

**Shanes Park and West Schofields
Precincts: North West Growth Centre**

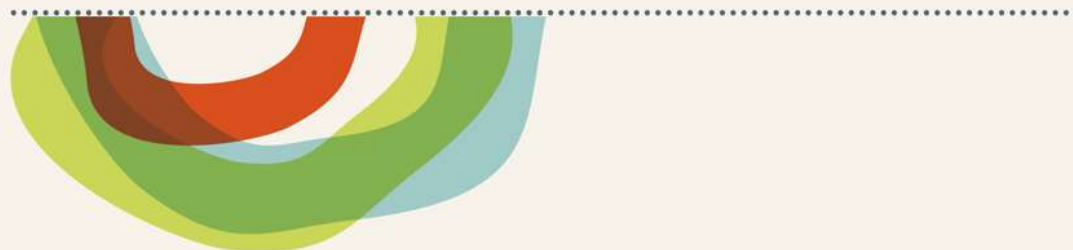
**Aboriginal and Historic Heritage
Report: Gap Analysis and Future
Direction**

**Final Department of Planning &
Environment**

2 June 2015



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ABBREVIATIONS

ACHA	Aboriginal Cultural Heritage Assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AHMS	Archaeological and Heritage Management Solutions
BP	Before present (AD 1950)
CHL	Commonwealth Heritage List
CRM	Cultural Resource Management
DCP	Development Control Plan
DECCW	Department of Environment, Climate Change and Water (now OEH)
DP	Deposited Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERS	Eastern Regional Sequence
ka	Abbreviation for thousands of years ago (e.g. 1 ka equals 1,000 years ago)
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
LTO	Land Titles Office
NHL	National Heritage List
NPW Act	National Parks and Wildlife Act 1974
OEH	Office of Environment and Heritage (formerly DECCW)
PAD	Potential Archaeological Deposit
RAP	Registered Aboriginal party
REP	Regional Environmental Plan
RNE	Register of the National Estate
SEPP	State Environment Planning Policy
SHR	State Heritage Register
SHI	State Heritage Inventory
WHL	World Heritage List

Executive Summary

A *Plan for Growing Sydney* requires that the NSW Government delivers timely and well planned greenfield precincts and housing (Action 2.4.1). In response to this action, the Department of Planning & Environment (DPE) is updating the structure plan for the North West Growth Centre to realise the full potential of investment in new infrastructure.

As part of this project, Archaeological and Heritage Management Solutions Pty Ltd (AHMS) has been commissioned by the DPE to undertake an Aboriginal and Historic Heritage Gap Analysis of the two remaining unreleased North West Growth Centre (NWGC) precincts: Shanes Park and West Schofields. This is the first step in characterising the cultural heritage values of the area and identifying any further investigation required. This analysis is undertaken, in part, in response to a recent review of DPE's Aboriginal heritage processes (AHMS, 2013a), which recommended that an over-arching consideration of cultural and archaeological values for the Growth Centres be undertaken, rather than the adoption of a piecemeal approach. This gap analysis uses the same methodology as that being employed for the concurrent gap analyses being carried out for the South-west Growth Centre and the Greater Macarthur Investigation Area. This is the first attempt to develop a regional study to highlight the cultural heritage knowns and unknowns for these precincts.

This report aims to:

- a) To compile and review of existing documentation and listing for Aboriginal and historic heritage within the NWGC.
- b) To identify areas where previous assessment has been minimal or lacking.
- c) To identify areas of key Aboriginal cultural heritage and historical cultural heritage interest and/or significance.
- d) To propose future priorities for subsequent investigation to assist in the progression of the Shanes Park and West Schofields precincts in the development of the NWGC.

Key Findings

- The preliminary history included here details the early agricultural expansion outside the early colony of Sydney, as well as the associated infrastructure required to support this agricultural expansion. The agricultural/pastoral landuse of the area changed through the 19th century, with the inclusion of industry that supported the burgeoning colony as the population grew. However, the rural nature of the landscape was largely maintained until the post-WWII period when the area was increasingly settled, although, even with this expansion the rural to semi-rural nature of the landscape was largely maintained until the present time.
- There are no listings on the World Heritage List, National Heritage List or Commonwealth Heritage List (CHL) within the two precincts. However, two sites are listed on the CHL immediately east of Shane Park precinct, namely the Llandilo International Transmitting Station and the Shale Woodland Llandilo. The State Heritage Register, Register of National Estate, Stage Heritage Inventory and National Trust listings for the region reflect the rural environment. The listings, while not in the study areas themselves, relate to large and small scale agricultural/pastoral establishments.
- While there are no listed historic sites within the two precincts, this appears to be the product of 'an absence of investigation' rather than an absence of sites.

- In regard to the West Schofields Precinct, a brief examination of the data presented by the listings has indicated that there are a number of localities that are worthy of further assessment. These include:
 - The site of 'Wilmington'- a large estate associated with the Marsden and Betts families.
 - The site of an important early nineteenth century horse stud.
 - Several small cottages dating between 1815 and 1840
- In regard to the Shanes's Park Precinct, there is again an absence of listed sites despite the fact that this parcel of land formed part of one of the earliest land grants in the region – John Harris' 'Shane's Park' Estate.
- Environmentally, the two study areas are characterised by the Cumberland Plain subregion and from an Aboriginal heritage perspective are archaeologically similar to the surrounding North West, and South West Growth Centres. The precincts have several key waterways, including South Creek, Ropes Creek, Eastern Creek, and Bells Creek, and therefore have potential for significant cultural sites along these, similar to those found elsewhere along Second Ponds Creek and the Hawkesbury River. Recent work by AHMS in the Schofields Dairy Corporation site, and the Colebee release area, suggest the banks of Eastern Creek contain extensive cultural material (including sites with tens of thousands of stone tools) and are some of the most important deposits currently known in the Cumberland Plain.
- Two other areas of key importance were also identified in relation to Aboriginal heritage, Plumpton Ridge and a possible pre-contact Aboriginal cemetery. Plumpton Ridge is a well-referenced, raw material resource used by Aboriginal people over the last few thousand years (and possibly longer) for stone tool production. In other studies, it has been considered of both high cultural and scientific significance. It is the likely source of the vast majority of Aboriginal stone tools found across the Cumberland Plain. Its general extent is poorly understood, but it probably runs along the centre of the West Schofields precinct, and has been impacted in several areas to the south of the precinct by extractive industries. Despite its importance, no accessible data was available for this report that documents the full extent of this site in detail. The Aboriginal cemetery is not documented in the AHIMS database, but is shown in several early historical maps as being situated in the vicinity of Angus, Kerry and Durham Streets (in the eastern central part of the West Schofields precinct). Such a site if it remains intact would be of exceptional cultural and scientific significance.
- Currently, 36 Aboriginal objects/sites have been documented in the vicinity of the Shanes Park and West Schofields precincts. Known sites are clustered consistent with the limited compliance-based archaeological investigations that have occurred, but their distribution also suggests some other patterns. Specifically, the Cumberland Plain subregion, encompassing much of the study area, is dominated by surface and sub-surface artefactual material generally found within 200m of the larger river systems within the region. Distances of sites up to 500m away are documented, but remain relatively sparse.
- Based on a limited review of heritage studies, and the archaeological predictive modelling, there is high potential for Aboriginal objects/sites to occur along the banks of South Creek, Ropes Creek, Eastern Creek, and Bells Creek. There is also some limited potential for culturally modified (scarred) trees to be present in areas with remnant native vegetation.

- Aboriginal consultation has been undertaken, including a series of cultural mapping workshops with a selection of stakeholders. Seven areas of cultural value were identified within, or in close proximity to the two precincts, as well as general areas considered to have a prevalence of cultural material. The seven areas included burial sites, a birthing site, a waterhole and a conservation area dedicated to prominent Aboriginal figure, Maria Locke. A number of other areas of potential significance were identified in West Schofields, mainly in the southwest associated with Plumpton Ridge, but also in vegetated (undisturbed) locations throughout the precincts. South Creek running along the boundary of the Shanes Park precinct was also highlighted as an area with high potential for cultural material.

Key Constraints

- A CHL-listed site, the Llandilo International Transmitting Station, was located adjacent the eastern edge of Shane's Park precinct. While the site is not within the precinct, there may be constraints associated with viewsheds or encroachment onto the site's buffer. Such constraints are likely to be very low. The core of the Llandilo International Transmitting Station is obscured by two broad buffers of re-growth. There are no significant view lines from the facility or to the facility. The Llandilo International Transmitting Station site has some heritage significance associated with the post-1959 operation of this important telecommunications facility. These values rest with the core building complex and mast. The current listings are mainly in regard to the woodland and eco-system that has developed as a result of the reduced operation of the facility.
- The potential historic archaeological resource is generally poorly understood. Areas of this region were settled from an early period and the potential for early settlement sites must remain high. These sites are often of high significance and can impose significant constraints to any development in this vicinity.
- From an Aboriginal heritage perspective, areas within 200m of any waterway are likely to contain extensive and/or significant cultural material. This is especially the case along the Eastern Creek, Bells Creek and South Creek. Recent finds along the banks of Eastern Creek at Colebee release area and within the Schofields Dairy Corporation have recovered some of the most extensive and significant archaeological sites in the Cumberland Plain; and any development encroaching into these areas (e.g water infrastructure works), are likely to have a high impact on cultural heritage values and be subject to extensive and costly sub-surface archaeological works.
- Historical records have revealed a potential pre-contact Aboriginal cemetery ('Burial ground of the Blacks') on the western portion of Joseph Pye's 'Waaraa Warara' Estate in the vicinity of Durham, Angus and Kerry Roads, between Bells Creek and Eastern Creek. Specific information on this site could not be obtained for this report, but if present this site would be of exceptional cultural and scientific significance. It is considered unlikely that any development in the vicinity of the site would be feasible, and a large buffer would likely be required. The identification of this site is a critical issue to any future planning of the West Schofields precinct.
- A well-known, silcrete raw material source - Plumpton Ridge - is located within the West Schofields precinct. Based on existing data, the source is primarily situated in the southern parts of the precinct, but silcrete is found throughout the region, and it is likely to be more widespread across the precinct. This site is considered likely one of the main resources used by Aboriginal people for tool production in the last few thousand years, and is considered of

high cultural and scientific value. This is made all the more so by a number of high-profile legal cases exploring the site in the 1990s. Any development in these areas would likely be subject to extensive and costly archaeological programs, with the need for extensive conservation a probable outcome. The extent of the silcrete ridge requires detailed mapping and documentation.

Areas where research has yet to occur

- Due to the limited timeframe available for this study the review of historic heritage reports while thorough is not regarded as exhaustive and further information may emerge as investigation of these precincts progresses. This will be built on in subsequent stages of this project.
- Blacktown LGA has been subject to a Heritage Study (1988) and an Aboriginal Archaeological study of Aboriginal sites (1986), and subsequent reviews. These have provided opportunities for Council, planners and selected consultants to survey, review and assess the heritage significance of items in the LGA. The Heritage Study review has provided the opportunity to rationalise the listings for the LGA through removal of demolished structures or duplications of listing. It establishes and highlights local historic themes relevant to each LGA. However the Heritage Study, while addressing the built heritage aspects of the LGA, does not adequately address the archaeological sensitivity of their respective areas. Some archaeological sites are noted in the Draft LEP (2013) but none, specifically, in the Shanes Park and West Schofields precincts. The assessment of these sites extends beyond the scope of the Gap Analysis but they suggest that a more detailed analysis would determine accurate locations, significance and potential survival of archaeological remains that would be covered by the heritage Act 1977. An Archaeological Zoning Plan should, therefore, be completed for the Shanes Park and West Schofields precincts in a similar manner and scale to the Parramatta Historical Archaeological Landscape Management Survey (PHALMS <http://sydney.edu.au/arts/timemap/examples/PHALMS.shtml>). An AZP would provide a greater degree of certainty in regard to development options. The AZP recommendations may range from in situ conservation of sites (excluding particular locations from development completely), to archaeological management and mitigation that may include formal excavation, monitoring, salvage or archaeological testing. The AZP would also define curtilages associated with potential sites.
- The gap analysis has indicated (in regard to historical heritage) that further, detailed analysis of the sites identified by this study would help determine the appropriate management strategy for these locations. Possibly the largest 'gap' for both precincts is the absence of data gathered through detailed investigation of the precincts.
- A selection of Aboriginal heritage assessments was reviewed as part of this study. This will be supplemented in later stages of the project, as further documentation becomes available.
- Previous Aboriginal heritage assessments within the Shanes Park and West Schofields precincts have been limited. The majority of studies have been focussed towards the south of the West Schofields precinct and/or have been for small scale development proposals and therefore reflect only isolated patches of on-site assessment. Further, most of the assessments are quite dated (often written pre-AD2000) and do not conform to current guidelines. It is considered that more detailed investigation for both precincts but especially, the West Schofields Precinct, would be essential prior to any form of development planning.

- Sections of the study area have yet to undergo any Aboriginal heritage investigation, including most of the Shanes Park precinct, and the northern part of the West Schofields precinct. Parts of these areas, particularly in the north of West Schofields, are considered likely or very likely to contain highly significant Aboriginal sites.

Conclusions

Based on the review undertaken it is clear that there has only been limited Aboriginal and historic heritage investigation in the Shanes Park and West Schofields precincts to date. Many of the reports do not conform to current guidelines. It is therefore likely that any future planning and development would need to incorporate heritage investigation from a very early stage.

In relation to areas of key constraint, they are highlighted in **Section 5.2**. In brief, the two precincts are similar in environment and landscape to the wider Cumberland Plain within which the overall North West and South West Growth Centres are currently situated. It is considered likely that the heritage concerns previously identified in those areas would be similar in these precincts. Specifically, it is likely that extensive and/or significant Aboriginal sites would be prevalent along the large river systems and their riparian corridors throughout the precincts. Based on modelling, key areas occur along Eastern Creek and Bells Creek especially. The review suggests that significant development constraints may be present across the West Schofields precinct, with the presence of a known culturally and scientifically important raw material resource (Plumpton Ridge), and the historical reference to a pre-contact Aboriginal cemetery in the eastern quadrant of the precinct and these two issues require early investigation to understand what, if any, constraints they pose. Recent discoveries along the Eastern Creek demonstrate that this corridor contains some of the most significant archaeological deposits in the Cumberland Plain, and extensive archaeological programs, along with conservation, would likely be required for any form of development in these areas.

Notwithstanding the above constraints and limitations, it appears likely that areas free of, or with minimal, cultural heritage constraints would be developable across much of the Shanes Park precinct, and parts of West Schofields precinct.

The report also includes direction for future studies to allow the successful development of the precincts, and provides discussion around the approval process and current issues with Aboriginal Heritage Impact Permits.

It should be noted that the following tasks are yet to be completed to the level required to adequately address cultural heritage concerns.

- Consultation with the Aboriginal community should be maintained and opportunities provided to build on the cultural values layer.
- Areas which have been identified by the Aboriginal community should form the focus of subsequent research to ensure they are managed appropriately in any future development context.
- The review here was necessarily brief due to project timeframes, but has highlighted the lack of up-to-date or comprehensive assessments for any part of the precincts. Further investigation of previous studies and databases, and the development of new assessments should be undertaken on individual locations or precincts when they are proposed for planning and development.

- Several key constraints have been identified, and this report provides future direction on their management in **Section 5.2**. These tasks should be implemented at least 6-12 months prior to the overall re-zoning program for the precincts.
- Several Section 170 registers could not be accessed as part of this gap analysis. DPE should contact the respective State Government agencies and request their data to assist future planning and development. If these become available these can be integrated into the project mapping during later phases of this project.
- Broader regional archaeological studies and research frameworks should be completed to assess and manage the archaeological statutory requirements of the two precincts.

1 INTRODUCTION

1.1 Background and Purpose

A *Plan for Growing Sydney* requires that the NSW Government delivers timely and well planned greenfield precincts and housing (Action 2.4.1). In response to this action, the Department of Planning & Environment (DPE) is updating the structure plan for the North West Growth Centre to realise the full potential of investment in new infrastructure.

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This report aims to:

- To compile and review of existing documentation and listing for Aboriginal and historic heritage within the Shanes Park and West Schofields precincts of the NWGC.
- To identify areas where previous assessment has been minimal or lacking.
- To identify areas of key Aboriginal and historical interest and/or significance.
- To proposed future priorities for subsequent investigation to assist in the progression of the precinct planning process.

Due to the short timeframes of the project, and constraints with the accessibility of data, this report has not undertaken a complete review of all literature available for the study area. Rather, it reviews key assessments and reports to determine the 'hot spots' of Aboriginal and historic value, and any obvious gaps in the information, which are then recommended for further, more detailed investigation.

1.2 Study Area

The North West Growth Centre (NWGC) covers an area of c.100km² within The Hills, Blacktown and Hawkesbury Local Government Areas (LGAs), approximately 30km west of Sydney. The two precincts under investigation as part of this study are Shanes Park and West Schofields, in Blacktown LGA (**Figure 1**).

1.3 Project Methodology

To achieve the objectives outlined above, the methodology consisted of:

- Reviewing a selection of Aboriginal and historical reports for the region to determine the general archaeological patterns for these two precincts in the NWGC.
- Reviewing existing Aboriginal and historical databases and listing to identify previously recorded and documented items and sites within the NWGC. These include: World Heritage

List, Commonwealth Heritage List, National Heritage List, State Heritage Register, Local Environmental Plan heritage schedules for the Blacktown Local Government Areas (LGA), State Government Agency Section 170 Heritage and Conservation Registers, State Heritage Inventory, Register of the National Trust of Australia (NSW), Register of the National Estate, Office of Environment and Heritage's Aboriginal Heritage Information Management System (AHIMS), AHMS Mapping Greater Sydney's Aboriginal Past dataset and OEH Aboriginal Sites Decision Support Tool (ASDST) GIS dataset.

- Mapping the extent of previous heritage studies across the NWGC to identify where areas have been intensely investigated versus those that have not.
- Developing an archaeological model using environmental data and known cultural heritage sites to 'predict' where significant Aboriginal objects and/or sites may be present.
- Preliminary cultural mapping workshops with Aboriginal people to identify any areas of particular significance to the Aboriginal community

1.4 Limitations

This report is based on existing and publicly available environmental, archaeological and historical information and reports about the subject area. The background research did not include any independent verification of the results and interpretations of externally sourced existing reports.

Information from the Aboriginal Heritage Information Management System (AHIMS) was provided to AHMS by OEH. Information in the assessment reflects the scope and the accuracy of the AHIMS site data, which in some instances is limited.

Aboriginal stakeholder consultation while included in the overall project, is not incorporated in this report. The outcomes of preliminary cultural mapping are still pending. This means that in the current document may present an under-representation of cultural sites and/or values associated with the Shanes Park and West Schofields precincts. The outcome of the Aboriginal consultation should be integrated into the final assessment report.

1.5 Authorship

This report was written by Alan Williams, (MAACAI) and Graham Wilson, Senior Heritage Advisors and Ngaire Richards, Heritage Advisor. The consideration of the Aboriginal heritage approval process (**section 6.3**) was developed with Katie O'Rourke. Further input and review has been provided by Fenella Atkinson, Senior Heritage Advisor and Susan McIntyre-Tamwoy (Associate Director).

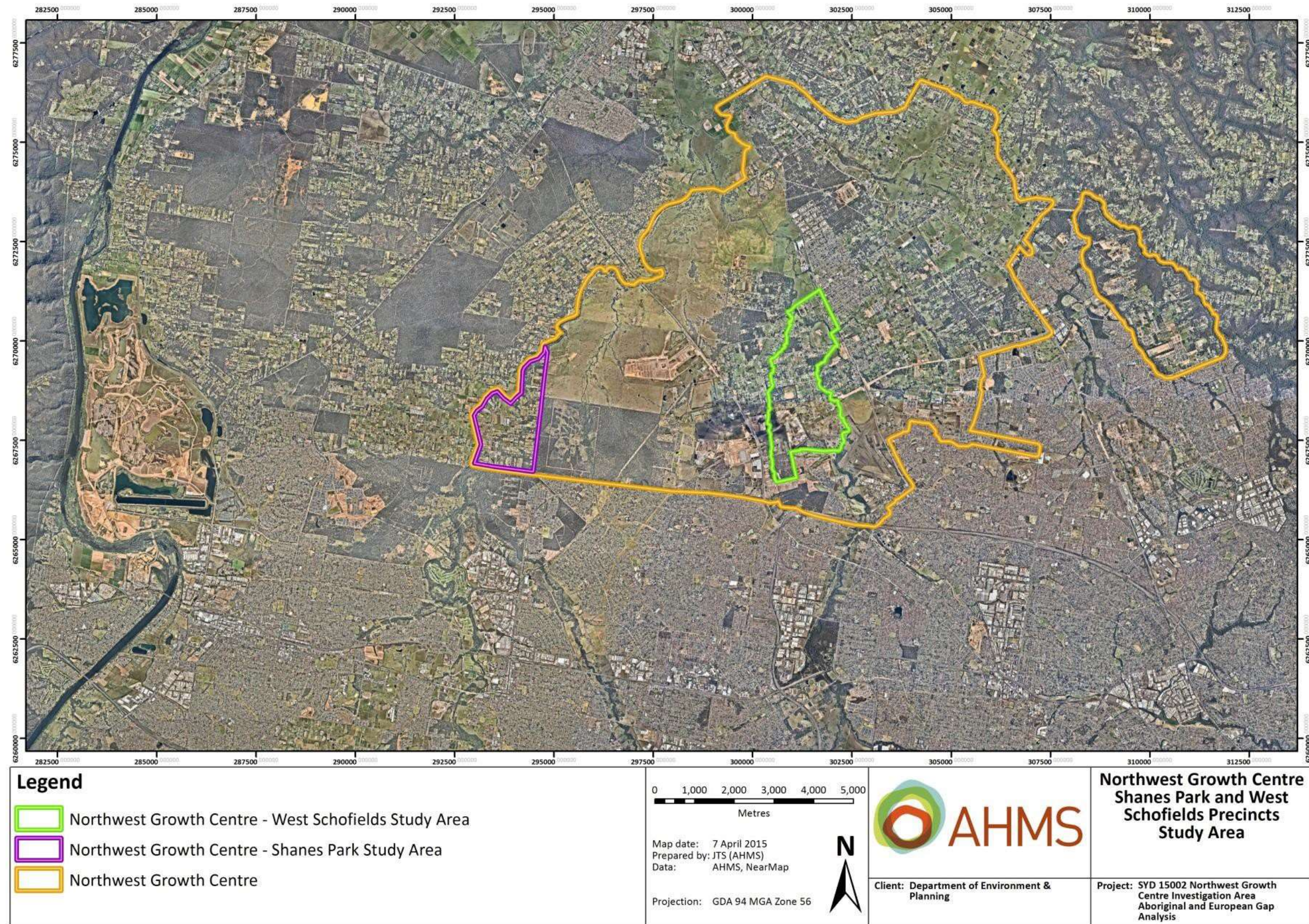


Figure 1. Shanes Park and West Schofields Precincts, North West Growth Centre.

2 EXISTING ENVIRONMENT

A full description of the existing environment of Shane Park and West Schofields precincts is provided in **Appendix 1**. A summary is included below.

The NWGC is located within the Cumberland subregion, which is characterised by low rolling hills and wide valleys on Triassic Wianamatta group shales and sandstones. From a historical perspective, the Cumberland subregion was suitable for settlement and pastoralism in the 19th Century. The large river systems running through the Cumberland subregion would also form key resources along which Aboriginal activity would likely have occurred.

Geologically, several parts of the West Schofields precinct are important for Aboriginal people in the past. Specifically, stone materials suitable for flaking, including pebbles, cobbles and occasional large boulders (up to 20cm in size) of silcrete, silicified wood, quartzite and quartz, occur within the sand/clay matrix of the Berkshire Park formations dominating this area. Plumpton Ridge, a low rise in the south of the West Schofields precinct, is part of the St Marys formation, and is known archaeologically as a very important Aboriginal silcrete quarry (**Figure 2**).

The two precincts encompass the alluvial South Creek and Berkshire Park soil landscapes, and the residual Blacktown soil landscape. These types of landscapes are often shallow, and can be significantly disturbed by historical and modern activities. This has significant implications for the survivability of historical and Aboriginal deposits. Further, it is rare for these types of soil to contain significantly deep, stratified or old archaeological deposits except in the depositional contexts such as the South Creek soil landscape.

The precincts have been extensively disturbed by land clearance and weed invasion is well established and as a result, remnant vegetation now occurs mostly as small and fragmented patches. From an Aboriginal heritage perspective, remnant and old vegetation is important for two reasons: 1) it is in these locations that culturally modified trees (if present) may be found; and 2) these areas have been subject to fewer disturbances in the last 200 years than other parts of the study area.

The NWGC is located within the South Creek sub-catchment of the Hawkesbury-Nepean River system. Major watercourses in the vicinity of the subject area include South Creek, Ropes Creek, Eastern Creek and Bells Creek (**Figure 3**). These large watercourses would have been key resources for both Aboriginal and historic settlement and movement through the NWGC. As such, these watercourses are highlighted throughout the report as of key importance.

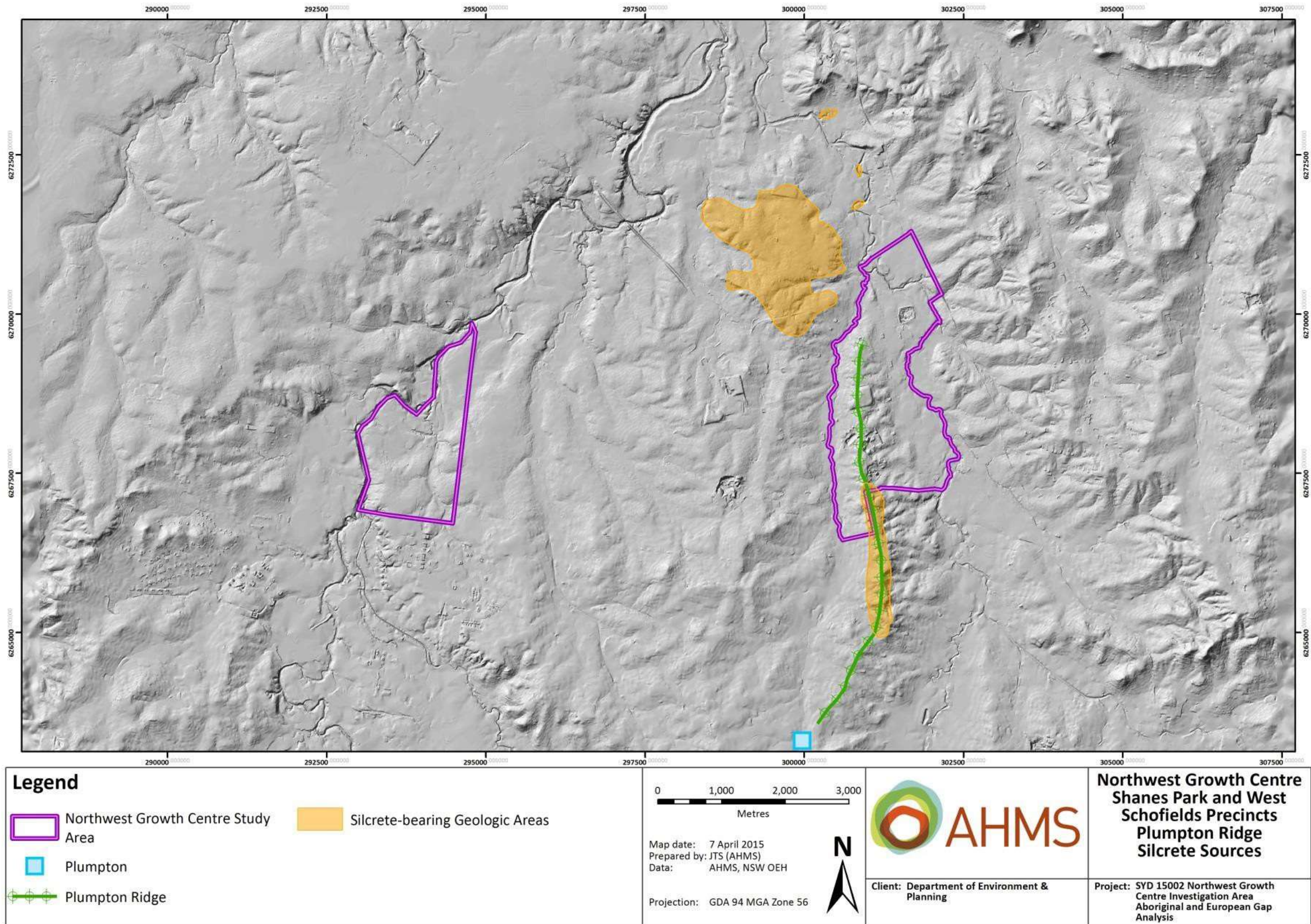


Figure 2. Plumpton Ridge and silcrete-bearing geologic areas in the vicinity of the NWGC study area.

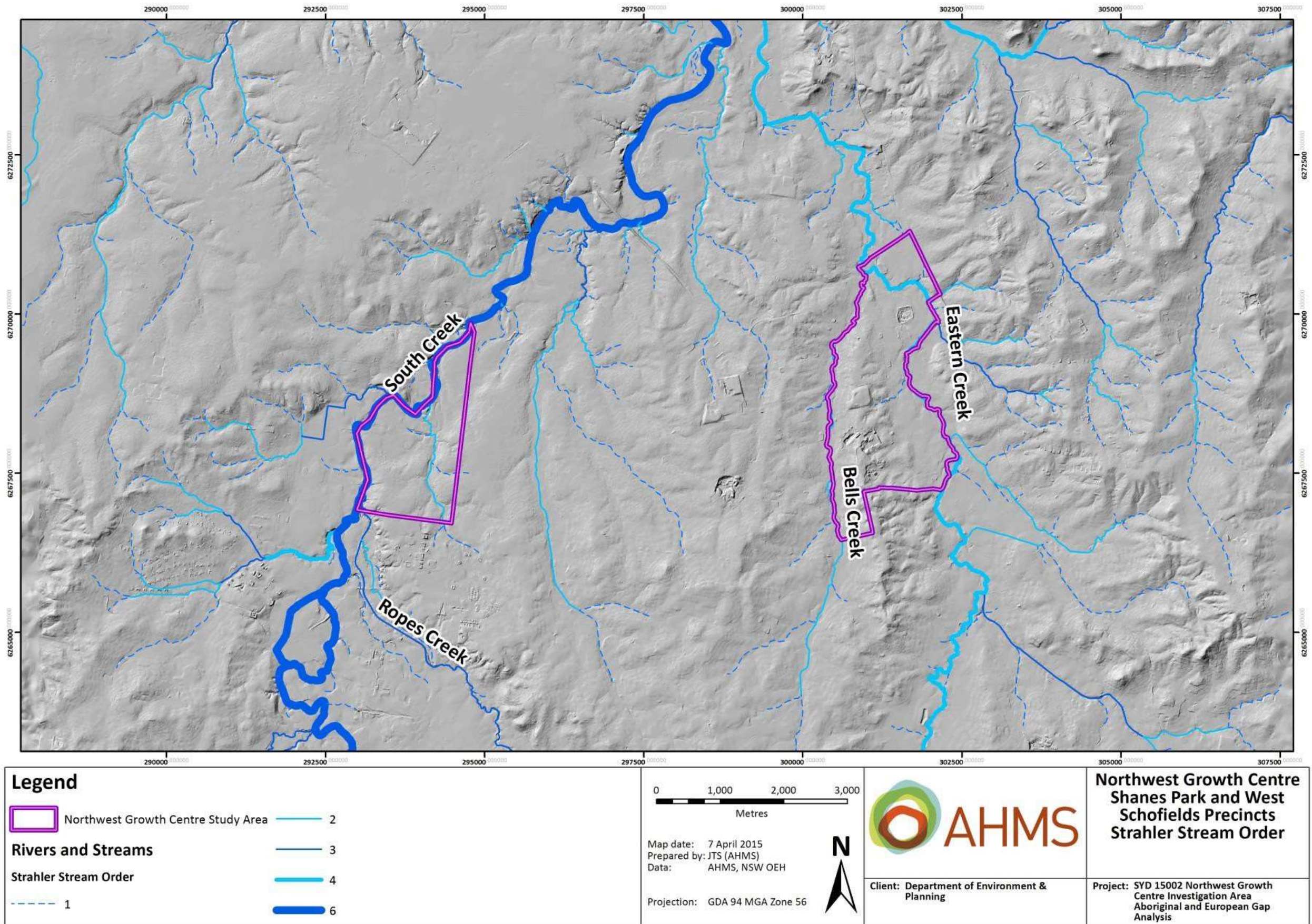


Figure 3. Hydrology in the vicinity of the NWGC study area. Stream order classification is based on hierarchy of tributaries (after Strahler 1964).

