Greater Macarthur Investigation Area

Aboriginal and Historic Heritage - Gap Analysis and Future Direction

Final

Department of Planning & Environment

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AHMS

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ABBREVIATIONS

ACHA	Aboriginal Cultural Heritage Assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
BP	Before present (AD 1950)
CHL	Commonwealth Heritage List
DP	Deposited Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
GMIA	Greater Macarthur Investigation Area
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

The Department of Planning and Environment (DPE) is investigating the potential for greenfield development south and south-west of Campbelltown-Macarthur region referred to as the Greater Macarthur Investigation Area (GMIA) in *A Plan for Growing Sydney*. Preliminary analysis has identified an urban capable boundary that varies slightly from that in the above plan (this is shown in Figure 1 of this report). The Framework report, currently being prepared by Urbis and to which this current heritage assessment contributes, will identify the urban suitable boundary for further action by government. If the area is considered suitable, a long-term growth framework will be developed to assist with the future orderly release of land, allowing efficient delivery of infrastructure. It will also allow the cumulative effects of development to be carefully considered and addressed. 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 GMIA as a 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 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 North-west Growth Centre. 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 GMIA.

b) To identify areas where previous assessment has been minimal or lacking.

c) To identify areas of key Aboriginal and historical cultural heritage interest and/or significance.

d) To propose future priorities for subsequent investigation should GMIA be progressed as a growth area.

Key Findings

- The area formed part of the early agricultural expansion outside the immediate area of the early colony of Sydney. The majority of the better soils in the area were settled by MacArthur at Camden Farm (part of which lies within the study area). The agricultural/pastoral mix of the area changed over the course of the 19th Century but the rural nature was largely maintained until the post-WW2 period. Only two townships within the study area provided commercial and service-hubs for this landscape: Appin and Menangle.
- There are no listings on the World Heritage List, National Heritage List or Commonwealth Heritage List (CHL) within the study area.
- The State Heritage Register (SHR), [former] Register of the National Estate (RNE), State Heritage Inventory (SHI) and National Trust listings for the study area reflect the rural environment. Many of the listings relate to large and small scale agricultural/pastoral establishments. Other items listed in the SHR and RNE relate to transport, via the Menangle Railway Bridge and Station.
- Environmentally, the GMIA is dominated by the Cumberland Plain subregion and from an Aboriginal heritage perspective is archaeologically similar to the southwest and northwest Growth Centres. This area has several key waterways, including the Nepean, Cataract and Georges River, and therefore has potential for significant cultural sites along these, akin to those found elsewhere along Second Ponds Creek, Eastern Creek, South Creek and Kemps Creek. To the south and east, the Sydney Cataract subregion is dominated by dissecting sandstone and has

potential for rock-shelters, engravings and grinding grooves. It is likely to be archaeologically comparable with the North Kellyville precinct within the north-west growth centre.

- Based on AHMS' ethnographic database, several instances of Aboriginal-early European interaction occurred around Menangle and Menangle Park. This area was formerly a well-used series of swamps and waterways, and is likely to have formed a focus of activity and occupation in the past. It has remained largely unmodified since European arrival.
- Currently, 323 Aboriginal objects/sites have been documented within the GMIA. 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 few. Along the eastern margins, within the Sydney Cataract subregion, rock-shelters and other closed sites dominate, and they are located along creek-lines where the sandstone geology has been incised to form such features.
- Based on a limited review of heritage studies, and the archaeological predictive modelling, there is high potential for Aboriginal objects/site to occur along the banks of the Nepean, Cataract and Georges Rivers, and Allens, Elladale, Clemens, Cascade, and Wallandoola, creeks. The Georges River, Allens Creek, Elladale Creek and headwaters of the Cataract River (including Wallandoola creek) reveal the highest potential for significant cultural material, primarily due to frequent elevations along these corridors and a general absence of development. Recent excavations by AHMS along Georges River have demonstrated deeply stratified and old (>20ka) cultural materials on an elevated ridgeline at Moorebank, and it is considered more would be found along other parts of the river system. Conversely, large areas of the Nepean River are highly flood prone, and while Aboriginal people would have carried out activities along the river, thereby creating what archaeologists record as ‘sites’, there is a lower likelihood that such sites would be preserved due to the history of flooding.
- Aboriginal consultation has been undertaken, including a cultural mapping workshop with a selection of stakeholders, and six areas of cultural value were identified along with areas of observed Aboriginal site abundance and diversity. The six areas included areas particularly important for subsistence activities along the lagoons and creeks and a traditional story place near Menangle, and a massacre event southwest of Appin. A number of other areas were also identified in other parts of the GMIA near Gilead, Menangle Park, Bingara Gorge and Elladale Creek. All of these areas would require further investigation prior to development being considered.

Areas Where Research Has Not Occurred

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 GMIA as indicated below.

- Due to the limited timeframe available for this study the review of Aboriginal and historic heritage reports while thorough is not regarded as exhaustive and further information may emerge as should investigation of GMIA be progressed. This will be built on in subsequent stages of this project.
- Both Wollondilly and Campbelltown LGAs have apparently been subject to initial Heritage Studies and subsequent reviews, however the complete Wollondilly heritage study has not been made available for this review. The Campbelltown Heritage Study establishes and highlights local historic themes relevant to the LGA. However while it addresses the built heritage aspects of the LGA, it does not adequately address archaeological sensitivity. Given the lack of information available it is assumed that the same is the case for Wollondilly LGA. Some archaeological sites are noted in the Wollondilly LEP but none, specifically, in the Campbelltown LEP. The archaeological 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. Any historic archaeological assessments undertaken in these LGAs have primarily been focussed on specific impacts and developments related to existing allotments/cadastral boundaries. On this selective basis the reports do not provide a broad regional picture of the archaeological potential of the study area.

- A Regional Archaeological Research Design and Management Strategy (RARDMS) should, therefore, be completed for the development 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). The RARDMS would provide a better understanding of areas where potential archaeology might be a constraint at a regional level, address archaeological issues for a broad scope approach to statutory requirements in relation to archaeology and therefore provide a greater degree of certainty in regard to development options. The RARDMS 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 RARDMS may also define curtilages associated with potential sites. The PHALMS project, which might provide the basis for approach for a regional study here, divided the Parramatta LGA into a number of archaeological management units (AMU) based on current cadastral boundaries. Each AMU's historical background was outlined, the degree of disturbance identified and assessed by ground survey and archaeological potential and significance assessed on this basis. Each AMU was then assigned management recommendations ranging from low potential/low significance – no further action required to high potential/high significance – undertake archaeological assessment on areas subject to disturbance through development.
- Previous Aboriginal heritage assessments have been limited. The majority of studies have been focussed towards the north of the GMIA and/or have been for exploratory activities (such as gas wells) and therefore reflect only isolated patches of on-site assessment. Further, the vast majority of assessments are quite dated (often being pre-AD2000) and do not conform to current guidelines. While it is understood that investigations have been undertaken in relation to mining activities these reports do not appear to have been lodged in the AHIMS report catalogue and were not available for this study.
- Several parts of the study area have yet to undergo any Aboriginal heritage investigation, including along the Cataract River between Brooks Point and Douglas Park, and south and west of Appin. The periphery of the GMIA i.e., around Maldon, the Dharawal State Recreation area, and near the Cordeaux River, does not appear to have been investigated. Several of these areas are predicted to contain extensive and/or significant cultural material.
- Many previous Aboriginal heritage assessments have had limited field investigation, such as focussing on a handful of gas wells within a much wider area, and for this reason most areas in the vicinity of the GMIA would require some level of re-investigation.

Conclusions

Based on the review undertaken it is clear that there has been only limited Aboriginal and historic heritage investigation in the GMIA to date. Many of these studies have been for exploratory works (such as gas wells, or coal seams) and are therefore dominated by desktop research, with only minimal field investigation. Further, many of the reports are quite dated, and fail to 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.

The key areas of constraint are highlighted in **Section 4.2**. In brief, the GMIA is similar in environment and landscape to the wider Cumberland Plain within which the 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 the GMIA. 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 GMIA. Based on modelling, key areas appear to be the Georges River and many of the tributaries of the Nepean River in the southern parts of the study area. In areas where the river banks are steepest and consist of sandstone gorges Aboriginal sites are likely to cluster around the upper reaches of tributaries where sandstone shelters begin to form. The northern part of the study area appear to have been more heavily impacted by urban spread, and are generally more swampy and low-lying, such as around Menangle. It must be noted, however, that the Menangle area was used and occupied by Aboriginal people as observed by explorers at European contact and Aboriginal activity continues through particular families as indicated in the cultural values workshop.

Notwithstanding the above constraints and limitations, there appear opportunities for development which may have minimal impact on cultural heritage values across much of the GMIA, especially in areas between Douglas Park and Menangle along the Nepean River; in the vicinity of Gilead; south and west of Appin, and surrounding Wilton.

If DPE decides to progress the GMIA as a future growth centre, it should be noted that the following tasks are yet to be completed to the level required to adequately address cultural heritage concerns.

- Regional cultural heritage frameworks should be developed to guide and optimise future investigations. These should include:
    - Preparation of a regional Aboriginal and archaeological research and investigation framework. All future Aboriginal heritage assessments in the area should be consistent with, and feed into that framework. This will maximise opportunities to create knowledge of value to the Aboriginal and broader community and will facilitate the assessment and management of the heritage resource while avoiding duplication
    - Development of a Regional (Historical) Archaeological Research Design and Management Strategy (RARDMS) Archaeological Zoning Plan.
- 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.
- Further investigation of previous studies and databases, and the development of new assessments, which contribute to the regional research and investigation framework, should be undertaken on individual locations or precincts when they are proposed for planning and development.
- The tasks identified in section 5.2 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.

1 INTRODUCTION

1.1 Background and Purpose

A Plan for Growing Sydney requires that the NSW Government develop a framework for the identification of new Growth Centres (Action 2.4.2). The framework is needed to improve the management of future land release, stimulate competition to keep downward pressure on prices, and help prevent speculative investment and land-banking. In response to this action, the Department of Planning & Environment (DPE) is undertaking the Greater Macarthur Investigation Area (GMIA) project. The overarching objective of this project is to investigate the potential for greenfield development south and south-west of Campbelltown-Macarthur region. If the area is considered suitable, a long-term growth framework will be developed to assist with the future orderly release of land, allowing efficient delivery of infrastructure. It will also allow the cumulative effects of development to be carefully considered and addressed.

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 GMIA. 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 a piecemeal approach. This is the first attempt to develop a regional study to highlight the knowns and unknowns for a potential Growth Centre.

This report aims to:

a. To compile and review of existing documentation and listing for Aboriginal and historic heritage within the GMIA.

b. To identify areas where previous assessment has been minimal or lacking.

c. To identify areas of key Aboriginal and historical interest and/or significance.

d. To propose future priorities for subsequent investigation should GMIA be progressed as a growth area.

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. Information about Aboriginal cultural heritage gleaned from reports has been complemented with information provided by Aboriginal people through a preliminary cultural values workshop,

1.2 Study Area

The Greater Macarthur Investigation Area (GMIA) as defined in the document *A Plan for Growing Sydney* covers an area of 180.2km^2 within the Campbelltown and Wollondilly Local Government Areas (LGAs), approximately 50km south east of Sydney. The adjusted boundaries of the GMIA called the Urban Capable Area (**Figure 1**) is slightly smaller in total area but includes the same localities, which include Glenlee, Appin, Gilead, Brooks Point, Wilton Menangle Park, Menangle, and parts of Glen Alpine, Rosemeadow, Douglas Park and Pheasants Nest.

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 the GMIA.
- Reviewing existing Aboriginal and historical databases and listing to identify previously recorded and documented items and sites within the GMIA. These include: World Heritage List, Commonwealth Heritage List, National Heritage List, State Heritage Register, Local Environmental Plan heritage schedules for the Campbelltown and Wollondilly Local Government Areas (LGAs), 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 GMIA 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.
- Conducting a preliminary workshop with Aboriginal people to map cultural values.

1.4 Limitations

This report is based on existing and publicly available environmental and archaeological 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 (except where the fieldwork indicated inconsistencies).

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.

At the time of reporting the Wollondilly Heritage Study had not been provided for consideration in this review only a summary copy of the review that did not contain substantive information.

This report is one of many specialist studies feeding into the DPE's assessment of the area. In the course of the investigation the study area boundary altered slightly from the original GMIA study area to the 'Urban Capable' area as shown in **Figure 1**. As a result of this iterative process some elements of the investigation may not have specifically covered the adjusted boundary, most notably north of Douglas Park, and south of Maldon.

1.5 Authorship

This report was written by Alan Williams, (MAACAI) and Matthew Kelly, Senior Heritage Advisors and Ngaire Richards, Heritage Advisor. Susan McIntyre-Tamwoy and Ben Christensen contributed to the sections relating to Aboriginal cultural values. The report was reviewed by Susan McIntyre-Tamwoy (Associate Director).

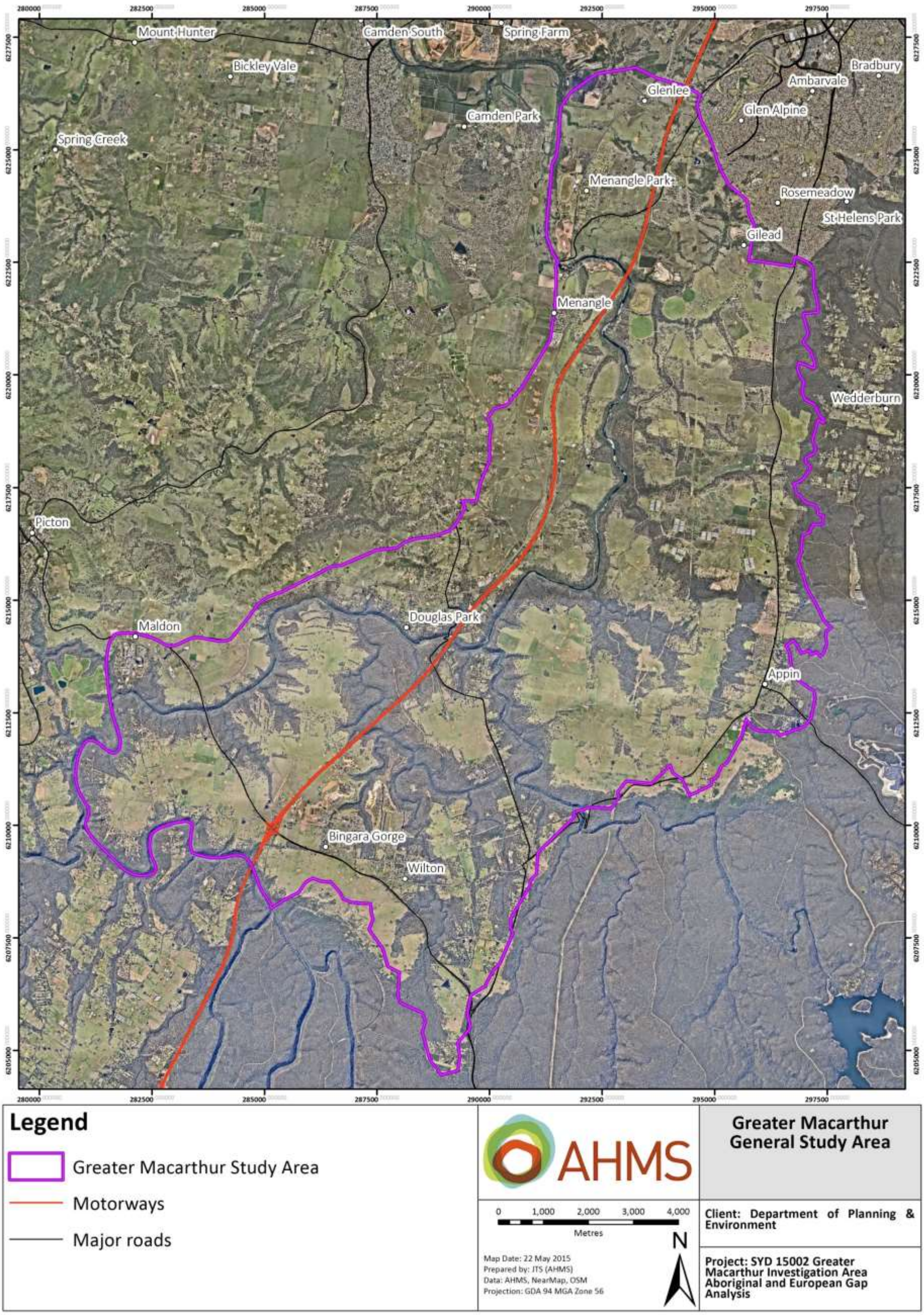

Figure 1. The Greater Macarthur Investigation Area following preliminary analysis to identify the Urban Capable Boundary.

