-5-4159	MPP-02	296245	6268750	Open artefact site (artefact scatter)	Valid	Kelleher Nightingale Consulting (KNC 2012)
45-5-4160	MPP-03	295841	6268870	Open artefact site (artefact scatter)	Valid	Kelleher Nightingale Consulting (KNC 2012)
45-5-4161	WP1	297189	6268648	Open artefact site (artefact scatter)	Valid	Kelleher Nightingale Consulting (KNC 2010)
45-5-4164	WP6	295938	6269646	Open artefact site (artefact scatter)	Valid	Kelleher Nightingale Consulting (KNC 2010)
45-5-4166	WP5	295992	6269259	Open artefact site (artefact scatter)	Valid	Kelleher Nightingale Consulting (KNC 2010)
45-5-4170	MPP-07	295309	6270180	Open artefact site (isolated artefact)	Valid	Kelleher Nightingale Consulting (KNC 2012)

2.3 Review of Environmental Factors

2.3.1 Topography

The topography of the Project area is typical of Bannerman and Hazelton's (2011) Cumberland Lowlands physiographic region and can be broadly described as flat to gently undulating, with level ($\leq 1^\circ$) to very gently inclined ($1-3^\circ$) creek flats (floodplains) in the central, northern, western and eastern portions of the site giving way to low, variably-dissected ridgelines and/or rises. Floodplain topography within the Project's area two main alluvial

valleys (i.e., South Creek and Little Creek) is relatively complex¹, with alluvial landform elements and features in both valleys indicative of geomorphologically dynamic alluvial environments.

As shown on **Figure 2** and **Figure 6**, three low, flat-topped ridgelines dominate the topography of the Project area, with the largest, north-northeasterly trending ridgeline comprising the watershed between South Creek in the west and Little Creek in the east. Reference to Bannerman and Hazelton (2011) and Smith and Clark (1991) indicates that these ridgelines are remnants of an extensive Tertiary gravel terrace (i.e., the Rickabys Creek Gravel) associated with a former course of Nepean-Hawkesbury river system. In the westernmost portion of the Project area, locally prominent residual rises on the South Creek floodplain are likewise interpreted as 'isolated' terrace remnants. Bounded to the east and west by unnamed 1st order drainage depressions, both of which are interpreted as former channel alignments of South Creek, these rises offer good views across the South Creek floodplain. Views from the Project area's major ridgelines are typically even more expansive, with each ridgeline offering multiple vantage points over adjacent alluvial valley floors.

Elevations within the Project area range from 4 to 37 m AHD providing a total local relief of up to 33 m. Elevations are highest in the easternmost portion of the Project area and lowest along South Creek in the westernmost part of the site. Slopes are predominantly very gently to gently inclined (1-10°). Following Speight (2009), a breakdown of the relative representation of morphological landform units within the Project area is provided in **Table 3**. Identified landform units, meanwhile, are shown on **Figure 6**.

Table 3 Morphological landform units within the Project area

Landform unit	Area (ha)	%
Flat	172.3	41.2
Simple slope	121.8	29.1
Crest	77.4	18.5
Intra-slope flat	22.5	5.4
Depression	11.7	2.8
Residual rise	10.6	2.5
Terrace	2.4	0.6
Total	418.7	100

2.3.2 Hydrology

Located within the South Creek sub-catchment of the broader Hawkesbury-Nepean catchment, the Project area contains parts of several, ephemeral to intermittent watercourses ranging in magnitude from 1st to 5th order streams. South Creek, a regionally significant perennial watercourse, flows in part along the western boundary of the Project area (**Plate 1**), with level to very gently inclined terrain in the western and northern portions of the site comprising part of the creek's extensive floodplain. At this point along its course, South Creek comprises a deeply incised 6th order stream. Unnamed 1st order tributaries of South Creek in the westernmost portion of the Project area are interpreted as former channel alignments of this major regional watercourse. South Creek enters the Hawkesbury-Nepean River at Windsor approximately 10 km to the north of the Project area.