3 HISTORIC HERITAGE

This section presents an assessment of the historical heritage items, places and potential within the Shanes Park and West Schofields precincts of the NWGC (**Figure 4**).

3.1 General Development of the North-West

3.1.1 Early European History

The first European incursion into the Northwest Growth Centre precinct was an expedition led by Governor Arthur Phillip to find out whether the Hawkesbury River linked with the Nepean River. His party consisted of Lieutenant Tench, Lieutenant Dawes, Surgeon White, Mr. Collins, a servant, three convicts, eight Marine privates, two sergeants, one captain, and two Aboriginal guides: Colbee and Boladeree. On their return on 16 April 1791 the party traversed the area of study, noting the recently burnt landscape and describing the land, in Phillip's words, as 'poor soil but finely formed and covered with the stately white gum tree' (Hunter 1793:459).

During the course of 1794 seventy-two families, almost all headed by ex-convicts, took up residence on the Hawkesbury River, South Creek and McKenzies Creek. These early settlers cleared the land of trees and scrub and sowed crops of wheat and maize in the fertile river soils. In some seasons they grew 'from fifteen to twenty thousand bushels of wheat' (Hunter 1799:354-355).

Despite early success growing wheat and maize, the colony was chronically short of livestock. Much of the livestock that arrived with the settlers in 1788 had either died or disappeared, forcing the administration to import cattle and sheep from India and South Africa. In 1800 a Government Stock Yard was established on the western side of the Hawkesbury road, to the north of Meurants Lane (Casey and Lowe, 1993: 4). But small farmers found it difficult to both afford the new livestock and find the land on which to run them. This led Governor King in 1802 to initiate a policy of loaning government cattle, sheep and pigs to small settlers to build up their own herds and flocks.

3.1.2 Early Land Grants

The Shane's Park Precinct lies entirely within a 700 acre land grant made to Surgeon John Harris in December 1805. Harris subsequently added two blocks located to the east of this property with the resulting 2300 acre property being named as 'Shane's Park'. Harris was an active and controversial public figure, especially in the fallout of the Rum Rebellion. Unlike most of these early landholders, who did not live on their estates and employed managers to run cattle, sheep and horses on their land, Harris was actively involved in farm work and raising stock. He later moved from his Sydney property and resided at Shane's Park where he died in 1838 (ERM 2012:19). Following Harris' death 'Shane's Park' passed to members of the Harris family. It is unclear what activities were undertaken on this portion of the precinct.

The northern portion of the West Schofields Precinct falls within a grant of 700 acres made to John Liddiard Nicholas in October 1815. Nicholas was an associate of Rev. Samuel Marsden but left the Colony for New Zealand a month later. He sold the property to Marsden in 1822 and does not appear to have carried out any improvements on the property. In 1816 Governor Macquarie ordered William Cox to upgrade the colonial road system and construct Richmond Road. The improved road drew new settlers to the West Schofields Precinct and a number of land grants were made within the study area (ERM 2012:16-21). These were mostly small holdings that varied between 30 and 60 acres in size. A number of these land grants were made to former convicts. Many remained undeveloped into the mid-nineteenth century or were incorporated into larger landholdings. Richmond road was again improved in 1822 using John McAdam's system of road building, that involved layers of broken stone on a convex, well-drained earth base (GML 2009:5).

In the absence of any detailed historical survey of the study area, reference was made to a map prepared in 1842 Plan of part of the Windsor District contained between the Old Richmond Road and the Road from Windsor (State Library of New South Wales, Z/M4 811.1822/1842/1). Many of the localities relate to families that occupied grants in the period after 1815. Using this map AHMS has identified seven sites within the study area (**Figure 4**). These included 'Wilmington' a large estate located in the northern portion. This is located on the former Nicholas property and in 1840 passed to Marsden's son-in-law Josiah Allen Betts. Betts planted a vineyard and fruit trees of various kinds, and undertook cultivation and dairying. A second location identified was the property of Charles Ivory. The Ivory family were noted horse-breeders and Charles' son Thomas was a noted owner trainer of racehorses raised on this property. Several smaller sites were also noted on the map of 1842. During the second half of the nineteenth century many of the larger properties in the West Schofields Precinct were leased and then subdivided for sale.

3.1.3 Twentieth Century

During the early part of the twentieth century the West Schofields Precinct consisted of small-holdings that were involved with orcharding and poultry production. .

The history of the Shane's park Precinct during the first half of the twentieth century is unclear. The property appears to have retained its cadastral integrity until at least 1945 at which time it was purchased by the Commonwealth Government. During the Second World War a number of large holdings in the South Creek district were purchased by the Commonwealth for a variety of purposes.

Schofields and Riverstone were connected to the Metropolitan Water Supply in 1933 and electrical services in 1934. The inhabitants of the Northwest Growth Centre precinct pulled through the grim years of the Depression comparatively smoothly due to the diversity of industries in the district and generous owners of surrounding orchards and farms (Sharpe 2000:92).

The post-war period saw a boom of new homes in the precinct and a range of new accents sounding in the streets (Sharpe 2000: 92; Gillespie and Gillespie 2006). The western portion of the West Schofields precinct along Richmond Road became subject to increasing development, as the outer suburbs of Sydney sprawled. The County of Cumberland Plan was adopted in 1947-48 in an attempt to create a 'green belt' around Sydney (Barry et al 1980:15). The new guidelines restricted building on sites of less than five acres, helping the area to retain its rural character and encouraging the establishment of small intensive farms. Many of the new migrants channelled their energy and labour into market gardens and poultry farms.

3.1.4 Historical Themes

No historical themes have been developed for the Blacktown LGA through the process of preparing a Heritage Study for the LGA. Should such a process be undertaken, themes are likely to include the following:

- Early European Settlement;
- Contact History
- Notable Figures;
- Communication;
- Roads

- Agriculture and pastoralism;
- Servicing Sydney;
- Close Settlement

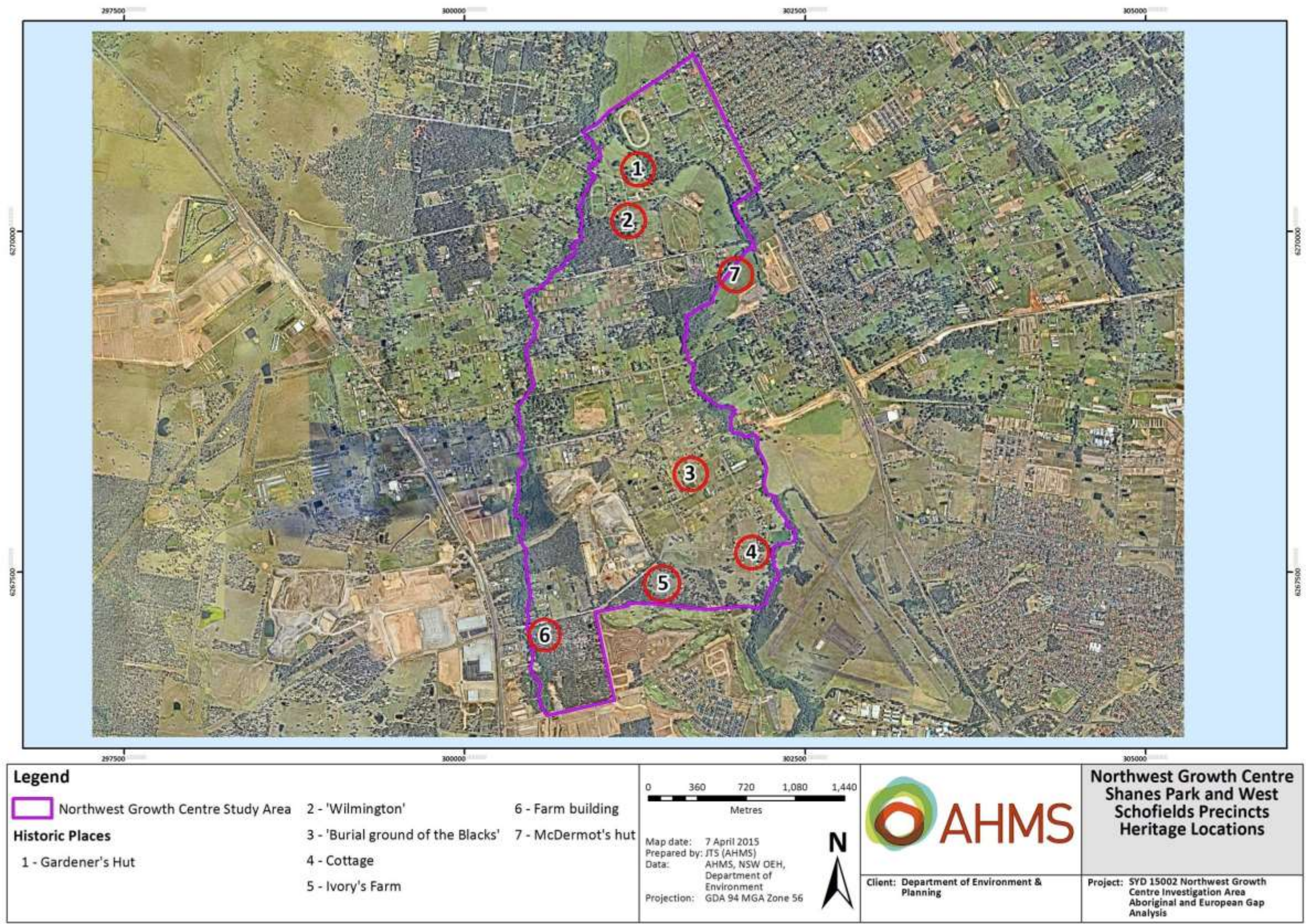


Figure 4. Historical items and sites geo-referenced from the 1842 map onto the West Schofields Precinct. The identification of a possible burial ground (3) is a potential constraint for the development.

3.2 Listings

Further details of historical listings are included in **Appendix 2**. A summary of the findings are presented below.

A search of a wide range of historic heritage lists identified no listed heritage items of sites within the two precincts. However, two items listed on the Commonwealth Heritage List (CHL) are in close proximity, namely the Llandilo International Transmitting Station (CHL Item 106101) and the Shale Woodland Llandilo (CHL Item 105534) (**Figure 5**). These are in the same location, immediately east of Shanes Park precinct.

A range of other historical items and sites are listed in the surrounding area, reflecting the pastoral history outlined in Section 3.1 (**Figure 5**).

3.3 Archaeology

There is no specific Archaeological Zoning/Management Plan for use in planning assessment related to development. However, the LEP contains requirements related to archaeological sites within the LGA. The Draft BLEP 2013 identifies five sites with reference to archaeological remains. None of these are located within the study area.

The Blacktown City Council Development Control Plan (2010) states that building proposals on properties identified as European cultural heritage sites on the LEP are required to be assessed by a qualified heritage consultant and pursuant to the requirements of the *Heritage Act 1977*.

The NSW Heritage Division, Office of Environment and Heritage, issues Excavation Permits for archaeological sites in NSW. Details of the sites where permits have been issued are held in the Heritage Office Database (HOD) which also holds data on enquiries, reports and other.

Enquiries have been made with the Heritage Division regarding Excavation Permits issued in Blacktown LGA; however, this data was not available for the current report, and further work would be required to identify the particular sites and nature of archaeological reporting/involvement on those sites.

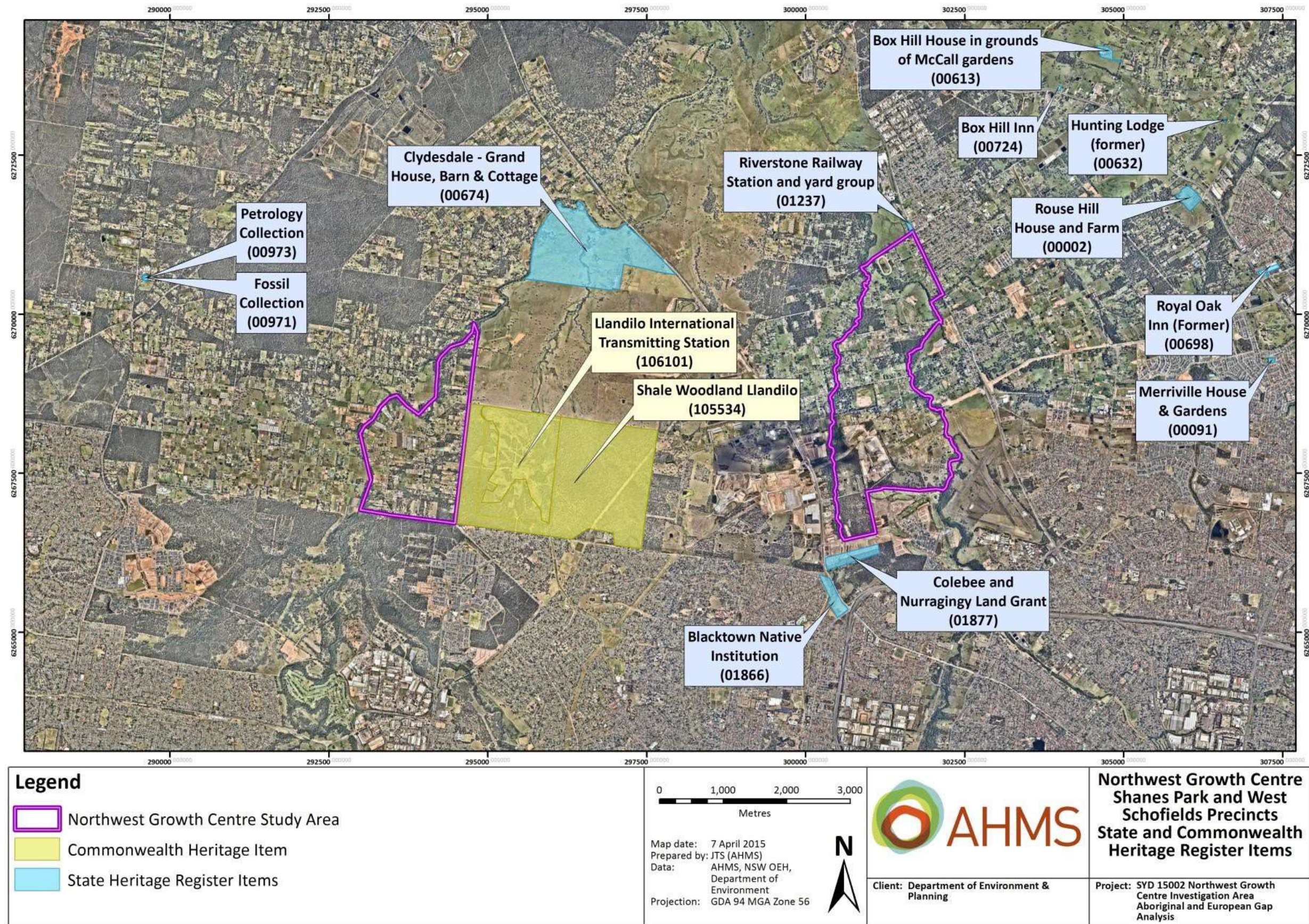


Figure 5. Commonwealth and State Heritage Items in the vicinity of the NWGC study area.

4 ABORIGINAL HERITAGE

4.1 Aboriginal Consultation

Aboriginal consultation is being undertaken for this project. To enhance the outcomes of the consultation process a dual approach to consultation was undertaken. This involved the basic steps as outlined in OEH guidelines (see below), plus a preliminary cultural values mapping workshop targeting willing participants with specific knowledge of the area.

As noted above consultation has been initiated in accordance with OEH's *Aboriginal Consultation Requirements for Proponents 2010*. While this process is only required for projects requiring an Aboriginal Heritage Impact Permit (AHIP), it provides an inclusive process to identify all Aboriginal people with an interest in the area and the project. Specifically, pre-notification and notification processes have been undertaken to identify the Aboriginal individuals and organisations who will be included in the consultation process for the GMIA.

The following Aboriginal organisations registered an interest in the project by the 13th May 2015, which was the due date advised in the notification process:

1. Deerubbin LALC.
2. Darug Aboriginal Cultural Heritage Assessments.
3. Darug Custodian Aboriginal Corporation.
4. Darug Tribal Aboriginal Corporation.
5. Darug Land Observations.
6. Tocomwall.
7. Gunjeewong Cultural Heritage Aboriginal Corporation.
8. Kamilaroi- Yankuntjatjara Working Group.
9. Badu.
10. Walbunja.
11. Murrumbul.
12. Munyunga.
13. Wingikara.
14. Aboriginal Archaeology Service.
15. Nundagurri.
16. Corroboree Aboriginal Corporation.
17. Murri Bidgee Mullangari.
18. Bilinga.
19. Warragil.
20. Yerramurra.
21. Eora.
22. Ngunawal.

- 23. Wandanian.
- 24. Gangangarra.
- 25. Bidjawong.

These organisations have been invited to identify areas of cultural importance to them. In addition individuals and organisations with long term historic and /or traditional interests in the area were invited to participate in cultural values workshops. The results of these processes will be incorporated into the planning for the precincts.

4.1.1 Preliminary Cultural Values Workshops

This project provided an opportunity to incorporate an Aboriginal voice into initial discussions about the values of the study area with the aim of enriching the characterisation of the NWGC. To this end a series of small cultural values mapping workshops were held on May 13 at Rouse Hill, May 13 at Penrith and May 20 at Rouse Hill. The purpose of these cultural values mapping workshops was to discuss cultural places and values associated with the NWGC. Participants were selected on the basis of either:

- a long term residency in the area which could suggest they had historic interests in the study area or
- claims for traditional descent specific to the study area which might mean that the participants could hold traditional cultural information.

From amongst those invited the following people agreed to participate: Steven Randall (Deerubbin Local Area Land Council), Celestine Everingham (Darug Aboriginal Cultural Heritage Assessments), Phil Kahn (Kamilaroi- Yankuntjatjara Working Group), Cherie Turrise, Bruce Turrise and Marilyn Carroll Johnson (Gunjeewong Cultural Heritage Aboriginal Corporation), Leanne Watson (Darug Custodian Aboriginal Corporation), John Riley (Darug Tribal Aboriginal Corporation), Robert Lester (Tocomwall), Brent Williams (Aboriginal Archaeology Service), and Gordon Workman (Darug Land Observations).

At the workshop participants were asked to annotate a large format (A0) aerial photograph of the study area with places of particular cultural interest or concern to them. The resulting map (see **Figure 6**) was a composite of places nominated by participants, although all places may not have been known to all participants.

The workshops identified seven areas with specific cultural value to the Aboriginal community (**Figure 6**) which might not otherwise have been identified at this stage of the planning process. These areas were as follows:

1. **Sensitive Data – Not for Public Exhibition**
2. **Sensitive Data – Not for Public Exhibition**
3. **Sensitive Data – Not for Public Exhibition**
4. **Sensitive Data – Not for Public Exhibition**
5. **Sensitive Data – Not for Public Exhibition**
6. **Sensitive Data – Not for Public Exhibition**
7. **Sensitive Data – Not for Public Exhibition**

In addition to the specific cultural locations listed above, a number of other areas were considered to have cultural importance arising from participant's first-hand knowledge of Aboriginal cultural materials (primarily stone tools), open sites and natural resources (e.g. stone raw material) occurring within these regions. The areas included locations in the West Schofields precinct particularly in the southwest (Plumpton Ridge and Stonecutter's Ridge); north of Garfield road between the study areas; and to the east of the Shanes Park precinct. Potential significance was also indicated in areas where cultural materials have been recovered from cultural resource management (CRM) projects, including in the southwest of West Schofields, in the vicinity of Veron Road, along South Creek at Shanes Park, and to the east of Garfield Road (between study areas). The cultural importance of South Creek within the Shanes Park precinct was also highlighted as an area of high potential for significant cultural materials. Participants also highlighted national park land to the south, and Deerubbin LALC-owned land to the north of Shanes Park precinct. Discussions indicated that the whole of the Shanes Park area needed to be further investigated, and that parts of Plumpton Ridge should be conserved. Concerns were raised in relation to promises of conservation at Colebee that were not fulfilled. In general, these areas identified as of concern conform well with regional and local archaeological models developed for the two precincts (**Section 4.2-4.4**).

The Aboriginal cultural values layer that resulted from this exercise must be considered preliminary and more information may be revealed in subsequent stages of the project planning and consultation. However it has highlighted several areas of significance to the local community that were not identified through archaeological modelling and these should be considered in any future planning for the area.

Sensitive Data – Not for Public Exhibition

Figure 6. Map of cultural values including sites and places identified by Aboriginal people in the preliminary cultural mapping workshop

4.2 Ethnographic Record

To assist in the development of CRM, AHMS has initiated a mapping project to explore early historical texts and diaries to identify spatial locations where Aboriginal activities were observed. The AHMS project 'Mapping Sydney's Aboriginal Past' provides a spatial understanding of Aboriginal activity around the temporal point of contact. It consists of an interactive map, a searchable database of site-specific ethnographic evidence, and a range of other tools which bring a spatial perspective to the primary sources. Further details of the program are provided in **Appendix 3**.

4.2.1 A Summary of the Sydney Basin

Over thirty separate Aboriginal groups populated the wider Sydney area in 1788, each with their own country, practices, diets, dress, and dialects. We now know of these groups as 'clans' and each identified with broader cultural-linguistic groups known as 'tribes': Darug, Darkinjung, Gundungarra, Tharawal, Guringai (Coastal Darug), Eora (Coastal Darug) and Awabakal.

Each clan of thirty to fifty people lived within their own territory, occasionally converging with other clans to trade, hunt, fight, feast, arrange marriages, conduct ceremonies, resolve disputes, and share information. The database includes details of a gathering of three clans on their way to Camden to learn a new song (Backhouse, 1843), Burramattagal people venturing out to Manly to feast on a beached whale (Tench, 1793), and groups of hunters near Carabeely cooperating on a large-scale kangaroo hunt (Barrallier, 1802). There was often tension between neighbouring groups and the boundaries between territories were not lightly traversed (White 1788). On an expedition north-west of Parramatta, Watkin Tench records that his guides Colebee (Gadigal) and Ballederry (Burramattagal) quickly found themselves in 'country unknown' and that they described those who lived there as 'enemies'. When the party finally reached the Hawkesbury River, Tench (1791) surmised that 'Our natives had evidently never seen this river before'.

The interactive map reveals a landscape criss-crossed with Aboriginal paths, many of which later became roads. Missionary James Backhouse was amazed by the speed and sophistication of communication between clans. For example, on 23 October 1835 he encountered Aboriginal people in Richmond who knew of his brief visit to Wellington, over three hundred kilometres away: 'Our persons, costume, and many other particulars, including our manner of communicating religious instruction, had been minutely described' (Backhouse, 1843, p. 339).

The same paths that wove these communities together rapidly spread the small pox virus throughout the region in 1789. The devastating outbreak of small pox forced major reorganisation amongst clan groups. When William Bradley sailed into Sydney in May 1789, he recorded the 'dreadful havock' that small pox had wrought amongst Aboriginal communities: 'we did not see a Canoe or a Native the whole way coming up the Harbour & were told that scarce any had been seen lately except laying dead in & about their miserable habitations' (Bradley, 1969). Traditional burial practices broke down and clans merged together as entire communities were taken by the virus (Hunter, 1793). Bodies were found in caves and by streams, around the harbour and all along 'the path between Port Jackson & Broken Bay' (Bradley, 1969). The impact of small pox continued to ripple across the country, reducing communities in the Hunter 'from about 200, to 60' (Backhouse, 1843, p. 401).

The primary sources offer only glimpses of the ceremonial life of these Aboriginal communities. Europeans recorded some Aboriginal customs, such as the avulsed teeth and 'scarifications' of certain initiated men, and the kangaroo teeth necklaces and the missing little finger joints of 'mountaineer' and coastal women. But, due to the secrecy surrounding ceremonial events, there are serious limitations to even the most richly described accounts like the 'Yoo-long Erah-ba-diang' initiation ceremonies Collins records at the head of Farm Cove and in the 'middle harbour' (Collins,

1798); the contests and dances conducted on 'a clear spot between the town and the brickfield' (Collins, 1798); and the operation performed by Yellomundee, a 'caradyee', on Colebee's wound on the banks of the Hawkesbury (Tench, 1791).

Those clans that lived along the coast were saltwater people. They harvested shellfish from the shore; men fished from the shallows with long four-pronged spears, while the women fished in bark canoes using turban shell hooks and lines. The hunters' toolkit included clubs, boomerangs, womeras, spears tipped with shell, and, of course, fire. At times they stayed for several months in the one area: Joseph Banks (1998) records finding 'a small village consisting of about 6 or 8 houses' on the south shore of Botany Bay in April 1770, and in December 1790, Watkin Tench describes a similar 'little village (if five huts deserve the name)' on the north side of the bay. Botany Bay was a focal point of Aboriginal activity; it has the highest density of plotted ethnographic sources in the Sydney area.

The inland clans fished for mullet and eels in rich lagoons, but much of their food came from yams dug out from the river banks and worms known as 'cah-bro' extracted from river driftwood. Colebee and Ballederry called these people the 'climbers of trees' after their practice of skilfully ascending gums in pursuit of animals, cutting footholds in the trunks with a stone axe. More hunting traps were plotted in the area from Parramatta to Richmond than any other part of Sydney. These included 'bird decoys' full of feathers, hollowed-out trees, and a tapering chute at the foot of Richmond Hill 'between forty and fifty feet in length', constructed of earth, weeds, rushes, and brambles (Collins, 1798).

Fire was a constant presence in early Sydney, from the 'moving lights' seen on the harbour at night (Banks, 1998, p.243) to lone trees burning on the Cumberland Plain, 'the smoke issuing out of the top part as through a chimney' (White 1788). 'In all the country thro' which I have passed,' wrote Arthur Phillip in May 1788, 'I have seldom gone a quarter of a mile without seeing trees which appear to have been destroyed by fire' (Phillip, 15 May 1788). The first Australians became known as the 'fire-makers' (Cox, 1815). They used fire to open paths and to clean country; to drive animals into the paths of hunters and then to cook the kill; to keep warm at night and to carry as a torch the next day; to treat wood, melt resin and crack stone for tools; to gather around and dance and share stories.

The interactive map gives us an insight into local burning regimes. On a hot dry day in September 1790, for example, David Collins observed Aboriginal people 'burning the grass on the north shore opposite to Sydney, in order to catch rats and other animals' (Hunter, 1793). Almost exactly twelve months later, on 31 August 1791, they were again 'firing the country' in the same place on a hot day ahead of heavy rains. While Collins regarded this to be another 'remarkable coincidence', it suggests a connection to the land and an understanding of the seasons which the settlers could not fathom. This dismissive approach proved devastating during 1799 flood of the Hawkesbury. Settlers who ignored the flood warnings given by Aboriginal people were engulfed by a destructive torrent as the 'river swell'd to more than fifty feet perpendicular height above its common level' (Collins, 1798).

After contact, early Sydney remained, in the words of historian Grace Karskens, 'an Eora town' (Karskens, 2009:351). Crowds of Aboriginal people would flow through the settlement at Sydney Cove, eating in the yard of Government House, sharing a table with the Governor himself, or gathering at Bennelong's hut. Large parties of convicts paid regular visits to an Aboriginal family in Woolloomooloo, 'where they danced and sung with apparent good humour' (Collins, 1798). A short-lived fish trade sprang up in Parramatta, with Aboriginal people selling fresh bream and mullet for bread and salted meat (Collins, 1798). Fierce warfare broke out on the Hawkesbury. And clans came 'not less than one Hundred Miles' to attend Governor Macquarie's 'Annual Meeting of the Natives' at Parramatta. Each of these events makes up a single plotted marker in the ethnographic database. Combined they knit together a rich tapestry of Aboriginal activity around early Sydney.

4.2.2 The Study Area

The Shanes Park and West Schofields precincts of the NWGC lie within the traditional country of the Darug language group of Aboriginal people. The extent of the traditional territory of the Darug people can be interpreted as largely co-incident with the Cumberland subregion of the Sydney Basin Bioregion (Brown, 2010; Attenbrow, 2010).

The Cumberland Plain Woodland, particularly when it would have had a fire managed understorey dominated by grasses, had greater game resources (grazing and browsing mammals such as kangaroos and possums) than in surrounding sandstone areas on the periphery of the Cumberland Plain. The freshwater creeks (such as South Creek and Eastern Creek), wetlands and rivers (Hawkesbury-Nepean in the west and north and Georges in the south) were also known to be fundamental to the Darug subsistence economy. The existence of different foraging strategies used by people identifying as a separate cultural group to those on the coast was described in some detail by David Collins in the early years of European settlement (Collins, 1798, pp. Vol 1, Appendix IV):

The natives who live in the woods and on the margins of rivers are compelled to seek a different subsistence [to those on the coast], and are driven to a harder exercise of their abilities to procure it. This is evinced in the hazard and toll with which they ascend the tallest trees after the opossum and flying squirrel [gliders]. At the foot of Richmond Hill, I once found several places constructed expressly for the purpose of ensnaring animals or birds.

...By the sides of lagoons I have met with holes which, on examining, were found excavated for some space, and their mouths so covered over with grass, that a bird or beast stepping on it would inevitably fall in, and from its depth be unable to escape.

*In an excursion to the Hawkesbury, we fell in with a native and his child on the banks of one of the creeks of that noble river. We had Cole-be with us [a Cadigal clansman from the coastal sandstone country of Sydney's east], who endeavoured, but in vain, to bring him to a conference; he launched his canoe, and got away as expeditiously as he could, leaving behind him a specimen of his food and the delicacy of his stomach; a piece of water-soaked wood (part of the branch of a tree) full of holes, the lodgement of a large worm, named by them *cah-bro* [cobra or *Teredo* spp.; a type of burrowing mollusc known as shipworm]*

...They resort at a certain season of the year (the month of April) to the lagoons, where they subsist on eels which they procure by laying hollow pieces of timber into the water, into which the eels creep, and are easily taken.

These wood natives also make a paste formed of the fern-root and the large and small ant bruised together; in the season they also add the eggs of this insect.