2 EXISTING ENVIRONMENT

A full description of the existing environment of GMIA is provided in **Appendix 1**. A summary is included below.

The GMIA is located within the Sydney Basin Bioregion, on the central east coast of NSW. There are two subregions within the GMIA; the Cumberland and the Sydney Cataract (**Figure 2**). The GMIA is predominantly within the Cumberland subregion, which is characterised by low rolling hills and wide valleys on Triassic Wianamatta group shales and sandstones. The eastern and southern margins of the GMIA are within the Sydney Cataract subregion, the extent of which is defined by the Triassic Hawkesbury sandstone plateau on the coastal edge of the Sydney Basin (Morgan 2001). From a historical perspective, the Cumberland subregion would have been more suitable for settlement and pastoralism in the 19th Century, with the Sydney Cataract being composed of inaccessible deep disjointed sandstone valleys and escarpments. Conversely, when considering Aboriginal heritage, the Sydney Cataract has high potential for the presence of rockshelters and overhangs - a key repository for past human activity - to be present.

The GMIA extends across several different soil landscapes: residual Blacktown and Lucas Heights landscapes, colluvial Hawkesbury and Picton landscapes, erosional Luddenham landscape, and fluvial Theresa Park landscape. In the Cumberland subregion, 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. In the Sydney Cataract, soil landscapes have greater potential to contain deeply stratified and old cultural materials - usually of greater scientific significance. However, in incised sandstone valleys, scouring and water erosion often means these soils are of a very young age, being frequently re-cycled and re-deposited along the main river systems.

The GMIA has been disturbed by land clearance 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 GMIA is within the Hawkesbury-Nepean and Georges River catchments (**Figure 3**). Major permanent watercourses (from west to east) include the Nepean, Cataract and Georges Rivers. These large water-courses would have been key resources for both Aboriginal and historic settlement and movement through the GMIA. As such, all of these rivers are highlighted throughout the report as of key importance.

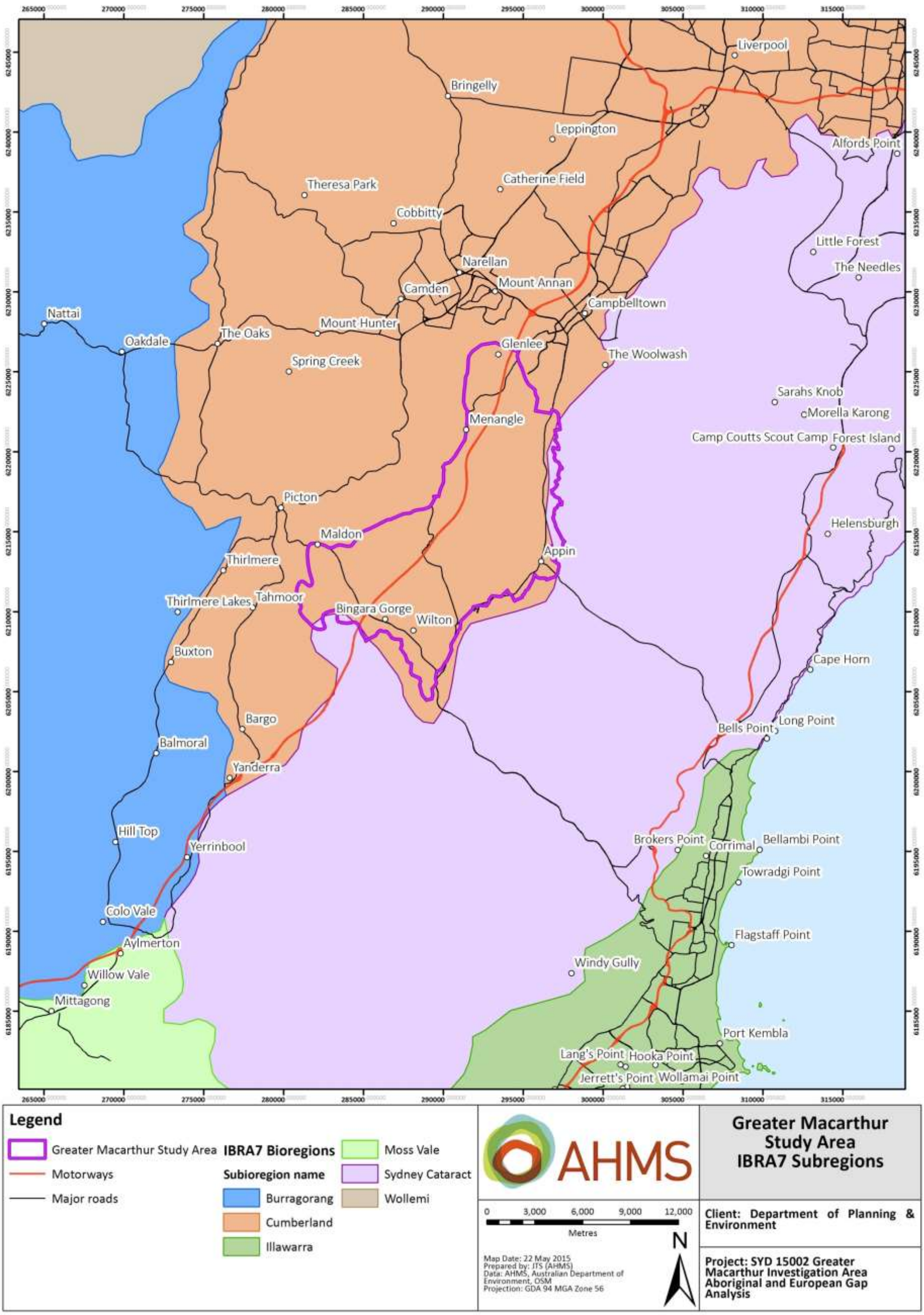

Figure 2. The bioregions of the GMIA

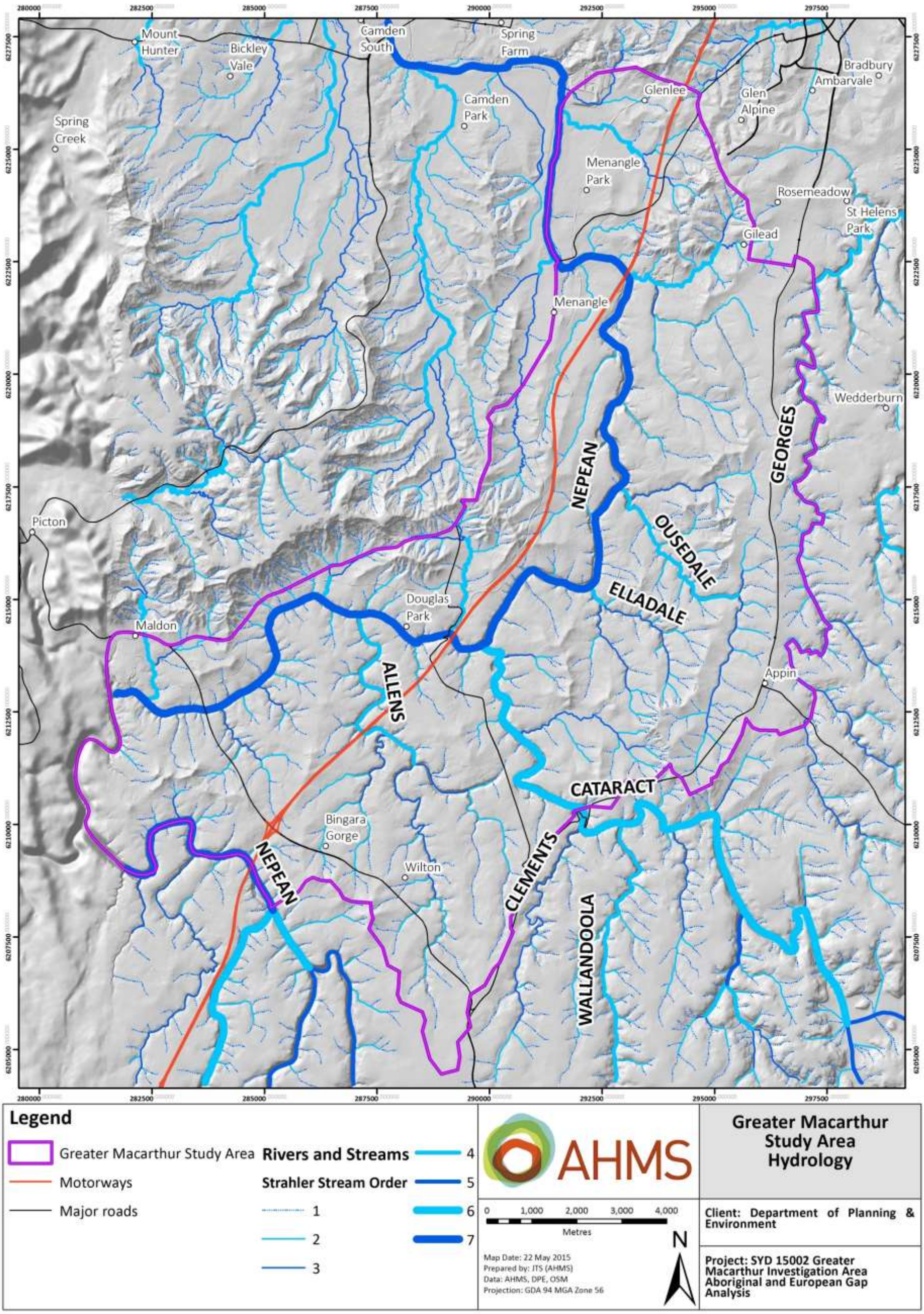

Figure 3. The hydrology of the GMIA This figure shows the size of creeklines based on Strahler (1951), with the larger number indicating the larger creekline.

3 HISTORIC HERITAGE

This section presents an assessment of the historical heritage items, places and potential within the GMIA.

3.1 General Development of the South-West

The search for productive agricultural land saw the expansion of the early settlement at Sydney to include areas such as Parramatta, the Hawkesbury and 'Cowpastures'. The fertility of the latter was centred on the rich alluvial soils of the Nepean River. Much of the best land at Cowpastures was occupied by John MacArthur's Camden Park.

Early town development was stimulated by Governor Macquarie who laid out the sites of Campbelltown and Appin to supplement his proposed capital of the south-west - Liverpool. Both these towns were expanded and replanned by T.L. Mitchell in the early 1830s. Macarthur also initiated the private town of Camden in the 1830s to compete with the Government foundation at Narellan. It was not to become a concrete proposition until the 1840s however.

The agricultural base in the south-west changed in the 1830s and 1840s and both diversified, with the introduction of vines and fruit growing, and the general movement from grain to grazing - especially on the larger holdings. By the 1860s the area capitalised on an opportunity to grow hay for sale in Sydney and supplemented this move with a growing butter industry from the 1880s. By the 1880s the Camden Estate was also being broken up, tenants moved out, and allotments sold - some as hobby farms.

Transport in the area remained focussed on the small scale and horse powered vehicle for many years. While other regions in the Greater Sydney area saw the introduction of rail the south west had to be satisfied with the tramway between Camden and Campbelltown. The old railway line south of Sydney had finished at 'Menangle North' station but was extended south in 1863 with the construction of the Menangle Railway Viaduct over the Nepean and its floodplain and a new station at Menangle The rail line was introduced from Sydney, south to Wollongong in the 1880s.

The small scale rural nature of the south west persisted through the early part of the 20th Century with the towns of Campbelltown, Picton, Appin, Wilton etc. providing commercial and service centres for the rural population. The 1945 "Map of Existing Land Use in the County of Cumberland" shows much of the study area still overwhelmingly used for arable and grazing purposes. The post war expansion of suburbs, the growth of private car use and the County of Cumberland Plan (1947) have all had their effect on the development of the region. Campbelltown developed as a regional service centre on a larger scale by the 1980s and 1990s.

3.1.1 Historical Themes

Campbelltown LGA

The Campbelltown Heritage Study Review was undertaken in 2009 identified the following overarching themes related to the historical development of the LGA (see also **Appendix 2**):

- Early European Settlement;
- Establishment of Campbelltown
- Notable Figures;
- Communication;
    - Roads

- Railway
- Camden Tramway
- Mail Coaches

- Agriculture and pastoralism;
- Water Supply;
- Servicing Sydney;
- Development of Campbelltown as a Regional City;

Wollondilly LGA

Despite requesting it the Heritage Study was not made available to this study. A very brief review document dated 2006, which did not include substantive information was provided.

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 13 sites on the Register of National Estate, ~50 on the State Heritage Inventory (and duplicated on the Local Environment Plans and Section 170 registers), and 33 sites on the National Trust of Australia. Of note, for the purposes of future planning are eight sites listed on the State Heritage Register (**Table 1** and **Figure 4**). These listings focus on rural places such as Beulah, Glenlee, Sugarloaf Farm, Camden Park but also include the late 19th Century Upper canal System (Pheasants Nest Weir to Prospect Reservoir) and the Menangle Railway Station Group and the Menangle Rail Bridge. These listing are afforded the highest level of protection in NSW, and would constrain or inhibit any development within or in close proximity to their curtilages.

A range of other historical items and sites are listed in the surrounding area, reflecting the pastoral history outlined in Section 3.1 (**Figure 4**).

Table 1 SHR items within the study area.