Little Creek, an intermittent, northerly-flowing tributary of South Creek, is the primary and only named watercourse within the Project area. Following Strahler (1952), the creek enters the Project area as a 3rd order stream and exits it as a 5th order stream, being fed within the site by two unnamed, north-northwesterly trending tributaries, both of which comprise ≥3rd order streams. Little Creek and its tributaries flow across level (<1°) to very gently (1-3°) inclined alluvial valley floors that are highly flood prone (J.Kennedy, pers. comm. August 2015). Sections of South Creek floodplain within the current Project area are likewise highly flood prone and form part of a much broader, level to gently sloping alluvial valley floor. Terraces along both watercourses within the Project area attest to their vertical and lateral migration over time.

At present, Little Creek and its tributaries can be classified as highly degraded, intermittent watercourses with semi-continuous incised channels. However, field observations (**Plate 4**) and available historical reference

¹ Note that, owing to the scale of pre-fieldwork landform mapping, the 'flat' landform unit shown on Figure 6 incorporates a number of 'micro' alluvial landform elements.

materials for the greater Marsden park area suggest that the pre- and early post-European settlement morphology of these watercourses was likely that of chains of ponds. Chains of ponds, sometimes referred to as swampy meadows, are a hydrologically distinctive form of watercourse, generally found in alluvial valley-floors, that are characterised by a linear series of irregularly-spaced ponds of varying dimensions (Eyles 1977a, 1977b). Once common across the Cumberland Plain, known examples, Little Creek and its tributaries included, are now highly degraded and characterised by continuous or semi-continuous incised channels. As in other landscape contexts (e.g., Dean-Jones & Mitchell 1993; Eyles 1977a, 1977b), transitions from chains of ponds to incised channels across the Plain can be attributed to dramatically increased flow rates associated with intensive, broad-scale native vegetation clearance and the widespread construction of hard surfaces.

2.3.3 Geology

Reference to the 1:100,000 Geological Map Sheet for Penrith (9030) indicates that the surface geology of the Project area is of Tertiary to Quaternary age, with Quaternary alluvium (Qal) blanketing the Project area's alluvial valley floors and Tertiary sediments belonging to the Rickabys Creek Gravel (Tr) and Londonderry Clay (TI) formations mantling its elevated ridgelines and rises (**Figure 8**).

Named after the village of Londonderry, northwest of the Project area, the Londonderry Clay (TI) has been described as "a moderately to highly plastic, relatively impervious clay, composed of poorly crystalline kaolinite, illite, and mixed-layered clay, with associated ferruginous material and a significant proportion of free quartz" (Smith and Clark, 1991: 36). The formation, which overlies the Rickabys Creek Gravel, varies in thickness from one to nine metres and occurs as a relatively continuous sheet between Cranebrook and Windsor. The Rickabys Creek Gravel (Tr), meanwhile, consists of a poorly sorted, polymictic gravel deposit, with rounded to well-rounded, pebble to cobble-sized clasts of quartz, quartzite, silcrete, silicified tuff, porphyry, granite, hornfels and sandstone set within a sandy clay matrix (**Plate 5**). The formation varies in thickness from 2 to 12 m and occurs extensively across the northwestern portion of the Cumberland Plain (including its interface with the Blue Mountains Plateau), both as high-level terraces along contemporary creek systems (e.g., South, Rickabys and Mulgoa Creeks) and as isolated remnants (Smith and Clark, 1991: 32).