Within the considerable territorial extent of the Darug, area-specific knowledge was held and transmitted within separate clan groups. On the basis of a review of historical documents presented by Attenbrow (2010), Kohen (1993) and Goodrum (1987), two different clan groups may have been active in the study area – the Gomerrigal or Gomerigal, also referred to in the literature as the 'South Creek Tribe'. In the early 19th century, Governor Macquarie granted 30 acres of land on Bells Creek, immediately south of the West Schofields precinct, to two members of the South Creek Tribe, Nurragingy (Creek Jemmy) and Colebee (see Figure 5). Historic records also place the 'Buruberongal' to the north-west of Parramatta, approximately two hours walking distance from the Hawkesbury River.

Western Sydney is also currently home to a large contemporary Aboriginal community, most of whose pre-1788 ancestors were from outside of the Sydney area, but whose current sense of community and engagement with Aboriginal cultural heritage is often directed at their local area as well as places that they may identify in their traditional country. The Blacktown LGA, which includes the study area,

has a population of more than 7,000 people identifying as either Aboriginal or Torres Strait Islander, representing 2.7% of the total community (Australian Bureau of Statistics 2014). Through the *Aboriginal Land Rights Act 1983*, representation of much of this community in Aboriginal cultural heritage matters is through the system of Local Aboriginal Land Councils. Membership of the Land Council includes people from other areas who now reside within the Land Council boundary as well as residents who may be traditionally descended from the Darug. Consequently, Aboriginal stakeholders considered to be important in the process of community consultation may be involved either as Darug traditional or through the Deerubbin LALC.

A search of AHMS' ethnographic database reveals no specific observations within the Shanes Park or West Schofields precincts. However, it does indicate that a number of explorers travelled through the area in the 18th Century, including John Hunter and Watkin Tench in April 1791; and a later expedition by James Backhouse between Parramatta and Wellington in September-October 1835 (**Figure 7**).

Date: 11 April 1791

Summary: Evening encounter with Bereewan of the 'Boorooberongal' tribe.

Key words: Bereewan; Boorooberongal; hunting; possums; tribes; tea-tree torch; fire; spears; Bidjigals; small pox; dog; enemies; stone hatchet; throwing stick; hair; ornamented; animal tails; canoe; teeth

Location: 33°37'35.54"S, 150°54'38.58"E (Accuracy: within 2 km - being two hours walk from the river in the north and two hours walk from the border of stone country and river country in the south)

Source: Watkin Tench, *A Complete Account of the Settlement at Port Jackson* (London: G. Nicol and J. Sewell, 1793), 11 April 1791; John Hunter, *An Historical Journal of the Transactions at Port Jackson and Norfolk Island* (London: Printed for John Stockdale, 1793), 11 April 1791.

Quotes: Tench: At a very short distance from Rose Hill, we found that they [Colbee and Boladere] were in a country unknown to them, so that the farther they went the more dependent on us they became, being absolute strangers inland. We asked Colbee the name of the people who live inland, and he called them Boorooberongal; and said they were bad ... [During the course of the day Colbee and Boladere examined] some trees to see if they could discover on the bark any marks of the claws of squirrels and opossums, which they said would show whether any of those animals were hidden among the leaves and branches.

About an hour after sunset, as we were chatting by the fire side and preparing to go to rest, we heard voices at a little distance in the wood. Our natives caught the sound instantaneously and, bidding us be silent, listened attentively to the quarter whence it had proceeded. In a few minutes we heard the voices plainly; and, wishing exceedingly to open a communication with this tribe, we begged our natives to call to them, and bid them to come to us, to assure them of good treatment, and that they should have something given them to eat. Colbee no longer hesitated, but gave them the signal of invitation, in a loud hollow cry. After some whooping and shouting on both sides, a man with a lighted stick in his hand advanced near enough to converse with us. The first words which we could distinctly understand were, 'I am Colbee, of the tribe of Cadigal.' The stranger replied, 'I am Bereewan, of the tribe of Boorooberongal.' Boladere informed him also of his name and that we were white men and friends, who would give him something to eat. Still he seemed irresolute. ... Bereewan seemed to be a man about thirty years old, differing in no respect from his countrymen with whom we were acquainted. He came to us unarmed, having left his spears at a little distance. After a long conversation with his countrymen, and having received some provisions, he departed highly satisfied.

Hunter: The natives (Colbee and Boladere) informed them that this part of the country was inhabited by the Bidjigals, but that most of the tribe were dead of the small-pox.

Quote: Soon after the fires were lighted, the voice of a native was heard in the woods, hunting his dog; and, as Colebe and Ballederry were very desirous of having an interview with him, though they said the tribe of Bu-ru-be-ron-gal, who were bad men and their enemies, resided near the spot, they frequently halloed, and were answered by the stranger; and, as the voice drew nearer, they desired our party would all lie down and keep silence. A light was now seen in the woods, and our natives advancing towards it, a pretty long conversation ensued between them and the stranger, who approached them with great precaution: a little boy who was with him carried the fire, which was a piece of the bark of the tea-tree.

They were all introduced to the stranger by name, and he was pressed to come to their fire, which was forty or fifty yards distant; but this he declined, saying he would go and fetch his family, and would return in the morning.

This man had a stone hatchet, a spear, and a throwing-stick, which one of our natives was very desirous of his leaving; probably as a pledge for his returning in the morning, but this he refused: he was a young man, of the tribe of Bu-ru-be-ron-gal, and named Bur-ro-wai; his hair was ornamented with the tails of several small animals, and he had preserved all his teeth. On Colebe being asked how this man lived, he said that he had no canoe, but lived by the chase.

Colebe and Ballederry told this man that their party were going to the river, which he pointed out as lying in the direction they had taken.

Details: 11-16 April 1791, an expedition set out from Rose Hill in order to ascertain whether or not the Hawkesbury and the Nepean were the same river. The party consisted of Governor Phillip, a servant, three convicts, eight soldiers, two sergeants, one captain, Lieutenant Tench, and Lieutenant Dawes, Mr. White, Mr. Collins, Colbee and Boladeree.

Other: Location deduced from maps (Dawes), being two hours walk from the river in the north and two hours walk from the border of stone country and river country in the south, and beside 'some pools of good water'. See William Dawes' 'A map of all those parts of the territory of New South Wales which have been seen by any person belonging to the settlement established at Port Jackson', 1791-92.

Date: 15 April 1791

Summary: Recently burnt area.

Key words: burnt area; fire

Location: 33°38'36.83"S, 150°49'40.21"E (Accuracy: within 500 metres - creek divides into two branches)

Source: John Hunter, An Historical Journal of the Transactions at Port Jackson and Norfolk Island (London: Printed for John Stockdale, 1793), 15 April 1791.

Quote: It was high water in this creek at forty minutes past twelve o'clock, and at half past three, they found it divide into two branches, either of which might have been crossed on a tree; but by this time the party were tired, and threatened with heavy rain, which would make their night very uncomfortable, as they had no tent; they therefore took up their residence at a spot where a quantity of timber, from trees, which had already been burnt down by the natives, promised them good fires with little labour.

Details: 11-16 April 1791, an expedition set out from Rose Hill in order to ascertain whether or not the Hawkesbury and the Nepean were the same river. The party consisted of Governor Phillip, a servant, three convicts, eight soldiers, two sergeants, one captain, Lieutenant Tench, and Lieutenant Dawes, Mr. White, Mr. Collins, Colbee and Boladeree.

Date: 7 September 1835

Summary: Encounter with the 'half-domesticated' Aboriginal people at South Creek.

Key words: Blacktown; missions; Parramatta; river banks; half-domesticated

Location: 33°37'22.39"S, 150°49'12.98"E

Accuracy: Within 2 km - South creek, not far from the Nepean.

Source: James Backhouse, Narrative of a Visit to the Australian Colonies (London: Hamilton, Adams and Co., 1843), 303-304.

Quotes: 7th. Samuel Marsden provided us with a guide to South Creek: he was a Black, of that place, named Johnny, an intelligent man, speaking English very fairly, and wearing a hat, jacket, trowsers, and shoes. He carried our bundles, and was very attentive, and by no means meriting the character given to us this morning, of their race, by a settler from Wollongong : " That nothing could be given to these fellows that they valued a straw." ...

On the way from Parramatta, we stepped into several cottages, conversed with the inhabitants, and gave them tracts. We had also many conversations with persons travelling on the road, on foot, in carts. We were kindly received by Charles Marsden, and his family, at the South Creek, sixteen miles from Parramatta, and in the evening had a satisfactory religious interview with them and their servants. Before dark, we walked to the side of the Creek, to see the Black Natives, who resort thither. In comparison with some other tribes, the South Creek Natives may be considered as half-domesticated, and they often assist in the agricultural operations of the settlers. The wife of our guide can read, she is a half-cast, who was educated in a school, formerly kept for the Natives, at Parramatta.

It is to be regretted that this school was abandoned; for though many who were educated in it, returned into the woods, yet an impression was made upon them, favourable to their further progress in civilization. A few of the Natives were, at one time, located upon a piece of the worst land in this part of the country, at a place, called Black Town. Here some of them raised grain, in spite of the sterility of the soil, at a time when they were unable to dispose of it; and to add to their discouragement, at this juncture, the Missionary, who had been a short time among them, was withdrawn. The want of success, in this unfair experiment, is sometimes brought forward, as a proof that nothing can be done for these injured and neglected people.

Details: Backhouse led an expedition from Parramatta to Wellington in September-October 1835.

During the gathering of information for this project, reference was made to a map of the district dating to 1842 (Plan of part of the Windsor District contained between the Old Richmond Road and the Road from Windsor [State Library of New South Wales, Z/M4 811.1822/1842/1]). A feature shown on this map is the 'Burial ground of the Blacks' (Item 3 in **Figure 4**). This feature is located on the western portion of Joseph Pye's 'Waaraa Warara' Estate. The extent, nature and date of this feature are currently unknown. That the site was described on a district map suggests that it was clearly known and identified as an Indigenous site. The site is not listed in any of current databases; however members of the local Aboriginal community have reported in previous assessments in the northern Cumberland Plain (e.g. Haglund 1983, Dallas 1982, Kohen 1986), the existence of a possible burial ground between Eastern Creek and Bells Creek, north of Richmond Road.

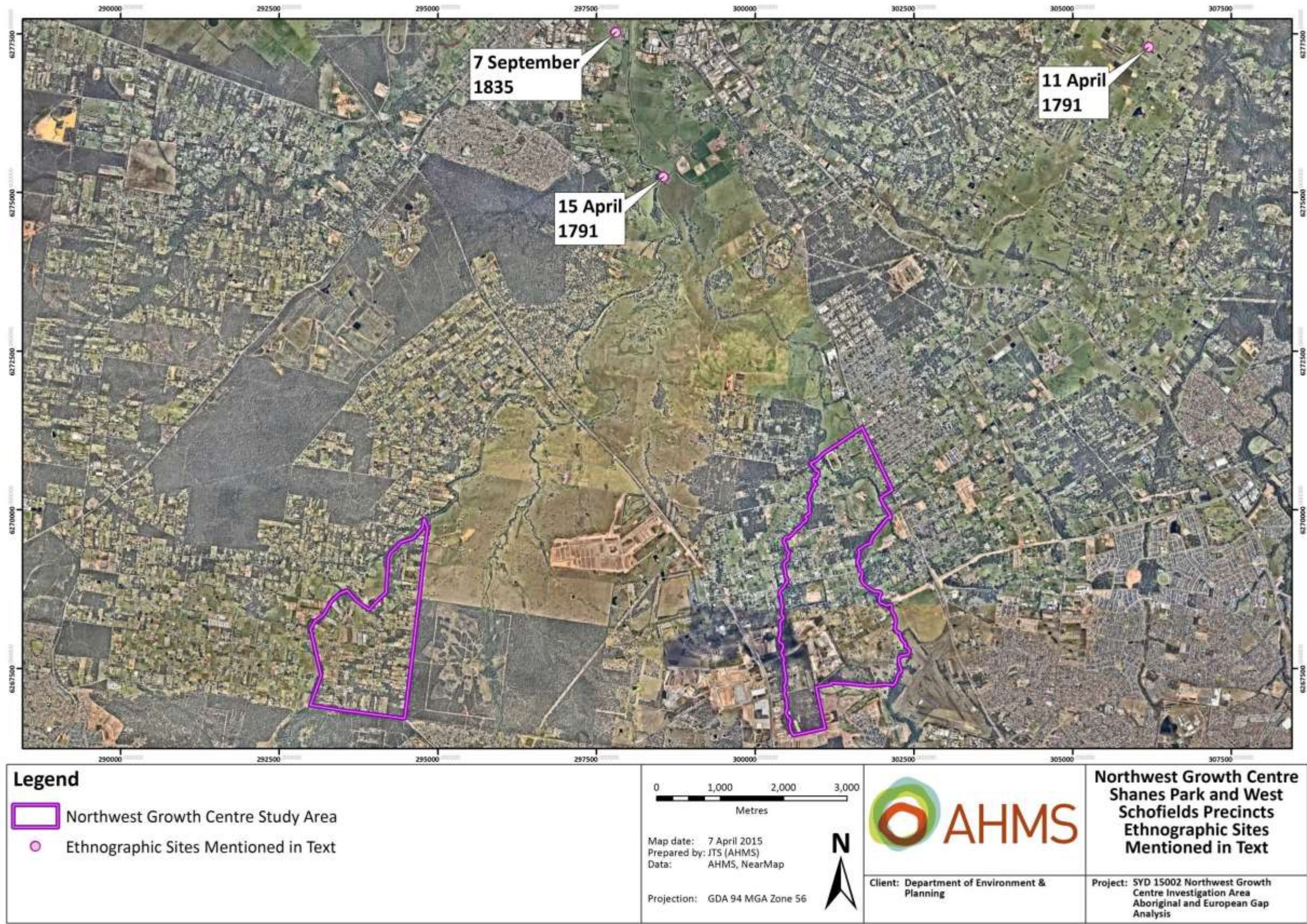


Figure 7. Map showing the location of ethnographic sites in the vicinity of the study area.

4.3 Archaeological Context

As discussed in **Section 2**, the Shanes Park and West Schofields precincts of the NWGC encompass portions of the Cumberland subregion of the Sydney Basin bioregion. The archaeology of the Sydney Basin has been well documented over the past 30 years (see **Appendix 4**) and 36 Aboriginal sites have been recorded and registered on the OEH Aboriginal Heritage Information Management System (AHIMS) within this part of NWGC (one in the Shanes Park Precinct, and 35 in West Schofields). This reflects the limited number of archaeological investigations undertaken in these areas, rather than the wealth of archaeology in the region.

Archaeological context is established by examining local and regional trends in the distribution and character of known sites in relation to environment and topography. This, in turn, can indicate the occupational history of the area, trends in the nature and survivability of the archaeological record and the patterns of site distribution across the region.

A review of the history of archaeological investigation in the Sydney Basin, and regional patterning across the Cumberland Plain is presented in **Appendix 4**. This section provides specific information on the investigations in the vicinity of the two precincts.

4.3.1 Local Context

A number of archaeological assessments have been undertaken within, and partially within, the Shanes Park and West Schofields Precincts of the NWGC. A spatial dataset by OEH indicates that at least 16 studies have taken place between 1979 and 2011. However, this list is not comprehensive and only includes Aboriginal heritage reports submitted to the AHIMS archive prior to 20 May 2014. The cumulative footprint of the study areas covers the south west corner of Shanes Park (0.2km², or approximately 6% of the Precinct) and the southern half of the West Schofields (3.2km², or approximately 52% of the Precinct; **Figure 8**). However, it should be noted that the dataset only shows the overall extent of the study areas, and does not represent the actual areas surveyed.

The survey coverage previously undertaken at Shanes Park was related to a wider program of works for the re-development of the ADI site, St Marys. The majority of the study area for this project is located outside the Precinct, to the south west. The majority of survey coverage in the south of the West Schofields Precinct relates to proposed subdivision and residential release areas at Plumpton and Schofields. There have been fewer investigations in the north; including a linear infrastructure survey for the Plumpton to Kooragang Island section of a natural gas pipeline between Sydney and Newcastle, as well as smaller scale investigations for proposed developments at 132 Burfitt Road, Riverstone (a greenwaste recycling facility); 65 Burfitt Road, Riverstone; and Garfield Road, West Blacktown (the Riverstone Trotting Track).

Broader scale patterns in the distribution, abundance and typology of stone artefacts in the local area is perhaps most cogently combined by several large scale projects undertaken by JMCHM, culminating in some recent academically published summary analysis (White and McDonald 2010; see **Appendix 4**).

In the Second Ponds Creek Release Area (of the Rouse Hill Development Area), some 4.5km to the east of the West Schofields Precinct, 32,987 artefacts were recovered from 1,310m² of excavated deposits (JMCHM 2005b). This was part of a series of projects in the area undertaken by JMCHM over ten years (see also JMCHM 2005c; White and McDonald 2010) which has been used as a significant set of data, testing the artefact distribution models for western Sydney that had started coming together from the 1980s (e.g. Haglund 1980, Smith 1989). While these investigation areas are not in the immediate vicinity of the subject area, they nonetheless provide very important comparative data (as applied in relation to predictive artefact distribution modelling in **Section 4.5**).

In 2005-6 McDonald undertook a salvage investigation for the construction of a proposed golf course as part of the Colebee Release Area, near the suburb of Plumpton, immediately south of the West Schofields Precinct (JMCHM 2006). More than 80,000 artefacts were recovered from 687m² of excavated area. This represents the highest densities of artefacts excavated anywhere in the Cumberland Plain, with one 60m² area yielding more than 45,000 artefacts including c.1,100 backed artefacts and densities in excess of 1000 artefacts/m² in some trenches. The high densities can be attributed to proximity to both the amenity and resources of Eastern Creek to the east and the rich silcrete source of Plumpton Ridge to the west. The density of backed blades can be used to suggest specialised production of these tools in some parts of the investigated area and supports an interpretation that tools from the Plumpton Ridge area, often with some preliminary working in areas like Colebee, were subsequently transported widely across the region.

The investigation included parts of a known Aboriginal stone (silcrete) quarry known as 'Plumpton Ridge' and was close to Eastern Creek. A number of tributary creeklines extended from the ridge down to the creekline. The excavation focused on landforms which included open slopes between the banks of Eastern Creek and the upper slopes of Plumpton Ridge. Other landforms investigated included floodplains, lower slopes, middle ridges to lower slopes, crests and ridges.

The average densities excavated on these landforms were:

- Floodplain - average density of 8/m²;
- Lower Slope - average density of 29/m²;
- Middle-ridge/Lower Slope - average density of 60/m² and 59/m² respectively;
- Crest and Lower Slope - average density of 27/m²;
- Upper Ridge/Slope - average density of 97/m²;
- 1 km from Eastern Creek - 8/m².

Silcrete dominated the stone assemblage, although significant quantities of silicified tuff, silicified wood and quartz artefacts were also recovered. Other materials such as quartzite, hornfels and sandstone were also found although in smaller quantities. Based on the results of the stone artefact analysis (particularly the presence and/or absence of particular stone artefact types and raw materials) it was estimated that most of the archaeological assemblage may be less than 6,000 years of age.

In summary, the excavation results indicated the highest artefact densities were found on middle ridges, upper ridges and lower slopes. The lowest artefact densities were on floodplains and upper slopes. Crests had a medium artefact density. It was estimated the assemblages were less than 6,000 years old, however, the assemblage located on the lower slope indicated evidence of pre-Bondaian occupation (i.e. earlier than 6,000 years).

Recently, AHMS undertook an archaeological mitigation program for Lend Lease for extensive pipeline installation across the North West Growth Centre. Works were primarily in the form of open area excavations in advance of under-bore installations, along with individual test pitting programs to determine site significance prior to finalising construction methods. Overall, 561.5m² of archaeological excavation was carried out, divided between 236 test pits (1m²) and 325.5m² of open area. The work was spread across sixteen locations along parts of Eastern Creek, First Ponds Creek, Cattai Creek, Smalls Creek and tributaries of the Killarney Chain of Ponds (**Figure 9**). The excavations recovered 13,221 Aboriginal objects (artefacts), the majority of which were recovered from the terraces and creek flat areas on the banks of Eastern Creek immediately east of the West Schofields Precinct. At

this location, artefact densities at these sites were frequently $>45/m^2$, and in some test pits $>150/m^2$. More commonly, across the Cumberland Plain, artefact densities were $<6/m^2$ and reflective of a transitory use of much of the landscape in the past.

Relative and absolute dating indicates that these sites were all occupied in the last 2-3,000 years, although components of the Cattai Creek assemblage may be $>5,000$ years ago. Occupation of sites appears to have been intense (i.e. comprising many people) and/or to have consisted of repeated visitation (evident through the high breakage of the assemblage) with intermittent gaps in active use of these locations (evident in the uncontrolled burning of the assemblage). Activities included extraction of nearby raw material resources and maintenance of tools.

This evidence is strongly suggestive that the region was occupied only in the last few thousand years, probably as a response to wider demographic growth and pressure on other nearby resources (such as the Hawkesbury River corridor), and during a period of increased aridity. This is at least partially supported by investigation of the Eastern Creek soil profiles, parts of which have been dated to $>16,000$ years ago, without any archaeological evidence of a Pleistocene assemblage associated with these earlier layers

This work provided a number of broader results and recommendations for future directions of research, including:

- improvements to predictive modelling of the region (with data suggesting terraces and creek flats 50-100m from 3rd and 4th order streams are key locations for cultural materials),
- a greater understanding of the horizontal extent of significant Aboriginal sites (generally 100-400m²),
- artefact density thresholds for further investigation (conservatively 15/m², but values of up to 20-30/m² would still highlight key sites); and
- key locations for further investigation including the Eastern Creek, Cattai Creek and South Creek corridors.

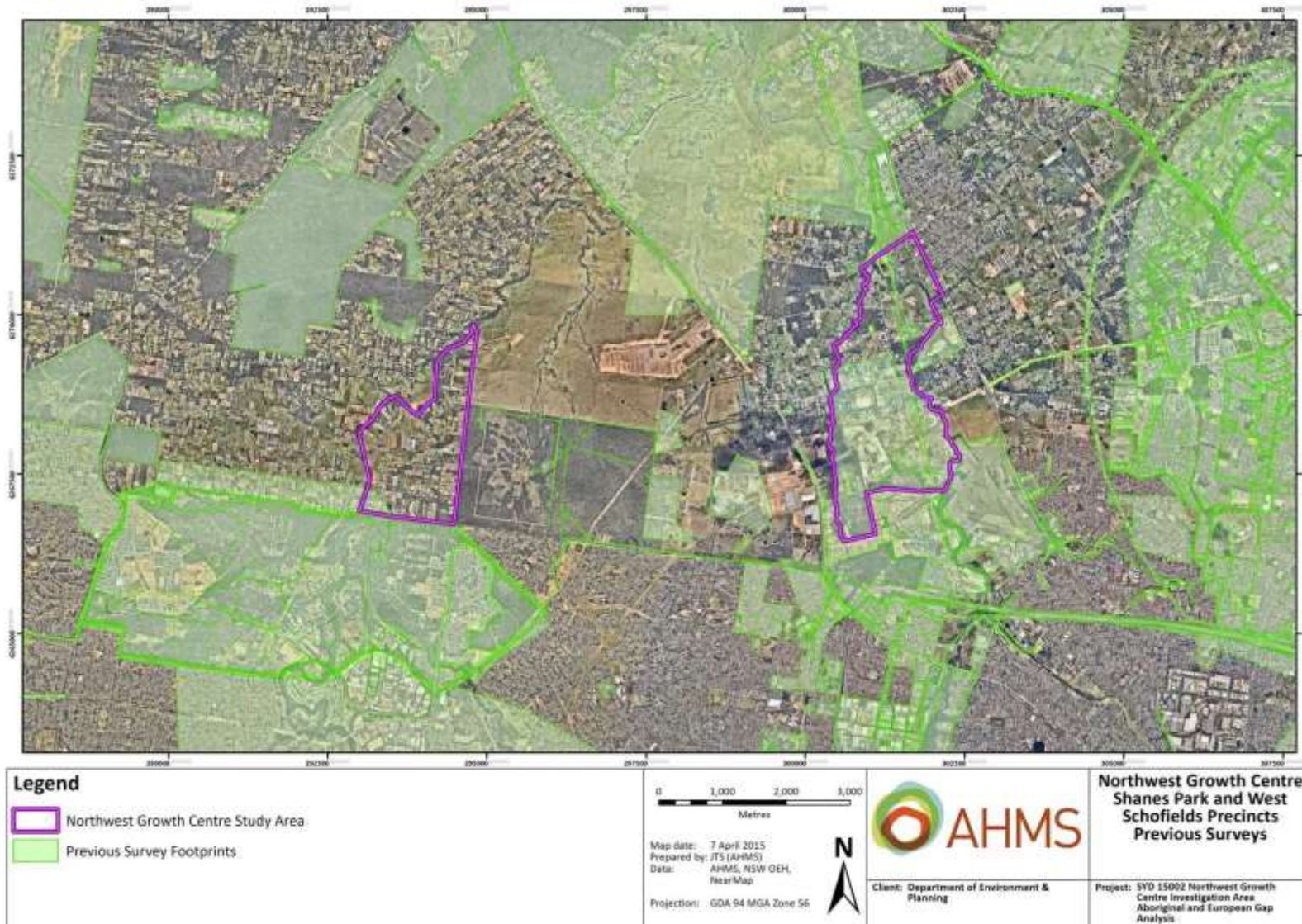


Figure 8. Previous Aboriginal survey areas in the vicinity of the NWGC study area, as carried out for archaeological reporting (based on OEH data).

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Figure 9. Areas of key Aboriginal foci and occupation over the last few thousand years based on a large-scale excavation program by AHMS. Note the largest concentration is situated along Eastern Creek in close proximity to the West Schofields Precinct.

4.3.2 Summary

The following is a general summary of the information obtained from a review of select and key studies about archaeological site patterning across the Cumberland subregion of the Sydney Basin bioregion (**Appendix 4**), and in the vicinity of the two precincts (**Section 4.3.1**).

Archaeological investigation of the subregion has been fairly extensive, especially in areas developed for residential, industrial and land use planning purposes (see **Section 4.3.1**). Investigations have included heritage surveys, test excavations and salvage works. From these studies, numerous archaeological models have been developed.

- The predictive models generally indicate that regardless of landform type, stream order proximity is the primary determiner of the scale and complexity of archaeological sites. The number of sites in a given area and sites with higher stone artefact densities (>100 artefacts per site) occur near high order streams and drainage lines, while less sites in a given area and lower densities of artefacts per site occur near low order streams/drainage lines.
- The excavations and stone artefact assemblages in proximity to higher order streams/drainage lines also show evidence of a variety of tool types and repeated occupation over time, whereas the stone artefact assemblages in sites near low order drainage are less varied (as well as less in number) and appear to indicate more transient and casual occupation. The scale of occupation near higher order drainage lines has been attributed to the greater number of resources in these areas.
- High densities of artefacts have been principally found on lower slopes, alluvial floodplains next to high order streams and on middle to upper ridges. Some of these high density sites show evidence of knapping (stone tool making) activities. However, low density artefact scatters have been found on the surface of all landforms including creek banks, creek terraces, flats, lower and upper slopes, elevated spurs, crests and ridge tops. These results are indicative of a 'background scatter' of occupation occurring across the region with sporadic areas of intensive or repeat usage.
- High density open artefact scatters occur along the major rivers and associated stream/drainage networks. This landform is subject to cyclical flooding which can result in archaeological material being buried by alluvial and colluvial deposits. This means that archaeological material is often not visible on the ground, but can be found in areas of sub-surface exposure, such as those caused by erosion.
- Regardless of landform, it has also been shown that elevation is a more important determining factor in the location of archaeological sites than aspect.
- Analysis indicates that local availability of raw materials is also a key factor in Aboriginal occupation and site distribution. A number of silcrete sources relating to the St Marys formation have been identified in the local area, the nearest of which is Plumpton Ridge, in the south of the West Schofields Precinct. Plumpton Ridge is known to have been a source of raw material for artefact manufacture. Several completed excavations indicate that the use of raw materials from a known quarry was preferred over local river/creek gravels.
- Following the trend of the archaeology of the Sydney Basin, the majority of sites in the subregion typologically date from the mid- to late Holocene (<6,000 years BP).

4.4 AHIMS Data

The AHIMS database is managed by OEH, and includes all spatial and compositional of all Aboriginal objects and sites previously recorded through academic and cultural resource management (see **Appendix 5** for further explanation of site types).

Extensive searches of the Office of Environment & Heritage (OEH) Aboriginal Heritage Information Management Systems (AHIMS) database were carried out on 9 April 2015 (AHIMS Searches #168265, #168267, and #168277) and 10 April 2015 (#168623). A total of 36 previously registered Aboriginal sites were identified in the vicinity of, the two precincts within the NWGC. The count includes sites that plot within 20m of the study area boundary, in order to account for site location data that may have reduced precision arising from conversion between coordinate systems. All of these are open sites, with artefactual material the most frequently recorded site feature (**Table 1** and **Figure 10**). In addition, one culturally modified tree has been registered in the north of the West Schofields Precinct, near Eastern Creek (EC2 - Schofields Eastern Creek 2; AHMIS Site #45-5-2611), in a forested area with remnant Shale Plains Woodland. One PAD has also been registered on a minor, unnamed tributary of Eastern Creek (PAD 1037-6; AHIMS Site # 45-5-4095).

It should be noted that although it is not registered on the AHIMS database, it is possible that an Aboriginal burial ground is located within the West Schofields Precinct (see **Section 4.2.2**).

Table 1. Aboriginal sites summarised by site feature, see also Figure 9.

Site Feature	Site Count	Total (%)
Artefact	34	94.44
Modified Tree (Carved or Scarred)	1	2.78
PAD	1	2.78
Total	36	100

The range of site features recorded within the Shanes Park and West Schofields Precincts is representative of those in the North West Growth Centre, the majority of which are artefactual (either artefact scatters or isolated finds), followed by PADs and scarred trees. The distribution of previously identified sites in the Shanes Park and West Schofields Precincts is likely to reflect the location and intensity of previous Aboriginal heritage surveys, rather than accurately represent patterns of past Aboriginal occupation of the landscape.

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Figure 10. Aboriginal heritage site features recorded in the AHIMS database within the NWGC study area, including 20m buffer.

4.5 Predictive Model

Archaeological predictive models identify, locate and map where archaeological resources are likely to survive. They can apply to small single sites or large areas, and can be simple exercises or enhanced by the use of specially designed GIS based spatial models.

This section provides a summary of the predictive model created for the two precincts. Further details regarding the background, development, testing and limitations of the model is presented in **Appendix 6**.

The final model for the Shanes Park and West Schofields precincts of the NWGC is shown in **Figures 11-13**. The final model has been developed using a series of ‘environmental’ and ‘archaeological’ variables to predict the archaeological potential across the subject area. **Appendix 6** provides more detailed information on the specific variables that needed to be present to classify an archaeological probability ranking for any given area. Existing disturbance also played a role. In contrast, areas identified as of very low archaeological classification were considered areas that did not retain any of those variables. Overall, the model identifies between 15 and 53% of the precincts land area as of moderate or high potential to contain Aboriginal cultural heritage (**Table 2**).

Table 2. Percentage and area of the Shanes Park and West Schofields Precincts for each category of Aboriginal heritage potential.