Name of Item	Group/Collection	Primary Address	LGA	Item #
Glenlee; outbuildings, garden and gate lodge	Farming and grazing	Glenlee Road, Menangle Park, NSW 2563	Campbelltown	00009
Sugarloaf Farm (Mt Huon)	Farming and grazing	Menangle Road, Gilead, NSW 2560	Campbelltown	01389
Beulah	Landscape cultural	767 Appin Road, Gilead, NSW 2560	Campbelltown	00540
Camden Park Estate and Belgenny Farm	Farming and grazing	Elizabeth Macarthur Avenue, Camden South, NSW 2568	Camden	01697
Menangle Rail Bridge of Nepean River	Transport - Rail	Main Southern Railway, Menangle, Gilead, NSW 2571	Wollondilly	01047
Menangle Railway Station group	Transport - Rail	Main Southern Railway, Menangle, NSW 2571	Wollondilly	01191
Windmill Hill Group, including Ruins (other names: North Farm, Middle Farm aka Larkin Farm and Windmill Hill, South Farm, Steven's Homestead	Farming and grazing	Wilton Road, Appin, NSW 2560	Wollondilly	01931
Wilton Park	Farming and grazing	Wilton Park Road, Wilton, NSW 2571	Wollondilly	00257

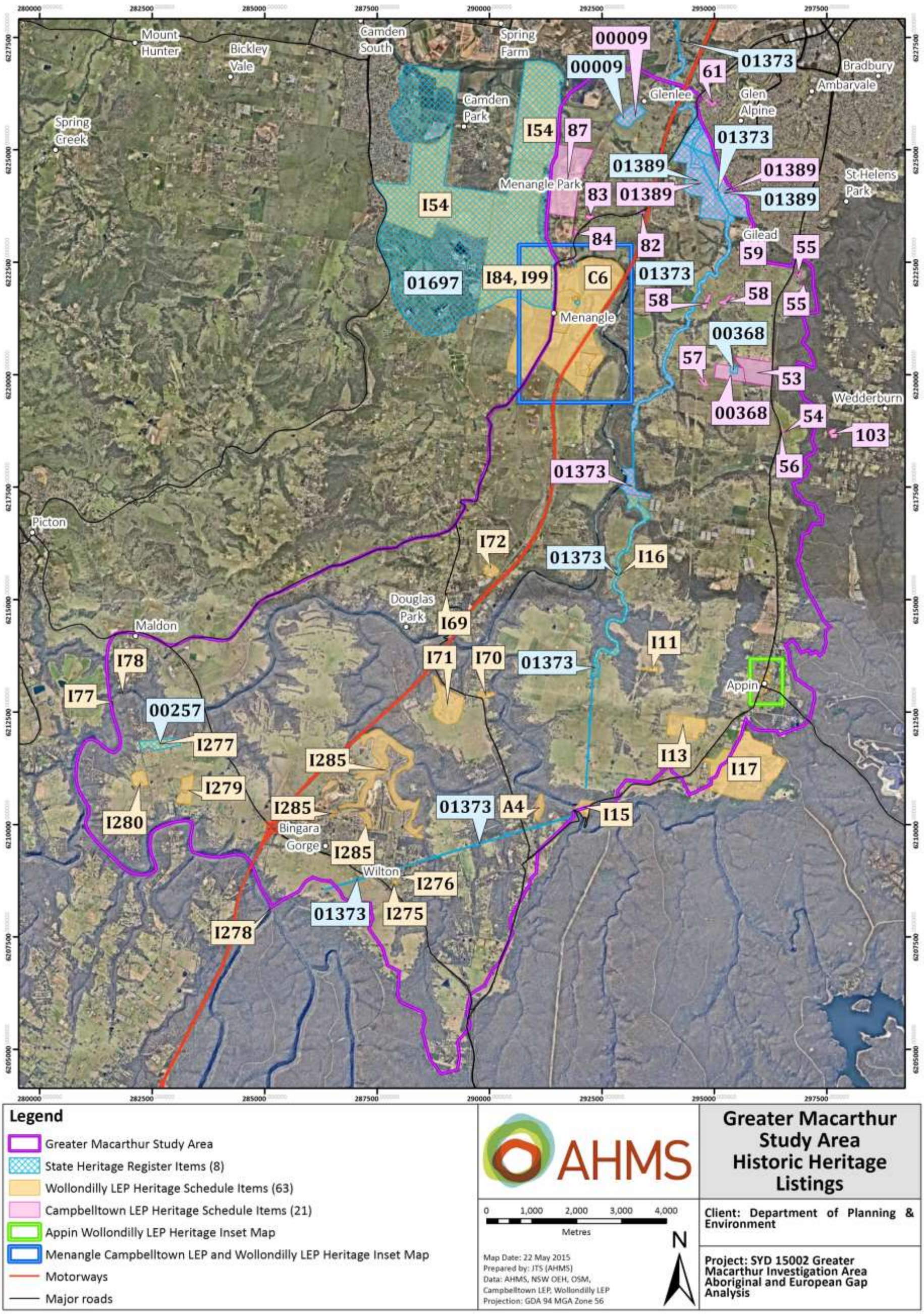

Figure 4. Historical heritage listings within the GMIA (see Appendix 2 for details and inset maps).

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. Tharawal LALC.
2. Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTAC).
3. Peter Falk Aboriginal Consultancy.
4. Darug Aboriginal Cultural Heritage Assessments.
5. Darug Land Observations.
6. Tocomwall.
7. Kamilaroi- Yankuntjatjara Working Group.
8. Walbunja.
9. Murrumbul.
10. Munyunga.
11. Wingikara.
12. Bilinga.
13. Corroboree Aboriginal Corporation.
14. Warragil
15. Gunyuu

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4.1.1 Preliminary Cultural Values Mapping

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 GMIA. To this end a small cultural values mapping workshop was held on 7 May 2015 at Narellan to discuss cultural places and values associated with the GMIA. 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: Glenda Chalker of CBNTAC, Abbi Whillock of Tharawal LALC, and Duncan Falk (Peter Falk Aboriginal Consultancy).

At the workshop participants were asked to annotate a large format (A0) aerial photograph of the study area with place of particular cultural interest or concern to them. The resulting map (see **Figure 5**) was a composite of places nominated by participants, although all places may not have been known to all participants.

The meeting identified six areas with specific cultural value to the Aboriginal community (**Figure 5**) which might not otherwise have been identified at this stage of the planning process:

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**

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 a large number of rockshelter and open sites occurring within these areas. These areas included areas south of Gilead, the catchment of Elladale Creek, a small area north of Menangle and a small location near Bingara Gorge. The importance of the Nepean River was also identified with the riverbanks between Menangle and Douglas Park being highlighted. In the southern part of the study area participants commented that many sites occurred along the headwaters of the upper creeks at the interface with the relatively flat country where access to both the open hunting grounds and the sandstone shelters occurring along the creeklines was relatively easy. Participants also noted that a large area of land was owned by Tharawal LALC in the Appin region along the south-eastern border of the study area and as yet no decision have been made as to its future use.

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.

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Figure 5. Map of cultural values including sites and places identified by Aborginal people in the preliminary cultural mapping workshop

4.2 Ethnographic Record

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. 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 Findings

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 Balledery (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; 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, 1998:243) 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 Traditional Owners of the Greater Macarthur area were reluctant to tell the new arrivals about their history and customs. What little we know comes from archaeology, later oral histories, and scraps of information recorded in early journals, such as those quoted above. Lieutenant David Collins (Organ, 1993, p. 134.) described 'the men from the Cowpastures' as 'the most remarkable' of those present at a large gathering in colonial Sydney: 'They were rather short, stocky, strong and superbly built. The painting on their bodies, resembling some kinds of coats of mail, added even more to their martial attitude...'

From Barralier's account we learn that Aboriginal people in the study area harvested yams and other seasonal fruits and vegetables from river banks, caught eels, fish, and shellfish from creeks and lagoons, and hunted kangaroos, possums and waterbirds on the plains. As a meeting point between three cultural linguistic groups, we can also assume that the Darug, Dharawal and Gandangara people would have met to feast, conduct business and perform ceremonies. The Darug dialect closely resembled the Gandangara language, which allowed easy communication between tribes (Wrigley, 2001).

A search of AHMS' ethnographic database reveals few historical interactions in the GMIA (**Figure 6**). Specifically, two were documented in the northern part of the GMIA:

Date: February 1804

Summary: Caley observes a lake full of eels known as Munangle.

Key words: Munangle; Menangle; eels

Location: 34° 5'56.58"S, 150°44'28.99"E (Accuracy: Within 2 km - 'Munangle', 'five miles south of Camden ford')

Source: Governor King to Mr. John Macarthur, 2 November 1805, Historical Records of Australia, Series 1, Volume 5, July 1804-August 1806, Governor's Despatches to and from England (Sydney: The Library Committee of the Commonwealth Parliament, 1915), 580.

Quotes: About five Miles from the Ford to the Southward is a Lake or Pond, named by the Natives Munangle. It is tolerable large and produces a quantity of Eels, but it is sometimes dry in long droughts.

Details: King is writing from Caley's 1804 report, "A journey to ascertain the Limits or Boundaries of Vaccary Forest" (the Cowpastures).

Date: 7 November 1802

Summary: Barrallier describes the fishing practices of Aboriginal people around the swamp 'Manhangle' and the use of fire when hunting kangaroos around 'Carabeely'. [10-11 December] Encounter at Menangle.

Key words: eels; fishing; hunting; fire; strategy; kangaroo; possum; spears; shouting; cooking

Location: 34° 6'48.39"S, 150°44'0.95"E (Accuracy: Within 2 km - swamp called Manhangle/Menangle on Barrallier's route. Based on journals, sketch, and secondary analysis.)

Source: Francis Barrallier, 'Journal of the expedition, undertaken by order of His Excellency Governor King, into the interior of New South Wales', in Historical Records of New South Wales Volume V (Sydney: William Applegate Gullick, Government Printer, 1897), Appendix A, 7 November 1802.

Quote: On the 7th November, I went towards another swamp, called Manhangle by the natives,* S. 48° W., and a few miles distant from the first.[* In the swamps of Manhangle, Carabeely, and others, enormous eels, fishes, and various species of shells are found, which are sometimes used by the natives as food. They usually feed upon opossums and squirrels, which are abundant in that country, and also upon kangaroo-rat and kangaroo, but they can only catch this last one with the greatest trouble, and they are obliged to unite in great numbers to hunt it.]

When passing Carabeely,** we saw a kangaroo which we killed, and after half-an-hour's walk we entered a valley where there was a herd of wild cattle. I counted 162 of them peaceably pasturing; they only perceived my party when it was at a short distance from them.[** When the natives assemble together to hunt the kangaroo, they form a circle which contains an area of 1 or 2 miles, according to the number of natives assembled. They usually stand about 30 paces apart, armed with spears and tomahawks. When the circle is formed, each one of them holding a handful of lighted hark, they at a given signal set fire to the grass and bush in front of them. In proportion as the fire progresses they advance forward with their spear in readiness, narrowing the circle and making as much noise as possible, with deafening shouts, until, through the fire closing in more and more, they are so close as to touch one another. The kangaroos, which are thus shut into that circle, burn their feet in jumping on every side to get away, and are compelled to retire within the circle until the fire attacks them. They then try to escape in various directions, and the natives frightening them with their shouts throw their spears at the one passing nearest to them. By this means not one can escape. They roast the product of their chase, without skinning nor even gutting the animals, and then divide it among themselves, after having cut each animal into pieces.]

... [10 December] I saw a native coming. Gogy went to welcome him, and after a short conversation, they came and sat by my side. I learnt from this native that Kelly had passed at Manhangle in the morning, accompanied by two men and one horse loaded with provisions, and that they had shot at them several times. He told me that himself and Wooglemai, whom I knew, were the only men in his party, the rest being women and children. They had been obliged to run away, and one bullet passed very near his shoulders. Having seen my camp, he had come to make his complaint to me.* When he had finished speaking, he took his net and gave me several swamp shells, which I liked very much. I gave him, in return, a joint of kangaroo, which he ate, and, picking up his axe and his net, he returned whence he had come.[* It is not of any advantage, but, on the contrary, it is very dangerous, to offer any insult to the natives. They avenge themselves of it sooner or later, and the first white man they meet without means of defence becomes their victim. They make use of the most cruel tortures on the one they can catch, whoever he might be, without troubling in the least about enquiring whether he belonged or not to the party who ill-treated them.]

... On the 11th December, thinking the waggon would very likely cross the river in the morning, I went with Gogy and two of my men to meet it. When I arrived at Manhangle I directed my march towards a fire I had caught sight of, and when I was thirty paces from it, the native pointed out to me a big wild dog lying in a bush.... Gogy told me that the fire I had reached by that time had been lighted by the native who had come to complain the day before. I saw several natives on the bank opposite Manhangle, who, recognising Gogy, called him. He went to them after giving his new axe to his wife. He told me he would come to meet me at Barhagal.

Details: Expedition by Francis Barrallier and four other men with the intent 'to explore the interior of the country and of trying to penetrate as far into the Blue Mountains as I should find it practicable', 6 November - 21 December 1802.

The mapping also shows that a number of tribal boundaries extend through the GMIA. The Greater Macarthur area sits at the intersection of three tribal boundaries. On the basis of reviews of the historical documents by Kohen (1993), Tindale (1974) and Capell (1970), the area of study encompasses three distinct cultural linguistic groups: the Darug, the Dharawal and the Gandangara people. The rich resources of the Nepean, Georges and Cataract rivers would have played a significant role in dividing the territories.

The 'Muringong' clan, whose territory included the northern portion of the study area, were Darug people (Kohen, 1993). Their land bordered to the east with the territory of the Tharawal people, who retain a strong presence in Campbelltown and Appin, and to the south-west with the Gandangara people, whose territory extended west into the mountains and south to Goulburn and Berrima.

The Greater Macarthur area 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 Wollondilly Shire, which includes the study area, has a population of more than 1000 people identifying as either Aboriginal or Torres Strait Islander, representing 2.4% of the total community (Australian Bureau of Statistics, 2011), while 2,426 people identified as Aboriginal or Torres Strait Islander in Campbelltown at the 2011 Census, representing 3.5% of the total community. 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. Consequently, Aboriginal stakeholders considered to be important in the process of community consultation may be involved either as Traditional Owners.

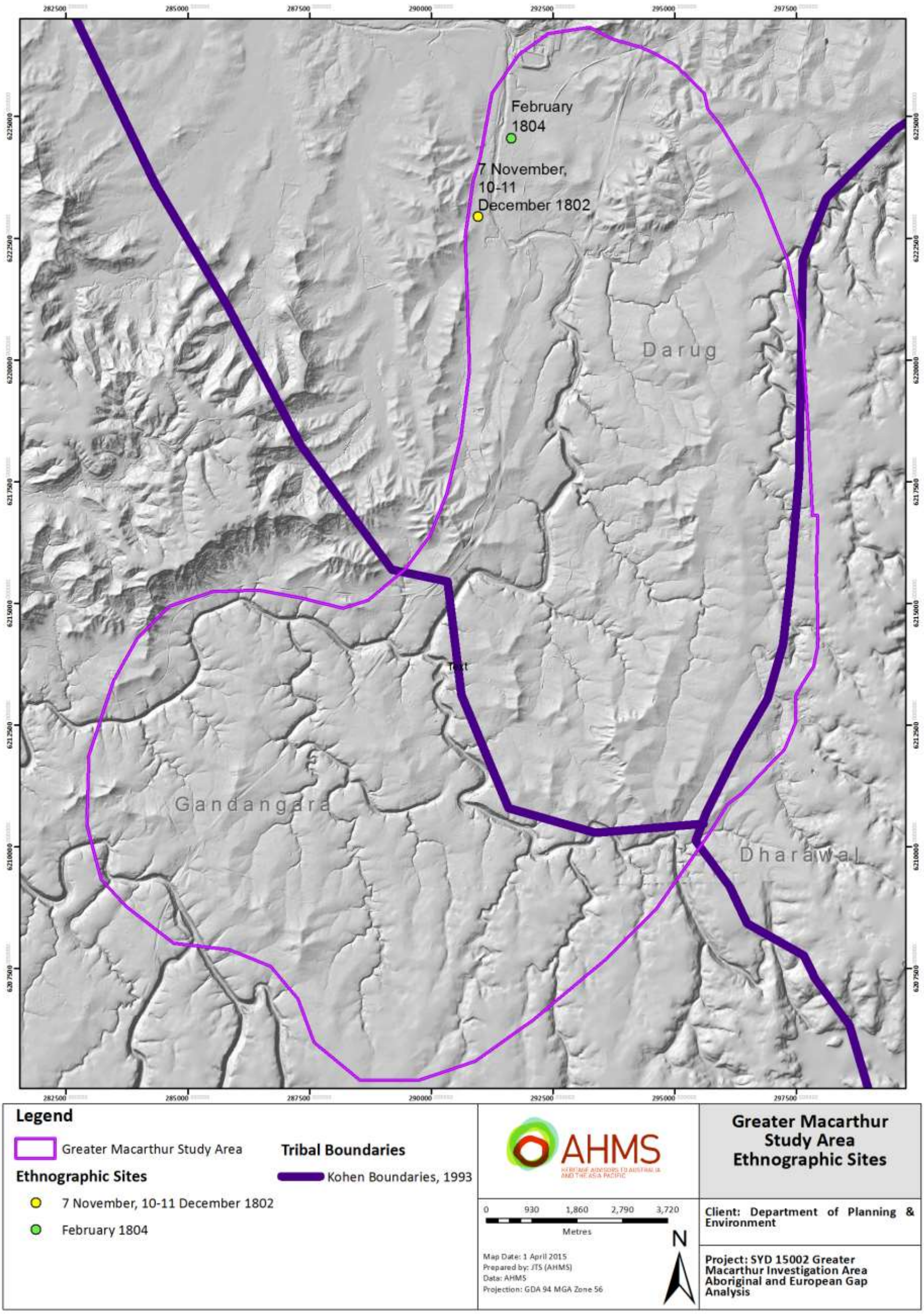

Figure 6. Map showing the location of ethnographic sites and boundaries within the GMIA.