Together with available geological mapping (**Figure 8**), field observations indicate the presence of extensive surface and subsurface deposits of Rickabys Creek Gravels within the current Project area, with intercepted near-surface examples of the latter (**Plate 8**) interpreted as reworked expressions of the formation as opposed to *in situ* deposits. Observed surface deposits are widely distributed across the site, with aerially extensive deposits of loose polymictic gravels occurring on the Project area's three flat-topped ridgelines (**Plate 6**). Gravels derived from the formation are also present in the bedloads of the Little Creek and its major tributaries (**Plate 7**). While linked to extant surface geology, it should be noted that the contemporary distribution of surface deposits of Rickabys Creek Gravels across the Project area likely bears little resemblance to that in pre- and early post-European settlement times, with most, if not all, of the surface deposits visible today exposed by erosion precipitated by historical native vegetation clearance². Knappable rock types observed in surface and near surface deposits of Rickabys Creek Gravels within the Project area include quartzite, quartz, silicified tuff, FGS, petrified wood and silcrete, as well as various fine-grained volcanics (A.McLaren, pers. obs., July-August 2015).

Outside of the Project area, other locally-occurring geological formations/phenomena of demonstrated or potential Aboriginal archaeological significance include the Tertiary St Marys (Ts) formation and volcanic diatremes (Jv) of Cretaceous to Jurassic antiquity. Alluvial in origin, the St Marys formation consists of channel remnants cut into shales of the Triassic Wianamatta Group, and contains, amongst other rocks, abundant quantities of silcrete, as well as silicified wood, quartzite and quartz (Corkill 1999: 56). Recorded deposits, which occur on ridge flanks and crests across the northern Cumberland Plain, vary in thickness from approximately 1 to 10 metres (Smith and Clark, 1991: 30). Silcrete from the St Marys formation is typically light red or yellowish brown in colour, with a bleached weathering rind, and occurs in the form of complete and fragmentary³ pebbles, cobbles and boulders (Byrnes 1982; Corkill 1999; Jo McDonald CHM 2006b). Recent research by Doelman et al. (2015) indicates significant intra- and inter-exposure variation in the knapping quality of silcrete clasts derived from the St Marys formation, with variability tied to differences in grain-size, degree of silicification, the presence of internal inclusions/fractures, and the influence of bushfires.

In terms of geographic extent, the St Marys formation has been mapped at various localities in the Mulgoa, South and Eastern Creek catchments, with archaeologically significant deposits occurring along the upper parts of Plumpton Ridge between Bells and Eastern Creeks, c.4 km southwest of the current Project area (AMBS 2002;

² The absence of any observed evidence of stone quarrying within the Project area provides further support for this proposition.

³ Broken by heat (i.e., bushfires)

Dallas 1983; Jo McDonald CHM 2006b). However, in common with the Rickabys Creek Gravel, the formation is known to be more widely distributed than currently mapped. Observations of the distribution of silcrete pebbles/cobbles and associated ironstone fragments on and adjacent to Plumpton Ridge, for example, have indicated a formation width three to four times that depicted on the Penrith 1:100 000 Geological Map (Mitchell 2002, 2005). Attention is also drawn to the identification in various archaeological contexts (e.g., AECOM 2012; Biosis 2010; Austral Archaeology 2005) of natural silcrete gravels on the floodplains of Bells and Eastern Creeks, a phenomenon suggestive of colluvial and/or fluvial transportation of silcrete clasts from the St Marys formation⁴. These observations notwithstanding, on the basis available stratigraphic data and field observations, there are no *in situ* or reworked deposits of St Marys formation gravels present within the current Project area.

Existing archaeological and geological data for the greater Marsden Park area preclude detailed comment on the utility, in terms of raw material availability (*sensu* Andrefsky 1994), of the volcanic diatremes that occur in this area. Silcrete and other knappable rock types are known to occur in the vicinity of such features, having been brought to the surface from intruded strata below (Corkill 1999: 55). However, the presence of flakeable rocks in these specific instances cannot be confirmed. As for the diatremes themselves, Attenbrow's (2010: 44) observation that many of the volcanic diatremes, dykes and intrusions present within the Sydney region are deeply weathered and contain rock that would not have been suitable for making edge-ground hatchet heads, may be applicable. In the absence of specific geological and/or archaeological observations, however, this remains unclear.