Ranking	% of Land	Area (km ²)
Negligible	15.95	1.43
Low	30.86	2.76
Moderate	38.14	3.41
High	15.05	1.35
Total	100	8.95

Once the model was developed, it was tested using a ‘test set’ of known archaeological sites, the entire dataset and comparisons with other models of the region (**Appendix 6**). The testing indicated that the model predicts archaeological material with 65% accuracy when considering the zones of moderate and high ranking, but ~84% when incorporating the low ranking as well. A comparison with regional models developed by OEH produced similar results and confirmed the reliability to the model produced here.

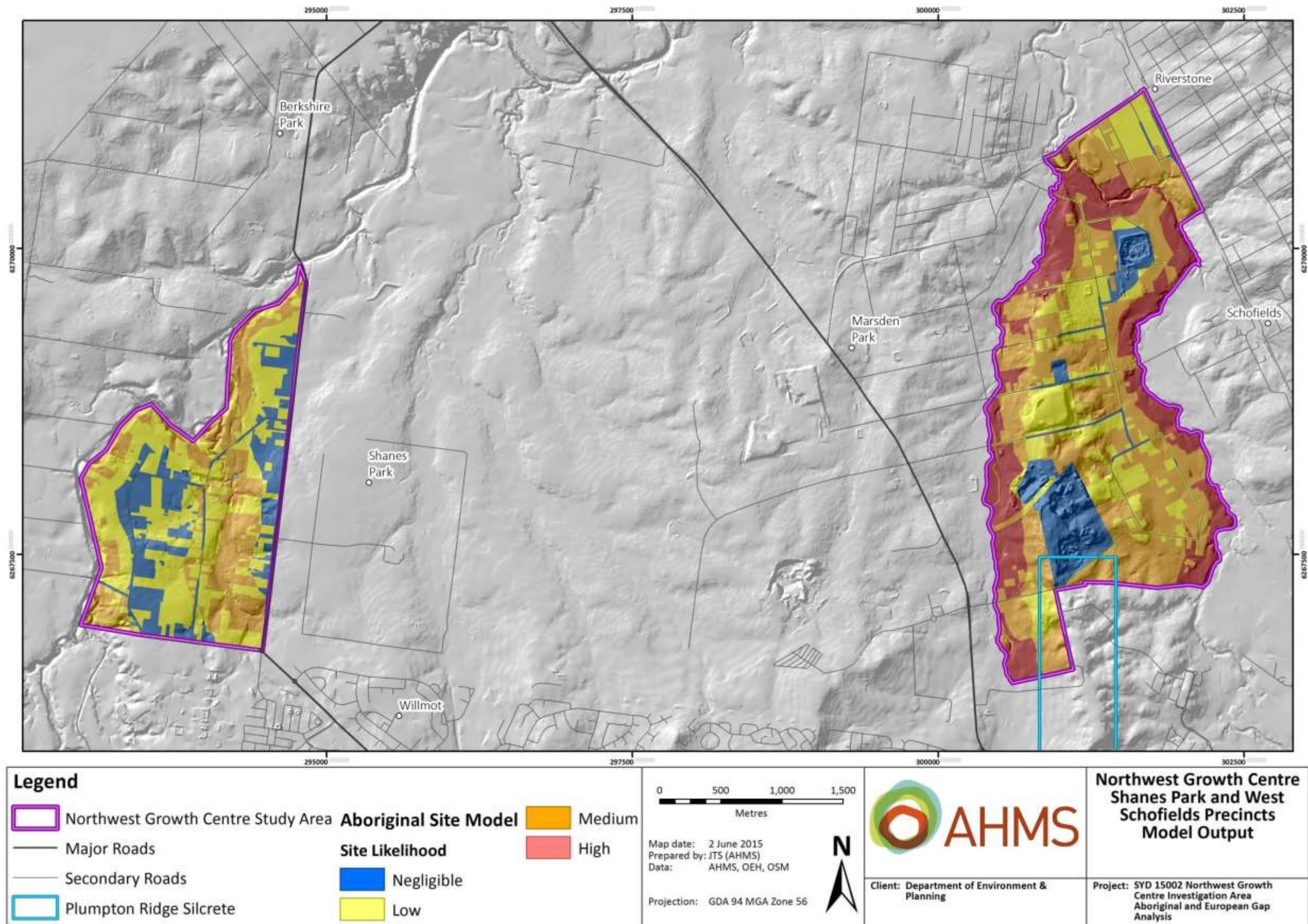


Figure 11. Composite predictive model of archaeological sensitivity for NWGC study area. Note that while Plumptown Ridge is a widely known and mentioned significant raw material resource situated in the West Schofields Precinct, it is poorly documented in the AHMS database. Since the model utilised information from this database, the resource is under-represented in these models. It is shown here in a blue box.

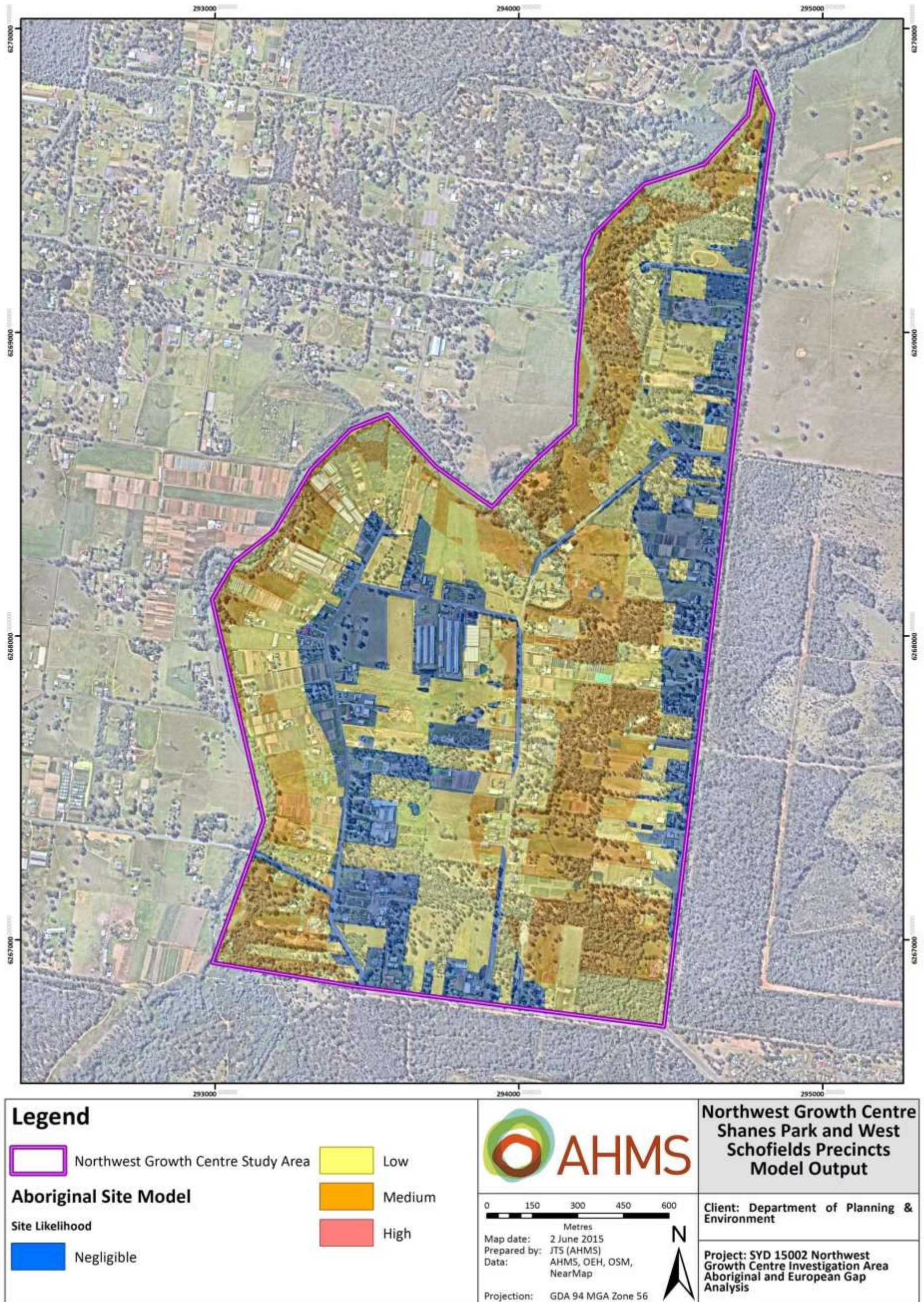


Figure 12. Composite predictive model of archaeological sensitivity for the Shanes Park Precinct.

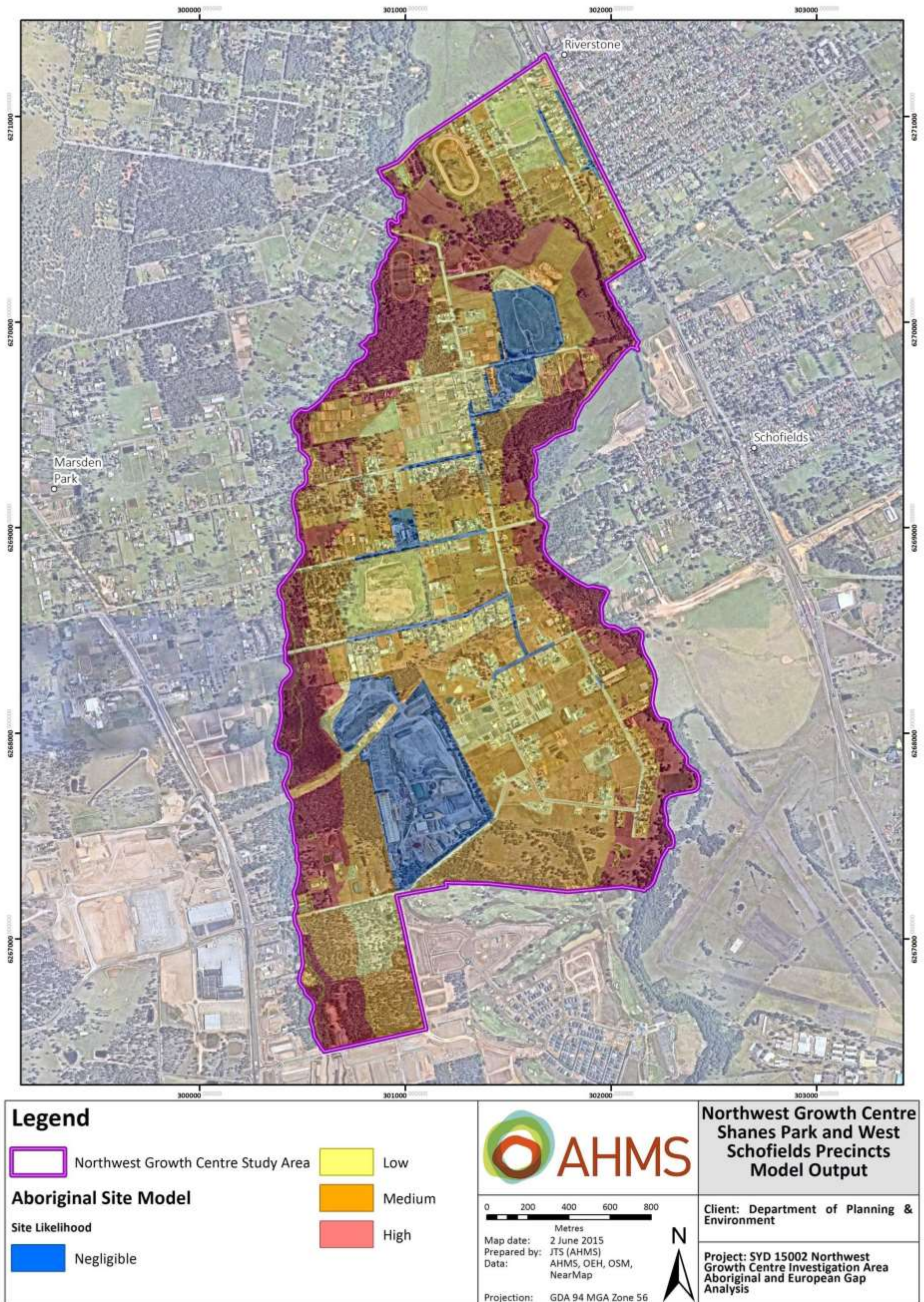


Figure 13. Composite predictive model of archaeological sensitivity for the West Schofields Precinct. Note that while Plumpton Ridge is a widely known and mentioned significant raw material resource situated in the West Schofields Precinct, it is poorly documented in the AHIMS database. Since the model utilised information from this database, the resource is under-represented in these models.

5 GAP ANALYSIS

This section provides a gap analysis of the Aboriginal and historical heritage for the Shanes Park and West Schofields Precincts of the NWGC. It includes sections that summarise what we know about the distribution of heritage items, sites and zones of potential within the study area, highlights areas of high heritage risk, and areas where no investigation has previously occurred.

5.1 Summary of the Findings

Based on **Sections 2-4**, the following summary of the Aboriginal and historical heritage of the Shane Park and West Schofields precincts can be identified.

The preliminary history included here demonstrates the early agricultural expansion outside the early colony of Sydney, as well as the associated infrastructure required to support such pastoralism. The agricultural/pastoral mix of the area changed through the 19th century, with the inclusion of industry that supported the burgeoning colony as the population grew. This rural nature was largely maintained until the post-WWII period when the area was increasingly settled, however, even with this expansion the rural to semi-rural nature was largely maintained.

There are no listings on the WHL, NHL or CHL within the two precincts. The SHR, RNE, SHI and National Trust listings for the region reflect the rural environment. The listings, while not in the study areas themselves, relate to large and small scale agricultural/pastoral establishments.

While there are no listed historic sites within the two precincts this appears to be the product of an absence of investigation rather than an absence of sites. A brief examination of a small dataset has indicated that in the West Schofields Precinct there are a number of localities that are worthy of further assessment. These include:

- The site of 'Wilmington'- a large estate associated with the Marsden and Betts families
- The site of the early nineteenth century horse stud
- Several small cottages dating between 1815 and 1840.

The degree to which any of these elements survive has not been determined.

In regard to the Shane's Park Precinct there is again an absence of listed sites despite the fact that this parcel of land formed part of one of the earliest land grants in the region – John Harris' 'Shane's Park' Estate.

Environmentally, the two study areas are characterised by the Cumberland Plain subregion and from an Aboriginal heritage perspective are archaeologically similar to the surrounding North West, and South West Growth Centre. The precincts have several key waterways, including South Creek, Ropes Creek, Eastern Creek, and Bells Creek, and therefore have potential for significant cultural sites along these, akin to those found elsewhere along Second Ponds Creek and the Hawkesbury River. Recent work by AHMS in the Schofields Dairy Corporation site, and the Colebee release area, suggest the banks of Eastern Creek contain extensive cultural material (numbering in the tens of thousands of stone tools) and are some of the most important deposits currently known in the Cumberland Plain.

Two other areas of key importance were also identified in relation to Aboriginal heritage, Plumpton Ridge and a possible pre-contact Aboriginal cemetery. Plumpton Ridge is a well-referenced, raw material resource used by Aboriginal people over the last few thousand years (and possibly longer) for stone tool production. In other studies, it has been considered of both high cultural and scientific significance. It is the likely source of the vast majority of Aboriginal stone tools found across the

Cumberland Plain. Its general extent is poorly understood, but it probably runs along the centre of the West Schofields precinct, and has been impacted in several areas to the south by extractive industries. Despite its importance, no accessible data was available for this report that documents the full extent of this site in detail. The Aboriginal cemetery is actually not documented in the AHIMS database, but is shown in several early historical maps as being situated in the vicinity of Angus, Kerry and Durham Streets (in the eastern central part of the West Schofields precinct). Such a site if it remains intact would be of exceptional cultural and scientific significance.

Currently, 36 Aboriginal objects/sites have been documented in the vicinity of the Shanes Park and West Schofields precincts. Known sites are clustered consistent with the limited compliance-based archaeological investigations that have occurred, but their distribution also suggests some other patterns. Specifically, the Cumberland Plain subregion, encompassing much of the study area, is dominated by surface and sub-surface artefactual material generally found within 200m of the larger river systems within the region. Distances of sites up to 500m away are documented, but remain relatively sparse.

Based on a limited review of heritage studies, and the archaeological predictive modelling, there is high potential for Aboriginal objects/sites to occur along the banks of South Creek, Ropes Creek, Eastern Creek, and Bells Creek. There is also limited potential for culturally modified (scarred) trees to be present in areas with remnant native vegetation.

Aboriginal consultation has been undertaken, including a series of cultural mapping workshops with a selection of stakeholders. Seven areas of cultural value were identified within, or in close proximity to the two precincts, as well as general areas considered to have a prevalence of cultural material.

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Key Constraints

The following highlights areas that are likely to form key constraints for any future development. That is not to say that development would not be feasible, but that significant further investigation, mitigation measures and conservation would likely be required.

- A CHL-listed site, the Llandilo International Transmitting Station, was located adjacent the eastern edge of Shane's Park precinct. While the site is not within the precinct, there may be constraints associated with viewsheds or encroachment onto the site's buffer. Such constraints are likely to be very low. The core of the Llandilo International Transmitting Station is obscured by two broad buffers of re-growth. There are no significant view lines from the facility or to the facility. The Llandilo International Transmitting Station site has some heritage significance associated with the post-1959 operation of this important telecommunications facility. These values rest with the core building complex and mast. The current listings are mainly in regard to the woodland and eco-system that has developed as a result of the reduced operation of the facility. Recommendations for the management of this site are outlined below.
- The potential historic archaeological resource is generally poorly understood. Areas of this region were settled from an early period and the potential for early settlement sites must remain high. These sites are often of high significance and can impose significant constraints to any development in this vicinity.
- From an Aboriginal heritage perspective, areas within 200m of any waterway are likely to contain extensive and/or significant cultural material. This is especially the case along the Eastern Creek, Bells Creek and South Creek. Recent finds along the banks of Eastern Creek at Colebee release area and within the Schofields Dairy Corporation have recovered some of the most extensive and significant archaeological sites in the Cumberland Plain;

and any development encroaching into these areas (e.g. water infrastructure works), would be subject to extensive and costly sub-surface archaeological works.

- Historical records have revealed a potential pre-contact Aboriginal cemetery ('Burial ground of the Blacks') on the western portion of Joseph Pye's 'Waaraa Warara' Estate in the vicinity of Durham, Angus and Kerry Roads, between Bells Creek and Eastern Creek. Specific information on this site could not be obtained for this report, but if present this site would be of exceptional cultural and scientific significance. It is considered unlikely that any development in the vicinity of the site would be feasible, and a large buffer would likely be required. The identification of this site is a critical issue to any future planning of the West Schofields precinct.
- A well-known, silcrete raw material source - Plumpton Ridge - is located within the West Schofields precinct. Based on existing data, the source is primarily situated in the southern parts of the precinct, but silcrete is found throughout the region, and it is likely to be more widespread across the precinct. This site is considered likely one of the main resources used by Aboriginal people for tool production in the last few thousand years, and is considered of high cultural and scientific value. This is made all the more so by a number of high-profile legal cases exploring the site in the 1990s. Any development in these areas would likely be subject to extensive and costly archaeological programs, with the need for extensive conservation a probable outcome. The extent of the silcrete ridge requires detailed mapping and documentation.

5.2 Areas where research has yet to occur

There are a number of gaps in both geographic coverage of past studies and in the information that was available for this gap analysis. Further work needed in relation to the Shanes Park and West Schofields precincts is indicated below.

Due to the limited timeframe available for this study the review of historic heritage reports while thorough is not regarded as exhaustive and further information may emerge as investigation of these precincts progresses. This will be built on in subsequent stages of this project.

Blacktown LGA has been subject to a Heritage Study (1988) and an Aboriginal Archaeological study of Aboriginal sites (1986), and subsequent reviews. These have provided opportunities for Council, planners and selected consultants to survey, review and assess the heritage significance of items in the LGA. The Heritage Study review has provided the opportunity to rationalise the listings for the LGA through removal of demolished structures or duplications of listing. It establishes and highlights local historic themes relevant to each LGA. However the Heritage Study, while addressing the built heritage aspects of the LGA, does not adequately address the archaeological sensitivity of their respective areas. Some archaeological sites are noted in the Draft LEP (2013) but none, specifically, in the Shanes Park and West Schofields precincts. The assessment of these sites extends beyond the scope of the Gap Analysis but they suggest that a more detailed analysis would determine accurate locations, significance and potential survival of archaeological remains that would be covered by the heritage Act 1977. An Archaeological Zoning Plan should, therefore, be completed for the Shanes Park and West Schofields precincts in a similar manner and scale to the Parramatta Historical Archaeological Landscape Management Survey (PHALMS <http://sydney.edu.au/arts/timemap/examples/PHALMS.shtml>). An AZP would provide a greater degree of certainty in regard to development options. The AZP recommendations may range from in situ conservation of sites (excluding particular locations from development completely), to archaeological

management and mitigation that may include formal excavation, monitoring, salvage or archaeological testing. The AZP would also define curtilages associated with potential sites.

The gap analysis has indicated (in regard to historical heritage) that further, detailed analysis of the sites identified by this study would help determine the appropriate management strategy for these locations. Possibly the largest 'gap' for both precincts is the absence of data gathered through detailed investigation of the precincts.

A selection of Aboriginal heritage assessments was reviewed as part of this study. This will be supplemented in later stages of the project, as further documentation becomes available.

Previous Aboriginal heritage assessments within the Shanes Park and West Schofields precincts have been limited. The majority of studies have been focussed towards the south of the West Schofields precinct and/or have been for small scale development proposals and therefore reflect only isolated patches of on-site assessment. Further, most of the assessments are quite dated (often written pre-AD2000) and do not conform to current guidelines. It is considered that more detailed investigation for both precincts but especially, the West Schofields Precinct, would be essential prior to any form of development planning.

Sections of the study area have yet to undergo any Aboriginal heritage investigation, including most of the Shanes Park precinct, and the northern part of the West Schofields precinct. Parts of these areas, particularly in the north of West Schofields, are considered likely or very likely to contain highly significant Aboriginal sites.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Report Summary

Based on the review undertaken it is clear that there has only been limited Aboriginal and historic heritage investigation in the Shanes Park and West Schofields precincts to date. Many of the reports do not conform to current guidelines. It is therefore likely that any future planning and development would need to incorporate heritage investigation from a very early stage.

In relation to areas of key constraint, they are highlighted in **Section 5.2**. In brief, the two precincts are similar in environment and landscape to the wider Cumberland Plain within which the overall North West and South West Growth Centres are currently situated. It is considered likely that the heritage concerns previously identified in those areas would be similar in these precincts. Specifically, it is likely that extensive and/or significant Aboriginal sites would be prevalent along the large river systems and their riparian corridors throughout the precincts. Based on modelling, key areas occur along Eastern Creek and Bells Creek especially. The review suggests that significant development constraints may be present across the West Schofields precinct, with the presence of a known culturally and scientifically important raw material resource (Plumpton Ridge), and the historical reference to a pre-contact Aboriginal cemetery in the eastern quadrant of the precinct and these two issues require early investigation to understand what, if any, constraints they pose. Recent discoveries along the Eastern Creek demonstrate that this corridor contains some of the most significant archaeological deposits in the Cumberland Plain, and extensive archaeological programs, along with conservation, would likely be required for any form of development in these areas.

Notwithstanding the above constraints and limitations, it appears likely that areas free of, or with minimal, cultural heritage constraints would be developable across much of the Shanes Park precinct, and parts of West Schofields precinct.

6.2 Future Direction

Based on the analysis here, there are several future directions to enable the successful re-development of Shanes Park and West Schofields precincts. In accordance with other priority growth areas, further site specific assessment would be required. While this report provides most of the background and a good foundation for the precincts, there is further need for Aboriginal consultation, and more detailed assessment with a focus towards on-site investigation. This should at the very least include surface survey, but ideally should also include sub-surface investigation extent of archaeological deposits, which are known to be widespread, significant and focussed on creeklines in this region.

While, the archaeological models of the northwest Cumberland Plain are well understood, and sub-surface investigation is not essential prior to re-zoning, it is usually a pre-requisite for OEH prior to determining any Aboriginal Heritage Impact Permits (AHIP). It is considered likely that such permits would be required for both precincts prior to development. It is recommended that close liaison between DPE and OEH is undertaken to determine what level of assessment is required within the two precincts to allow re-zoning, and subsequent approvals, especially given the scale of work already undertaken in the region. Further discussion is undertaken on this below.

The review here suggests that Shanes Park is likely to have fewer Aboriginal and historic heritage issues, than West Schofields. It is therefore suggested that Shanes Park is assessed and re-zoned ahead of West Schofields, where more time is likely to be required to identify and resolve constraints.

It is recommended that prior to the wide-scale assessment of either precinct, or any proposed re-zoning options that the following tasks are implemented as soon as possible:

1. Shane Park: A Statement of Heritage Impact (SoHI) is required to determine whether there would be any development constraints associated with the adjacent Llandilo International Transmitting Station. The SoHI would identify the values of the transmitting station, and determine whether direct, or more likely indirect, impacts from the future development of Shanes Park would affect its existing values. If such impact is identified, consideration to modifying the development would be required, or alternatively a referral for such impact would need to be lodged with the Commonwealth Department of Environment for consideration in accordance with the *Environment Protection and Biodiversity Conservation Act 1999*. It is considered that 3-4 months would be required to undertake the investigations; and likely 6-12 months if referral and subsequent approval is needed.
2. West Schofields: The identification of a possible Aboriginal burial ground in the eastern quadrant of the precinct is essential prior to any re-zoning or re-development. This site would be of high cultural and scientific significance, and almost certainly require conservation. Further investigation would need to include initially archival research and geo-referencing of historical maps to try and constrain the general area of the site. Aboriginal consultation may also assist in narrowing down the location. Once achieved, site investigation to determine the location and extent of the burial ground is essential. This may include survey of the area to identify any extant features (scarred or marked trees, engravings on rocks, etc), non-invasive investigation (e.g. Ground penetrating radar, magnetometry, etc), and excavation to confirm any non-invasive findings and/or identify cultural material present. Any form of invasive investigation (which at some point is likely to be required) would require an AHIP (for testing), and therefore some form of Aboriginal Cultural Heritage Assessment Report to be developed. It is considered that 6-12 months would be required to undertake the investigations.
3. West Schofields: The characterisation of the quarry site of Plumpton Ridge is required. While widely known in archaeological circles as an important cultural resource for stone tool production across the northwest Cumberland Plain, the actual extent and condition of the ridge is poorly understood. Generally, it appears to be situated south of the precinct, but the ridge landform extends throughout the precinct, and the site may similarly extend accordingly. The site is of high scientific and cultural significance, made all the more so by its piecemeal destruction from quarrying, landfill and road construction over the last 20 years. Initially, there is a need to compile previous existing reports and studies on the site, which has been sporadically investigated for over 20 years. Once, this has been done, a site investigation focussing on silcrete deposits along the ridge is required to determine whether parts of the site are present within the precinct, and assess their significance. It is considered likely that should such deposits be found, conservation of at least a portion of them would be required. These investigations could be combined with (2) above, and would require 4-6 months to complete.

6.3 Approval Process

The requirement for Aboriginal Heritage Impact Permits (AHIPs) to allow for the destruction of Aboriginal objects prior to development, so that the process is not in breach of the *National Parks and Wildlife Act 1974* can involve significant time frames that contribute to the lengthy time needed to re-zone and release priority growth areas.

AHIPs are generally obtained by the individual property developers following the precinct release. This may significantly delay the on-selling of land, and adds to OEH's workload in assessing multiple applications often for adjacent properties. This was a key issue raised in AHMS' review of the DPE

processes in 2013 (AHMS, 2013a), and has yet to be adequately resolved. As a subsequent part of this project, AHMS will be exploring legislative and approval pathways on this issue and the potential for obtaining AHIPs across whole precincts or other large areas of land.

The initial stages of this analysis indicates that there are five key issues that need to be considered with the existing AHIP process as required by OEH to assist in stream-lining development:

1. the amount of information that OEH requires to determine the extent of potential impacts to Aboriginal heritage, and whether the precinct wide studies currently undertaken can achieve this.
2. the need for access to individually owned properties to carry out assessments to obtain an AHIP. In some cases the precincts can include several hundred individual landowners.
3. currently OEH requires that landowners consent to AHIP applications although we note that there is no legislative or regulatory requirement that the landowner provide consent.
4. the AHIP is connected to the applicant not the land, and therefore unless DPE is undertaking the development, it would still result in administrative requirements and time-delays to change the AHIP holder when the land is passed on (it is also unclear how many applicants can be included on an AHIP). However, we note that the transfer of an AHIP to one landowner to another is not as difficult after the 2010 amendments to the legislation. We are currently investigating the circumstances in which section 90R of the *National Parks and Wildlife Act 1974* can apply, and which refers to some AHIPs running with the land.
5. OEH policy is, in general, not to grant an AHIP application until a formal development approval is obtained, although in some instances indicative layout plans have been considered adequate (e.g. East Leppington growth centre precinct).

Our initial investigation suggests that the applicant should work closely with OEH. This will ensure that OEH can clearly qualify and quantify what is required in the broader planning context, so that requirements are consistent with the legislation and the regulations.

An alternative to applying for AHIPs is the declaration of parts or all, of the works under Part 4, Division 4.1 (State Significant Development) or Part 5, Division 5.1 (State Significant Infrastructure or Critical State Significant Infrastructure) of the *Environmental Planning and Assessment Act 1979*. For State significant development and State significant infrastructure the provisions of the *National Parks and Wildlife Act 1974* do not apply and there is no requirement for AHIPs., Dependent on the specific Secretary Environmental Assessment Requirements (SEARs) relating to the project this may require less upfront archaeological field investigation but with subsequent stages of heritage investigation, salvage and interpretation as the project develops. However the benefit of this process in terms of cultural heritage outcomes may be variable.

The declaration of an area as State significant infrastructure, or critical state infrastructure may be suitable for the necessary government infrastructure, which is often in similar locations and has been spatially constrained through the Structure Plans. Part 5.1 also removes the need for landowner consent, when the proponent is a public authority which for infrastructure corridors is often the NSW Government.

There are other options, but they may require legislative or regulatory amendments. A few examples may include:

- The development of heritage offsets, similar to the now well-established biodiversity certification may be one option, whereby priority growth areas are allowed large-scale destruction of Aboriginal heritage, as long as comparable areas of value are retained.

- The inclusion of access onto private property for cultural heritage investigations.
- Modifications to the *National Parks and Wildlife Regulations 2010* and/or OEH guidelines to revisit the requirements of an AHIP. Such changes may include eliminating the need for landowner consent; the ability to have applicants added to the AHIP; or the development of a staged AHIP, which provides over-arching approval for impact based on precinct wide studies, with subsequent work to refine any findings as the development progresses.

6.4 Recommendations

It should be noted that the following tasks are yet to be completed to the level required to adequately address cultural heritage concerns.

- Consultation with the Aboriginal community should be maintained and opportunities provided to build on the cultural values layer.
- Areas which have been identified by the Aboriginal community should form the focus of subsequent research to ensure they are managed appropriately in any future development context.
- The review here was necessarily brief due to project timeframes, but has highlighted the lack of up-to-date or comprehensive assessments for any part of the precincts. Further investigation of previous studies and databases, and the development of new assessments should be undertaken on individual locations or precincts when they are proposed for planning and development.
- Several key constraints have been identified, and this report provides future direction on their management in **Section 5.2**. These tasks should be implemented at least 6-12 months prior to the overall re-zoning program for the precincts.
- Several Section 170 registers could not be accessed as part of this gap analysis. DPE should contact the respective State Government agencies and request their data to assist future planning and development. If these become available these can be integrated into the project mapping during later phases of this project.
- Broader regional archaeological studies and research frameworks should be completed to assess and manage the archaeological statutory requirements of the two precincts.