4.3 Archaeological Context

As discussed in **Section 2,** the GMIA encompasses portions of the Cumberland and Sydney Cataract subregions of the Sydney Basin bioregion. The archaeology of the Sydney Basin has been well documented over the past 30 years (see **Appendix 4**) and 323 Aboriginal sites have been recorded and registered on the OEH Aboriginal Heritage Information Management System (AHIMS) within the GMIA. This reflects both the wealth of archaeology in the region and the number of archaeological investigations undertaken.

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 region is presented in **Appendix 4**. This section provides specific information on the investigations in the vicinity of the GMIA.

4.3.1 Local Context

A number of archaeological assessments have been undertaken within, and partially within, the GMIA. A spatial dataset by OEH indicates that at least 115 studies have taken place between 1982 and 2012. 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 most of the GMIA (~100km^2, or approximately 62%; **Figure 7**). 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.

In the north of the GMIA, the majority of previous archaeological assessments relate to proposed sand and gravel extraction sites at Mt Gilead and Menangle Park, and gas production wells at Mt Taurus. Between Menangle and Appin, archaeological assessments that have taken place have generally been in response to the proposed resource extraction activities, and relate to longwall mining applications, as well as supporting infrastructure such as gas and water pipelines within colliery areas. In the vicinity of Wilton, the assessments generally comprise linear studies for proposed rail (Maldon to Dumbarton rail route), road (Wilton Bypass), electricity (Wilton Substation 66kV Feeder Works) and gas infrastructure (Moomba to Sydney Ethane Pipeline). To the south and east, the Illawarra Prehistory Group has undertaken a series of archaeological surveys within the Sydney Cataract subregion, focussed on the Cordeaux and Woronora Rivers, and the junction of the Cordeaux and Nepean Rivers.

More recent studies not included in the OEH dataset have been undertaken in various parts of the GMIA in response to land rezoning proposals at Appin (Heritage Concepts Pty Ltd 2007, Mary Dallas Consulting Archaeologists 2014), Menangle (Environmental Resources Management Australia (ERM) 2008, Jo McDonald Cultural Heritage Management Pty Ltd (JMDCHM) 2010), Wilton (Kayandel Archaeological Services 2014), and Mt Gilead (Campbelltown City Council 2015) (refer to **Appendix 4** for a summary of the findings). These assessments have been mapped separately by AHMS.

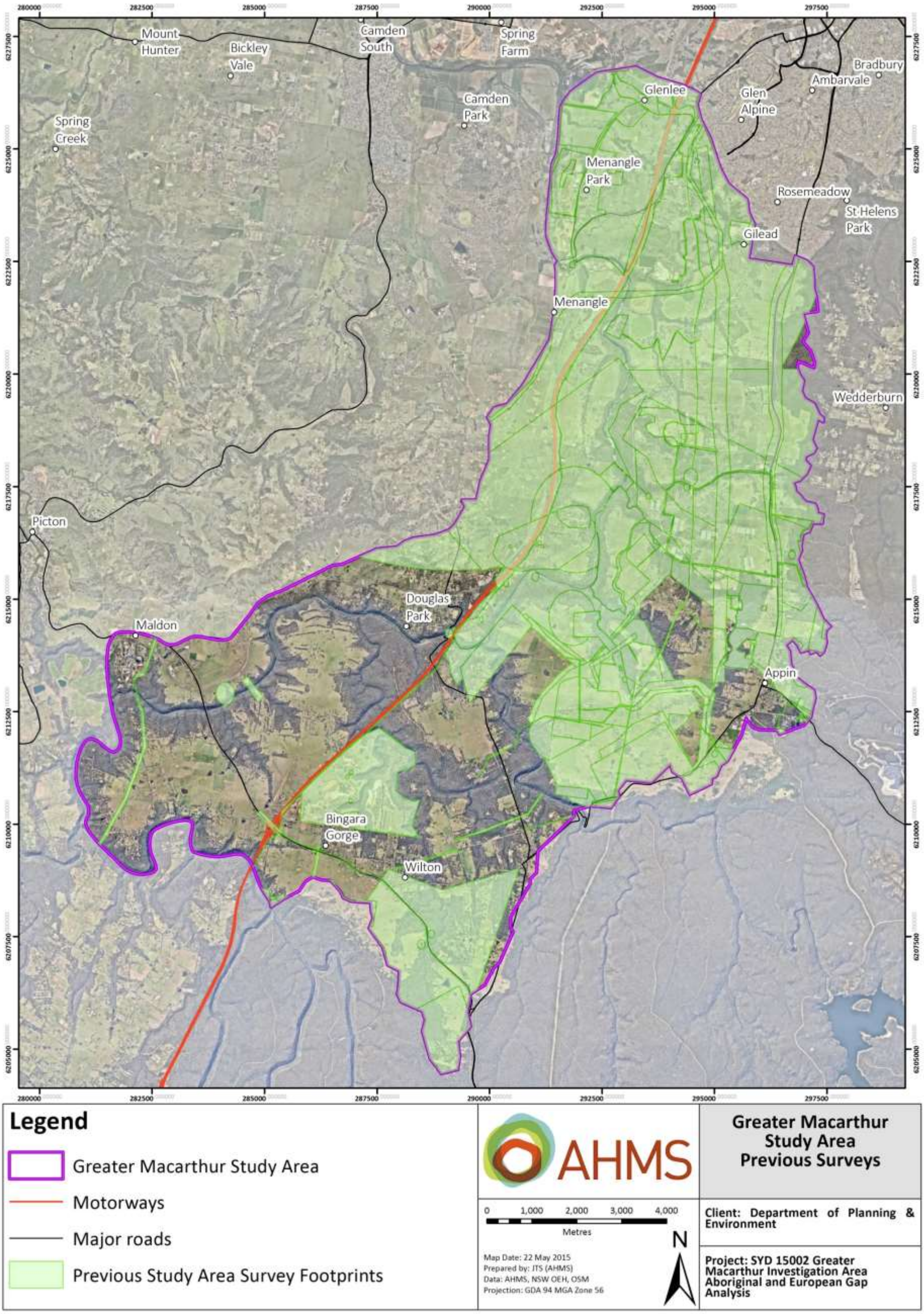

Figure 7. Map showing previous Aboriginal heritage assessments in the GMIA based on OEH AHIMS data.

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 GMIA, Cumberland Plain and Sydney Cataract subregions (refer to **Appendix 4**).

Cumberland Plain Sub-region

- Archaeological investigation of the subregions has been fairly extensive, especially in areas developed for residential, mining and agricultural purposes (see Section 5.2.2). Investigations have included site surveys, excavation and salvage works. From these studies, numerous archaeological models have been developed.
- The 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 high 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. Unfortunately, our understanding of the distribution of such sources in the GMIA is poorly understood.
- Following the trend of the archaeology of the Sydney Basin, the majority of sites in the subregion typologically dated to the mid- to late Holocene (<6,000 years BP). Some evidence suggests that earlier archaeological sites may, however, occur in the form of rockshelters or sand dune deposits in key resource areas.

Sydney Cataract Sub-region

- Archaeological investigation of the Sydney Cataract sub-bioregion is limited. Few site surveys and excavations have been completed in the area due to limited development in the area. The majority of work in the area has been primarily focused in the Holsworthy Defence base to the east of the study area.

- Unlike the Cumberland Plain subregion, archaeological site patterning is not strictly related to stream order.
- Studies across this region have tended to focus on the individual characteristics of sites, rather than on site patterning across the area. This is because sites will tend to occur in the area in relation to sandstone formations rather than water sources or other variables. Patterning tends to not be as effective in relation to this due to the relatively random and isolated occurrence of shelter formations.
- The main site types across the subregion are shelters with deposits, rock art and grinding grooves.
- On the Hawkesbury sandstone formations along the river and its feeder creeks the most common site types were Aboriginal art and occupation sites. These were located within sandstone overhangs or shelters. Sheltered, painted art/occupation sites tend to occur more frequently above valley floors or below ridge tops. There appears a general preference for northerly or north-westerly aspects.
- In other similar parts of the Sydney Basin, Attenbrow (2004) found that any overhang or rock shelter with reasonable head room, a level dry floor and a depth offering protection from extremes of sun, wind and rain could have been occupied by Aboriginal people in the past. Attenbrow (2004) also demonstrated that 70% of potential archaeological deposits (PAD) recorded within shelters are Aboriginal sites.
- Open artefact scatters are less common due to the lack of open flat areas in the steep sandstone country. However, these site types may still occur and are most likely to be situated on flat terraces adjacent to higher order streams (as in the Cumberland subregion).
- Axe grinding grooves are commonly found in creek beds, at the tops of valleys, above or along watercourses and also around rock pools or ridge tops near aquifers.
- Aboriginal burial sites may be located in rock shelter occupation deposits or within soft dry deposits such as sand bodies.

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 24 March 2015 (AHIMS Searches #166835, #166836, #166837, #166838 and #166839). A total of 253 previously registered Aboriginal sites were identified within the GMIA. Approximately two thirds of these are open sites (189/72%), with artefactual material the most frequently recorded site feature, particularly within the shale-based Cumberland subregion (**Figure 8**). Approximately one third of the sites are rock shelters (74/28%), the majority of which are in the south of the GMIA, particularly within the Hawkesbury and Lucas Heights soil landscapes where suitable stone outcrops occur (**Table 2** and **Figure 8**). It should be noted that one additional closed site was identified in the general vicinity of west Appin which had location and site content restrictions.

Table 2. Aboriginal sites summarised by site context and site feature, see also Figure 9.

Site Types	Site Count*	% of Total
Undefined Art Site	20	7.60
Axe Grinding Groove	6	2.28
Rockshelter with Art	36	13.69
Rockshelter with Deposit	17	6.46
Rockshelter with Midden	1	0.38
Burial/s	1	0.38
Habitation Structure	7	2.66
Isolated Find	63	23.95
Midden	1	0.38
Moderate sized artefact scatter (<50)	2	0.76
Small sized artefact scatter (<10)	17	6.46
Potential Archaeological Deposit	34	12.93
Scarred Tree	13	4.94
Stone Arrangement	1	0.38
Undefined Artefact Site	44	16.73
Total	**263**	**100**

* Note some sites have multiple archaeological features, and hence the total presented here may be greater than the AHIMS database results.

On average, the GMIA has approximately one previously recorded site per 0.5 square kilometres, although this is likely due to a lack of investigation across much of the study area. The Cumberland subregion contains by the far the greatest number of sites - about 86% of all sites previously documented with a distribution of approximately 1.75 sites per square kilometre, but this bioregion does encompass most of the study area. These sites are primarily open sites and often composed of artefactual material (either artefact scatters or isolated finds). Sites are clearly clustered, most likely as a result of small-focussed development related CRM studies. They appear to be largely distributed along the margins of the Nepean and Georges River and their tributaries. Conversely, the Sydney Cataract subregion has a lower number of previously recorded sites, at a slightly higher density, around 2.1 per square kilometre. The subregion has the highest concentrations of enclosed sites, and sites that retain rarer features, such as shell (freshwater midden material), rock art, and grinding grooves. The majority of these sites are situated along the Georges and Cataract Rivers, Wallandolla Creek, and unnamed, minor first and second order tributaries.

The factors that define the site distribution referred to in the subregional comparisons relate to whether a particular area has a sandstone or substrate. The Cumberland subregion is mostly shale and the Sydney Cataract mostly sandstone country, but these are by no means absolute distinctions, with a relatively broad transition area. There are a number of sites in the Cumberland subregion that are sandstone country sites (94 closed sites, mostly rock shelters with art) even though these generally occur in very low numbers across the majority of the subregion. Conversely, a number of open sites, predominantly artefact scatters or grinding grooves, were located in the Sydney Cataract subregion (n=12). The subregional patterns outlined here are therefore less clear than would happen with selected sample areas in the centre of the two subregions or if the current mapping were refined to better reflect local intricacies of the geological transition.

It should be further noted that the distribution and significant numbers of previously documented sites within the Cumberland subregion almost certainly reflects some form of bias towards areas that have been subject to greater investigation due to proposed resource extraction activities. The inaccessibility of parts of the Sydney Cataract subregion within the GMIA is probably also a factor in the under-representation of previously documented sites in these areas.

Sensitive Data – Not for Public Exhibition

Figure 8. Open and closed Aboriginal sites based on the AHIMS database.

Sensitive Data – Not for Public Exhibition

Figure 9. Aboriginal heritage site types recoreded in the AHIMS database for the GMIA.

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 GMIA. Further details regarding the background, development, testing and limitations of the model is presented in **Appendix 6**.

The final model for the GMIA is shown in **Figure 10.** 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 negligible archaeological classification were considered areas that did not retain any of those variables. Overall, the model identifies between 24 and 36% of the GMIA land area as likely or very likely to contain Aboriginal cultural material (**Table 3**).

Table 3. Percentage and area (km) of GMIA within each area of Aboriginal heritage potential.

Result	% of land	km^2
Negligible	43.41	69.32
Low	26.29	41.98
Moderate	20.54	32.80
High	9,76	15.59

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 58% accuracy when considering the zones of moderate and high ranking, but ~73% 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.

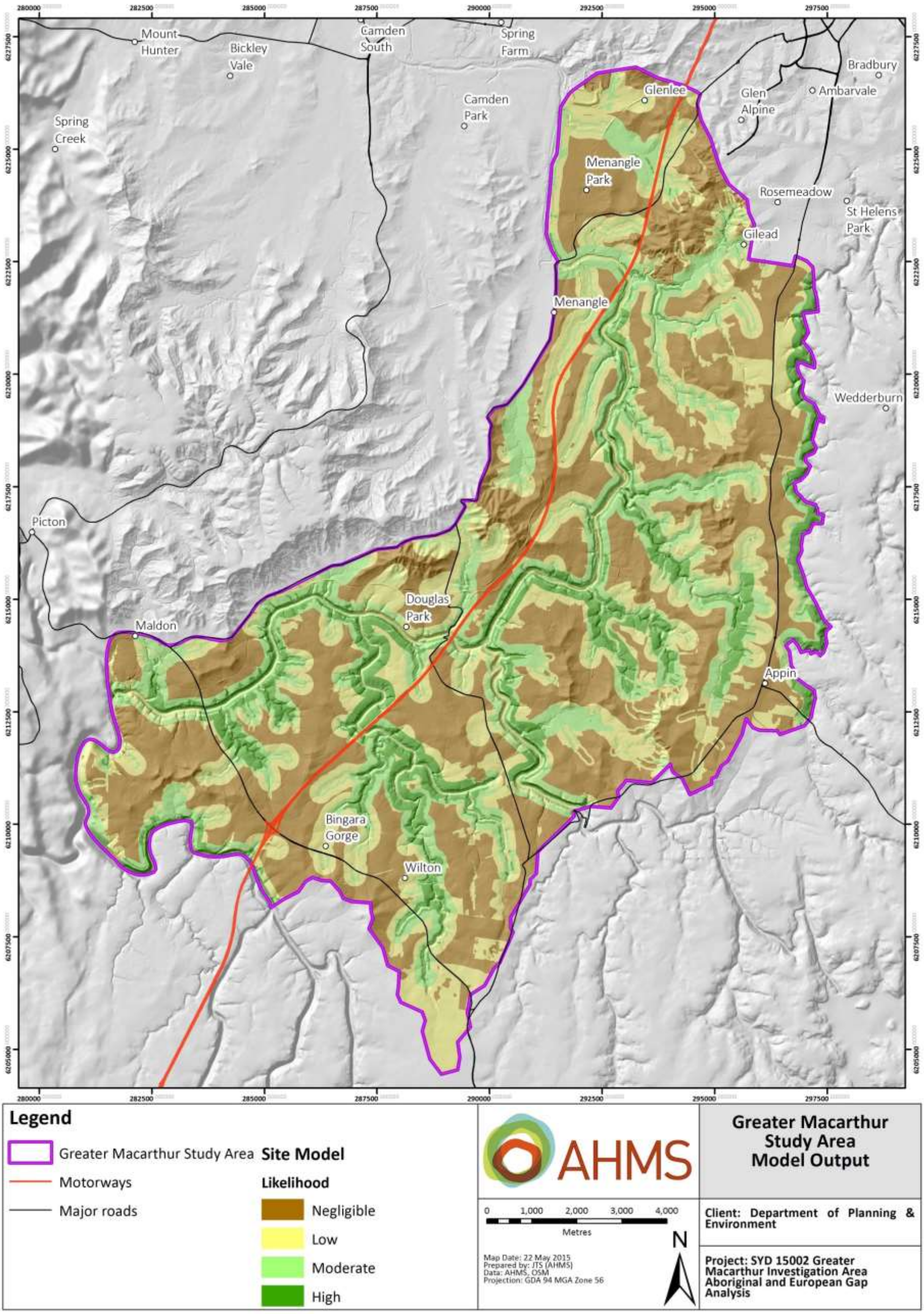

Figure 10. Composite predictive model of archaeological sensitivity for the GMIA. The development and testing of this model is outlined in Appendix 6.Note Information on Area of Cultural Importance have been removed for Public Exhibition.