2.3.4 Soils and Geomorphology

Soils within the Project area have been mapped as belonging to the South Creek (sc) and Berkshire Park (bp) soil landscapes, with the former corresponding broadly to the mapped distribution of Quaternary alluvium within the site and the latter, to that of Tertiary sediments associated with the Rickabys Creek Gravel and Londonderry Clay formations.

Soils of the Berkshire Park Soil Landscape are the result of three depositional phases of Tertiary alluvial/colluvial origin⁵ and have been characterised by Bannerman and Hazelton (2011) as weakly pedal orange heavy clays and clayey sands. Dominant A-horizon soils comprise sandy loams to sandy clay loams with pH levels ranging from neutral (pH 7.0) to moderately acidic (pH 5.5) (Bannerman and Hazelton, 2011: 27). Subsoil units include a light to heavy clay (bp4) with up to 90% stones, which corresponds to the Rickabys Creek Gravel (Tr) and St Marys (Ts) formations described by Smith and Clark (1991).

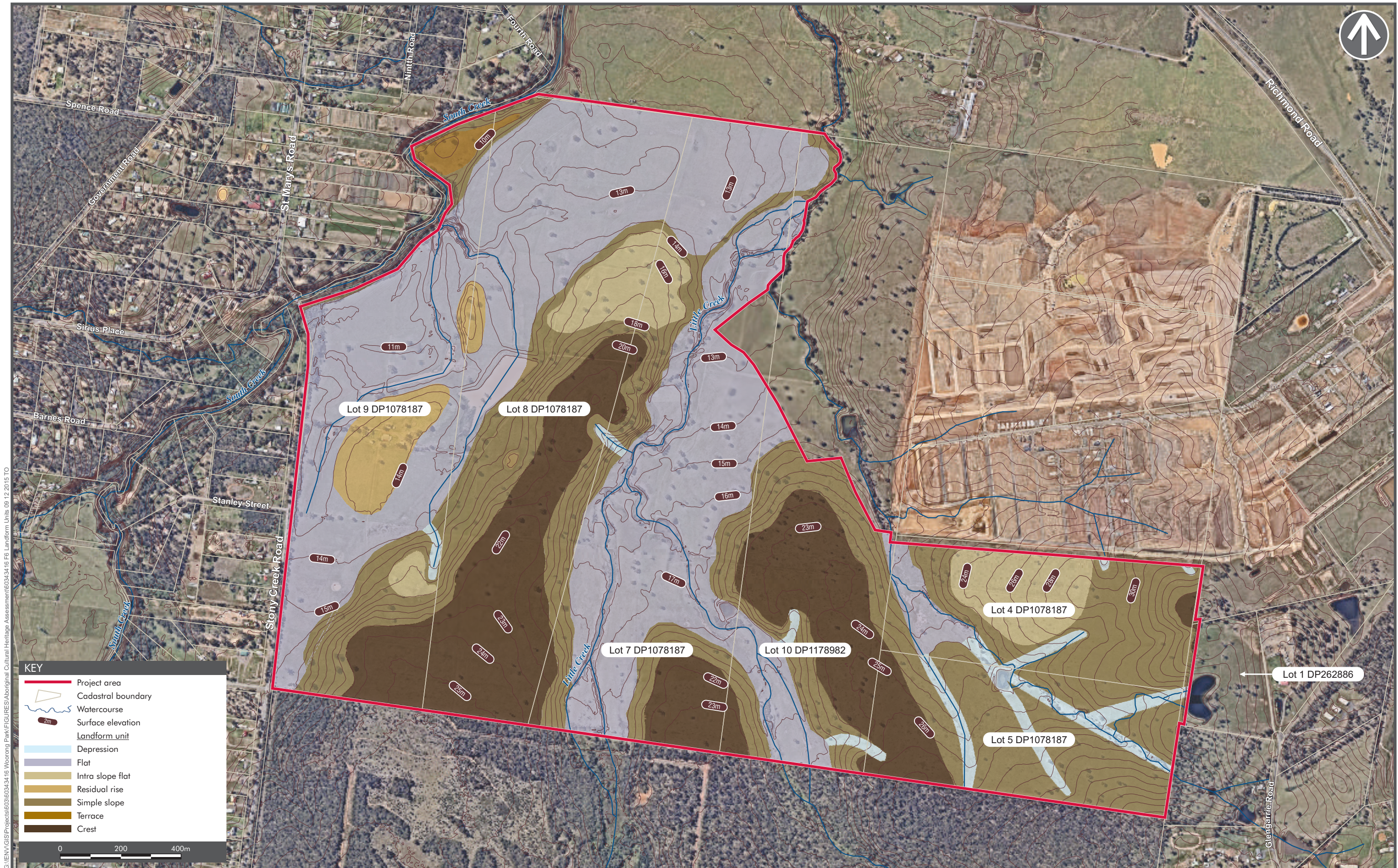
Soils of the South Creek landscape comprise alluvium over residual clays or bedrock. Deep layered profiles are a common feature of this fluvial landscape. Where pedogenesis has occurred, structured plastic clays or loams occur within and immediately adjacent to drainage lines. Red and yellow podzolic soils, meanwhile, are typical for associated terraces. Dominant A-horizon soils comprise sandy/clay loams with pH levels ranging from neutral (pH 7.0) to strongly acidic (pH 4.5).