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Appendix 1: Existing Environment

A1 Existing Environment

A1.1 General

Describing environmental characteristics is an essential initial step in identifying how people used land in the past, and establishes a context for identifying the archaeological potential of any given area. It also assists to explain why certain historical events may have occurred and why certain historical themes may apply or dominate in a particular area. The environmental context of the NWGC is discussed below.

A1.2 Bioregions

The NWGC is located within the Sydney Basin Bioregion, on the central east coast of NSW. Bioregions are large, geographically distinct areas that are distinguished from one another based on differences in geology, landform patterns, climate, ecological features and plant and animal communities. Bioregions are often further classified into finer-scale subregions, with localised differences in geomorphology and vegetation (Thackaway and Crasswell 1995). The NWGC is part of the Cumberland subregion, which is characterised by low rolling hills and wide valleys on Triassic Wianamatta group shales and sandstones (**Figure A1**) (Morgan 2001).

From a historical perspective, the Cumberland subregion was suitable for settlement and pastoralism in the 19th Century. The large river systems running through the Cumberland subregion would also form key resources along which Aboriginal activity would likely have occurred.

A1.3 Soils

Within the Cumberland subregion, red and yellow texture contrast soils typically occur on slopes, becoming harsher and sometimes affected by salt in tributary valley floors. Pedal uniform red to brown clays occur on volcanics. Poor uniform stony soils, often with texture contrast profiles, are present on older gravels, and high quality loams on modern floodplain alluvium (Morgan 2001).

These types of soils are often shallow, and can be significantly disturbed by historical and modern activities. This has significant implications for the survivability of historical and Aboriginal deposits. Further, it is rare for these types of soil to contain significantly deep, stratified or old archaeological deposits except in the depositional contexts such as the South Creek soil landscape.

The study area encompasses the alluvial South Creek and Berkshire Park landscapes, and the residual Blacktown landscape (**Figures A2 and A3**) (OEH 2015).

South Creek

The South Creek soil landscape incorporates the active floodplain of the drainage networks of the South Creek system (within the Shanes Park precinct), and Eastern Creek system (West Schofields precinct). It is characterised by layered Quaternary alluvial sediments of variable depth, derived from Wianamatta Group shales and Hawkesbury Sandstone parent material. This soil landscape is dynamic and frequently inundated, with many areas of erosion and deposition. Streambank and sheet erosion of the floodplain are common.

These types of soil have greater potential to contain deeply stratified and old cultural materials - usually of greater scientific significance.

Berkshire Park

The Berkshire Park soil landscape is characterised by dissected, gently undulating low rises on the Tertiary terraces of the Hawkesbury-Nepean River system. It comprises weakly pedal orange heavy clays and clayey sands formed from three depositional phases of Tertiary alluvium/colluvium; the St Marys formation, Rickabys Creek Gravel formation, and Londonderry Clay formation. Total soil depth is generally less than 450cm.

Stone materials suitable for flaking, including pebbles, cobbles and occasional large boulders (up to 20cm in size) of silcrete, silicified wood, quartzite and quartz, occur within the sand/clay matrix of these formations. Plumpton Ridge, a low rise in the south of the West Schofields precinct, is part of the St Marys formation, and is known archaeologically as an Aboriginal silcrete quarry (**Figure 2**). Porphyry, hornfels and tuff are also known to occur in the Rickabys Creek Gravel formation (Attenbrow 2010: 43-44).

These types of soils are often shallow, and can be significantly disturbed by historical and modern activities. This has significant implications for the survivability of historical and Aboriginal deposits. Further, it is rare for these types of soil to contain significantly deep, stratified or old archaeological deposits.

Blacktown

The Blacktown soil landscape occurs extensively across the Cumberland subregion, and is characterised by low hills and rises with broad rounded crests and ridges on Wianamatta Group Shale. It comprises shallow to moderately deep (<150cm) soils on crests, upper slopes and well-drained areas. Deep (150-300cm) soils occur on lower slopes, drainage depressions and in localised, poorly drained areas. Topsoils reach a depth of up to 30cm, and contain significant sand and silt content overlying hard-setting clay subsoils.

In most areas, soil deflation and erosion tends to expose, rather than bury, former land surfaces on which stone artefacts may have been deposited (this is a contributing factor to the large number of Aboriginal artefacts recorded as surface finds on this soil type across western Sydney). These types of soils are often shallow, and can be significantly disturbed by historical and modern activities. This has significant implications for the survivability of historical and Aboriginal deposits. Again, it is rare for these types of soil to contain significantly deep, stratified or old archaeological deposits.

A1.5Vegetation

Remnant vegetation communities within the study area include Shale Plains Woodland, Alluvial Woodland, and Shale/Gravel Transition Forest. These communities would have covered much of the study area at the time of European contact, and were the most common type of native vegetation in the Cumberland subregion. However, they have been extensively disturbed by land clearance and weed invasion, and now occur mostly as small and fragmented patches (**Figures A4 and A5**) (Department of the Environment, Water, Heritage and the Arts 2010:4-5).

From an Aboriginal heritage perspective, remnant and old vegetation is important for two reasons: 1) it is in these locations that culturally modified trees (if present) may be found; and 2) these areas have been subject to fewer disturbances in the last 200 years than other parts of the study area. Native vegetation typical of the Cumberland subregion is outlined below (**Table A3**).

Table A3 Native vegetation in the Cumberland subregion (after Morgan (2001); The Royal Botanic Gardens and Domain Trust (2015))

Location	Vegetation
Shale hills	Grey box (<i>Eucalyptus moluccana</i>), forest red gum (<i>E. tereticornis</i>), narrow-leaved ironbark woodland with some spotted gum (<i>E. crebra</i> , <i>Corymbia maculata</i>)
Alluvial sands and gravels	Hard-leaved scribbly gum (<i>Eucalyptus sclerophylla</i>), rough-barked apple (<i>Angophora floribunda</i>), and old man banksia (<i>Banksia serrata</i>)
River flats	Broad-leaved apple (<i>A. subvelutina</i>), cabbage gum (<i>E. amplifolia</i>) and forest red gum with abundant swamp oak (<i>E. tereticornis</i> , <i>Casuarina glauca</i>)
Lagoon and swamps	Tall spike-rush (<i>Eleocharis sphacelata</i>), and juncus (rushes) with Parramatta red gum (<i>E. parramattensis</i>)

A1.6 Hydrology

The NWGC is located within the South Creek sub-catchment of the Hawkesbury-Nepean River system. Major watercourses in the vicinity of the subject area include South Creek, Ropes Creek, Eastern Creek and Bells Creek (**Figure 3**).

South Creek rises near the north east of Narellan and flows generally north through the Cumberland subregion to Windsor. It forms the western boundary of the Shanes Park precinct, between Palmyra Avenue and Sirius Place. The confluence of South Creek and Ropes Creek, one of its major tributaries, is in the south of the Shanes Park precinct between Eighth Avenue and the Wianamatta Regional Park. Eastern Creek, another major tributary, rises near Prospect and also flows in a northerly direction before joining South Creek at South Windsor. It forms the eastern boundary of the West Schofields precinct between Colebee and Garfield Road West, Riverstone. Bells Creek flows in a north-easterly direction along the western boundary of the West Schofields precinct, and joins Eastern Creek in the north of the precinct.

These large watercourses would have been key resources for both Aboriginal and historic settlement and movement through the NWGC. As such, these watercourses are highlighted throughout the report as of key importance.

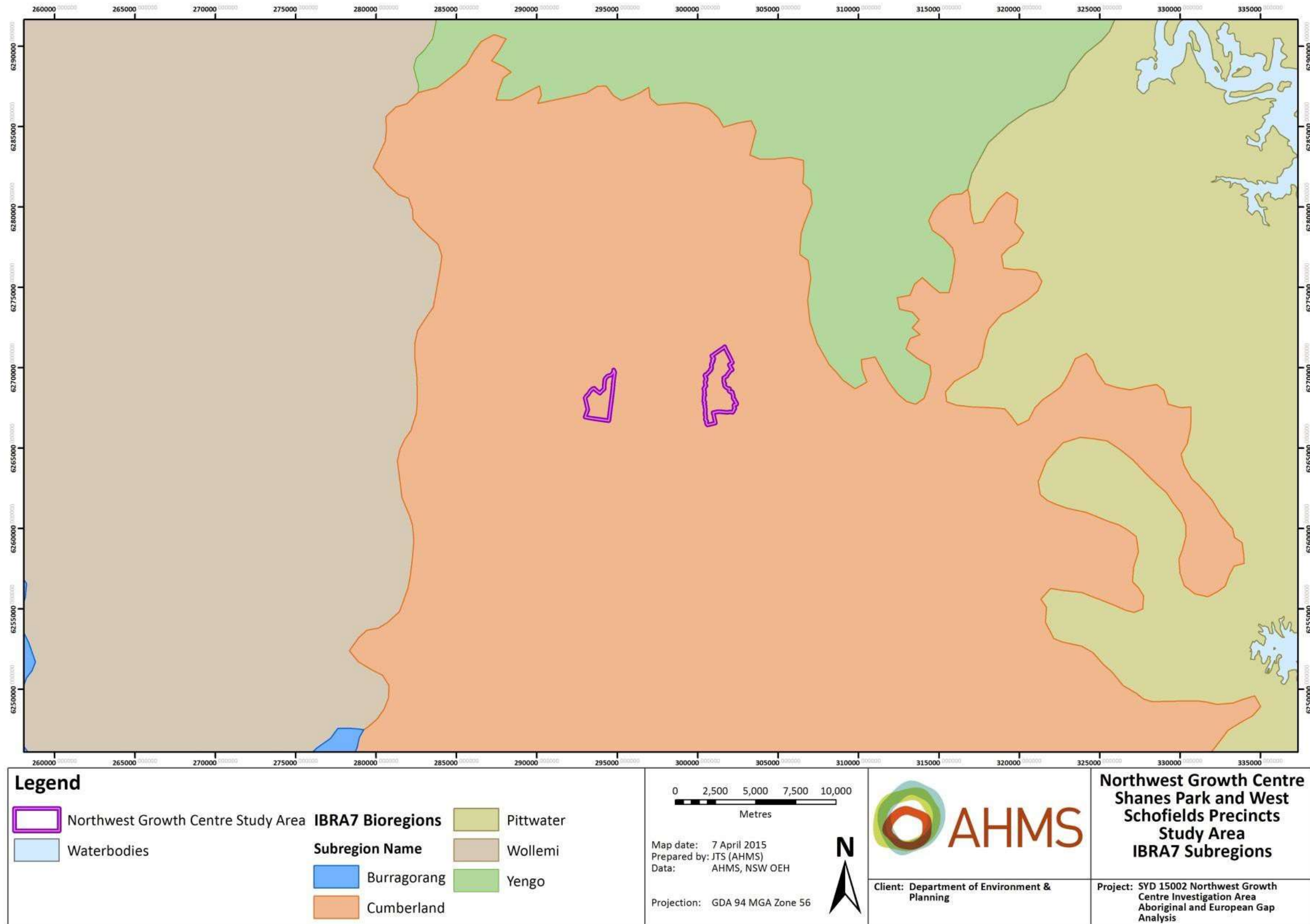


Figure A1. Subregions of the Sydney Basin Bioregion in the vicinity of the NWGC study area.

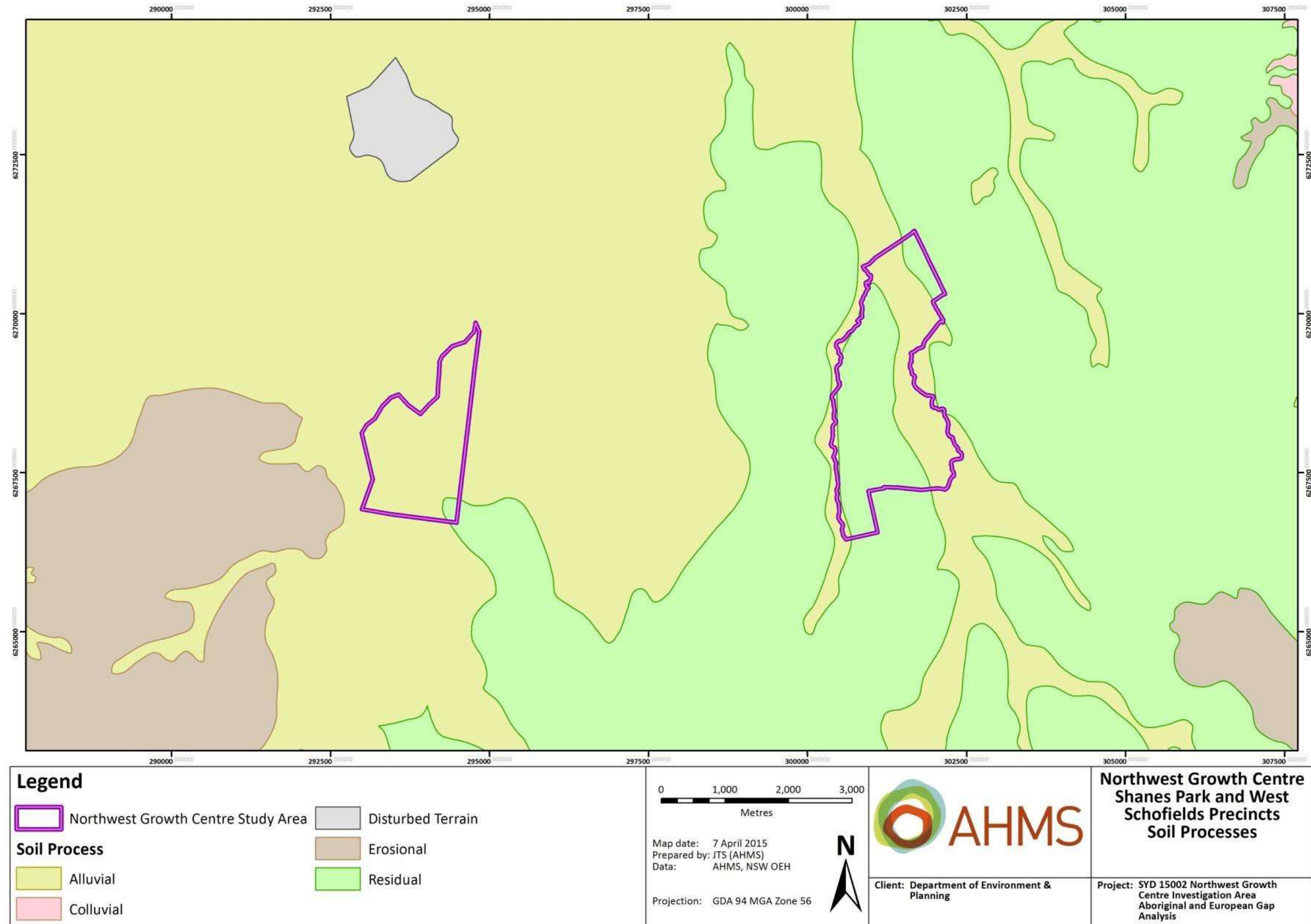


Figure A2. Soil processes in the vicinity of the NWGC study area.

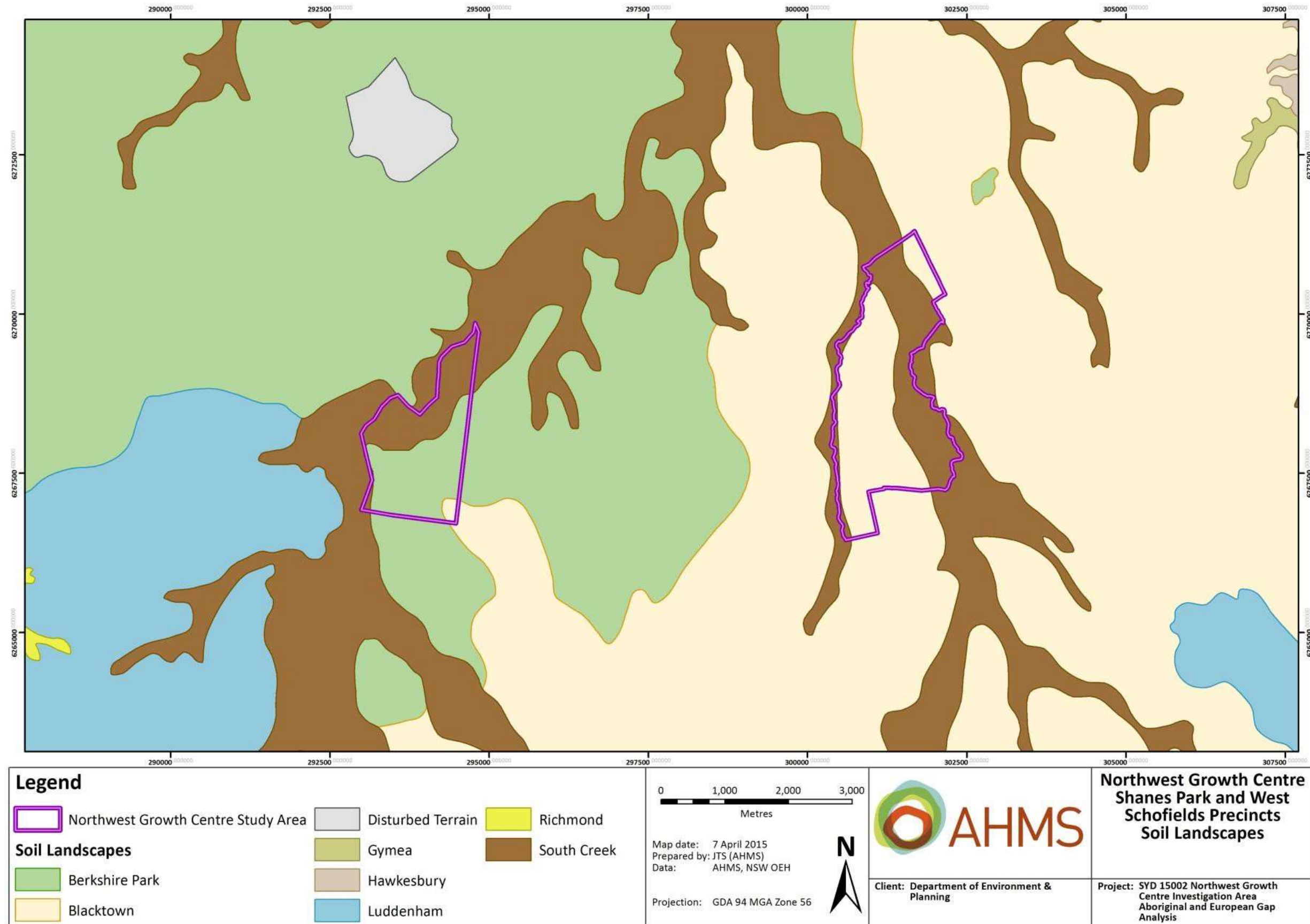


Figure A3 Soil landscapes in the vicinity of the NWGC study area.

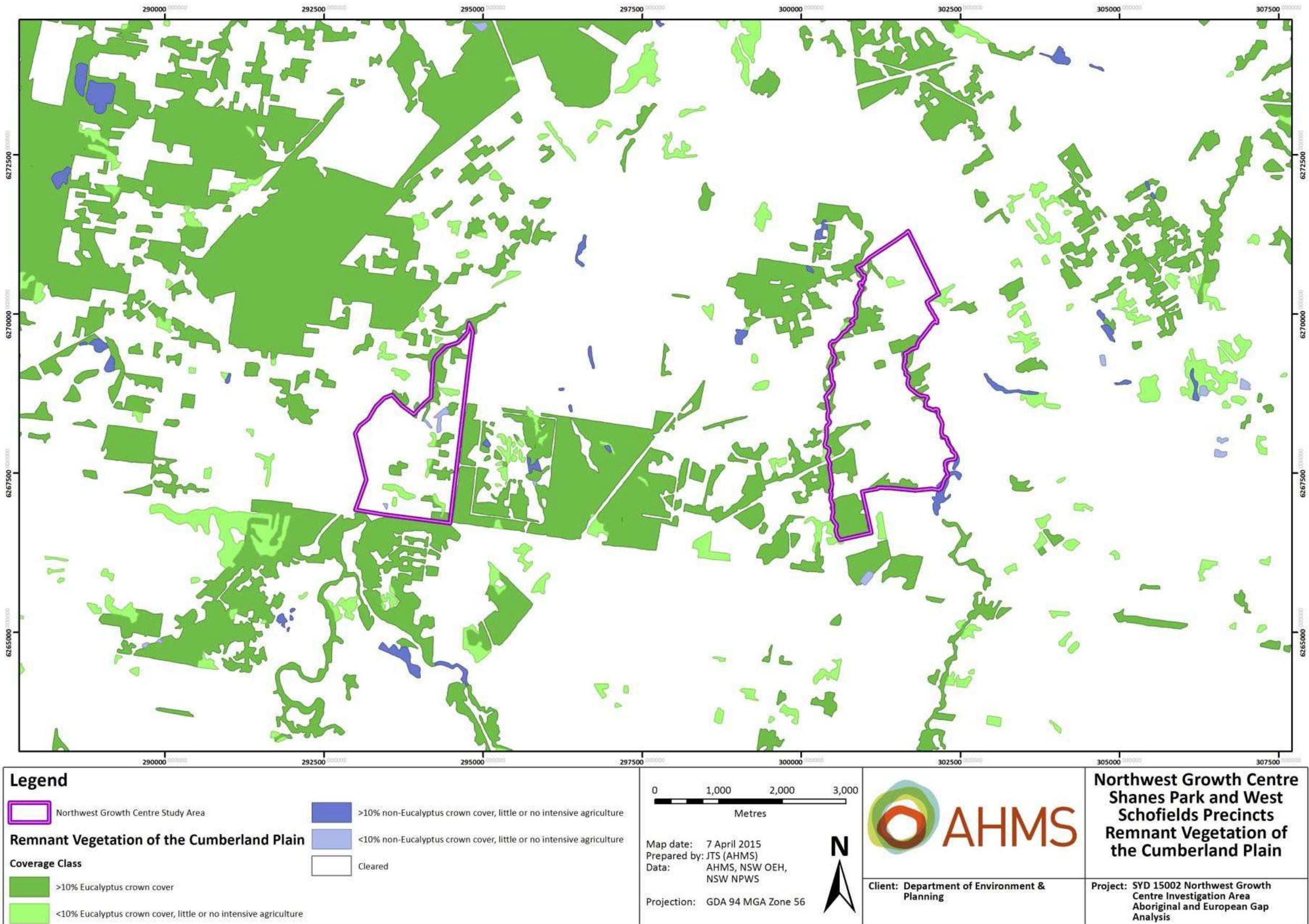


Figure A4. Remnant vegetation of the Cumberland Plain - Vegetation Cover.

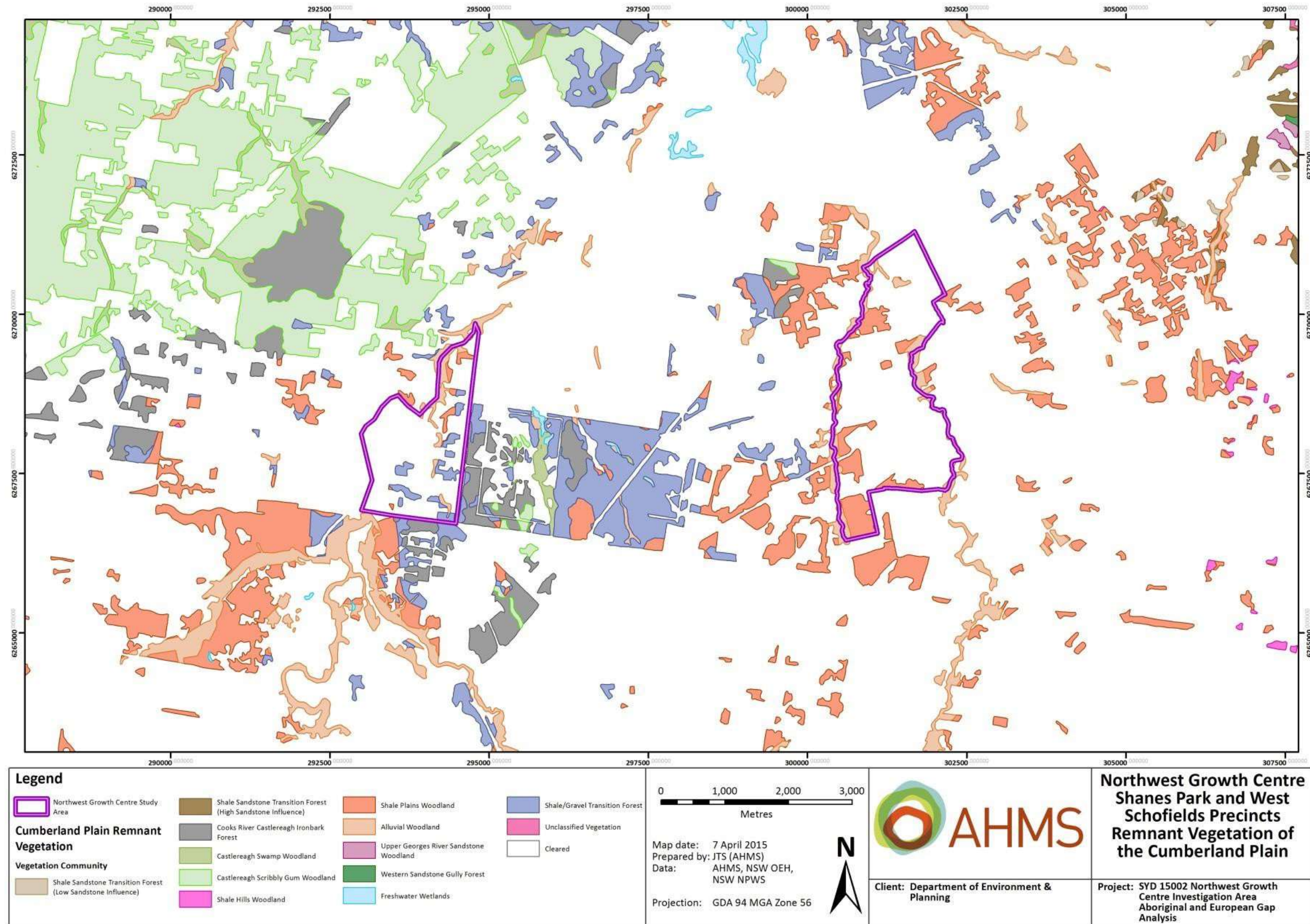


Figure A5. Remnant vegetation of the Cumberland Plain - Vegetation Communities.

Appendix 2: Historic Heritage Listings

A2.1 World Heritage List

World heritage sites that are nominated for World Heritage status are inscribed on the list only after they have been carefully assessed as representing the best examples of the world's cultural and natural heritage. Australia currently has 19 properties on the World Heritage List (WHL).

A register search of the WHL shows that it lists no specific site within the study area. However the south eastern edge of the Greater Blue Mountains listed area lies approximately 25km west of the study area.

A2.2 National Heritage List and Commonwealth Heritage List

The National Heritage List has been created to list places of outstanding heritage significance to Australia. It includes 103 natural, historic and Indigenous places of which 23 are in NSW. The Commonwealth Heritage List is a list of natural, Indigenous and historic heritage places owned or controlled by the Australian Government. These include 128 places in NSW connected to defence, communications, customs and other government activities that also reflect Australia's development as a nation.

A register search of the CHL shows two items in the region. Both in the suburb of Shanes Park (but not within the precinct - see **Figure 5**), the first is listed as Llandilo International Transmitting Station (CHL Item 106101) and the second is listed as Shale Woodland Llandilo (CHL Item 105534). They have been listed in **Table A4**.

There are also two items on the NHL within 20km of the study area. They are the Greater Blue Mountains, and Royal National Park and Garawarra State Conservation listed areas.

A2.3 Register of the National Estate

The Register of the National Estate (RNE) was originally established under the *Australian Heritage Commission Act 1975* (repealed). Under that Act, the former Australian Heritage Commission (AHC) entered more than 13,000 places in the register, including many places of local or state significance. The Australian Heritage Commission Act 1975 provided a basic level of statutory protection for places in the RNE, limited to actions by Commonwealth agencies.

A search of the RNE showed Shale Woodland Llandilo (Item 16587) listed on this register due to the rarity of sites containing the natural vegetation of the Cumberland Plain, including nationally-endangered and vulnerable plant species.

A2.4 State Heritage Register

The *Heritage Act 1977* establishes the State Heritage Register (SHR), a list of places and items of State heritage significance. The Act provides statutory protection for items included on the SHR. Approval from the Heritage Council of NSW is required prior to undertaking work that results in the alteration or modification of a SHR-listed item, unless an endorsed 'Exemption' applies. This includes any archaeological work undertaken on the site.

The SHR currently lists over 1,650 items on its database. A register search of the SHR shows no sites within the defined boundaries of the study area; however, a wider search provides the range of natural and built features that characterise the wider Blacktown area. These are listed in **Table A5**.

A2.5 State Heritage Inventory

The present State Heritage Inventory (SHI) has developed from the recognised need for a State register and survey of heritage places that would document the cultural significance of places on the

basis of thematic histories. The State Heritage Inventory is essentially an electronic database or a 'list of lists' that contains all of the items listed on statutory heritage lists in New South Wales.

The SHI currently contains over 25,000 heritage items in NSW that are contained in statutory lists. The information in the SHI is provided by each local council and State government agencies (s170 Registers). The level of information for each heritage item is variable and ranges from only basic information such as site name, address and reason for listing to detailed information on history and assessment of significance.

A register search of the SHI shows no sites in the designated study areas. However, in the wider vicinity, a range of heritage buildings, features, and landscapes are visible in the wider area. These (as shown in **Figure 5**), are a range of domestic, commercial and infrastructure features that contributed to the development of the Blacktown of today.

A2.6 Local Environmental Plans

In 1979, the *Environmental Planning & Assessment Act 1979* was passed. This provided for local Councils to make Local Environmental Plans (LEPs). Local Environmental Plans are to guide development at the Local Government level. From 1979 the heritage Council made funds available to Local Councils to undertake local heritage studies. These studies were designed to outline the course of historical development of the area but also to identify places and sites of heritage significance within the LGA. These sites and places were to be set out in the heritage schedules of the LEP. Over 130 Local Councils in NSW currently have LEPs with heritage schedules. Council LEPs are reviewed, revised and updated at intervals. There are two LEPs in use for Blacktown LGA, the Blacktown Local Environmental Plan 1988 (BLEP 1988), and the Draft Blacktown Local Environmental Plan 2013 (Draft BLEP 2013). The Draft BLEP 2013 has been placed on public exhibition but has not yet been gazetted.

The BLEP 1988 (Schedule 2) lists over 100 sites in Blacktown LGA. These range from sites that have contributed to the development of Blacktown, including domestic, commercial, and infrastructure – such as schools, churches, halls, farms – to places including the 'Battle of Vinegar Hill' location, tree scapes, water holes, and other such features. These are present through the suburbs of the Blacktown LGA. There are no sites in the designated study areas listed on the BLEP 1988 or the Draft BLEP 2013. Local heritage places and sites in the vicinity of the designated study areas are presented in **Figure 5**.

A2.7 Section 170 Registers

The *Heritage Act 1977* also set the requirement for Government instrumentalities to establish a Conservation Register, known familiarly as a 'Section 170 Register', after the relevant section of the Act. Much of the Section 170 Register has been added to the SHI but some instrumentalities have yet to either establish a register or make such information available publically.