5 GAP ANALYSIS

This section provides a gap analysis of the Aboriginal and historical heritage for the GMIA. 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 GMIA can be identified:

The area formed part of the early agricultural expansion outside the immediate area of the early colony of Sydney. The majority of the better soils in the area were settled by MacArthur at Camden Farm (part of which lies within the study area). The agricultural/pastoral mix of the area changed over the course of the 19th Century but the rural nature was largely maintained until the post-WW2 period. Only two townships within the study area provided commercial and service hubs for this landscape - Appin and Menangle.

There are no listings on the WHL, NHL or CHL within the study area.

The SHR, RNE, SHI and National Trust listings for the study area reflect the rural environment. Many of the listings relate to large and small scale agricultural/pastoral establishments. Other items listed in the SHR and RNE relate to transport, via the Menangle Railway bridge and station.

Environmentally, the GMIA is dominated by the Cumberland Plain subregion and from an Aboriginal heritage perspective is archaeologically similar to the southwest and northwest Growth Centres. This area has several key waterways, including the Nepean, Cataract and Georges River, and therefore has potential for significant cultural sites along these, akin to those found elsewhere along Second Ponds Creek, Eastern Creek, South Creek and Kemps Creek. To the south and east, the Sydney Cataract subregion is dominated by dissecting sandstone and has potential for rock-shelters, engravings and grinding grooves; it is likely archaeologically comparable with the North Kellyville in the North West growth centre.

Based on AHMS' ethnographic database, several instances of Aboriginal-early European interaction occurred around Menangle and Menangle Park. This area was formerly a well-used series of swamps and waterways, and is likely to have formed a focus of activity and occupation in the past. It has remained largely unmodified since European arrival.

Currently, 323 Aboriginal objects/sites have been documented within the GMIA. 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 few. Along the eastern margins, within the Sydney Cataract subregion, rock-shelters and other closed sites dominate, and they are located along creek-lines where the sandstone geology has been incised to form such features.

Based on a limited review of heritage studies, and the archaeological predictive modelling, there is high potential for Aboriginal objects/site to occur along the banks of the Nepean, Cataract and Georges Rivers, and Allens, Elladale, Clemens, Cascade, Wallandoola, and Elladale creeks. The

Georges River, Allens Creek, Elladale Creek and headwaters of the Cataract River (including Wallandoola creek) reveal the highest potential for significant cultural material, primarily due to frequent elevations along these corridors and a general absence of development. Recent excavations by AHMS along Georges River have demonstrated deeply stratified and old (>20ka) cultural materials on an elevated ridgeline at Moorebank, and it is considered more would be found along other parts of the river system. Conversely, large areas of the Nepean River are highly flood prone, and while Aboriginal people would have carried out activities along the river, thereby creating what archaeologists record as 'sites', there is a lower likelihood that such sites would be preserved due to the history of flooding..

Aboriginal consultation has been undertaken with a selection of stakeholders, and six areas of cultural value were identified. **Sensitive Data – Not for Public Exhibition**

5.2 Key constraints

The following section highlights areas and issues that are likely to operate as constraints to future development. That is not to say that development would not be feasible, but rather that significant further investigation, mitigation measures and conservation are likely to be required.

- From an historical heritage perspective the key constraints are the presence of items on the SHR which are of State Heritage Significance. Development within the curtilages of these sites is restricted subject to review by the NSW Heritage Council. Development adjacent to these items would also be subject to review should it be determined that view lines, significant corridors or extended curtilages were at risk.
- The as yet undefined potential historic archaeological resource (this is subsurface archaeological deposits) also presents another significant constraint. Areas of this region were settled from an early period and the potential for as yet undiscovered early settlement sites, similar to the one recently excavated at Belgenny is high. The history of the area is entwined with key historic figures (i.e Macarthur family) and it is possible that archaeological investigations may contribute further to an understanding of the activities of such figures and the significance of some listed sites. The cost and time impacts of piecemeal archaeological discovery and excavation are a potential constraint on effective development of the area. Once again this supports the idea for a regional archaeological framework to guide and integrate further archaeological research in the GMIA.
- 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 Georges River and Allens, Elladale, Clemens, Cascade, Wallandoola, and Ousedale creeks. It is likely that in some instances, these areas of archaeological importance may extend up to 500m from the creek edge.

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- The east and southern margins (and many of the main creek corridors) of the GMIA are in geology and soil landscapes conducive to the presence of rockshelters, engravings and grinding grooves. These types of sites are often of scientific and cultural significance and because of this destruction via an AHIP may not be appropriate. Depending in the nature and significance of the site they may require management if they become more accessible to the general public through the development. Although conversely, the presence of such sites if managed and interpreted in open space areas can add to the amenity and enjoyment of residents.
- There are two sites that were identified as 'burial' or 'restricted information' situated in the Appin area. Specific information on these will not be included in this report, but have been provided to DPE confidentially to assist in the planning process. Development in the vicinity of burial sites would be restricted and require adequate site protection measures to be in place.
- Several sites of cultural importance to Aboriginal people were identified through the preliminary cultural values workshop. These were located around Menangle and southwest of Appin. Further investigation of these sites would be necessary to refine their boundaries (see **Section 5.2**). Several of these such as the massacre site and the story place are likely to warrant long term protection.
- Riparian and swampy areas along the Nepean River in the vicinity of Menangle have been documented as used extensively by Aboriginal people in the past. Limited assessments have been undertaken in these areas (primarily desktop), with little evidence of cultural material to date. However, it is considered that these areas have high risk of significant material being present and may form a constraint to future development.

5.3 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 GMIA as indicated below.

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

Both Wollondilly and Campbelltown LGAs have apparently been subject to initial Heritage Studies and subsequent reviews, however the complete Wollondilly heritage study has not been made available for this review. The Campbelltown Heritage Study establishes and highlights local historic themes relevant to the LGA. However while it addresses the built heritage aspects of the LGA, it does not adequately address archaeological sensitivity. Given the lack of information available it is assumed that the same is the case for Wollondilly LGA. Some archaeological sites are noted in the Wollondilly LEP but none, specifically, in the Campbelltown LEP.

The archaeological 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. Any historic

archaeological assessments undertaken in these LGAs have primarily been focussed on specific impacts and developments related to existing allotments/cadastral boundaries. On this selective basis the reports do not provide a broad regional picture of the archaeological potential of the study area. A Regional Archaeological Research Design and Management Strategy (RARDMS) should, therefore, be completed for the development 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). The RARDMS would provide a better understanding of areas where potential archaeology might be a constraint at a regional level, address archaeological issues for a broad scope approach to statutory requirements in relation to archaeology and therefore provide a greater degree of certainty in regard to development options. The RARDMS 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 RARDMS may also define curtilages associated with potential sites.

The PHALMS project, which might provide the basis for approach for a regional study here, divided the Parramatta LGA into a number of archaeological management units (AMU) based on current cadastral boundaries. Each AMU's historical background was outlined, the degree of disturbance identified and assessed by ground survey and archaeological potential and significance assessed on this basis. Each AMU was then assigned management recommendations ranging from low potential/low significance – no further action required to high potential/high significance – undertake archaeological assessment on areas subject to disturbance through development.

Previous Aboriginal heritage assessments have been limited. The majority of studies have been focussed towards the north of the GMIA and/or have been for exploratory activities (such as gas wells) and therefore reflect only isolated patches of on-site assessment. Further, the vast majority of assessments are quite dated (often being pre-AD2000) and do not conform to current guidelines.

Several parts of the study area have yet to undergo any Aboriginal heritage investigation, including along the Cataract River between Brooks Point and Douglas Park, and south and west of Appin. The periphery of the GMIA (i.e., around Maldon, the Dharawal State Recreation area, and near the Cordeaux River) do not appear to have been investigated. Several of these areas are predicted to contain extensive and/or significant cultural material.

Previous Aboriginal heritage assessments have had limited field investigation, such as focussing on a handful of gas wells within a much wider area, and for this reason most areas in the vicinity of the GMIA would require some level of re-investigation.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Report Summary

Based on the review undertaken it is clear that there has been only limited Aboriginal and historic heritage investigation in the GMIA to date. Many of these studies have been for exploratory works (such as gas wells, or coal seams) and are therefore dominated by desktop research, with only minimal field investigation. Further, many of the reports are quite dated, and fail to 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.

The key areas of constraint are highlighted in **Section 4.2**. In brief, the GMIA is similar in environment and landscape to the wider Cumberland Plain within which the 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 the GMIA. 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 GMIA. Based on modelling, key areas appear to be the Georges River and many of the tributaries of the Nepean River in the southern parts of the study area. In areas where the river banks are steepest and consist of sandstone gorges Aboriginal sites are likely to cluster around the upper reaches of tributaries where sandstone shelters begin to form, The northern part of the study area appear to have been more heavily impacted by urban spread, and are generally more swampy and low-lying, such as around Menangle. It must be noted, however, that the Menangle area was used and occupied by Aboriginal people as observed by explorers at European contact and Aboriginal activity continues through particular families as indicated in the cultural values workshop.

Notwithstanding the above constraints and limitations, there appear opportunities for development which may have minimal impact on cultural heritage values, especially in areas between Douglas Park and Menangle along the Nepean River; in the vicinity of Gilead; south and west of Appin, and surrounding Wilton.

6.2 Future Direction

Based on the analysis here, further site specific assessment would be required to facilitate development of the area. 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. The development of a regional archaeological framework and research methodology would guide individual assessments, reduce duplication and ensure that the end results contribute in a meaningful way to our understanding of the Aboriginal heritage of the study area.

The archaeology of the GMIA is still relatively poorly understood, and on-site works are likely to be an essential pre-requisite for OEH prior to determining any Aboriginal Heritage Impact Permits (AHIP). It is considered likely that such permits would be required for parts of GMIA 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 GMIA to allow re-zoning, and subsequent approvals, especially given the scale of work already undertaken in the region. This is discussed further below.

The review here suggests that the majority of Aboriginal heritage is likely to be in close proximity to major water courses, and often within riparian corridors unlikely to be developed. Notable exceptions include areas identified as cultural values in the vicinity of Menangle and southwest of Appin. From a historical heritage perspective, listings are generally focussed around existing conurbations, and development through the Menangle, Wilton and Appin areas are likely to require consideration of this. Based on the review here, it appears that areas west and south of Bingara Gorge and Douglas Park, and between Gilead and Appin have the least Aboriginal heritage issues. Conversely, areas in the vicinity of Menangle, Menangle Park, Appin and Wilton, are all likely to have far greater requirements to address Aboriginal and historic heritage.

It is recommended that prior to the wide-scale assessment of the GMIA, or any proposed re-zoning options that the following tasks are implemented as soon as possible to identify and manage significant heritage places:

1. Preparation of a regional Aboriginal and archaeological research and investigation framework.
2. Development of a Regional (Historical) Archaeological Research Design and Management Strategy (RARDMS) Archaeological Zoning Plan should, therefore, be completed for the GMIA.
3. Further historical investigation of Appin Wilton and Menangle is required to determine structures, places and areas of value, and any constraints that may be placed upon development in their vicinity. Based on the listings, each of these locations contains a number of historical items, but these have been collected piecemeal with no dedicated study of the towns. A more structured and focussed study is required to provide a 'town' wide plan for any future development to ensure retention and management of structures or groups of structures of key heritage value. It is considered that 3-4 months would be required to undertake the investigations
4. Further investigation of areas of cultural value which have been identified through the preliminary Aboriginal cultural values workshop through a combination of historical research, ongoing Aboriginal consultation and site investigation to further define the boundaries of these areas, and establish appropriate management strategies. It is considered that 6-12 months would be required to undertake the investigations.
5. Investigation of previously un-investigated area consistent with the proposed regional Aboriginal and archaeological research and investigation framework recommended above. These areas include the vicinity of Appin, west of Bingara Gorge, and south of Douglas Park.

6.3 Approval Process

Should GMIA be progressed to a Growth Centre, there are a number of legislative mechanisms and requirements that would need to be considered. The most notable is the requirement for Aboriginal Heritage Impact Permits (AHIPs) to allow for the destruction of Aboriginal objects in accordance with the *National Parks and Wildlife Act 1974* prior to development, which 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 part of the current project, AHMS is exploring legislative and approval pathways on this issue.

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 from 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* and which refers to some AHIPs running with the land can apply.
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.

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 in primary legislation of the right to access 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; 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

If DPE decides to progress the GMIA as a future growth centre, 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.
- 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.
- The tasks identified in section 5.2 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.
- Regional cultural heritage frameworks should be developed to guide and optimise future investigations. These should include:
    - Preparation of a regional Aboriginal and archaeological research and investigation framework. All future Aboriginal heritage assessments in the area should be consistent with, and feed into that framework. This will maximise opportunities to create knowledge of value to the Aboriginal and broader community and will facilitate the assessment and management of the heritage resource while avoiding duplication
    - Development of a Regional (Historical) Archaeological Research Design and Management Strategy (RARDMS) Archaeological Zoning Plan. .

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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 GMIA is discussed below.

A1.2 Bioregions

The GMIA 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).

There are two subregions within the GMIA; the Cumberland and the Sydney Cataract (**Figure 2**). The GMIA is predominantly within the Cumberland subregion, which is characterised by low rolling hills and wide valleys on Triassic Wianamatta group shales and sandstones. The eastern and southern margins of the GMIA are within the Sydney Cataract subregion, the extent of which is defined by the Triassic Hawkesbury sandstone plateau on the coastal edge of the Sydney Basin (Morgan 2001).

From a historical perspective, the Cumberland subregion would have been more suitable for settlement and pastoralism in the 19th Century, with the Sydney Cataract being composed of inaccessible deep disjointed sandstone valleys and escarpments. Conversely, when considering Aboriginal heritage, the Sydney Cataract has high potential for the presence of rockshelters and overhangs - a key repository for past human activity - to be present. Large river systems running through the Cumberland subregion would also form key resources along which Aboriginal activity would likely have occurred.

A1.3 Soils

The GMIA extends across several different soil landscapes: residual Blacktown and Lucas Heights landscapes, colluvial Hawkesbury and Picton landscapes, erosional Luddenham landscape, and fluvial Theresa Park landscape (**Figures A1** and **A2**). Discrete areas of disturbed terrain (defined as being disturbed by human activity to a depth of at least 100cm) occur at the Menangle sandstone quarry, and the former coal stockpiling area at Glenlee (Hazelton and Tille 1990).

The typical soils of each subregion are summarised below (Morgan 2001):

Cumberland Subregion

Red and yellow texture contrast soils 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.

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.

Sydney Cataract Subregion

Deep sands and clayey sands with peat occur in hanging swamps, and yellow earths on better drained sandstone ridges. Siliceous sands occur in younger dunes and well developed podzols in older dunes. Organic sands are present in swamps and estuary.

These types of soil have greater potential to contain deeply stratified and old cultural materials - usually of greater scientific significance. However, in incised sandstone valleys, scouring and water erosion often means these soils are of a very young age, being frequently re-cycled and re-deposited along the main river systems.