As in other Cumberland Plain contexts, existing archaeological, environmental and historical reference materials for the Project area suggest that a range of geomorphic processes are likely to have affected the Aboriginal archaeological record of the site. Potentially significant phenomena from an archaeological perspective include bioturbation, erosion and alluvial/colluvial aggradation. Possible effects of these processes include:

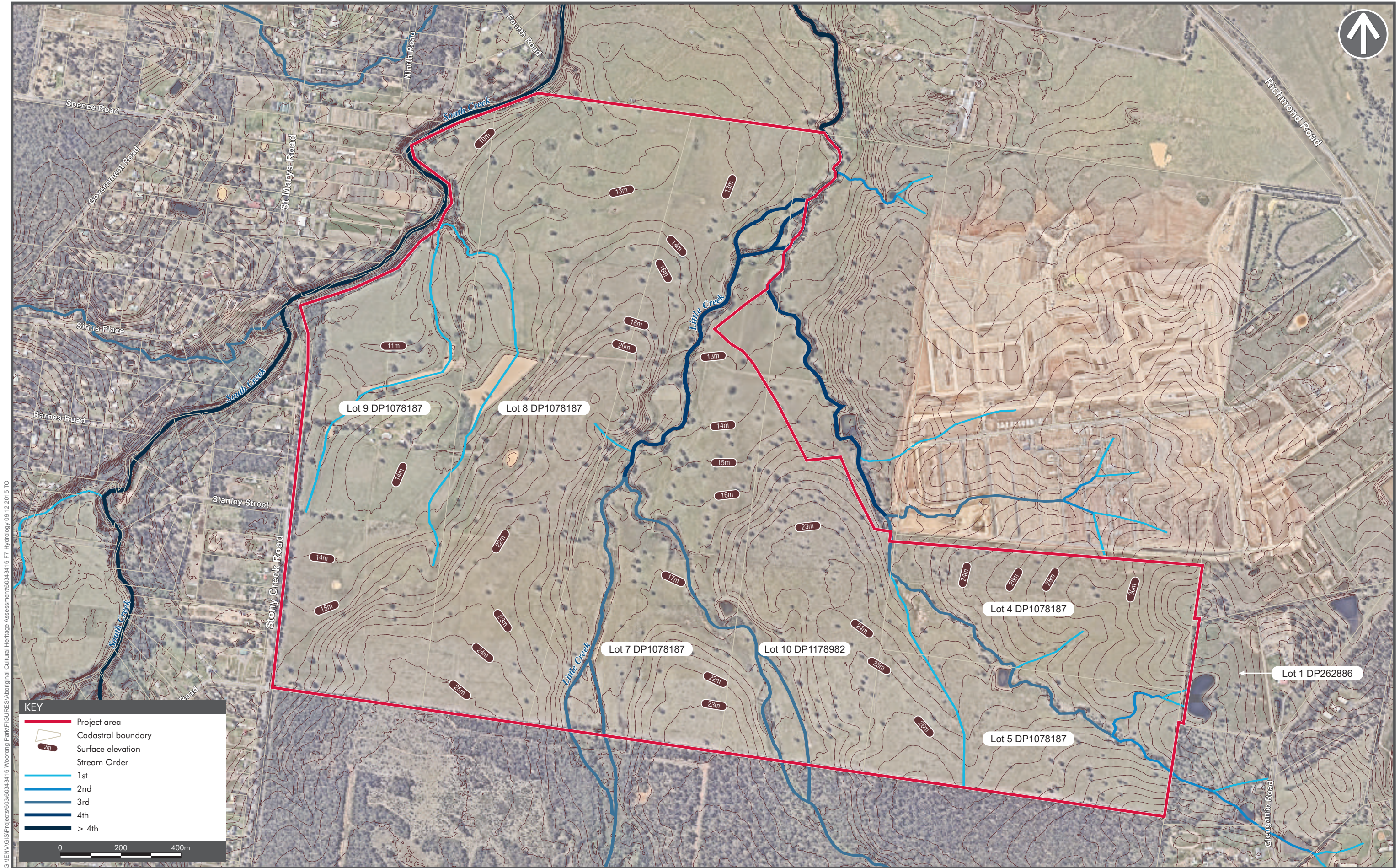
- Increased archaeological site visibility in eroded areas;
- Reduced archaeological site visibility in areas of sediment deposition;
- Horizontal and vertical translocation of artefacts;
- Stratigraphic mixing;
- Truncation of archaeological deposits; and
- Creation of thicker and potentially stratified archaeological deposits in floodplain and slope base contexts.

⁴ It is acknowledged that silcrete found in areas outside of those mapped geologically as St Marys formation may derive from other formations (e.g., Rickabys Creek Gravel).

⁵ I.e., the St Marys (Ts), Rickabys Creek Gravel (Tr) and Londonderry Clay (TI) formations



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Plate 1 View across part of South Creek adjacent to the Project area. At this point along its course, South Creek comprises a deeply incised, 6th order stream (GML 2013: 12) (Source: AECOM 2015).