The following have provided their registers on the SHI and their heritage assets form part of the listings presented in this report:

- Australian Rail Track Corporation;
- NSW Arts;
- Department of Commerce;
- Department of Planning;
- Department of Health;

- Energy Australia;
- NSW Department of Primary Industries;
- NSW Fire Brigades;
- Sydney Water;
- Transport Infrastructure Development Corporation;
- Country Energy;
- Roads and Traffic Authority; and
- Sydney Catchment Authority.

Notable omissions from this list are the NSW Department of Housing, Education, Justice, Corrective Services and NSW Public Works.

Review of the SHI identified 33 sites in the Blacktown LGA listed as part of s170 registers; none of these are located within the defined boundaries of the study area.

A2.8 National Trust of Australia (NSW)

The Australian National Trust was established in 1945 and subsequent years saw the establishment of state bodies up until 1976 when the Northern Territory and Australian Capital Territory Trusts. Each State and Territory National Trust is fully autonomous entity in its own right responsible for managing its own affairs. The Trust is a privately funded body which operates as an advocate, and educator with a mission to conserve our heritage.

The National Trust of Australia (NSW) maintains a Register of landscapes, townscapes, buildings, industrial sites, cemeteries and other items or places which the Trust determines have cultural significance and are worth of conservation. There are currently approximately 12,000 items listed on the register.

A search of the National Trust of Australia (NSW) register (LGA Blacktown) shows that there are no sites located within the study area.

A2.9 Heritage Division Library and Local Heritage Studies

A search was conducted of the NSW Heritage Divisions online library under applicable search terms (i.e. Blacktown, Schofields, Shanes Park, Hebe Farm, Llandilo) which may identify reports on sites or places within the study area.

The work represented by this collection is focussed on particular allotments and sites related to specific developments, mostly related to development impacts on potential archaeological sites. There is no broad regional approach to investigation of the archaeological landscape, its potential research design questions or its sensitivity.

The local heritage studies identified as being most relevant to the NWGC study area are listed in **Table A4**.

Table A4. CHL items located in the wider region.

LGA	Suburb	Item name	Address	Item No.
Blacktown	Shanes Park	Llandilo International Transmitting Station	Stony Creek Road	106101
Blacktown	Shanes Park	Shale Woodland Llandilo	Stony Creek Road	105534

Table A5. Local and SHR items located in the wider region.

LGA	Suburb	Item name	Address	Item No.	SHR
The Hills	Box Hill	Box Hill House	10 Terry Road	00613	Yes
The Hills	Box Hill	Box Hill Inn	Windsor Road	00724	
The Hills	Rouse Hill	Hunting Lodge (former)	The Water Lane	00632	
Blacktown	Riverstone	Hebe Farm	14 Bridge Street	1483	
Blacktown	Riverstone	Riverstone Railway Station group	Riverstone Parade	01237	
Blacktown	Rouse Hill	Rouse Hill House and Farm	Windsor Road	00002	
The Hills	Rouse Hill	Royal Oak Inn (former)	Windsor Road	00698	Yes
Blacktown	Marsden Park	Clydesdale – Grand House, Barn & Cottage	1270 Richmond Road	00674	Yes
Blacktown	Kellyville Ridge	Merriville House & Gardens	Vinegar Hill Road	00091	Yes
Blacktown	Colebee	Colebee and Nurragingy Land Grant	Richmond Road	01877	Yes
Blacktown	Oakhurst	Blacktown Native Institution	Richmond Road	01866	
The Hills	Bella Vista	Bella Vista	Elizabeth Macarthur Drive	00754	Yes
Blacktown	Glenwood	Exeter Farm	2 Knightsbridge Avenue	00205	
The Hills	Baulkham Hills	Pearce Family Cemetery	Seven Hills Road	00593	
Penrith	Agnes Banks	Natural Area	Rickards Avenue	00649	Yes
Penrith	Londonderry	Petrology Collection	947-953 Londonderry Road	00973	
Penrith	Londonderry	Fossil Collection	No address given	00971	
Penrith	Penrith	NSW Fire Brigades No 10 Vehicle Number Plates	Castlereagh Road	01519	
Penrith	Penrith	Shand Mason Fire Engine (1891)	1 Museum Drive	01716	
Penrith	Penrith	Torin Building	26 Coombes Drive	01796	Yes
Penrith	Penrith	Craithes House	34-40 Borec Road	00378	
Penrith	Penrith	Dennis Big 6 Fire Engine (1939)	1 Museum Drive	01718	
Penrith	Penrith	Ahrens Fox PS2 Fire Engine (1929)	1 Museum Drive	01717	
Penrith	St Marys	St Marys Railway Station Group	Great Western Railway	01249	Yes
Penrith	Penrith	Penrith Railway Station Group	Great Western Railway	01222	Yes

Table A6. Local heritage studies relevant to the study area.

Author	Title	Year	Subject	Reference Type
Jonathon Falk Planning Consultants Pty Ltd in association with Rodney Jensen and Associates Pty Ltd	Blacktown heritage study: final report. Prepared for Blacktown City Council and Department of Environment and Planning.	1988	Historic buildings.	Monograph
Jonathon Falk Planning Consultants Pty Ltd in association with Rodney Jensen and Associates Pty Ltd.	Blacktown heritage study: final report: heritage inventory. Prepared for Blacktown City Council and Department of Environment and Planning.	1988	Historic buildings	Monograph
Kohen, J.L.	Archaeological study of Aboriginal sites within the City of Blacktown. Report prepared for Blacktown City Council.	1986	Aboriginal sites	Monograph
Haglund, L.	Report on archaeological survey in the Blacktown area.	1980	Aboriginal and historic sites	Monograph
NSW Heritage Office	Blacktown Heritage Inventory – Draft	2009	Historic buildings	Working papers

Appendix 3: Ethnographic and Cultural Values

A3.1 A Further Approach to Ethnographic Research

To assist in the development of cultural resource management (CRM), AHMS has initiated a mapping project to explore early historical texts and diaries to identify spatial locations where Aboriginal activities were observed. The AHMS project 'Mapping Sydney's Aboriginal Past' provides a spatial understanding of Aboriginal activity around the temporal point of contact (**Figure A6**Reference source not found. and **Figure A7**). It consists of an interactive map, a searchable database of site-specific ethnographic evidence, and a range of other tools which bring a spatial perspective to the primary sources.

The database was created by systematically reviewing the early primary sources for the Sydney region and plotting any site-specific ethnographic evidence on an interactive map. The area of study extended from the Hunter River in the north to Jervis Bay in the south, and as far west as the Lachlan River. The sources consulted range from James Cook's visit to Botany Bay in 1770 through to Missionary James Backhouse's visit to the colony in 1835-1837. In total, this project reviewed over fifty primary sources, including all major First Fleet journals and all relevant volumes of the Historical Records of Australia.

The criteria for adding information to the database was threefold. It needed to:

- a) be from a primary source;
- b) contain evidence of Aboriginal activity; and
- c) be able to be pinned down to a specific point or a small area on a map.

Each entry was recorded using the same structure, including a quick summary remark, key words, location information, quotes and references, and additional details and interpretation.

The survey produced over two hundred and seventy plotted markers, with an average length of five hundred words per entry. These included seven Aboriginal tracks, covering a combined distance of over one hundred kilometres, and thirty-five historical paintings and engravings. The database also includes sixteen historical maps overlaid onto the Sydney area, archaeological site data, and the locations and 'boundaries' of particular 'tribes' and 'clans' as interpreted by Val Attenbrow (2010), Arthur Capell (1970), John Mulvaney & Peter White (1987), James Kohen (1993) and Anne Ross (1988).

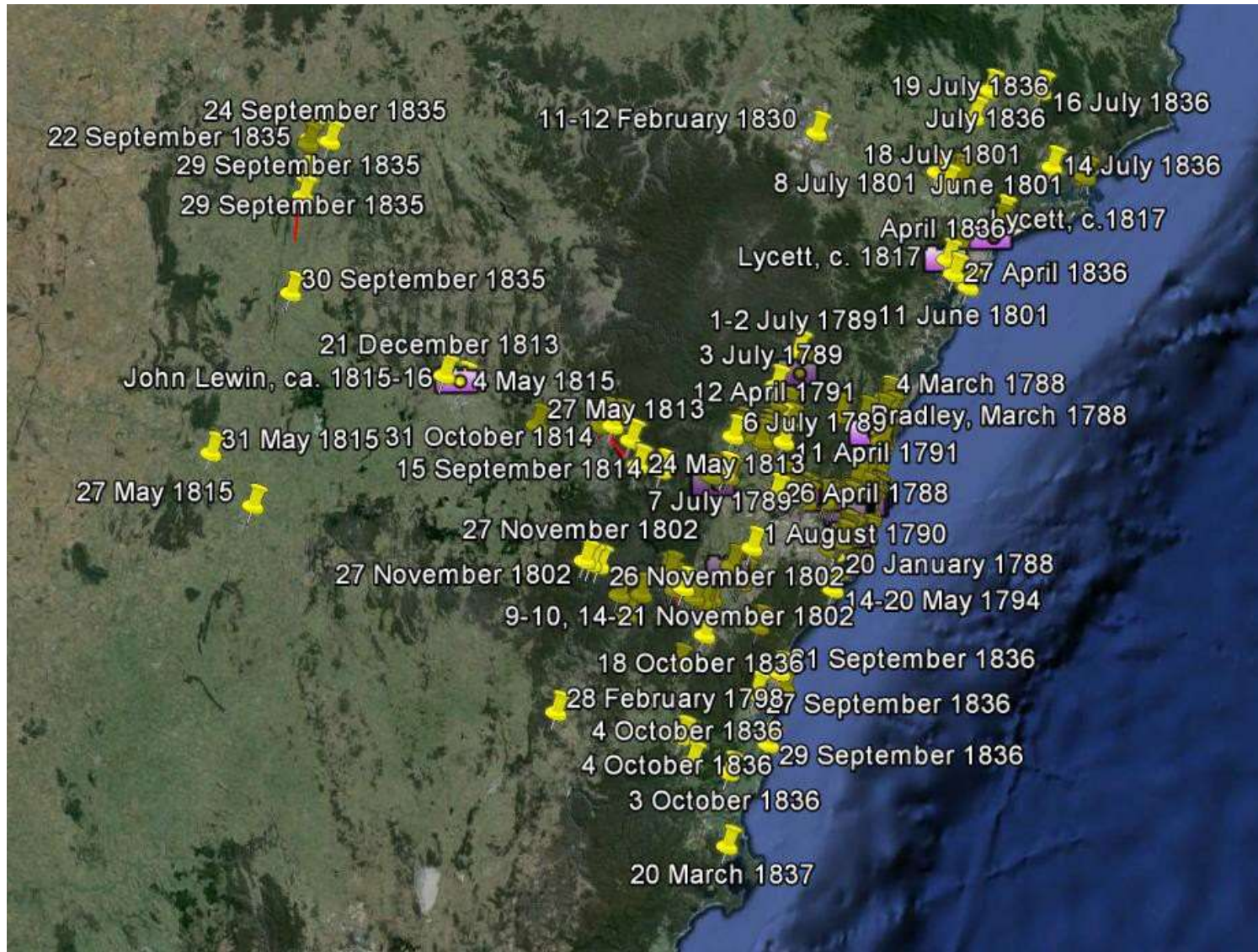


Figure A6 An overview of AHMS' ethnographic mapping program

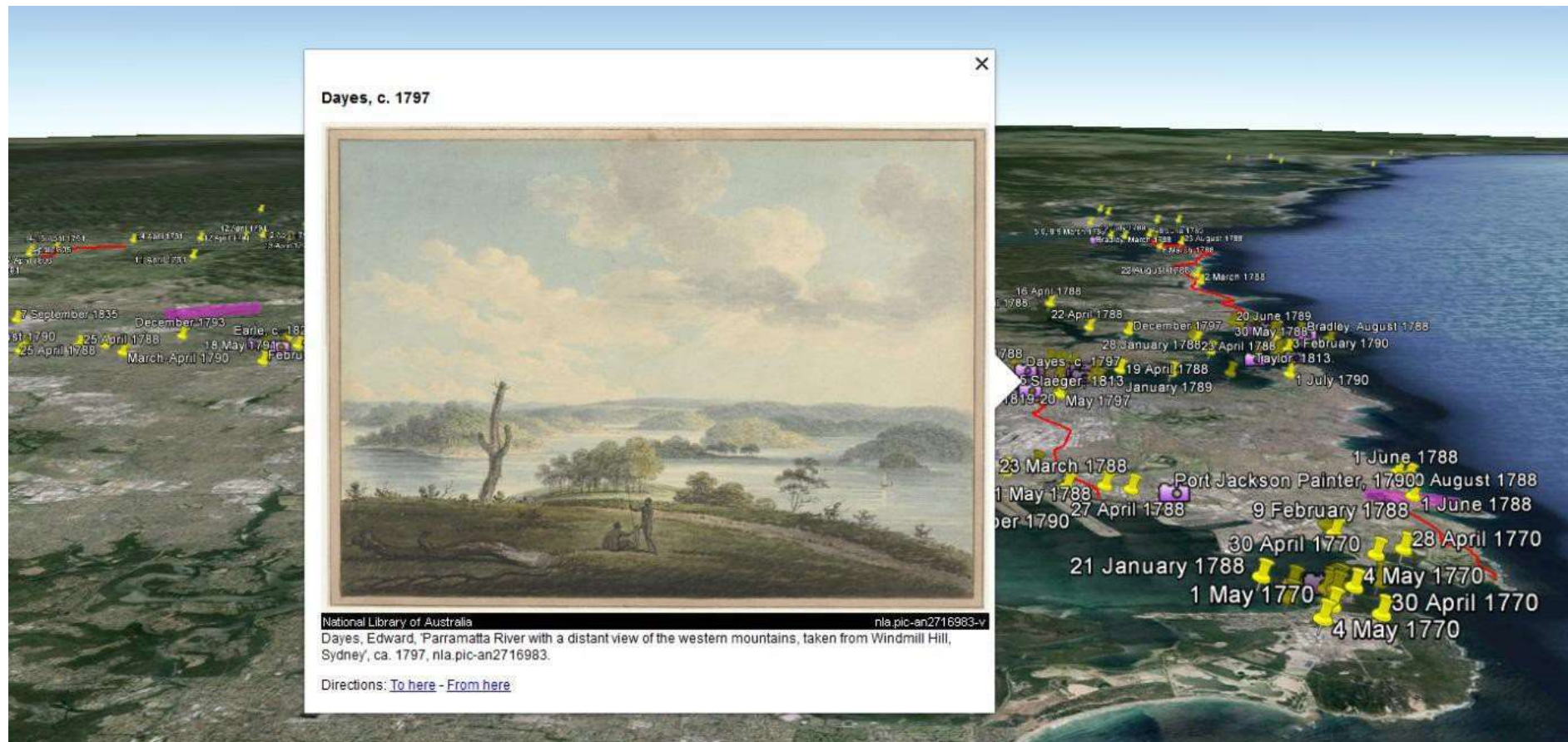


Figure A7 An example of some of the information within AHMS' ethnographic mapping program

Appendix 4: Archaeological Background – Cumberland Plain

A4.1 A History of Sydney Basin Heritage Investigation

One of the first investigations in the region was at Lapstone Creek, southwest of Emu Plains, in the foothills of the Blue Mountains (McCarthy 1948). Initially undated, this site was one of several used by McCarthy and others to differentiate the Bondaian and Eloueran artefact assemblages (e.g. Lampert 1966, 1971; McBryde 1966, 1974; Megaw 1965, 1968; Moore 1970, 1981). Radiocarbon ages suggesting a basal age of c.4 ka for the site were published in the late 1960s from archived samples of charcoal (McCarthy 1978; Polach et al. 1967). McCarthy (1978) also identified several 'surface workshops' along the banks of the river between Castlereagh and Emu Plains. These were large surface artefact scatters that were dominated by early reduction of pebbles derived from the Hawkesbury River. The sites were dominated by uniface pebble blanks, edge-ground implements, and percussions stones, with minor representations of microliths, and were considered to be of late Holocene age.

In the 1970s Stockton and Holland (1974) undertook excavations at several rockshelters in the Blue Mountains (including Kings Tableland, Walls Cave, Lyrebird Dell and Springwood Creek), which demonstrated occupation of the region through the Last Glacial Maximum and terminal Pleistocene (25-10ka). Excavations revealed initial occupation of the Blue Mountain/Hawkesbury region by c.22 ka, with a Capertian assemblage dominating between c.12 to 6 ka and a Bondaian assemblage from c.3 ka and European arrival (and peaking after 600 years). (The terms Capertian and Bondaian are explored further in the later sections of this report. However, in brief the Capertian and Bondaian were terms coined in the 1940's to characterise two different types of artefact assemblage, with the Capertian being composed of of amorphous pebble-tools dominated by silicified tuff and constrained to the Terminal Pleistocene, and the Bondaian generally composed of microliths and dominated by silcrete, and constrained to the late Holocene). A sterile phase was identified between the two assemblages at many of the Blue Mountain sites. As part of this work a disturbed rockshelter at Shaws Creek, K1, was excavated with preliminary findings indicating a potential for deep-time deposits in close proximity to the Hawkesbury River (Stockton 1973).

Subsequently, as part of his doctoral research, Kohen (1986; Kohen et al. 1984) undertook excavations of KII rockshelter, a more undisturbed site immediately east of K1. This excavation identified two main assemblages: a lower assemblage (within units 1-4/phases VI-IV) composed of amorphous core/flake tools and thick flakes, and an upper assemblage (within units 5-6/phases I-III) that included backed blades, geometric microliths, edge-ground hatchets and bipolar/scalar pieces (Kohen et al. 1984). The lower assemblage was dominated by chert (also referred to as silicified tuff), while the upper assemblage was dominated by igneous and metamorphic materials, as well as an increasing abundance of silcrete. Radiocarbon ages for the two assemblages indicated that the lower had a minimum age of 13 ka, while the upper was present in various guises from 4-1.2 ka. In contrast to Stockton (1973), Kohen saw no evidence of a hiatus between the two assemblages. With the exception of Cranebrook Terrace, the KII site currently provides the earliest evidence of occupation along the Hawkesbury River.

In the same study, Kohen et al.(1984) also referred to an open stratified site at Jamisons Creek, Emu Plains, where two ages suggested an initial occupation from c.7 ka, with a proliferation of backed blades associated with a hearth date to c.3 ka. Thermo-luminescence (TL) dating of an open site at Regentville (RS 1), similarly found a focus of occupation between 5.2 ± 0.5 ka (W 1892) and a basal age 7.6 ± 0.8 ka (W 1893) (McDonald 1995).

The earliest date for alleged Aboriginal occupation in the region comes from Cranebrook Terrace, where five reportedly flaked pebbles identified as stone tools by Stockton were found within a gravel pit (Stockton and Holland 1974). Subsequent work by Nanson et al. (1987) demonstrated these gravels to be c.40 ka. If correct, these finds would be the oldest site on the Australian eastern coast. However, the artefactual status of the pebbles, their provenance (several were in an eroded context rather than in situ) and the association between the dates (which ranged from 10 to 42 ka) and the

artefacts have been sources of controversy ever since. Mulvaney and Kamminga (1999) rejected these findings and despite extensive monitoring of the Penrith gravel pits over the past 30 years no other comparable artefacts or evidence of early human occupation has come to light at those levels (see Mitchell 2010 for further discussion).

Excavations by Austral Archaeology Pty Ltd at the Windsor Museum site recovered an extensive artefact assemblage within a sand dune deposit dated to between 149 ka and 8.5 ka (Mitchell pers. comm.). Correlating these TL ages with the archaeology has proven to be difficult as the sediments are known to be bioturbated but it is very likely that the oldest artefacts are of late Pleistocene age.

As part of a salvage excavation for the Rouse Hill Infrastructure project, a basal layer of silicified tuff artefacts were recovered at RH/CC2, a stratified open site, and while undated, based on artefact typology, it was considered to be of a terminal Pleistocene age (JMCHM 2005a, 2005b). Consulting work on the western Cumberland Plain by Smith (1986) at Quakers Hill and McDonald et al. (1994) at Seconds Ponds Creek have recovered hearths and other features in association with extensive artefact scatters dated to the late Holocene. Further afield in tributaries of the Hawkesbury River, studies at Upper Mangrove Creek (Attenbrow 2004), Darling Mills SF 2 rockshelter (Attenbrow 1993) and MR/1 (Moore 1981) have all demonstrated terminal Pleistocene and early Holocene occupation.

Between 2008-2013, Archaeological and Heritage Management Solutions Pty Ltd undertook archaeological investigations of a large sand body, PT 12 (#45-5-3198), in Pitt Town, northwest Sydney, in advance of development. PT 12 sand body is situated on the edge of a ridge line that follows the Hawkesbury River and associated tributaries. The most significant works consisted of a large salvage excavation totalling 100m² in two locations on the sand body. These works recovered ~10,000 artefacts along with a large number of OSL ages. The findings of the study indicate that the sand body had formed >100ka, with occupation by Aboriginal people at ~36ka, and continuing through until 8ka (Williams et al., 2012, 2014). Currently, this represents the earliest evidence of permanent occupation of the Sydney region.

More recent work by AHMS on a large archaeological mitigation in advance of ~40km of pipeline along several creeklines in northwest Sydney. This project involved 500m² of open area excavation and recovered ~10,000 artefacts, along with an intense dating program. The findings all indicated that much of the Sydney Basin had only been colonised in the last few thousand years. It was hypothesised that earlier in the past, populations focussed on the main river systems and coast, only in-filling the intermediate region when demographic pressure reached a threshold in the last few thousand years. This is further supported by Attenbrow (2010) who considered that the vast majority of dated sites in the Sydney region are less than 5,000 years old (35 out of a total of 48 dated sites).

A4.2 Regional Site Patterns

A total of 6,999 sites have been recorded on the OEH AHIMS database for the Cumberland subregion. The majority of these sites are artefacts (open camp sites or isolated finds) (n=3,756 or 54%) followed by Potential Archaeological Deposits (PADs) (n=1,212 or 17%), grinding grooves (n=936 or 13%) and other undefined site types, including quarries, non-human bone or organic material, shell, and waterholes (n=1,056 or 15%). These findings are similar to the frequency of site types recorded for the Sydney region (Attenbrow 2010:48-49). An absence of rockshelters in this region may be accounted for by the underlying geology of the area which lacks sandstone escarpments and outcrops.

A study of the regional archaeology of the Cumberland Plain by Kohen (1986) made a number of findings about site location patterns in the Sydney area. The study demonstrated that proximity to water was an important factor in site patterning. Kohen found that 65% of open artefact scatter sites were located within 100 metres of permanent fresh water. Only 8 per cent of sites were found more

than 500 metres away from permanent fresh water. It was argued that open artefact scatters are likely to be larger, more complex and more densely clustered along permanent watercourses. Kohen's study also found that silcrete (51%) and chert (34%) are the most common raw materials used to manufacture stone artefacts. Other raw materials include quartz, basalt and quartzite.

Although the patterns described above have been generally supported by subsequent investigations, Kohen's study was limited by a reliance on surface evidence. Extensive excavation across the Cumberland Plain has since shown that areas with no surface evidence often contain sub-surface deposits buried beneath current ground surfaces. This is a critical consideration in aggrading soil landscapes, such as those commonly found across the Cumberland Plain. In a 1997 study of the Cumberland Plain, McDonald found that 17 out of 61 excavated sites had no surface artefacts before excavation, and that the ratio of recorded surface to excavated material was 1:25. The character and composition of the excavated sites in McDonald's study could not be predicted on the basis of the surface evidence (JMCHM 1997). In short, surface evidence (or the absence of surface evidence) does not necessarily indicate the potential, nature or density of sub-surface material.

The results of McDonald's study clearly highlight the limitations of surface survey in identifying archaeological deposits in this landscape. The study also shows the importance of test excavation in establishing the nature and density of archaeological material on the Cumberland Plain.

McDonald has undertaken over 20 years of consulting archaeology in the Cumberland Plain, and, like Kohen, has developed a predictive model for the distribution of Aboriginal objects. In a recent publication, White and McDonald (2010) summarised this model as follows:

Topographic and stream order variables correlate with artefact density and distribution. High artefact density concentrations may have resulted from large number of artefact discard activities and/or from intensive stone flaking. Highest artefact densities occur on terraces and lower slopes associated with 4th and 2nd order streams, especially 50–100 metres from 4th order streams. Upper slopes have sparse discontinuous artefact distributions but artefacts are still found in these landscape settings.

A4.2 A Review of Previous Assessments in the Region

Riverstone Meatworks (Haglund and Stockton, 1983)

In 1983 Laila Haglund and J. Stockton carried out a survey of the Riverstone Meatworks. The study area covered Riverstone Meatworks holdings of about five square kilometres. Fourteen Aboriginal sites were found including nine open campsites and five isolated finds. All the sites were found in alluvial areas, located on the creek or stream banks. The majority of the stone artefacts found were of silcrete however, indurated mudstone, fine-grained basic rock, chert and quartz stone tools were also found.

In summary, the survey identified stone artefacts located on alluvial creekbanks. The raw material was predominately silcrete, however indurated mudstone, fine-grained basic rock, chert and quartz.

Industrial Estates in Blacktown City Council area (Kohen, 1985)

In 1985 Kohen conducted a survey of four areas zoned for industrial purposes by Blacktown City Council. These areas were Glendenning, Arndell Park, Huntingwood and Colyton Industrial Estates.

A total of 25 Aboriginal sites were found that comprised of nine isolated finds and 16 open campsites. The sites were found on relatively diverse natural and man made landscapes including tracks, creek banks, ridge tops, erosion scars and creek flats. The majority of the stone artefacts were silcrete but

artefacts of basalt, chert, quartz and quartzite were also found. In close proximity to the site identified as Southeast Plumpton 5 were at least seven eucalypts trees (north side of the road) bearing symmetrical scars up to 60 cm long.

In summary, the survey identified several sites on man made eroded and disturbed surfaces and on the landforms of creek banks and ridge tops. The predominant raw material used was silcrete but other raw material types were also present. Several potential scarred trees found in a previous survey were also identified in close proximity to the study area.

Proposed Schofields Regional Depot (McDonald, 1986)

This study was a preliminary archaeological investigation of an area of approximately 92 hectares, at Schofields between Townson Road, Eastern Creek and Plumpton Ridge (also known as Stringybark Ridge). The site is located to the east of the current study area. It had previously been selected by the National Parks and Wildlife Service as an appropriate conservation area, as a representative section of the Plumpton Ridge site, being located on the north-eastern slope of the ridge. It was later investigated as part of the Colebee Release Area (JMCHM 2006; see below).

The field investigation consisted of a survey (including detailed recording of three sample areas), and the excavation of five test pits (each 50 x 50 cm). The test pits were located to explore the various landforms of the site; the ridge, a minor spur and the gullies. The survey indicated that surface scatters of artefacts were present across the site, but that densities were much higher on the ridge. All but one of the test pits contained stratified archaeological material, with the recovered assemblages indicating differences in type and density across the site. From the test pits, the average artefact density was 8,065 artefacts / m³.

Preliminary analysis indicated that finer grained material was removed from the ridge, to locations where further stone working activities took place. The evidence suggested that the ridge area was used mainly as a quarry, but that other activities, perhaps woodworking, also took place there. Quarrying, and possibly manufacturing, was also taking place further from the ridge. It was considered that the sites were likely to date to the period 4,000-1,000 BP.

Based on the results of the preliminary investigation, it was recommended that the site be conserved, as a result of its high archaeological and cultural significance.

Plumpton Ridge Regional Waste Disposal Depot (McDonald, 1986)

In 1986 McDonald carried out an archaeological reconnaissance of the Proposed Regional Waste Disposal depot at Schofields for the Metropolitan Waste Disposal Authority. The site of the proposed development was 92 hectares between Townson Road, Eastern Creek and Plumpton Ridge.

McDonald sampled twelve sections of the study area and recorded eight isolated finds. McDonald concluded that the western side of the study area presented as continuous background scatter between identified concentrations of artefacts; thus isolated finds were only recorded on the lower slopes and creek banks. Over 90% of the stone artefacts found were silcrete although artefacts of chert, indurated mudstone and quartz were also present along with tuff, volcanic rock and petrified wood. Evidence of grinding activity was also observed.

In summary, the survey identified the site as having a continuous background scatter of artefacts. Isolated finds were found recorded on lower slopes and creek bank landforms. Silcrete was the dominant raw material however other material types were also present.

Schofields Aerodrome (Navin Archaeological Resource Management, 1992)

An archaeological survey of the HMAS Nirimba and Schofields Aerodrome property was undertaken in 1992, as part of a planning study addressing potential uses for the site. The report found that the property had undergone extensive historical landscape and environmental modification, and that this was likely to have impacted upon any archaeological sites present. This disturbance was considered likely to have destroyed any carved or scarred trees, stone arrangements, and earth rings or bora grounds; and to have disturbed artefact scatters. It was noted that four sites had been recorded within the subject area by Kohen in the 1980s; Eastern Creek 3, 4, 5 and 6. At the time of the 1992 study, site cards for only two of these were available (Eastern Creek 5 and 6).

The survey resulted in the recording of six sites; five artefact scatters and an isolated artefact. Three of these sites were considered likely to be the sites previously recorded by Kohen as Eastern Creek 3, 4 and 6; and three were considered to have been previously unrecorded. The two unrecorded scatters were named Schofields 1 and Schofields 2. The site descriptions are given in Table 2, and the locations are shown in Figure 14. The fourth site recorded by Kohen, Eastern Creek 5, could not be relocated during the survey, and was thought to have been destroyed. The archaeological significance of the sites was assessed as low.

All six identified sites were located on basal slopes adjacent to creek flats, and/or secondary drainage lines. It was noted that the flats and margins of Eastern Creek had low potential due to their poorly drained character and frequent inundation by flooding. For this reason, and the historical disturbance of the property, it was considered that there was low potential for additional sites to be present:

Based on the highly disturbed nature of the study area, and the existence of suitable surface visibility in areas of higher archaeological potential, it is considered that the probability of further sites occurring in the study area is low. The probability of scientifically significant or undisturbed archaeological material occurring within the study area is considered to be nil.

Riverstone land Release area (Darwala-Lia, 1999)

In 1999 Darwala-Lia conducted an assessment of the Riverstone Land Release Area for the Blacktown City Council. The study area extended from Bandon Road, Vineyard, along the eastern side of the railway to Schofields, east to First Ponds Creek and then back to Bandon Road along the western side of First Ponds Creek and Windsor Road.

Darwala-Lia located or relocated nine Aboriginal sites during her survey of this area. Of the nine sites, eight were open campsites and one was an isolated find. Two of the open campsites were located on ridge tops, three were located on slope features and two were located on creek terraces or flats. The isolated find was located on a slope feature overlooking a creek flat.

Most of the sites were composed primarily of debitage flakes and flaked pieces with occasional cores, tilted flakes and a small quality of blade flakes. A broken backed blade and stone axe were also recorded. The vast majority of the stone artefacts found were silcrete. Subsequent investigations of the Riverstone area by ENSR AECOM (2008a), suggested that some of the scatters of silcrete recorded by Darwala-Lia, were in fact naturally occurring and non-purposefully fractured silcrete nodules.