A1.4 Vegetation

The tall open forest (wet sclerophyll forest), open forest and woodland (dry sclerophyll forest) that would have covered much of the shale hills within the GMIA at the time of European contact has been extensively disturbed by land clearance for agriculture and urban development (Hazelton and Tille 1990:23, 27-28, 51, 70, 82, Keith 2006:87). However, pockets of uncleared vegetation remain, particularly in the gullies, narrow incised valleys, and sheltered side slopes associated with the Hawkesbury soil landscape (Hazelton and Tille 1990:46-49). Parts of the Upper Nepean State Conservation Area and Tr 57 Timber Reserve, Wilton also fall within the GMIA, in the south west and south east, respectively.

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 less disturbance in the last 200 years than other parts of the GMIA.

The native vegetation communities typical of the subregions in the GMIA are outlined below (Error! Reference source not found. and **Figure A3**).

Table A4 Native vegetation in the Cumberland and Sydney Cataract subregions (after Morgan 2001; The Royal Botanic Gardens and Domain Trust 2015)

Subregion	Location	Vegetation
Cumberland	Shale hills	Grey box (*Eucalyptus moluccana*), forest red gum (*E. tereticornis*), narrow-leaved ironbark woodland with some spotted gum (*E. crebra , Corymbia maculata*)
	Alluvial sands and gravels	Hard-leaved scribbly gum (*Eucalyptus sclerophylla*), rough-barked apple (*Angophora floribunda*), and old man banksia (*Banksia serrata*)
	River flats	Broad-leaved apple (*A. subvelutina*), cabbage gum (*E. amplifolia*) and forest red gum with abundant swamp oak (*E. tereticornis, Casuarina glauca*)
	Lagoon and swamps	Tall spike-rush (*Eleocharis sphacelata*), and juncus (rushes) with Parramatta red gum (*E. parramattensis*)
Sydney Cataract	Sandstone	Red bloodwood and black ash woodland with abundant shrubs (*C. gummifera, E. sieberi*)
	Hanging swamps	Extensive gahnia (sedges) and banksia
	Barrier system	Coastal dune sequence of tea-tree (*Leptospermum*

Subregion	Location	Vegetation
		spp.), coast wattle (*Acacia binervia*), smooth-barked apple (*A. costata*), blackbutt (*E. pilularis*) and swamp mahogany (*E. robusta*)
	Towra Point and up the Georges River estuary	Mangroves and salt marsh

A1.5 Hydrology

The GMIA is within the Hawkesbury-Nepean and Georges River catchments (**Figure 3**). The boundary between the Cumberland and Sydney Cataract subregions in the east of the GMIA marks the watershed between the two catchment areas. Major permanent watercourses (from west to east) include the Nepean, Cataract and Georges Rivers.

These large water-courses would have been key resources for both Aboriginal and historic settlement and movement through the GMIA. As such, all of these rivers are highlighted throughout the report as of key importance.

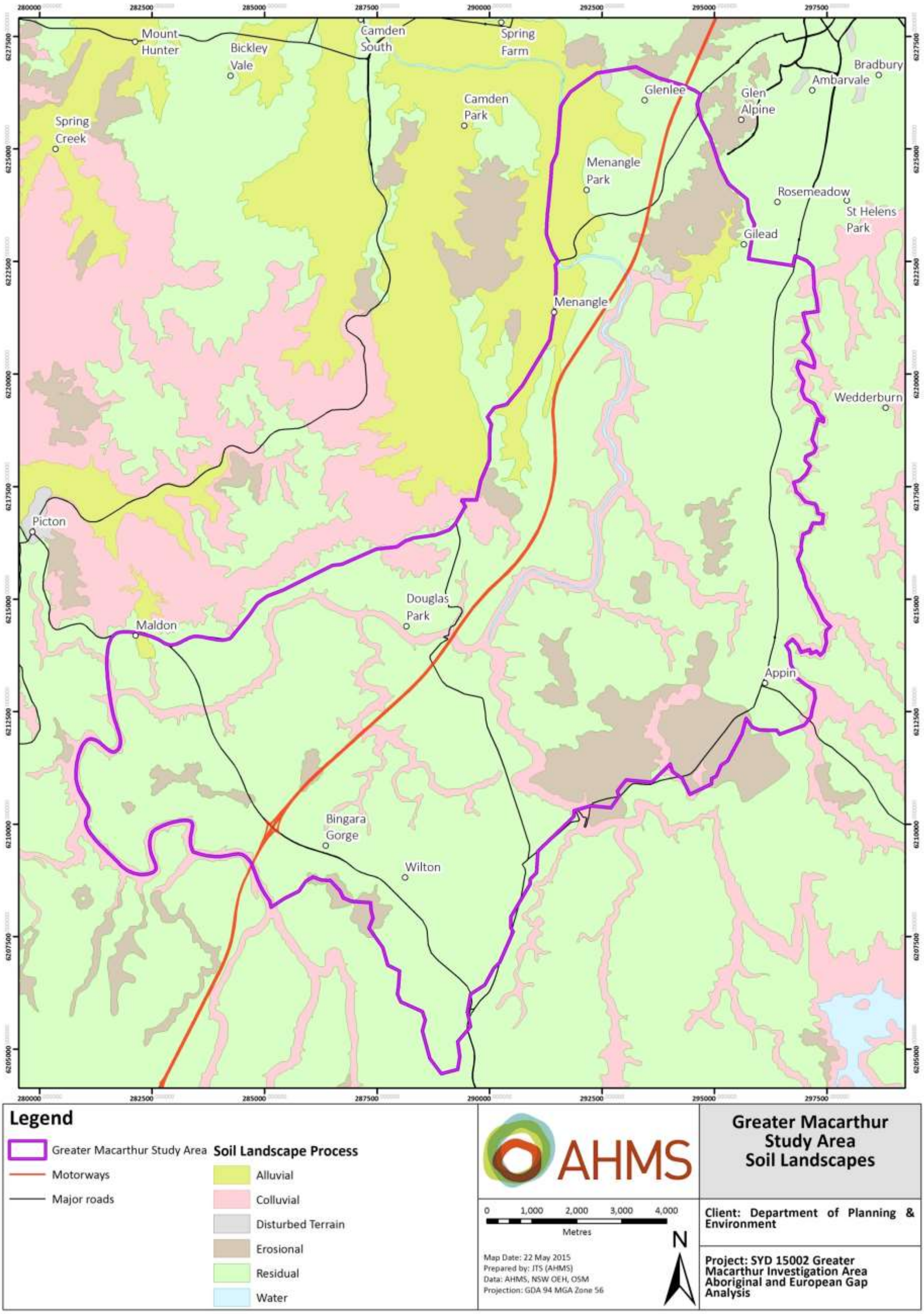

Figure A1. The type of soils of the GMIA

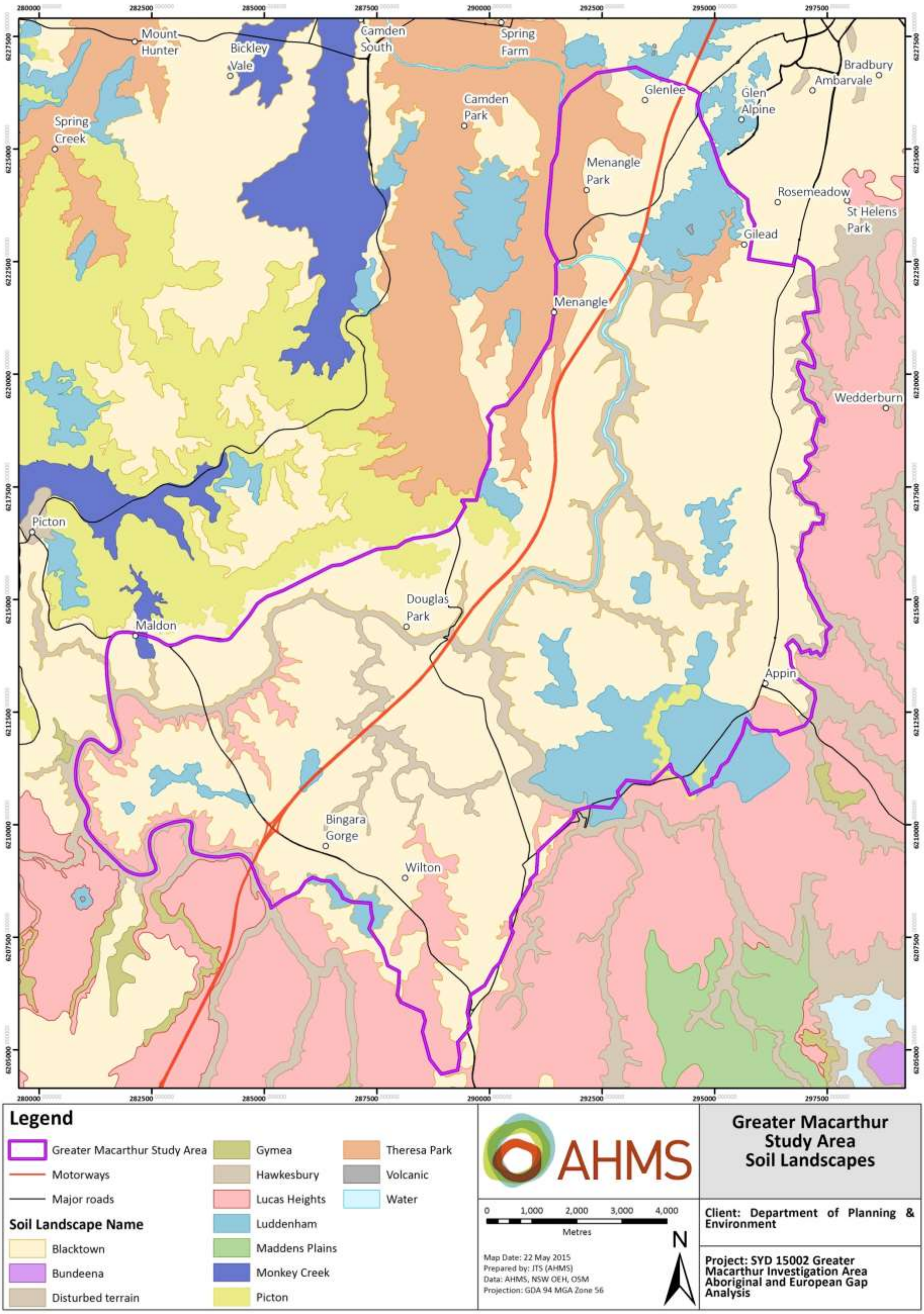

Figure A2. The type of soil landscapes of the GMIA

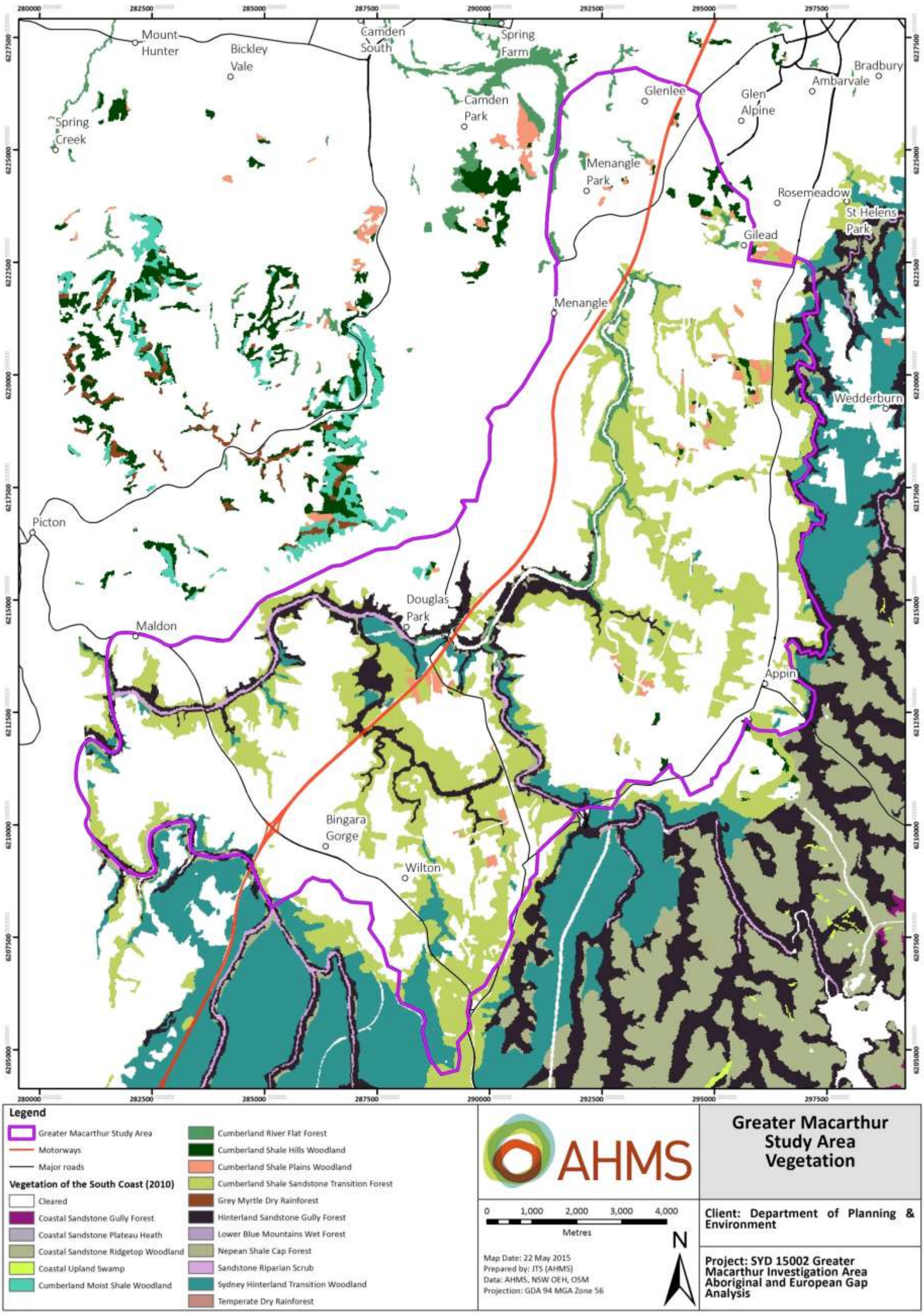

Figure A3. The type of vegetations of the GMIA

Appendix 2 Historic Heritage Themes and Listings

A2.1 Historical Themes

Campbelltown LGA

The Campbelltown Heritage Study Review was undertaken in 2009 identified the following overarching themes related to the historical development of the LGA (see also **Table A2**):

- Early European Settlement;
- Establishment of Campbelltown
- Notable Figures;
- Communication;
    - Roads
    - Railway
    - Camden Tramway
    - Mail Coaches
- Agriculture and pastoralism;
- Water Supply;
- Servicing Sydney;
- Development of Campbelltown as a Regional City;

Wollondilly LGA

Heritage Study not available at time of report.