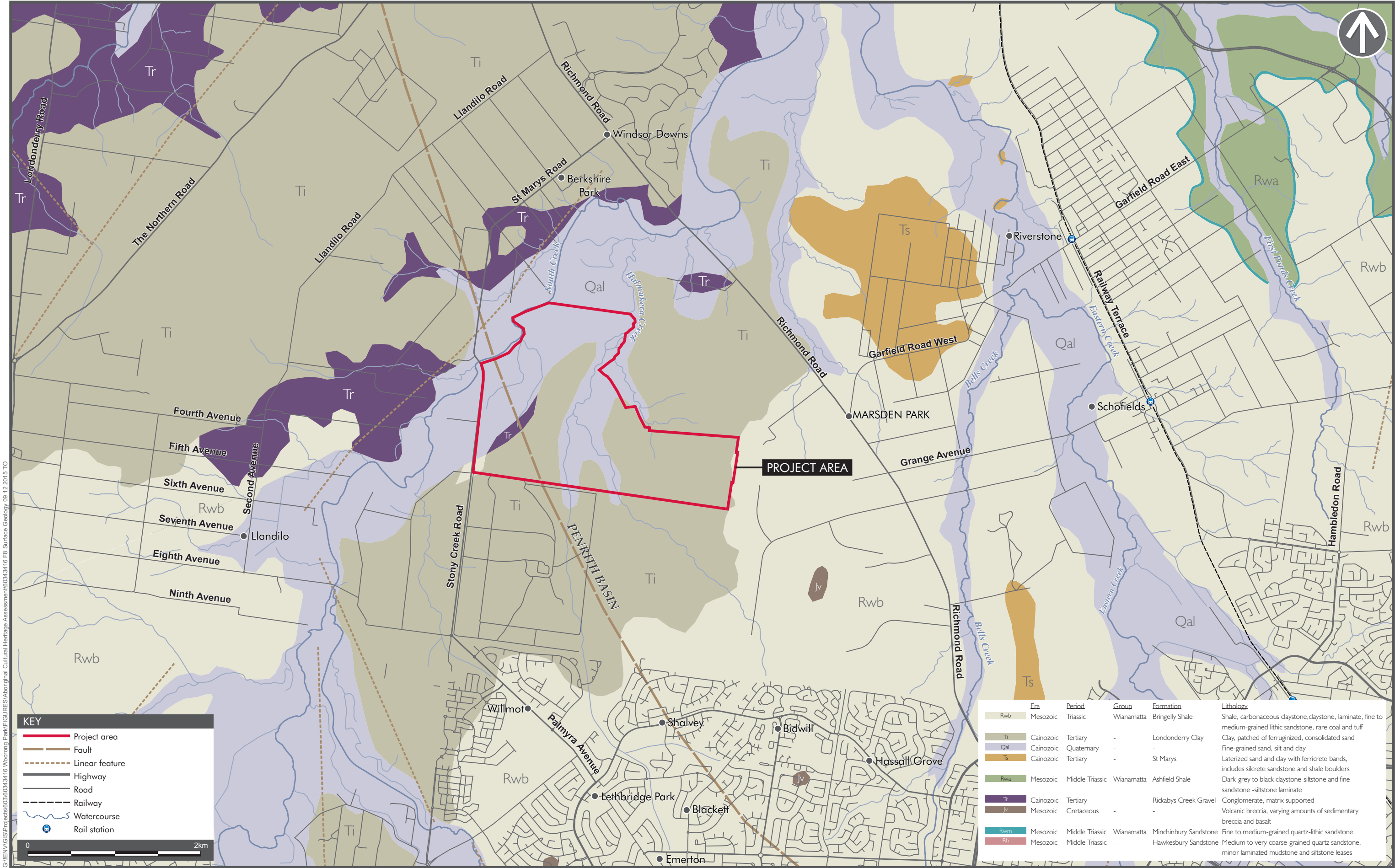
Plate 2 View across incised 3rd order reach of Little Creek in south-central portion of the Project area. Note presence of Rickabys Creek Gravels in bedload (Source: AECOM 2015).



Plate 3 View across incised, 2nd order reach of easternmost tributary of Little Creek (Source: AECOM 2015).



Plate 4 Sectional view of infilled pond observed along easternmost tributary of Little Creek. Capped by up to 30 cm of post-European material (PEM), the pond has a maximum width of 2.5 m and maximum depth of 0.6m (Source: AECOM 2015).



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Plate 5 Sectional view of *in-situ* deposit of Rickabys Creek Gravel in South Creek road cutting adjacent to Project area. The formation here has a maximum thickness of c.2.3 m (Source: AECOM 2015).



Plate 6 Surface deposit of Rickabys Creek Gravels on the largest of the Project's area three flat-topped ridgelines (Source: AECOM 2015).



Plate 7 Rickabys Creek Gravels in bedload of Little Creek in north-central portion of Project area (Source: AECOM 2015).



Plate 8 Stockpiled Rickabys Creek Gravels recovered from TP#11 expansion excavation on residual rise in westernmost portion of the Project area (Source: AECOM 2015).