Cosgrove Creek, Luddenham (Dominic Steele Consulting, 2001)

Excavations were undertaken of three previously recorded artefact scatters in the area of Cosgrove Creek between Luddenham and Mamre Roads. Based on previous excavation results an aim of the excavations was to increase understanding of past Aboriginal use and procurement of silcrete within the local area.

Three different landscape zones were tested: a portion of ridgeline spur, a slope area and part of the floodplain of Cosgrove Creek. In the majority of areas (low lying creeks side areas and hill slopes), densities of artefacts were very low; between zero and five artefacts per square metre. The low density of artefacts in these areas was interpreted as representing discard rather than knapping events.

In areas of elevated spur landforms, artefact densities were slightly higher: up to 76 per square metre in some test pits, however the average density in the area of spur line excavated was 24.5 per square metre. These assemblages on spur line platforms showed evidence of in situ knapping, particularly along those lines orientated north- south.

The focus of activities in the knapping zones seemed to have been tool maintenance and possibly working of wood and/or organic products rather than initial tool construction. The artefact assemblage was dominated by silcrete (over 90%) although signs of quarrying or extraction were not evident. Formal stone tool types were predominantly Bondi Points, in various stages of fragmentation.

It was concluded that Aboriginal people avoided quarrying poor quality silcrete gravels from topsoil in the local region when other, more superior quality, materials were available from other sources. The analysis identified at least one period of Aboriginal occupation which is likely to date to the Middle Bondaian, as reflected by the recorded artefact types.

In summary, artefacts were predominately found on elevated spur lines and highest densities were found on those that were elevated or had a north- south orientation. These assemblages were determined to represent knapping events for tool maintenance rather than tool construction. Lower densities of artefacts were found on hill slopes and flood plains adjacent to Cosgrove Creek. Silcrete was the dominant raw material (over 90%), and it was concluded this was likely to originate from quarries rather than local gravels.

Rouse Hill Development Area Sewerage Master Plan (JMCHM, 2002)

This study was an initial desktop assessment undertaken by Jo McDonald Cultural Heritage Management. It covered trunk drainage lands within future stages of the Rouse Hill Infrastructure Project. The study area included the Eastern Creek corridor, and extended into the present subject area. A strip of land adjacent to Eastern Creek, within the present subject area, was categorised as having low disturbance and high archaeological sensitivity, meaning that it had apparently never been subject to extreme soil disturbance, and had good potential for the preservation of intact Aboriginal archaeological sites.

Windsor Road Upgrades, Rouse Hill to Vineyard (Therin, 2002-2004)

Therin conducted a survey in association with Hyder Consulting for the proposed widening and upgrade of Windsor Road between Mile End Road, Rouse Hill and Henry Road, Vineyard. The area investigated by Therin encompassed a corridor of both sides of Windsor Road within the suburbs of Rouse Hill, Box Hill, Riverstone and Vineyard. Investigations were conducted in three phases:

26. Therin 2002: Desktop analysis and survey between Henry Road, Vineyard to Boundary Road, Vineyard. Areas and sites referred to in this part of Therin's study area are referenced with the prefix WBH;
27. Therin 2003: Desktop analysis and survey between Boundary Road, Vineyard and Mile End Road, Rouse Hill, encompassing part of the northern extent of the Riverstone East Precinct study area. Areas and sites referred to in this part of Therin's study area are referenced with the prefix WMB;
28. Therin 2004: Targeted test and open area excavation of areas of archaeological potential as identified in Therin 2002, 2003.

As a result of these investigations, fourteen surface archaeological sites were identified, comprising six isolated artefacts, seven open campsites (artefact scatters) and one quarry. Of these sites, WMB3-4 was located within the Riverstone East Precinct. In both survey areas, Therin considered the entire road corridor to have potential for archaeological deposits. The surface survey also aimed to detect areas of ground disturbance that would impact on the integrity and significance of the archaeology, and as a result, as part of the sub-surface investigations, it was recommended that geotechnical work be undertaken prior to archaeological excavation, in order to identify areas of imported fill.

The geotechnical work concluded that sites WBH1-3 were all located in disturbed contexts with no residual topsoil. However, five other areas of archaeological potential were found to be mostly intact, apart from general stock grazing and ploughing disturbance. Four of these areas were chosen for archaeological excavation, all located on alluvial landforms in the vicinity of drainage lines associated with either Killarney Chain of Ponds or Second Ponds Creek. Excavation was undertaken in 4m² test pits, located at 20m intervals. A total of 969 stone artefacts (approximately 80% manufactured from silcrete) were recovered.

The highest densities (105.4/m²) were recovered from an excavation area on Windsor Rd in the north of the Riverstone East precinct. Due to the proximity of the whole site to the creek, little intra-site variation between artefact densities and distance to water was identified. However, artefact densities were found to be higher in areas of higher elevation. Salvage was recommended for this site (AHIMS ID# 45-5-3024) before road upgrade works be initiated.

Rouse Hill Infrastructure Development (Jo McDonald/JMcDCHM, 2005)

A series of archaeological investigations associated with various stages of the Rouse Hill Infrastructure Development were undertaken from 1993 to 2005 (e.g. JMcDCHM, 2005b). The investigations covered a large area of urban release land in the vicinity of Kellyville and Rouse Hill. The sites were located near Caddies, Seconds Pond, Smalls and Cattai Creeks. More than 1,800 square metres were excavated during the project, yielding almost 68,000 stone artefacts. The landform types investigated included alluvial floodplain along high order creeklines, creek terraces adjacent to high order creeklines, a creekbank adjacent to a low order streamline and low hillslopes adjacent to low order creeklines.

Some key findings were made regarding Aboriginal site patterning in relation to these landforms and stream orders. They are:

- The results tended to indicate that irrespective of the landform types investigated, the density of stone artefacts recovered was lowest along low order creek lines and higher densities were associated with high order creek lines;

- While lithic assemblages decreased in scale and repetition further away from water, the composition of assemblages remained fairly consistent across the entire landscape;
- Occupation density was likely to be more a result of the proximity to steady resource areas such as higher order creeklines with access to fresh water and food, as opposed to preference of certain landform types;
- Sites on alluvial floodplains and creek terraces adjacent to higher order creeklines provided evidence of a wide range of activities;
- Occupation evidence on alluvial flood plains and creek terraces indicated the sites were used for short-term residential occupation over an extensive period of time, starting possibly as early as 9,000 BP;
- Low hill slopes and creek banks adjacent to low order creek lines showed evidence for casual to short term occupation; and
- Some stratification was evident on the creek banks indicating transient use of the landform through time. Recent use (4,000BP to 1,000 BP) showed evidence of knapping activities.
- Other findings regarding the stone tool assemblages for the area included:
- Many sites had little or no indication of artefacts on the ground surface, yet subsurface testing revealed artefacts were present even when surface artefacts were not seen. Therefore it was concluded that potential archaeological deposits should be identified on the basis of low levels of previous land use disturbance not the presence of artefacts on the surface;
- Indurated mudstone was the dominant raw material in the northern end of the study area;
- Silcrete (mostly heat-treated) was dominant toward the southern end of the study area;
- There was an absence of obvious conservation strategies in the stone tool assemblage and a lack of identified local stone sources. This was deemed problematic for explaining the variation in preferred stone types across the area;
- Most artefacts were small which was deemed to indicate that people prepared and “heat-treated” stone near sources and carried selected materials back to residential sites;
- Backed artefacts (commonly found across the landscape) had considerable variation in their morphology suggesting this artefact type was not standardised;
- Functional analysis of the backed artefacts indicated they were multi-functional – used as spear barbs and as hand-held tools for plant / animal processing;
- McDonald identified that areas with sparse lithic scatter represented low levels of accumulated activity. Areas with greater than 20 lithics per m² were likely to contain in situ knapping concentrations;
- The presence of silicified tuff may indicate pre-Bondaian occupation; and
- Fluvial deposits on a lower order tributary of Second Ponds Creek yielded a Pleistocene date. Although the date was not associated with cultural activity, it indicated significant changes in hydrology over time and suggests there is potential for investigating Pleistocene occupation on lower-order drainage lines.

In summary, the excavations at Rouse Hill and Kellyville had a number of key findings relating to site patterning for the area. It was found that sites were located in proximity to several creek lines. The order of the creekline had a bearing on the density of artefacts found on various landforms tested. Higher artefacts densities were found on higher order creeks and lower densities along low order

creeks. Consideration of changing hydrology should also be made during assessment, with lower order drainage lines having potential for intact older (Pleistocene) deposits to be found.

Emmaus Village Test Excavation (AHMS, 2005)

An Aboriginal archaeological test excavation was undertaken at 85 Bakers Lane, Kemps Creek, NSW, in 2005. The topography of the site was generally flat and low lying with low slope-gradients to the north west of the study area and more undulating to the south east of the study area. These slopes formed a watershed overlooking both the South and Ropes Creeks tributaries. Along the portion of the study area where the proposed access road was identified there is a relatively high narrow crest (approximately 60 metres above sea level (ASL)). To the west of the development area there was a drainage line which flowed north into South Creek.

Historic and natural site formation processes described above significantly disturbed natural soil profiles across the Emmaus Village site. Accordingly, it was deemed unlikely that the Aboriginal stone artefacts found during test excavation would be found in-situ.

Analysis of the stones identified a total of 11 definite and probable artefacts thinly distributed through the deposits. The stone types used to make the artefacts included silcrete and tuff. No cortex was found on the stones so identification of stone sources (i.e. quarries or river pebbles) could not be determined. The assemblage was dominated by tiny pieces broken from flakes, often referred to as 'debitage', and no formal types or finished implements were found among the assemblage. No artefacts were found on elevated spur platforms in the study area.

In summary, test excavations were undertaken in a study area on flat to low slopes overlooking tributaries of South and Ropes Creek and in the vicinity of a high (60 m ASL) ridgeline. Low densities of artefacts were found predominately of silcrete. No artefacts were found on elevated spurs.

Colebee Release Area (JMCHM 2006)

This investigation consisted of an archaeological salvage excavation prior to development of a golf course and housing estate. The study area included parts of Plumpton Ridge and was bordered by Eastern Creek, to the east of the present subject area. The study area in general was gently undulating, sloping down from the ridge to the creek, with four modified tributary drainage lines which ran from the ridge to the creek, towards the northern end of the study area.

There were seven investigation areas, referred to as Sample Areas (SA) 20-26, and an overall excavated area of 687 m² (including 20 open areas), resulting in the recovery of over 80,000 artefacts. The lithic assemblage was dominated by silcrete.

Three landscapes were sampled:

- The riverine corridor of Eastern Creek, including the floodplain (SA24) and a spur terminated and down-cut by the creek channel (SA23).
- The mid-ridge slopes; two different spurs, in three different landscape settings between Eastern Creek and Plumpton Ridge (SA20-22).
- The Plumpton Ridge margins, at c.50 m AHD elevation, at 1 km distance from Eastern Creek (SA 25-26).

Those parts of the ridge itself that fell within the study area did not have good conservation, and were not selected as part of the salvage work. SA23 Area A had the highest concentration of artefacts

from the site (in fact, from the Cumberland Plain), with over 45,000 artefacts found in an area of 60 m². Artefact densities varied from 335 to 1,289 / m². The evidence indicated that this area was a backed artefact production location, but also contained elements of other lithic activities and an earlier occupation period. SA23 was located on the end of a spur, being an extension of Plumpton Ridge, which reached almost to Eastern Creek. It was considered likely that proximity to both the silcrete quarry and to Eastern Creek, as well as elevated topography, contributed to the preferential use of this location.

The excavation clearly confirmed that Plumpton Ridge had been used as a silcrete quarry, and indicated that it may also have been a source of silicified wood and quartz. The evidence indicated that the primary use of the quarry may have been the procurement and initial processing of silcrete for use elsewhere. The main quarrying activities occurred on the upper slopes of the Ridge (the crest was not investigated). The assemblages from the salvage areas located further from the Ridge and closer to Eastern Creek were notably different from the quarry samples.

No direct dating was undertaken. Based on the nature of the assemblage, it was suggested that the majority of the evidence was less than 6,000 years old, although there was some indication of pre-Bondaian occupation at SA23 Area A.

Of the salvage areas investigated in the Colebee Release Area, SA24 is most comparable to the present subject area, in terms of landform (JMCHM 2006 v.1: 37-40; JMCHM 2006 v.2: 155-209). It was situated on the Eastern Creek floodplain, at an elevation of about 18 m AHD, on a low levee running between the current Eastern Creek stream channel and a palaeo-channel, thought to be composed of Holocene alluvium. It was located at a distance of 20 to 100 m from Eastern Creek (the nearest water source), and 900 m from the closest silcrete outcrop (JMCHM 2006: 94).

The investigation of SA24 commenced with the excavation of 38 test pits, each 1 x 1 m in size, resulting in the recovery of 292 artefacts. Average artefact densities were 8 / m²; this was the lowest average of all of the tested areas within the Colebee Release Area. Four of the 28 test pits had no artefacts; another 24 had ≤ 10 artefacts.

The main raw material was silcrete (85%), with the remainder being quartz, silicified tuff, silicified wood, quartzite, and low quantities of other stone types. Soil depth varied across SA24, ranging from a few centimetres to nearly 1 m, but in general two clear stratigraphic horizons were evident. The upper horizon was about 40 cm deep and consisted of a brown sandy loam; this was interpreted as a plough zone. The lower horizon was a slightly redder, sandy loam with clay content increasing with depth, to merge into the B-horizon clay.

The characteristics of the assemblage recovered from SA24 indicated that it derived from Middle Bondaian occupation (c. 4,000 - 1,000 BP). The relatively low artefact density in this area, when compared to the other salvage areas, was suggested to be a function of more generalised camping activities, which were not specifically related to complex or bulk backed artefact manufacture.

Following the test excavation, three open areas were excavated within SA24; Areas A, B and C. Area A consisted of 5 m², located close to the bank of Eastern Creek. The deposits in this area were 20-55 cm in depth, and consisted of coarse-grained sediments containing very high concentrations of gravel, including silcrete. This was interpreted as the remains of a former creek channel. Although 44 artefacts were recovered from Area A, it was considered that these may have been transported with the gravel by the former creek.

Area B was located on the edge of the levee, and consisted of 53 m². The depth of deposit varied, in general increasing with distance from the creek, and further onto the levee. 948 artefacts were recovered from Area B (a density of 18/ m²). Area C was located on the highest part of the levee, and consisted of 21 m². 447 artefacts were recovered from Area C (a density of 21/ m²).

From the total of 114 m² excavated in SA24, 1,695 artefacts were recovered. Artefact densities were fairly low, with a maximum of 30/m². Slightly higher artefact densities were found on higher ground; the average density above 19.5 m AHD was 15 / m², compared to 5 / m² below 19.5 m AHD. The open area excavation revealed moderate and low density patches of artefacts. The higher density foci that were found in other sample areas were not documented here.

The range of modified artefacts and raw materials indicated variation in lithic activities and suggested tasks other than intensive silcrete reduction. Domestic occupation (i.e. residential and/or off-site activities) may have occurred here, but the overall artefact densities were low. Large-scale stone reduction and backed artefact production did not appear to have been carried out here. Similarly, increased sedimentation may indicate that a number of flooding events occurred here.

The nature of the assemblage from SA24 indicates that it was Bondaian, and probably less than 6,000 years old. It was considered that the occupation represented by the assemblage was probably primarily during the Middle Bondaian period (perhaps c4,000-1,000 BP). There appeared to be some variation between the assemblages from spits 1 and 2, in Areas B and C, that might have related to changing occupation patterns over time. However, the variations were not clear cut.

Schofields Road Upgrade (JMcd CHM, 2006-2007)

JMcd CHM undertook a heritage assessment of 3,730m long stretch of Schofields Rd, encompassing the southern boundary of the Riverstone East Precinct. Prior to survey, the land was assessed for the impact of previous use through analysis of aerial photography. This analysis identified that the southern part of Schofields Rd was generally less disturbed than the north. The majority of the area of overlap between the JMcdCHM study area and the present study were assessed as being subject to high disturbance, with the exception of a small area of low disturbance in the vicinity of First Ponds Creek.

The length of Schofields Rd was traversed as part of the archaeological survey, and covered a variety of landforms including hill slopes, flats, floodplain and creek banks associated with First Ponds and Second Ponds Creeks. The survey identified one isolated artefact, approximately 800m from Second Ponds Creek, and an artefact scatter with ten artefacts and PAD, approximately 50m from First Ponds Creek. This artefact scatter is located directly over the road from the southern boundary of the Riverstone East Precinct. Three PADs were also located on the southern side of Schofields Rd.

A revised assessment was undertaken for this project in 2011 (Jo McDonald Cultural Heritage Management/GML 2011), and a further two PADs were identified. One of these was associated with an isolated artefact: SCR/UPG3 + PAD, (AHIMS ID# 45-5-4112), located within the south east corner of the Riverstone East Precinct. This site was later the subject of sub-surface testing by KNC (2012b), who identified a further three artefacts.

The site was re-assessed by Artefact Heritage Services (AHS) in 2013 as being of low scientific significance (see below). According to AHS, an AHIP to destroy the site had been granted, so it is highly likely that this site has since been disturbed or destroyed.

Vinyard to Rouse Hill Electricity Upgrade (AHMS, 2007)

Integral Energy engaged AHMS and Cultural Heritage Connections Pty Ltd to undertake an Aboriginal archaeological survey and excavation in advance of Integral Energy's proposed Electrical Transmission Line Upgrade between Vinyard and Rouse Hill, NSW. The area investigated comprises an 8.3 kilometre stretch of land which runs from Vinyard, through Riverstone, to Rouse Hill.

The density of artefacts across the landscape was extremely low, and was interpreted as 'background scatter' created during transitory use of the landscape. This interpretation is consistent with regional findings regarding low density, where artefact densities lessened with distance from high order waterways. This model is repeated along the Vineyard to Rouse Hill easement, where artefacts occur in lessening densities with distance from water courses.

Artefact densities recorded during excavation were highest on lower slope landforms close to creeks. The highest densities (13 artefacts/m²) were recorded at the Pole 26 site, located within 200 metres of two creeks (First Pond Creek and a tributary), which falls inside the northern part of the Riverstone East study area. Artefacts were also recovered during survey and excavations from Pole locations 30, 31, 32, 33, 38 and 39 within the study area (Site RV2). Three 1m x 1m test trenches were excavated at each pole location, on hill crest and upper slope landforms. Sterile clay B-horizon soils were typically reached at depths of 25-35cm.

The slightly higher density recorded at Pole 26 tentatively suggests that lower slopes close to creeks were targeted as areas of occupation by Aboriginal people in the past. This conclusion is consistent with McDonald's findings that areas on lower slopes within 50 metres of a creek will display evidence of complex and intensive occupation.

Test Excavations Horsley Drive, Horsley Park (Haglund and Associates, 2007)

In 2007 archaeological test excavation was undertaken by Haglund and Rawson for the widening and upgrading of Horsley Park Drive between Cowpasture Road and the Westlink M7. This work was undertaken to investigate a series of potential archaeological deposits virtually along the length of the road and identified by Oakley in 2005. The 2007 test excavations focused on six locations which considered a variety of landform types and were determined to be most likely to contain evidence of past Aboriginal occupation.

Testing involved investigation of the following landforms:

- Site 1 – lower slope landform within 130 m of Eastern Creek,
- Site 2 – lower slope to creek flat between 15 m and 170 m of Eastern Creek,
- Site 3 – mid-lower slope near a 1st order creek,
- Site 4 – mid to lower slope near a 1st order drainage line,
- Site 5 – a ridge crest (including upper slopes off the ridge), and
- Site 6 – middle slope, sloping towards a drainage line.

The testing revealed a total of 306 artefacts with a further three possible quartz artefacts. Silcrete was the dominant raw material (78/1%, n=239) followed by silicified tuff/fine grained siliceous material (15.0%, n=46) and quartz (6.9%, n=21).

The area of the lower slope to creek flat near Eastern Creek contained the highest artefact density, particularly between 30 m and 100 m of the creekline.

Investigation of middle to lower slopes along low (1st order) drainage lines resulted in very low densities of artefacts interpreted as limited evidence of occupation indicating passing usage of the landscape in these areas.

In summary, these results indicated that in this part of Western Sydney, sites situated up to 100 m from major creek lines on lower slopes display the highest density of artefacts and evidence of

Aboriginal occupation. Low densities of artefacts are located on mid to lower slopes near 1st order creeks.

Eastern Creek Geoarchaeological Model and Strategy Assessment, (AMBS, 2007) Case Study 1 – JMcD CHM - Nurragingy Reserve, Blacktown (2001)

This study involved sub-surface investigations for the widening of the western end of Nurragingy Reserve from Woodstock Avenue in Blacktown. The study area included three landform types; low ridge tops, hill slopes and alluvial creek flats.

The results of the investigation identified the assemblage was dominated by silcrete but there were also significant proportions of tuff and quartz. Most of the artefacts were recovered from the lower slope landforms (which averaged 20 artefacts per square metre) and declined upslope. A high proportion of artefacts from all areas were broken or damaged. However in the upper slopes there had been more disturbance and impact to soil profiles when compared to lower slope and floodplain areas investigated.

The testing methodology employed in this case meant it was not possible to determine whether the higher concentration of artefacts closer to the floodplain were a result of past human occupation, a consequence of soil and artefacts being re-deposited (taphonomy) or a combination of both factors.

In summary higher densities of artefacts were found on lower slope landforms. Few artefacts were located on upper slope landforms. The dominant raw material in the assemblage was silcrete, followed by tuff and quartz.

Alex Avenue and Riverstone Growth Centre Precincts Assessment (ENSR, 2008a)

This survey undertook 103 one-kilometre transects and investigated 303 ha (or 19%) of the 1601 ha of the study area. The study identified 37 Aboriginal sites within the two precincts – 25 within Riverstone and 12 within Alex Avenue.

These sites can be broken down into isolated finds (n=18), background scatters (n=5), artefact scatters (n=4), archaeological deposits (n=5), potential archaeological deposits (n=4), natural silcrete occurrences (n=3) and potential scarred trees (n=2). An assessment of these 37 sites identified 27 sites of low significance, four of moderate significance, and six of high significance. The latter all occur in two areas, either surrounding Site RAA23 adjacent to First Ponds Creek and/or within a large clearing around First Ponds Creek near the corner of Clarke Street and Guntawong Road.

In summary, the survey found artefact scatters and other site types on landforms in the vicinity of First Ponds Creek.

Assessment for water infrastructure, Rouse Hill, Kellyville and Stanhope Gardens (ENSR, 2008b)

In 2008 ENSR undertook an Aboriginal Heritage Assessment for Sydney Water infrastructure in the North West Growth Centre, incorporating Rouse Hill, Kellyville and Stanhope Gardens. The study identified nine Aboriginal sites and one PAD within different landforms.

Artefacts were found adjacent to drainage lines and on ridgelines during the survey. PADs were identified on an upper slope landform adjacent to Second Ponds Creek and on a large alluvial flat adjacent to Caddies Creek.

Kelleher Nightingale Consulting - North Kellyville Detention Basins, Smalls Creek (2008)

In 2008 Kelleher Nightingale undertook an Aboriginal Heritage Assessment for two detention basins proposed for Smalls Creek, North Kellyville, in north-western Sydney.

One isolated find was located on a lower slope landform and a scarred tree was located on a creek bank within 10 m of South Creek. Two PADs were identified on a gentle slope adjacent to Smalls Creek and on an elevated gentle to flat slope in the vicinity of South Creek.

In summary, sites were identified on lower slope landforms and creek banks. PADs were identified on an elevated gentle to flat slope in the vicinity of South Creek.

Spurway Drive Test Excavation Report, November (AHMS 2008c)

Archaeological test investigations were undertaken by AHMS within a proposed residential development of Spurway Drive, Baulkham Hills. Excavations were undertaken by machine in five contiguous 1 m² test pits in five locations on the lower, mid and upper slopes of (1st order) Strangers Creek. All sediments were dug in 10 cm spits and wet sieved through 5 mm mesh.

The excavation recovered 283 artefacts (dominated by silcrete and to a lesser extent tuff). 275 (97%) of the artefacts were recovered from a trench located within 30 metres of Strangers Creek. This area was subsequently identified as the Strangers Creek artefact scatter. A low level background scatter (<5 lithics per square metre) was identified in several other parts of the study area. Analysis of the artefact assemblage led to the hypothesis that the site was used for a brief period in the late Holocene for secondary knapping of early reduction stage artefactual material from nearby raw material sources. It was argued that the site may have been used to test the durability and usefulness of raw material that had been brought from raw material sources prior to leaving the vicinity of such resources. A significance assessment of the areas investigated identified only a 50 to 60 metre section of the lower slope of Strangers Creek as being of moderate archaeological significance.

In summary, the excavation revealed that the alluvial flats surrounding Strangers Creek were utilised by Aboriginal people in the late Holocene (last 5,000 years). Highest artefact scatters were on the lower slopes adjacent to Strangers Creek. The assemblage indicated at least one (and potentially several) knapping events, most likely for secondary knapping. It was believed that the site was used to test the durability and usefulness of raw material that had been brought from raw material sources prior to leaving the vicinity of such resources.

Alex Avenue and Riverstone Growth Centre Precincts (ENSR AECOM, 2008a and 2008b)

An archaeological survey was undertaken which investigated 303ha (a sample of 19%) of Alex Avenue and Riverstone Growth Precincts. The study identified 37 Aboriginal archaeological sites, 25 within Riverstone and 12 within Alex Avenue. These sites comprised 18 isolated finds, five low density artefact scatters, four artefact scatters, five archaeological deposits, four potential archaeological deposits, three natural silcrete occurrences and two potential scarred trees. The survey found artefact scatters and other site types on landforms in the vicinity of First Ponds Creek.

Sites considered to be of high scientific significance occurred in two areas, either surrounding RAA23 adjacent to First Ponds Creek and/or within a large clearing around First Ponds Creek near the corner of Clarke Street and Guntawong Road (referred to as the A7 Archaeological Complex site). These sites were considered highly significant due to the rarity of good preservation along First Ponds Creek.

Part of the A7 Archaeological Complex site is located within the Riverstone East precinct this site comprises 300 x 150m of lower slopes and creek flats. The site is made up of a series of surface artefact scatters, potential archaeological deposits and potential scarred trees, and was interpreted as representing a large scale occupation site. Investigation of this site has been more recently undertaken by AHMS.

ENSR AECOM (2008b) also undertook an assessment for water-related infrastructure within Riverstone and Alex Avenue Precincts. As part of this assessment, survey was undertaken of the proposed area impact, which included several major watercourses, namely First Ponds Creek, Killarney Chain of Ponds and Eastern Creek. A total of 21 sites were identified, comprising seven isolated finds, five background scatters, three artefact scatters, four PADs and eight scarred trees. Two of these sites (RV21 and A7 Complex) were identified within the Riverstone East Precinct, on the eastern side of First Ponds Creek. RV21 was identified as an isolated find and PAD, although this was not identified during the AHIMS search. The study recommended avoidance of the A7 Archaeological Complex Site, as well as RV 21

Oppy Reserve, Quakers Hill (Total Earth Care 2009)

This report was completed following archaeological investigation, which was a requirement of impact on site AHIMS #45-5-0358. The investigation consisted of collection of artefacts along a transect to be impacted by the construction of a path. Artefacts were collected from the surface, and also following an excavator scrape of the transect.

The site recorded within Oppy Reserve (QH2 / AHIMS #45-4-0358) consists of surface and subsurface Aboriginal artefacts (flaked stone). The raw material is predominantly silcrete, and is thought likely to derive from a variety of sources, including Plumpton Ridge to the west. This particular investigation resulted in the identification of three artefact concentrations, one of which was thought to represent either a single knapping event or several events that took place over a short period.

Area 20 Precinct North West Growth Centre: Aboriginal Heritage Assessment (Kelleher Nightingale Consulting Pty Ltd Archaeology and Heritage Management 2010)

Kelleher Nightingale Consulting (KHC) conducted an Aboriginal Heritage Assessment for the Area 20 Precinct. The study comprised desktop research, field survey and significance assessment. As a result of the survey, 19 Aboriginal archaeological sites were located, as well as eight PADs. The composition and extent was also able to be updated for many of the previously recorded sites located during the desktop phase.

The majority of Aboriginal sites were located on slopes or flats in the vicinity of Second Ponds Creek. Sites were also frequently located on ridge lines and slopes adjacent to ridge crests and were more commonly located in areas that had been subject to minimal or no ground disturbance in the historical period.

A number of the artefact sites and PAD extents identified by KHC were defined by the edge of individual properties, some of which lie at the border of the A20 and Riverstone East precincts.

Large, high density sites along Second Ponds Creek were assessed as being of high significance. These, and other, sites within the creek corridor were conserved within a riparian zone within the Indicative Layout Plan.

Schofields Precinct (AECOM 2011)

AECOM undertook desktop review, survey and significance assessment for Aboriginal cultural heritage within the Schofields Precinct, located approximately 7.9km east of the study area. The survey aimed to confirm aspects of the desktop review, through an assessment of a sample of landforms concentrated on those landforms identified as archaeologically sensitive, and a reassessment of previously recorded sites.

The survey relocated a total of eight previously recorded sites (three of which were not yet registered), and located an additional eight previously unrecorded sites. These sites comprised a high density artefact scatter and PAD located adjacent to Eastern Creek, three high density scatters with PAD located on the floodplains between Eastern creek and a tributary, four low density artefact scatters, a scarred tree and seven isolated finds. Four previously recorded sites (two artefact scatters and two isolated artefacts) could not be relocated and were presumed to be heavily disturbed or destroyed.

The high density artefact scatter associated with Eastern Creek was assessed as having exceptional scientific significance, and was recommended to be conserved within a riparian corridor. Further investigation was recommended for sites with a potential archaeological deposit, as well as for sensitive landforms that did not have surface material present. These landforms were identified as sandy rises and land adjacent to Eastern creek.

North West Growth Centre Water Related Services (AHMS 2011)

This report addressed the potential Aboriginal heritage impact of the installation of water related services for the second release precincts of the North West Growth Centre. The investigation for the assessment included development of a predictive model, and an archaeological survey. The results included the identification of a site on the terraces and flats adjacent to Eastern Creek, in the dairy property immediately to the north of the subject area (1035-6 / AHIMS No. 45-5-4093). This was considered likely to be an extension to the south of a site of very high significance, consisting of a high density artefact scatter and deposit, identified further to the north on the banks of Eastern Creek, identified further to the north (1026-46 / AHIMS No. 45-5-4087).

Archaeological test and salvage excavation for the project is in progress, and has included fieldwork in the dairy property immediately to the north of the subject area. Salvage excavation of an area of approximately 30 m², located on a spur, was undertaken. Over 2,000 objects were recovered from this area, including both artefacts and stone fragment which had been heated and/or smashed but did not show diagnostic features relating to flaking. Although the assemblage has not yet been analysed, the initial results suggest that it is late Bondaian in age (that is, from the last 2,000 years) (Alan Williams, pers. comm.). Similarly, an OSL age from a soil sample taken from the test excavation phase indicates that the occupation dates to about 2,000 years ago (Brian Armstrong, pers. comm.).

Box Hill and Box Hill Industrial precincts (AECOM 2012)

A Desktop assessment and archaeological survey were conducted of the Box Hill and Box Hill Industrial Precincts within the North West Growth Centre. The study re-identified 23 out of 27 previously registered sites, as the remaining four had been destroyed through road upgrades. In addition, 11 new Aboriginal archaeological sites, comprising nine artefact scatters and two isolated artefacts, were located. A natural outcrop of silcrete gravels was also located on the banks of an unnamed creek.