Table A5 Campbelltown LGA Historic Themes

National Theme	State Theme	Local Theme
Culture	Creative endeavour (Cultural sites)	Architectural styles and periods - colonial homestead
Culture	Creative endeavour (Cultural sites)	Building in response to climate - verandahs
Culture	Creative endeavour (Cultural sites)	Building in response to natural landscape features
Culture	Creative endeavour (Cultural sites)	Landscaping - 20th Century interwar period
Culture	Creative endeavour (Cultural sites)	Landscaping - Colonial period
Culture	Creative endeavour (Cultural sites)	Landscaping - Federation period
Culture	Creative endeavour (Cultural sites)	Landscaping - Victorian period
Culture	Creative endeavour (Cultural sites)	Vernacular structures and building techniques - slab barns, sheds
Culture	Domestic life	Living in a rural homestead
Culture	Domestic life	Living on the urban fringe
Culture	Leisure	Gardening
Culture	Leisure	Places of public recreation
Culture	Religion	Practising Catholicism
Culture	Religion	Presbyterians
Culture	Religion	The Anglican Church

National Theme	State Theme	Local Theme
Culture	Social Institutions	Animal Welfare
Culture	Social Institutions	Meeting Places
Economy	Agriculture	Arboretums – collections of trees for ornament or forestry
Economy	Agriculture	Attempting to transplant European farming practices to Australian environments
Economy	Agriculture	Clearing land for farming
Economy	Agriculture	Dairy farming
Economy	Agriculture	Experimenting with new breeds of stock
Economy	Agriculture	Farming by convict emancipists
Economy	Agriculture	Farming wheat and other grains
Economy	Agriculture	Farming with convict labour
Economy	Agriculture	Growing vines and maintaining vineyards
Economy	Agriculture	Marking the transition from pastoralism to agriculture
Economy	Agriculture	Orcharding
Economy	Agriculture	Pastoralism - grazing sheep, cattle
Economy	Agriculture	Poultry production
Economy	Agriculture	Processing wheat and other grains
Economy	Agriculture	Share farming
Economy	Commerce	Banking
Economy	Commerce	Innkeeping
Economy	Commerce	Shopkeeping
Economy	Commerce	Tanning industry
Economy	Communication	Communicating by mail
Economy	Communication	Communicating by telegraph
Economy	Environment - cultural landscape	Gardens and landscapes reminiscent of an 'old country'
Economy	Environment - cultural landscape	Landscapes and gardens of domestic accommodation
Economy	Environment - cultural landscape	Landscapes demonstrating styles in landscape design
Economy	Environment - cultural landscape	Landscapes of food production
Economy	Environment - cultural landscape	Significant tree(s) providing rural amenity or character
Economy	Exploration	Exploration in the local area
Economy	Exploration	Exploring and surveying for the Crown
Economy	Exploration	Routes taken by Surveyor Hamilton Hume
Economy	Health	Nursing Homes
Economy	Pastoralism	Working for pastoralists
Economy	Pastoralism	Breaking thoroughbreds for horseracing
Economy	Science	Horticultural experimentation, hybridising and acclimatisation
Economy	Science	Researching chemistry
Economy	Science	Researching mineralogy
Economy	Science	Researching new agricultural production techniques

National Theme	State Theme	Local Theme
Economy	Transport	Building and maintaining public roads
Economy	Transport	Coaching inns along roads
Economy	Transport	Engineering the public railway system
Economy	Transport	Technological solutions to petrol rationing in WWII
Educating	Education	Agricultural high schools
Educating	Education	Private (independent) schooling
Educating	Education	Private (religious) schooling
Educating	Education	Schooling in temporary premises
Educating	Education	Special education (private)
Educating	Education	Special education (public)
Environment	Environment-naturally	Cultural: natural landscapes valued by people
Peopling	Convict	Working for the Crown
Peopling	Convict	Working on private assignment
Peopling	Migration	Emigrating from one colony or state to another
Phases of Life	Events	Developing local landmarks
Phases of Life	Persons	Associations with Dr William Redfern, Doctor, prominent citizen, farmer
Phases of Life	Persons	Associations with Governor Lachlan Macquarie, 1810 -1821
Phases of Life	Persons	Associations with Governor Philip King, 1800 - 1806
Phases of Life	Persons	Associations with Governor William Bligh, 1806 -1810
Phases of Life	Persons	Associations with Gregory Blaxland, explorer and viticulturist
Phases of Life	Persons	Associations with Hamilton Hume, explorer
Phases of Life	Persons	Associations with James Meehan, Surveyor General
Phases of Life	Persons	Associations with Lieutenant Governor William Paterson, 1794 - 1796, 1809
Phases of Life	Persons	Associations with Major George Johnston, soldier, administrator, farmer
Phases of Life	Persons	Associations with Robert Townson, academic, farmer
Phases of Life	Persons	Associations with the Hon. John Kidd, prominent State politician and grazier
Phases of Life	Persons	Philanthropy
Settlement	Accommodation (Housing)	Gentlemen's villas
Settlement	Accommodation (Housing)	Housing famous families
Settlement	Accommodation (Housing)	Housing farming families

National Theme	State Theme	Local Theme
Settlement	Accommodation (Housing)	Housing for farm and station hands
Settlement	Accommodation (Housing)	Housing significant persons
Settlement	Accommodation (Housing)	Housing townsfolk - terraces and cottages
Settlement	Accommodation (Housing)	Housing working animals
Settlement	Land Tenure	Changing land uses - from rural to suburban
Settlement	Land Tenure	Expressing lines of early grants
Settlement	Land Tenure	Fencing with post and rail
Settlement	Land Tenure	Granting Crown lands for private farming
Settlement	Land Tenure	Marketing and selling land by auction
Settlement	Land Tenure	Naming places (toponymy)
Settlement	Land Tenure	Sub-division of large estates
Settlement	Towns, suburbs and villages (Townships)	Country Villa
Settlement	Towns, suburbs and villages (Townships)	Creating landmark structures and places in regional settings
Settlement	Towns, suburbs and villages (Townships)	Creating landmark structures in towns
Settlement	Towns, suburbs and villages (Townships)	Developing suburbia
Settlement	Towns, suburbs and villages (Townships)	Role of transport in settlement
Settlement	Towns, suburbs and villages (Townships)	Rural estates
Settlement	Utilities	Roads connecting coastal settlements
Settlement	Utilities	Water supply
Working	Labour	Working independently at mining
Working	Labour	Working independently on the land
Working	Labour	Working on pastoral stations

A2.2 World Heritage List

World heritage sites that are nominated for World Heritage listing 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 20km west and south of the study area.

A2.3 National Heritage 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 and NHL shows that they list no items within the study area. However two items on the NHL are within 20km. They are the Greater Blue Mountains, and Royal National Park and Garawarra State Conservation listed areas.

A2.4 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 register search of the RNE shows that it lists 20 places within the study area, of which 13 are historic. They have been listed in **Table A3**.

The items listed in the RNE all focus on the early rural development of the area - except for the 1 item associated with the introduction of the major transport rail corridor across the Nepean River.

A2.5 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 that it lists eight items partly or wholly within the study area (see **Table 1** and **Figure 4**). The listings focus on rural places such as Beulah, Glenlee, Sugarloaf Farm, Camden Park but also include the late 19th Century Upper canal System (Pheasants Nest Weir to Prospect Reservoir) and the Menangle Railway Station Group and the Menangle Rail Bridge.

A2.6 State Heritage Inventory

The present State Heritage Inventory (SHI) has developed from the recognised need for a Sate 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 that it lists just over 50 items (see **Figure 4**, and **Figures A4** and **A4** for detailed information of Menangle and Appin). Many of the items are associated with the rural

development of the area and items such as the Menangle Railway Bridge and the Upper Nepean Canal are also identified. The items also extend to the local town development and include items on town allotments in both Menangle and Appin. The historic themes identified in the SHI listings include a broader range of themes than the SHR and RNE listings and include: Recreation and Entertainment; Education; Residential buildings (private); Monuments and Memorials; Community Facilities; Farming and Grazing; Religion; Utilities - Water; and Transport - Land.

A2.7 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.

Wollondilly's current LEP dates from 2011. Campbelltown has a 2002 LEP in place but is in the process of completing its Draft 2014 LEP, which has recently finished its period for public comment and feedback. The LEP heritage listings for both Wollondilly and Campbelltown are contained within the SHI and included in **Tables A4** and **A5**.

A2.8 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;
- Australian Technology Park;
- Delta Electricity;
- Department of Commerce;
- Department of Planning;
- Department of Health;
- Energy Australia;
- Newcastle Port Corporation;
- NSW Department of Primary Industries;
- NSW Fire Brigades;
- NSW Maritime Authority;
- Parramatta Park Trust;
- RailCorp;
- Sydney Harbour Foreshore Authority;
- Sydney Ports Authority;
- Sydney University;

- Sydney Water;
- Transport Infrastructure Development Corporation;
- Country Energy;
- Hunter Water;
- Roads and Traffic Authority; and
- Sydney Catchment Authority.

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

Review of the SHI identifies a number of sites listed as part of s170 registers. They are: Sugarloaf farm (Department of Planning and Infrastructure), The Hamlet Cottages; Elizabeth Macarthur Agricultural Institute; Menangle Gate Lodge; Barrigal Monument and Vista, Dairy No 4 (NSW Department of Primary Industries), Menangle Railway Station; Menangle Nepean River Underbridge (Australian Rail Track Corporation) and the Windmill Hill Group (Water NSW.

A2.9 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 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 shows that it lists 33 items within the Campbelltown and Wollondilly LGAs (see **Table A7**).

A2.10 Heritage Division Library

A search was conducted of the NSW Heritage Divisions online library under a number of applicable search terms (i.e. Wollondilly, Appin, Menangle, Menangle Park, Douglas Park, Wilton, Gilead, Macarthur) 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 and its sensitivity.

Table A3 RNE Items within the Study Area

Suburb/Location	Name of Item	Address	Place ID	LGA
Menangle Park	Glenlee, early colonial homestead	Glenlee, Glenlee Road, Menangle Park, NSW	3277	Campbelltown
Menangle Park	Menangle House	Menangle House, Menangle Road, Menangle Park, NSW	3279	Campbelltown
Menangle Park	Menangle Railway Viaduct	Menangle Railway Viaduct, Menangle Road, Menangle Park, NSW	3284	Campbelltown
Douglas Park	Morton Park Bakery	Morton Park Bakery, Dowle Street, Douglas Park, NSW	101971	Wollondilly
Douglas Park	Morton Park Circular Brick Garden Structure	Morton Park Circular Brick Garden Structure, Dowle Street, Douglas Park, NSW	101975	Wollondilly
Douglas Park	Morton Park Early Dwelling	Morton Park Early Dwelling, Dowle Street, Douglas Park, NSW	101973	Wollondilly
Douglas Park	Morton Park Group	Morton Park Group, Dowle Street, Douglas Park, NSW	101970	Wollondilly
Douglas Park	Morton Park Homestead	Morton Park Homestead, Dowle Street, Douglas Park, NSW	101972	Wollondilly
Douglas Park	Morton Park Stone Stable	Morton Park Stone Stable, Dowle Street, Douglas Park, NSW	101974	Wollondilly
Appin	St Bedes Catholic Church and Graveyard	St Bedes Catholic Church and Graveyard, King Street, Appin, NSW	3320	Wollondilly
Menangle	St James Anglican Church	St James Anglican Church, Menangle Road, Menangle, NSW	3301	Wollondilly
Appin	St Mark the Evangelist Anglican Church	St Mark the Evangelist Anglican Church, Church Street, Appin, NSW	3321	Wollondilly
Douglas Park	St Marys Towers	St Marys Towers, Douglas Park Road, Douglas Park, NSW	3305	Wollondilly

Table A4 Campbelltown LEP Heritage Items within the Study Area

Suburb	Item Name	Address	Item No
Englorie Park	Englorie Park House	Lot 48 and Part Lot 50, DP 845826	49
Gilead	Humewood Forest	Lot 21, DP 1132464	53
Gilead	Brookdale site	Lot 7001, DP 1055415	54
Gilead	Glen Lorne	Part Lot 1 and Part Lot 2, DP 603674	55
Gilead	Hume Monument	Road Reserve Appin Road, adjacent to Lot 2 DP 547457	56
Gilead	Meadowvale	Part Lot 1, DP 602888	57
Gilead	Mount Gilead	901 Appin Road	58
Gilead	Kilbride	Lot 3 DP 1065919	59
Glen Alpine	Glen Alpine, site of original house	Lot 756, DP 787316 (140m outside the study area)	61
Menangle Park	Riverview	Lots 1 and 2, DP 589899	82
Menangle Park	Menangle House, house and outbuildings	Lot 102, DP 776612	83
Menangle Park	The Pines	Lot 12, DP 786117	84
Menangle Park	Menangle Weir	Lot 1, DP 775452	86
Menangle Park	Menangle Park Paceway, Entry Gate Structure	Lot 10, DP 1022204	87
Wedderburn	"Morning Glory" House	208 Minerva Road (225m outside the study area)	103
Gilead	Beulah	Lot 23, DP 1132464	00368
Gilead	Sugarloaf Farm, homestead group and rural landscape setting	Lot 2, DP 842735; Lot 3, DP 1007066; Part Lot 200, DP 1046336	01389
Menangle Park	Glenlee, outbuildings, garden and gate lodge	Lots 1, 2 and 3, DP 713646	00009
Menangle Park	Menangle Railway Viaduct		1047

Table A5 Wollondilly LEP Heritage Items within the Study Area

Location	Name of Item	Address	Property Description	Significance	Item #	LGA
Appin	Courthouse and Gaol (former)	22 Appin Road, corner Toggerai St	Lot 9, Sec 3, DP 758022	Local	I2	Wollondilly
Appin	Darcy's Corner	38 Appin Road	Lot 100, DP 1091955	Local	I3	Wollondilly
Appin	St Bede's Catholic Church and Graveyard	60 Appin Road	Lot 1, DP 227868	Local	I12	Wollondilly
Appin	Appin Inn	61 Appin Road	Lot 2, DP 529457	Local	I4	Wollondilly
Appin	Bungalow	66 Appin Road	Lot 2, DP 540843	Local	I5	Wollondilly
Appin	Shop (former)	70 Appin Road	Lot 8, Sec 1, DP 758022	Local	I6	Wollondilly
Appin	Stone Cottage	78 Appin Road	Lot 1, DP 1099896	Local	I7	Wollondilly
Appin	Appin Hotel	84 Appin Road	Lot 101, DP 1112297	Local	I1	Wollondilly
Appin	Appin Public School and Schoolmaster's Residence	97 Appin Road	Part Lot 1, DP 782250	Local	I8	Wollondilly
Appin	Windmill Hill Group (Brennan's Farm, Larkin's Farm and Winton's Farm)	Cataract Dam and Wilton Roads	Lot 1, DP 826121; Lots 3 and 4 and Part Lot 6, DP 1085929; Part Lots 8 and 9, DP 1127449	State	I17	Wollondilly
Appin	St Mark's Anglican Church and Graveyard	1–3 Church Street	Lots 19 and 20, Sec 3, DP 758022	Local	I9	Wollondilly
Appin	Weatherboard cottage	24 Church Street	Lot 6, Sec 5, DP 758022	Local	I10	Wollondilly
Appin	Elladale	80 Elladale Road	Lot 101, DP 790844	Local	I11	Wollondilly
Appin	Northhampton- dale Group—House, Trees, Slab Farm, Outbuildings, Stables	60–80 Northhampton-dale Road West	Lots 201 and 203, DP 819476	Local	I13	Wollondilly
Appin	St Mark's Anglican Rectory (former)	5 Toggerai Street	Lot 27, DP 747041	Local	I14	Wollondilly
Appin	Upper Nepean Scheme—Broughton Pass Weir	Wilton Road West	Lots 7–10, DP 1085929	Local	I15	Wollondilly
Appin	Upper Nepean Scheme—Upper Canal		Lots 1 and 2, DP 625921; Lots 1–3, DP 719962	State	I16	Wollondilly
Camden Park	Camden Park Estate—Dairy No 8, cottages and orchard site	445 Remembrance Drive (within 5m of Study Area)	Lot 2 DP 1050479	Local	I54	Wollondilly
Douglas Park	Railway Cottage	3 Camden Road	Lot 1, DP 828396	Local	I69	Wollondilly
Douglas Park	Stone Cottages	380 Douglas Park Drive	Lot 27, DP 5152	Local	I70	Wollondilly
Douglas Park	St Mary's Towers	415 Douglas Park Drive	Part Lot 11, DP 1068393	Local	I71	Wollondilly
Douglas Park	Mountbatten Group—house, chapel and garden building	655 Menangle Road and off Duggan Street	Part Lot 1, DP 576136; Lot A, DP 421246	Local	I72	Wollondilly
Maldon	Maldon Weir	Nepean River	Lot 119, DP 751297	Local	I77	Wollondilly
Maldon	Suspension Bridge over the Nepean Rive	Maldon Bridge Road and	Nil	Local	I78	Wollondilly