The majority of sites were located within 200m of water sources, predominantly tributaries of Killarney Chain of Ponds. The survey recognised several areas of disturbance along the watercourses due to intensive use over the last 200 years, lowering the archaeological sensitivity of the floodplain area.

Marsden Park Precinct-North West Growth Centre (KNC: 2012)

KHC undertook a desktop assessment and survey for the Marsden Park Precinct located to the east of the current study area. During the desktop phase, several potential areas of archaeological sensitivity were identified. Rickabys Creek Gravels were identified as a potential source of silcrete nodules and chert clasts throughout the centre of the precinct, and the floodplains of the high order stream South Creek were predicted to contain high densities of artefactual material. The primary type of disturbance identified was clearance of native vegetation. Therefore, the sub-surface potential of the Marsden Park Precinct was considered to be high.

A survey of the precinct was undertaken, utilising a sampling technique that assessed all landforms within the study area, with additional focus on high sensitivity landforms such as those related to the high order creeks, as well as spur and ridge crests.

Sixty-seven Aboriginal archaeological sites were located as a result of the survey, comprising open artefact scatters, isolated artefacts and two scarred trees. All sites within the precinct were assessed as being between low and moderately significant at a scientific level, with moderate significance indicating the presence of a probable sub-surface component to the site, and low indicating that the site was located in a disturbed context. No sites of extreme rarity or high significance were identified.

Rapid Transit Rail Facility: Aboriginal Cultural Heritage Report (Artefact Heritage 2013)

Artefact Heritage undertook an Aboriginal Cultural heritage assessment report on behalf of JBA for a rapid Transit Rail facility as a part of the North West rail Link at Tallawong Road, Schofields. The Study area comprised Schofields road to the South, Tallawong Road to the east, First Ponds Creek to the West and two properties (2 Oak Street and 57 Tallawong road) forming the northern boundary. During field survey, eight properties were surveyed while the remaining five were inaccessible. The survey was conducted by dividing survey areas by landform, these included crest and slope contexts. There was a generally high level of disturbance across the study area with introduced materials and excavation works identified, as such the archaeological potential for the study area was low.

Godden Mackay Logan/AHMS: Riverstone West Precinct, Sydney (2008/2009/2014)

Godden Mackay Logan Pty Ltd undertook an Aboriginal heritage assessment of the Riverstone West Precinct, to the north east of the current study area, in the NWGC in late 2008. More recently, AHMS (2009b, 2014) has undertaken Section 87 Aboriginal Heritage Impact Permit (AHIP) investigations in a development area located within the Riverstone West Precinct.

Ninety-two 1 m² test pits were excavated in linear transects, 20 m apart across a study area encompassing floodplains, slopes and hill tops. The study area could be characterised by these three landform types with shallow or disturbed duplex soils being identified on the slopes and hilltops, and a deeper fabric contrast soil on the floodplains of Eastern Creek. The floodplains revealed little evidence of extensive deposition or scouring with only 20 – 30 cm of the upper part of the profile being considered flood deposit from the European period. A small, now in-filled, creek line was also present running through the study area.

The excavations recovered 636 artefacts dominated by silcrete (83%), a not unexpected result given that a known silcrete quarry source was located on a ridgeline within the northern part of the study area. Very low densities of artefacts were found in most test pits (between 0 and 10 artefacts per m², and generally less than 5 per m²). High concentrations, however, were found in only three areas. Specifically, 363 (57%) of the artefacts were found within three areas encompassed by two different landform features as follows:

- Two areas of a large sandy levee bank located within 100 m of Eastern Creek retained higher than background artefact densities. One area, located within 50 m of the creek retained the highest concentration of densities with some 321 artefacts (50% of the total assemblage recovered) coming from 5 test pits; and
- A small levee bank located immediately adjacent a dam that would have originally formed part of the now in-filled minor tributary.

This project has more recently been re-activated (AHMS, 2014) following the discontinuance of the development in 2009. A more recent assessment has been developed using these results, and ultimately found that 15 Aboriginal object/sites (separately recorded with 23 AHIMS numbers) were situated across the study area. Of these, two were considered of moderate-high significance, both situated on the banks of Eastern Creek. A zone of moderate and high potential was also identified for all banks of Eastern Creek within 100m.

81 Riverstone Parade, Riverstone NSW Aboriginal Cultural Heritage Assessment (AHMS 2014)

In 20104 Archaeological and Heritage Management Solutions undertook an Aboriginal Cultural Heritage Assessment for the redevelopment of the Riverstone Meatworks and surrounding Yards for the North West Growth Centre Precinct.

Background research for the area indicated an extensive level of previous archaeological exploration throughout the area including both surface and subsurface investigation. A review of previous reports identified 15 Aboriginal objects/sites within the study area, primarily made up of isolated finds and artefact scatters. Based on previous studies and a site survey, it was determined that elevated areas such as levees, terraces and spurs were considered to have the highest archaeological potential, while areas within 100 metres of the Eastern Creek were identified as having moderate archaeological potential.

Tests excavation revealed that the hill slopes within the northwest quadrant of the subject area were generally disturbed, characterized by texture contrast soils. Evidence of historic cultivation was present within the alluvial flats. Altogether the test excavations included 91 test puts of 1m² and contained 636 Aboriginal objects, with the highest densities occurring within the levee bank (n=343, 53%). The artefacts were primarily made of silcrete and of late Holocene age (<5,000 years BP), however a piece of (possible) knapped glass suggests the site may have been used after European arrival.

Riverstone East Growth Centre Precinct: Aboriginal Cultural Heritage Assessment (AHMS 2015)

Archaeological and Heritage Management Solutions Pty Ltd (AHMS) undertook an Aboriginal Cultural Heritage Assessment of the Riverstone East Growth Centre Precinct, to the north east of the current study area. The total study area was 659 hectares, however not all of this was accessed during the field survey. The study identified that the precinct was located in the Cumberland Plain

Bioregion with the First Ponds Creek creating a landform of interest, with natural silcrete cobbles and boulders present throughout the area.

A total of 109 hectares (22 properties) were accessible during site survey. These were chosen for survey based on good ground surface visibility and correlation to landforms of interest. During the site survey, nine new sites were identified including Isolated Aboriginal objects and Low density artefact Scatters.

A second site inspection was undertaken in which no further Aboriginal sites were found within the study area, however previously recorded sites were identified within the vicinity of the study area. All together, the study identified 26 Aboriginal object/sites of which eight had been destroyed. Of the remaining sites, six were considered to have high local significance, two of moderate significance and the remaining eighteen of low significance. In conclusion, the study identified that the results of the survey were consistent with local studies undertaken within the region, with the more complex and significant sites occurring within the vicinity of The First Ponds Creek

Appendix 5: Aboriginal Site Information

A5.1 Aboriginal Sites

Aboriginal sites are classified in a number of ways. At the most basic level, sites are recorded as 'closed sites' or 'open sites'. Closed sites are associated with rock shelters, and include other evidence of Aboriginal occupation that may be present, such as accumulated cultural deposit within the shelter ('potential archaeological deposit' or PAD), faunal remains (animal bone or shell), and rock art on the shelter walls (paintings or engravings). Open sites are broadly defined, and encompass all other types of Aboriginal sites identified where there is no rock shelter. The most common types of open sites found in NSW include artefacts, which can occur almost anywhere in the landscape, grinding grooves, rock art across formations, culturally modified trees, and shell deposits (middens) (OEH 2012:7). The presence or absence of stone artefacts is often a defining factor, although it is worth pointing out that almost any site is likely to have at least some associated artefacts, as discard or loss of this most ubiquitous and practically indestructible marker of Aboriginal archaeology is likely to have occurred anywhere that Aboriginal people stopped or gathered for any length of time.

Any one site (or close group of linked sites described as a 'site complex') can contain several different site features. For example, a shelter may have art on the walls, artefacts on the floor surface or outside the shelter, and be predicted to contain faunal remains and further artefacts in the accumulated deposit inside.

A description of terms used to describe different site features recorded in the NWGC and within the vicinity of the Shanes Park and West Schofields precincts is provided in **Table A7**. Other features or types of Aboriginal cultural sites that do not necessarily leave physical evidence may exist or have once existed in the NWGC however such sites have not previously been recorded reflecting the archaeological focus of the past studies and the loss of traditional knowledge of such places in this area. Similarly there may be places of contemporary significance to Aboriginal people in the precincts and this will require consultation with the Aboriginal community to identify such places.

Table A7 Aboriginal site feature definitions (OEH 2012:4-5)

Site Feature	Definition
Artefact	Objects such as stone tools, and associated flaked material, spears, manuports, grindstones, discarded stone flakes, modified glass or shell demonstrating evidence of use of the area by Aboriginal people.
Potential Archaeological Deposit (PAD)	An area where Aboriginal objects may occur below the ground surface. The term 'potential archaeological deposit' was first applied in Sydney regional archaeology in the 1980s, and referred to rock shelters that were large enough and with enough accumulated deposit to allow archaeologists to presume that subsurface cultural material was highly likely to be present. Since then it has come to include open sites where the same prediction can be made.
Modified Tree (Carved or Scarred)	Trees which show the marks of modification as a result of cutting of bark from the trunk for use in the production of shields, canoes, boomerangs, burials shrouds, for medicinal purposes, foot holds etc., or alternately intentional carving of the heartwood of the tree to form a permanent marker to indicate ceremonial use/significance of a nearby area, again these carvings may also act as territorial or burial markers.
Stone Quarry	Usually a source of good quality stone which is quarried and used for the production of stone tools
Burial	A traditional or contemporary (post-contact) burial of an Aboriginal person, which may occur outside designated cemeteries and may not be marked, e.g. in caves, marked by stone cairns, in sand areas, along creek banks etc.

Stone Artefacts

Aboriginal stone artefacts are an important source of archaeological information because stone is preserved for long periods of time whereas organic materials such as bone, shell, wood and plant fibres often decay. Stone artefacts provide valuable information about technology, economy, cultural change through time and settlement patterning. Stone has also been used for 'relative' dating of sites where direct methods such as radiocarbon dating cannot be applied. A technological sequence for stone artefacts for the region was first described in the late 1940s by Fred McCarthy and has since been refined over time by Hiscock and Attenbrow (Hiscock and Attenbrow 1998, 2005) into the 'Eastern Regional Sequence':

- Capertian – is distinguished by large uniface pebble tools, core tools, horse-hoof cores, scrapers and hammerstones. Backed artefacts occasionally present. Generally dates to before 5,000 years BP.
- Early Bondaian – Aspects of the Capertian assemblage continue, but backed artefacts and ground-edged artefacts increase. Artefacts during this period were predominantly made from fine-grained siliceous stone such as silcrete and tuff. Generally dated from 5,000 BP to 2,800 BP.
- Middle Bondaian – Characterised by backed artefacts, particularly Bondi Points and ground-edged artefacts. Artefacts made from siliceous materials, however quartz becomes more frequent. Generally dated from 2,800 BP to 1,600 BP.
- Late Bondaian – characterised by bipolar technology, eloueras, ground-edged artefacts, and bone and shell artefacts. Bondi points are virtually absent and artefacts are predominantly made from Quartz. Generally dated from 1,600 BP to European contact.

Survivability of the Archaeological Record

The following observations can be made about the nature and survivability of the archaeological record across the Cumberland subregion:

- Archaeological material is often found in areas of sub-surface exposure, such as those caused by erosion.
- Surface evidence (or the absence of surface evidence) does not necessarily indicate the potential, nature or density of sub-surface material. Extensive excavations have shown that areas with no surface evidence often contain sub-surface deposits buried beneath current ground surfaces (JMCHM 2001; Kohen 1984).
- Due to the limitations of surface surveys, test excavation is often required to establish the nature and density of archaeological material.
- Aboriginal cultural material is more likely to survive in areas that contain remnant portions of the pre-European soil profile, in contrast to landforms that have been impacted by historical or recent disturbances.
- The potential for survival of any archaeological sites will largely depend on the degree of past disturbance.

- Past disturbance to the soil profile can be due to European activity such as clearing, ploughing, grazing, and urban development and/or due to environmental factors such as flooding events, erosion and colluvial movement. These activities may disturb, erode or remove the natural soil profile completely.
- Aboriginal stone artefacts are more likely to survive because stone is preserved for long periods of time whereas organic materials such as bone, shell, wood and plant fibres decay.
- A major impact of more than 200 years of post-contact settlement on Aboriginal sites would have been the destruction of carved and scarred trees, which would have been removed as part of clearing for agricultural activities and the construction of infrastructure such as buildings and roads. However, there is some potential for culturally modified trees to survive in areas where there are stands of remnant native vegetation.

Appendix 6: Archaeological Predictive Model

A6.1 General

Archaeological predictive models identify, locate and map where archaeological resources are likely to survive. They can apply to small single sites or large areas, and can be simple exercises or enhanced by the use of specially designed GIS based spatial models.

GIS based archaeological predictive models are primarily used in development and land use planning contexts to strategically identify constraints (e.g. AHMS 2008a, 2008b, 2013; Williams and Fredricksen 2006a, 2006b, 2007a, 2007b; Williams and Baker, 2007a, 2007b, 2008; Williams and Walther, 2008). By doing this, the risk often associated with archaeological resources and sites is decreased and planning processes streamlined. This is because predictive models allow information about the location and likely type and heritage value of archaeological sites to be combined with other environmental and cultural information in a common GIS environment to inform the overall planning process. Models also provide the best chance for areas with a higher potential of surviving cultural resources to be avoided, if possible, or for sites to be located and documented prior to their disturbance.

This study includes the development of an archaeological predictive model to identify areas of archaeological probability within the Shanes Park and West Schofields precincts. The models combine key environmental variables (Section 2) and known archaeological information (Section 4) within a GIS framework to characterise the natural and cultural landscape and 'predict' where archaeological resources are likely to occur and survive.

This section summarises the rationale, methods, framework and results of the exploration and development of an Aboriginal archaeological predictive models for the Shanes Park and West Schofields precincts. The model was used to identify areas of likely Aboriginal archaeological heritage sensitivity, and hence Aboriginal heritage risk, of land by highlighting archaeologically relevant environmental factors (such as proximity to water, elevation, etc.) and classifying them accordingly.

A6.2 Methodology

The development of the GIS-based archaeological predictive models of the Shanes Park and West Schofields precincts included:

- Collating environmental variable GIS layers (including hydrology, elevation, slope, soils, geology, geomorphology, vegetation, and archaeological sites).
- Rasterizing environmental variables and their components to allow for comparison between vector and raster based environmental datasets.
- Ranking or weighting each environmental variable component mathematically, dependent on its ability to influence cultural heritage site distribution.
- Adding selected environmental variable GIS layers together through their mathematical weightings.
- Manually classifying the multiple GIS raster layers for all the environmental variables into rankings of high, moderate or low (archaeological potential) dependent on the mathematical value of each pixel (and hence archaeological influence).

A6.3 The Dataset

The development of the model included all previously documented archaeological sites with the exception of isolated finds (**Appendix 5**). Due to the small number of sites within the two precincts, this was expanded to the surrounding areas, and ultimately included 136 sites.

Of the 136 sites within the general vicinity of Shanes Park and West Schofields precincts, 90 were used in the development of the model and the remaining 46 were used to test the model. These 90 sites were randomly selected from the overall dataset to provide statistical rigor in the testing process.

A6.4 Environmental Variable Rankings

The development of a model combines information about known or documented archaeological sites (i.e. from the AHIMS database) and their underlying environmental variables to extrapolate or predict where as yet 'unknown' sites are likely to occur. Environmental variables commonly include proximity to water, type of geology and soils, elevation, slope, aspect and landform. An initial map of archaeological probability, according to each environmental variable, can then be developed.

For example, if it is assumed that three environmental variables are significant to archaeological site distribution such as 'lower slopes', '100 m from a creek line' and 'on sandy soils', wherever these three variables overlap elsewhere in the subject area, it can be assumed that the likelihood of archaeological site distribution is high. Where only two of the environmental variables occur there is a still a chance of archaeological material occurring, however the classification of this combination of variables will be lower than the area with three converging variables. The presence of only one variable will be lower again. Models will use information from several environmental variables (generally over five and often over 10) and several 'known' archaeological sites, to develop a comprehensive picture of archaeological potential.

A6.5 GIS Layers Used

The content and accuracy of the data used to develop the archaeological probability maps has a direct effect on the model outputs. Often in GIS, the data sources used will be a 'best fit' for the purposes of the study. Accordingly, information regarding the source of the data, the content, and any manipulations and applications is essential for transparency and to provide for future improvements.

The GIS data layers to develop the models needed to be either sourced or specifically developed. DPE was able to provide AHMS with the environmental data, which was sourced from various agencies, such as the Office of Environment & Heritage. DPE also provided infrastructure data such as roads, railways and cadastre data. The landform data used in the modelling was developed by AHMS and was sourced from DPE and other sources.

Table A6 outlines the types of data used, their source and how they were used in the archaeological probability maps. The landform data used for the probability maps was generated by AHMS and requires a separate discussion located below. The selection of GIS layers was found through statistical exploration of the Aboriginal site data and each environmental variable in 'R'. Overall, some 14 GIS layers were examined (including slope, elevation, lithology, land use, vegetation), and those in **Table A6** were shown to explain the majority of the data distribution. Those layers that could not explain the data distribution were dropped from the model.

Table A6. GIS data and the environmental attributes used for the archaeological predictive models.

Attribute	Source	Dataset Name	Weighting used in Model
Land use	NSW Department of Environment and Heritage	NSW Landuse v1	Quarries and landfills: -4 Roads or road reserves: -3 Irrigated pastures, reservoirs, farm dams, river/creek/other incised drainage features, energy corridors: -2 Industrial/commercial, residential, rural residential, irrigated vegetables, riparian strips in urban areas with minimal use, abandoned urban or industrial areas, intensive poultry production, urban recreation, farm infrastructure: -1 Defence facilities, horse production: +1 Native forests, volunteer/naturalised/native/improved pastures: +2
Stream order*	NSW Department of Planning and Environment	Strahler stream order	Within 250 metres of 2nd - 4th order: +2 Within 250 metres of 6th order: +1
Distance from streams*	AHMS-derived data built from stream data	N/A	Within 150 metres of any waterway: +2 Within 150-250 metres of any waterway: +1
Distance from Plumpton Ridge area	AHMS-derived data	n/a	Within 2000: +2 Within 2000-5000 metres: +1
Distance from silcrete-bearing geologic areas	AHMS-derived data built from OEH geology data	n/a	Within 1000 metres of silcrete areas: +2 Within 1000-4000 metres of silcrete areas: +1

*Distance from stream was set as 250m to account for the difference between centre of the creek upon which the GIS data is based, and top of bank from which archaeological models indicate that 200m is significant.

A6.6 Development of the Models

The model was compiled using the environmental variable components identified in **Table A6**. Initially the model is a mathematical construct and identifies the importance of each environmental variable through numerical values and rankings across the subject area. The values assigned to variables can be of any number, as long as those components of importance are ranked higher than other components that are not. In this case, the majority of variables were assigned values 0, with those of influence valued between 1 and 2, and those that reduce the potential of archaeological sites to occur to between -1 and -2. Once all environmental variables were incorporated into the model, the overall numerical value attained for each spatial grid square based on values in **Table A6** was calculated between 0 (negligible potential) to 8 (high potential) simply by adding up the various numerical rankings each grid square achieved.

Disturbance was introduced as a negative variable where possible. Where areas could be identified as disturbed, they reduced the numerical ranking of an area by '2', so an area of high ranking would be reduced to one of moderate or low and so on. However, it should be noted that disturbance was constrained to existing GIS information, which largely captured major conurbations and road networks only.

Once the models were developed with the numerical ranking for each spatial grid square, areas of high, moderate and low archaeological potential were created from them using the archaeological information outlined in **Section 4.3** and **Appendix 4** and the previously recorded sites used to create the model. This division of the numerical scale was undertaken by the modeller and sought to ensure

the largest number of identified archaeological sites and places were encompassed within areas of high potential, while maintaining the effectiveness and usefulness of the model (i.e. ensuring the process maintained a balance between the ranking zones and not identifying the entire subject area as of high potential and thereby making the application of the model useless). Areas of high potential were delineated to encompass as much of the known archaeological sites as possible, and any areas highlighted by the review (such as close proximity to water), which meant that high areas encompassed all grid squares with numerical rankings of 5-8. The moderate areas were developed to capture any data that fell outside of 5-8, and included 3 and 4, while 0-2 were considered of low potential and encompassed the rest of the study area.

A6.8 Testing the Model

Following the completion of the final models (**Section 4.5**), the model was tested to identify its effectiveness at predicting archaeological materials. Typically there are three different ways to test this type of model:

- Compare the model with the previously documented archaeological sites and identify whether they are found in appropriately ranked areas. Use of both the archaeological data used to develop the model and/or a separate test subset can be suitable for comparison.
- Review the model against previous heritage assessment and/or excavations in the subject area to compare detailed local data with the wider model rankings. Unfortunately, few such assessments/excavations exist within the subject area, and make such analysis problematic.
- Undertake targeted field investigation to visually confirm/refute the identification of areas by the model. This may form a subsequent stage of this study.

As outlined in **Section A6.3**, a small subset of randomly selected sites was retained for testing. When considering the regional model (effectively an area encompassing the two precincts and ~2km in all directions), the subset data revealed that some 32 out of 46 (69.5%) fall within areas of high (likely) or very high (very likely) archaeological sensitivity. Using the entire dataset, this value increases to 90 out of 136 sites (66%) within areas of high (likely) or very high (very likely) archaeological sensitivity. When incorporating moderate (unlikely) areas, some 128 (94%) of the data is encompassed within the top three zones of sensitivity (**Table A7**). When considering just the precincts themselves, 29 (80.5%) of the data is located within very likely and likely zones.

These results indicate that the model is effective, with values in the order of 60-80% being considered satisfactory for modelling purposes. Ideally, the archaeological ranking zones would shift slightly by elevating some of the moderate areas into high ranking. Unfortunately, this would lead to an extensive amount of the subject area being identified as of archaeological sensitivity, and would reduce the overall usefulness of the model.

Table A7. Testing of the model using AHIMS data obtained for this study.

Ranking	# of testing data subset (n=46)	% of testing data subset (n=46)	# of all sites (n=136)	% of all sites (n=136)	# of sites within the precincts (n=36)	% of sites within the precincts (n=36)
Low (Very unlikely)	2	4.35	8	5.88	2	5.56
Moderate (Unlikely)	12	26.09	38	27.94	5	13.89
High (Likely)	19	41.30	59	43.38	17	47.22
Very High (Very likely)	13	28.26	31	22.80	12	33.33
Total		100		100		100

While detailed local assessments/excavations for the subject area are not readily available, the model can be compared with the predictive modelling of the region undertaken by OEH. OEH's modelling is a relatively new development to assist proponents and landowners in their due diligence processes under OEH's *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW, 2010). The models are not as detailed as those presented here, but do provide a rough indication as to Aboriginal heritage issues within a given area.

When comparing the OEH model with the model developed here, they show only loose correlation, with the OEH model under-representing disturbance, and likely over-representing flood erosion along the main creeklines, and thereby reducing potential along these areas (**Figure A8**). Data presented in this report, along with the distribution of our known sites in the region contradicts these assumptions and can account for the disparity between the OEH models and those produced here. Given, more site-specific data was used for this study, it is considered that this model is more reliable than the OEH model, which was designed for broad-scale regional consideration.

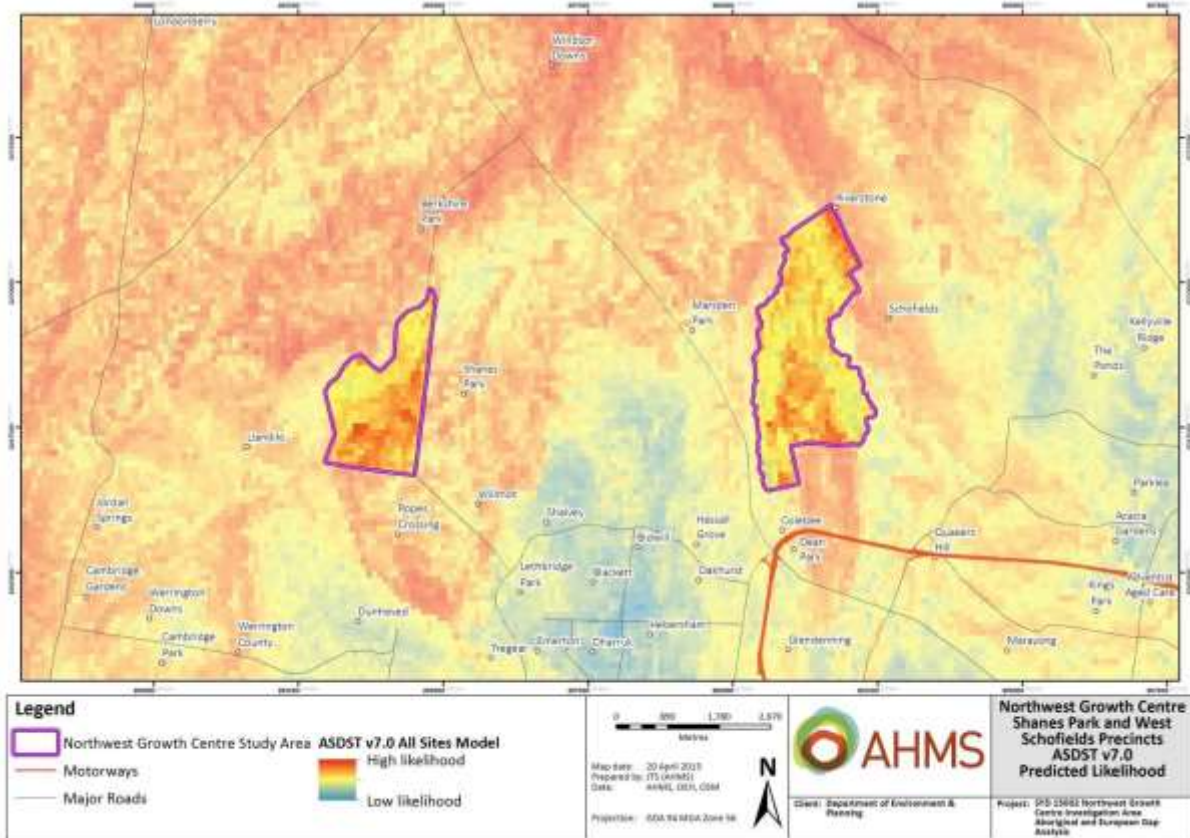


Figure A8. Predictive archaeological map of the Shanes Park and West Schofields Precincts by OEH’s Aboriginal heritage due diligence support tool. High sensitivity is identified by darker colours; lower sensitivity by lighter colours. Note this model picks up the sensitivity of the Plumpton Ridge but does not account for the disturbance of recent commercial quarrying,(Source: <http://www.environment.nsw.gov.au/licences/AboriginalSitesDecisionSupportTool.htm>).

A6.8 Limitations

Due to the theoretical and mathematical approaches to the development of the models, there were several limitations that apply, as follows:

- The model outlined in **Section 4.5** is a scientific model based on environmental variables and landforms known to be important for Aboriginal populations. However, there are cultural and ritualistic sites (such as bora rings, initiation, birthing and increase sites) that do not necessarily follow the environmentally determined principles above, since their location is related more to cultural importance than environmental attributes. These sites may not follow the trends above, and will display as an error within the model. Because of this reliance on the model solely without considering the possibility that such sites exist may lead to poor conservation outcomes.
- The development and nature of a model requires averaging of data to provide a holistic perspective to a given area. Such ‘averaging’ introduces error and reduces accuracy in predicting archaeological resources. For this reason, the models will not explain all of the archaeological data and are unlikely to be 100% effective in predicting archaeological sites.

- The model provides information on the probability of Aboriginal archaeological materials occurring. The models do not provide any information on or consideration of the significance or integrity of archaeological sites/deposits within these probability areas.
- Due to the nature of consulting archaeology, the archaeological knowledge and documented sites/deposits in the region are constrained to areas of proposed development. This can clearly be seen in several of the models where clusters of sites are shown in specific areas. Such an approach means that specific landform testing or research type analysis has not generally been undertaken in this area of the region, so there is likely to be some bias in the data in relation to the location and landform type where archaeological material occurs.
- The models were both developed and tested with existing and known Aboriginal site data from OEH's AHIMS database. However due to the size of the project no quality control of the AHIMS data (e.g. confirming site location and site types) could be undertaken. This had three main implications for the integrity of the model:
 - AHIMS sites are frequently assigned erroneous co-ordinates and locations. The development of a model based on site co-ordinates, therefore will not necessarily accurately represent the actual site's location.
 - Much of region retains a low density of artefacts (a background scatter) in all landforms and environments. Such a low density scatter indicates the general use of the region, but does not identify the specific areas of occupation or intense use. AHIMS data identifies 34 (94.44%) of the sites for this assessment as consisting of artefacts in nature, but does not distinguish (in all cases) between isolated artefacts (i.e. part of the wider background scatter) from large-scale artefact scatters. As such, the models could not be developed or focused towards significant archaeological sites.
 - The AHIMS data provides one co-ordinate or 'point' for each Aboriginal site in the subject area. However, it provides no contextual information on the size or extent of the site. Hence while the models have been developed and tested on these 'points', sites may extend beyond the co-ordinate in question and thereby affect the accuracy and/or effectiveness of the model.
- Modern disturbance and development is under-represented in the model. While, some disturbance is mapped through GIS layers, such as major roads, etc, there are a range of lesser impacts that are not currently captured. Here, we use GIS layers of land zoning to provide a general indication of the current use, which provides a broad pattern of disturbance across the study area. However, as greater spatial data on existing and past activities becomes available, they should be integrated into the model to improve disturbance mapping and revise potential rankings as necessary.
- There are some limitations in the application of the archaeological modelling within a GIS framework. For example, the archaeological modelling has identified areas within 200 m of a creekline to be archaeologically sensitive. The 200 m should be considered from the top of bank of the creek for archaeological interest, however, due to a limitation of the GIS data, the 50 m buffer either side of the creek originates from the centre line of the creek rather than the top bank of the creek. This adds some spatial disparity to the application of the model.

- The nature of GIS requires every environmental variable to be defined accurately, but in reality, this cannot always be the case. For example, several of the creeklines are identified as a singular creek line by GIS, whereas in reality some areas are a series of low lying swampy and water logged areas. The former is of interest archaeologically, while the latter is not. Therefore, the simplicity of GIS in some areas creates limitations and spatial constraints.
- This model has been developed based on existing data and desktop review. No field investigation has been undertaken to verify or ground-truth this model. Recommendations are made in **Section 5** that seek to demonstrate and test the effectiveness of the models in a real environment. Caution should be used when considering the effectiveness and accuracy of the models until such investigations and testing is undertaken.
- Plumpton Ridge while widely known as a key Aboriginal raw material resource in the past, is poorly documented in the AHIMS database. Since the AHIMS data was a critical input into the modelling process, and fails to document the ridgeline, the model under-represents this deposit. Therefore, areas of West Schofields shown to be less likely to contain Aboriginal objects/sites must first consider the potential for it to be in, or in the vicinity of Plumpton Ridge.
- The models presented here are first-order attempts at predicting as yet unrecorded archaeological material in the subject area. The models are not intended to be the determinant of archaeological resource distribution in the Shanes Park and West Schofields Precincts of the NWGC. Additional investigations, studies, excavations and assessments undertaken in these areas should be used to provide input into and revise the models as appropriate.