Location	Name of Item	Address	Property Description	Significance	Item #	LGA
		Wilton Park Drive				
Menangle	Slab Hut	40 Carrolls Road	Lot 123, DP 809576	Local	I79	Wollondilly
Menangle	Menangle Rail Bridge over Nepean River	Menangle Road (Main Southern Railway)	Nil	State	I80	Wollondilly
Menangle	Camden Park Estate—Central Creamery Manager's Cottage	15 Menangle Road	Part Lot 201, DP 590247	Local	I82	Wollondilly
Menangle	Camden Park Rotolactor	15 Menangle Road	Part Lot 201, DP 590247	Local	I83	Wollondilly
Menangle	Dairy No 4 (EMAI Cottage 29)	60 Woodbridge Road (within 5m of Study Area)	Lot 2 DP 1133910	Local	I84	Wollondilly
Menangle	Bungalow	92 Menangle Road (within 5m of Study Area)	Lot A, DP 940830	Local	I86	Wollondilly
Menangle	Bungalow	96 Menangle Road (within 5m of Study Area)	Lot 1, DP 305932	Local	I87	Wollondilly
Menangle	House	100 Menangle Road (within 5m of Study Area)	Lot 1, DP 587187	Local	I88	Wollondilly
Menangle	Cottage	102 Menangle Road (within 5m of Study Area)	Lot A, DP 322713	Local	I89	Wollondilly
Menangle	Bungalow	106 Menangle Road (within 5m of Study Area)	Lot B, DP 322713	Local	I90	Wollondilly
Menangle	St Patrick's Catholic Church	119 Menangle Road	Lot 100, DP 790213	Local	I91	Wollondilly
Menangle	Cottage	124 Menangle Road (within 5m of Study Area)	Lot 1, DP 979893	Local	I92	Wollondilly
Menangle	Cottage	128 Menangle Road (within 5m of Study Area)	Lot B, DP 398310	Local	I93	Wollondilly
Menangle	St James' Anglican Church	131 Menangle Road	Lot 1, DP 306367	Local	I94	Wollondilly
Menangle	Cottage	138 Menangle Road (within 5m of Study Area)	Lot 1, DP 963033	Local	I95	Wollondilly
Menangle	Gilbulla (Anglican Conference Centre)	710 Moreton Park Road	Lot 1, DP 370921	Local	I96	Wollondilly
Menangle	Dairy Cottage	1370 Moreton Park Road	Part Lot 202, DP 590247	Local	I97	Wollondilly
Menangle	Menangle Weir	Station Street	Lot 2, DP 775452	Local	I101	Wollondilly
Menangle	Menangle Railway Station Group	Station Street (Main Southern Railway)	Nil	State	I81	Wollondilly
Menangle	Menangle Store	2 Station Street	Lot 8, DP 531899	Local	I98	Wollondilly
Menangle	Menangle gate Lodge (former)	60 Woodbridge Road (within 5m of Study Area)	Lot 2 DP 1133910	Local	I99	Wollondilly
Menangle	Menangle School of Arts Community Hall	4 Station Street	Lot 1, DP 306368	Local	I292	Wollondilly
Menangle	Menangle Public School (former)	28 Station Street	Lot 1, DP 795181	Local	I291	Wollondilly

Location	Name of Item	Address	Property Description	Significance	Item #	LGA
Menangle	Camden Park Estate Central Creamery	45 Stevens Road	Part Lot 21, DP 581462	Local	I100	Wollondilly
Menangle	Dairy No 4 (EMAI Cottage 29)	60 Woodbridge Road	Lot 2, DP 1133910	Local	I84	Wollondilly
Menangle	Menangle Gate Lodge (former)	60 Woodbridge Road	Lot 2, DP 1133910	Local	I99	Wollondilly
Menangle	Dairy No 9 (EMAI Cottage 24)	240 Woodbridge Road	Lot 1, DP 130288	Local	I85	Wollondilly
Wilton	Cottage	1090 Argyle Street	Lot 32, DP 814280	Local	I275	Wollondilly
Wilton	St Luke's Anglican Church	1096–1099 Argyle Street	Lots 4–7, Sec 1, DP 759094	Local	I276	Wollondilly
Wilton	Kedron	305 Wilton Park Road	Lot 2 DP 572157	Local	I280	Wollondilly
Wilton	Aboriginal shelter sites	80 Condell Park Road (Wilton Park)	Part Lot 1, DP 270536	Local	I285	Wollondilly
Wilton	Upper Nepean Scheme—Pheasants Nest Weir	Nepean River	Nil	Local	I278	Wollondilly
Wilton	Cottage	180 Wilton Park Road	Lot 105, DP 794081	Local	I279	Wollondilly
Wilton	Kedron	305 Wilton Park Road	Lot 2, DP 572157	Local	I280	Wollondilly
Wilton	Wilton Park—stables, coachhouse, water tanks, stallion boxes, covered yards	370 Wilton Park Road	Lot 8, DP 243079	State	I277	Wollondilly
Appin	Darcy's House Site	51 Appin Road	Lot 2, DP 594426	Local	A1	Wollondilly
Douglas Park	Stone ruin	45 Whitticase Lane	Lot 390, DP 800151	Local	A4	Wollondilly

Table A7 National Trust of Australia (NSW) Register items within the study area.

Suburb/Location	Name of Item	Address	Listing ID	LGA
Appin	Mount Gilead including windmill, store and stable	Appin Road	R616	Campbelltown
Appin	Beulah, former Summer Hill	Appin Road	R515	Campbelltown
Appin	Timber Beam Bridge on 'Beulah'	Appin Road off over Woodhouse Creek on Beulah	R714	Campbelltown
Gilead	Sydney Water Supply: Upper Canal		S10079	Campbelltown
Menangle Park	The Pines	Menangle Road	S10491	Campbelltown
Menangle Park	Glenlee including park-like setting, with outbuildings and gate lodge	Menangle Road	S7769	Campbelltown
Menangle Park	Menangle House formerly Horse & Jockey Inn, including rear sandstone wing that was formerly a school	Menangle Road	S8936	Campbelltown
Menangle Park	Menangle Viaduct Rail Bridge	Main Southern Railway Line, Over Nepean River, North of Town	S11457	Wollondilly

Suburb/Location	Name of Item	Address	Listing ID	LGA
Douglas Park	Circular Brick Garden Structure (part of Morton Park Group - Card 6 of 6)	Dowle Street	R2155	Wollondilly
Douglas Park	Stone Stables (part of Morton Park Group - Card 5 of 6)	Dowle Street	R2156	Wollondilly
Douglas Park	Early Dwelling (part of Morton Park Group - Card 4 of 6)	Dowle Street	R2157	Wollondilly
Douglas Park	Bakery (part of Morton Park Group - Card 3 of 6)	Dowle Street	R2158	Wollondilly
Douglas Park	Homestead (part of Morton Park Group - Card 2 of 6)	Dowle Street	R2159	Wollondilly
Douglas Park	Morton Park Group (Morton Park Group - Card 1 of 6)	Dowle Street	R2160	Wollondilly
Douglas Park	St Mary's Towers, formerly Park Hall/Nepean Towers		R2161	Wollondilly
Douglas Park	Mountbatten and Outbuildings		R2162	Wollondilly
Menangle	Railway Station	Main Southern Railway Line	R4178	Wollondilly
Menangle	St James' Church		R4180	Wollondilly
Menangle	Menangle Store	Station Street, Corner Menangle Road	R4183	Wollondilly
Menangle	Anglican Church Conference Centre, formerly Gilbulla		R4184	Wollondilly
Menangle	Menangle Viaduct	Main South Railway Line, over Nepean River	R4185	Wollondilly
Appin	Former Courthouse	Main Street, corner Toggerai Street	R543	Wollondilly
Appin	Elladale, formerly Rectory	Brooks Point Road	R550	Wollondilly
Appin	House	20 Main Street	R579	Wollondilly
Appin	House Adjoining Hotel	Main Street, next to Hotel	R595	Wollondilly
Appin	Northamptondale	Brooks Point Road	R621	Wollondilly
Appin	Former Rectory	Toggerai Street	R643	Wollondilly
Appin	St Bede's Roman Catholic Cemetery	King Street, at rear of Church	R671	Wollondilly
Appin	St Bede's Roman Catholic Church and Grounds (including adjacent graveyard)	King Street	R672	Wollondilly
Appin	St Mark the Evangelist Anglican Cemetery	Church Street	R678	Wollondilly
Appin	St Mark the Evangelist Anglican Church	Church Street	R679	Wollondilly
Appin	Windmill Hill, formerly Upchurch Farm	Appin Road	R733	Wollondilly
Wilton	Sydney Water Supply: Upper Canal		S10078	Wollondilly

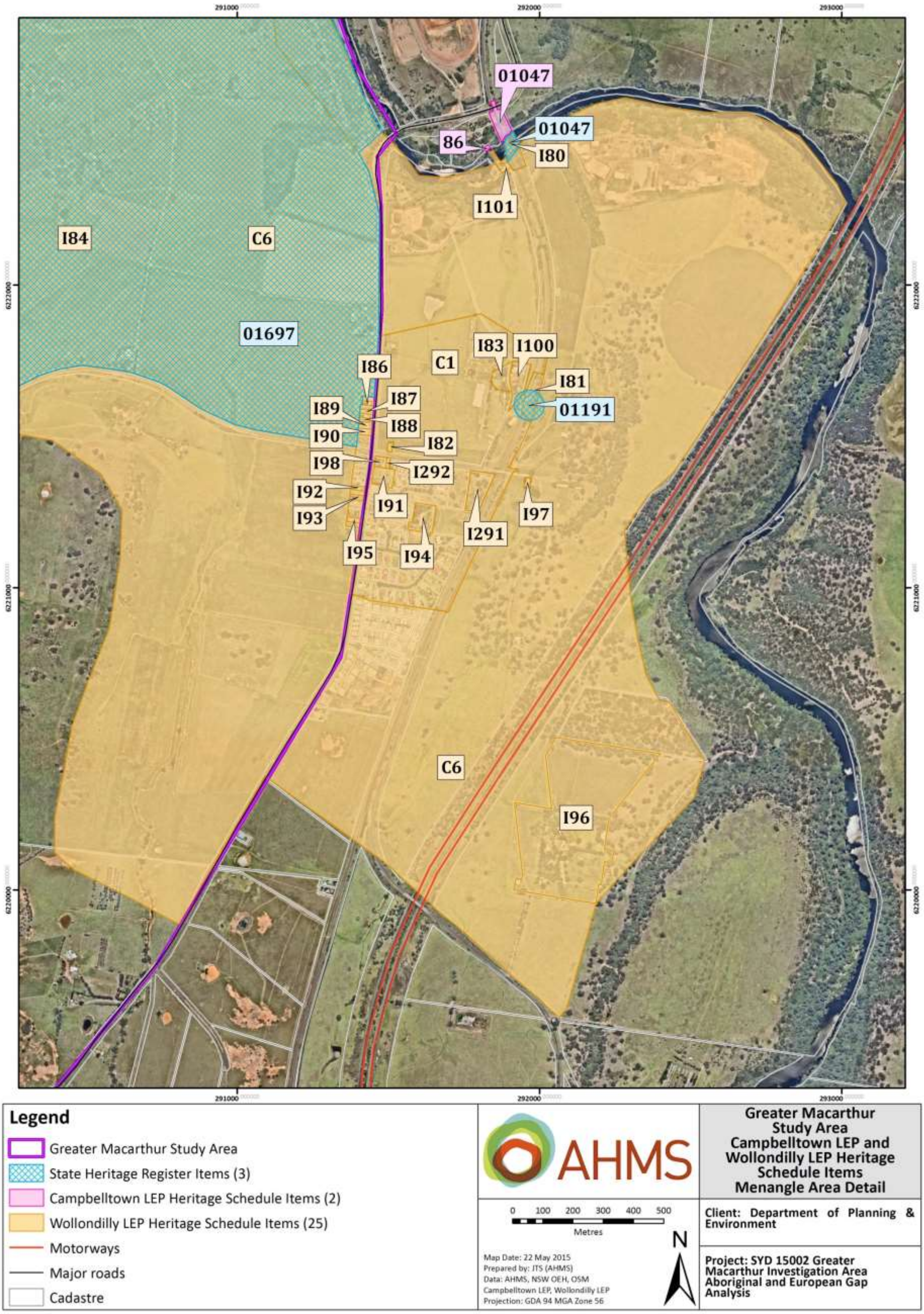

Figure A4. Menangle ineset from Figure 4.

Figure A5. Appin inset from Figure 4.

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** and **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).

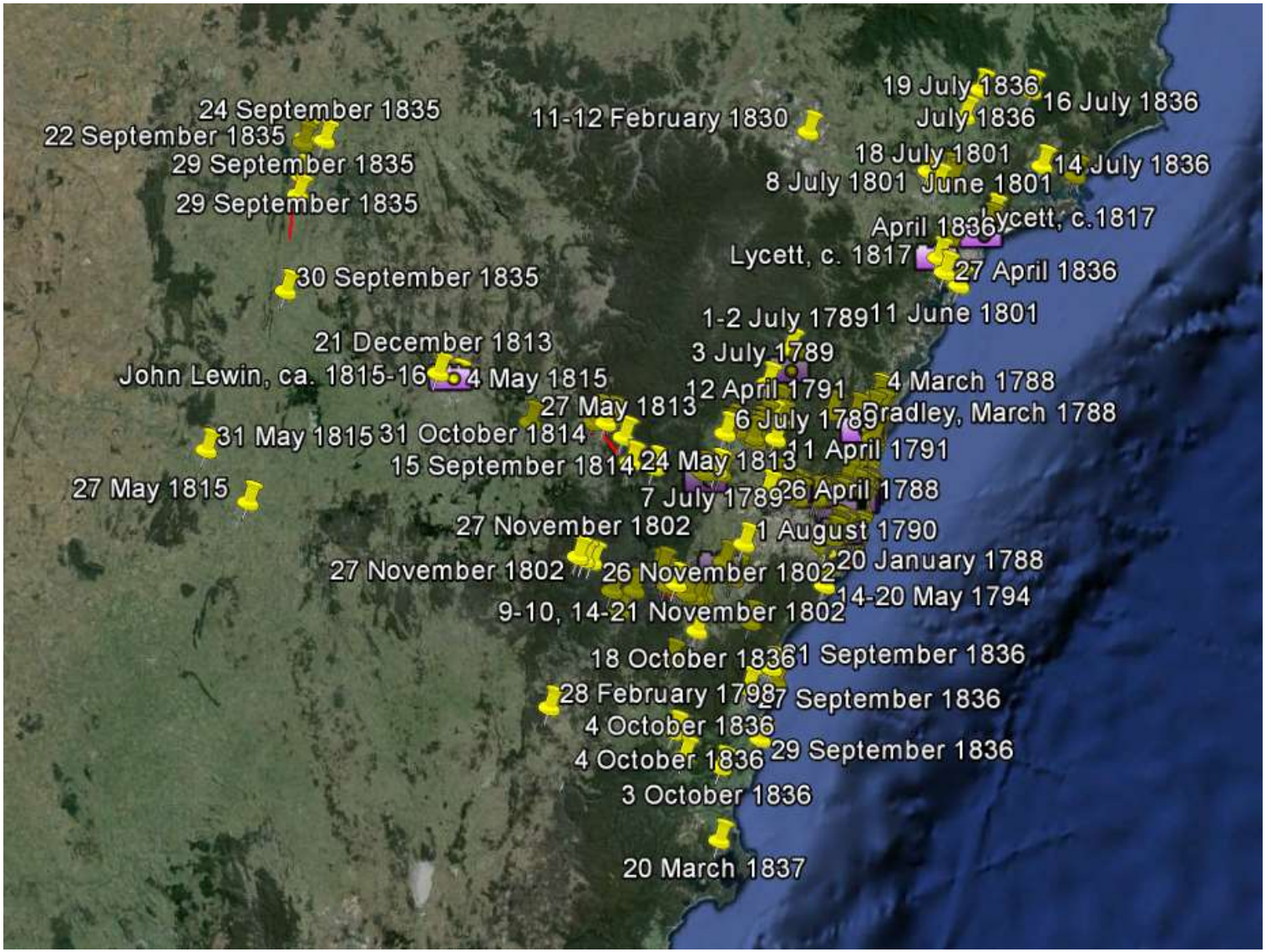

Figure A6 An overview of AHMS' ethnographic mapping program

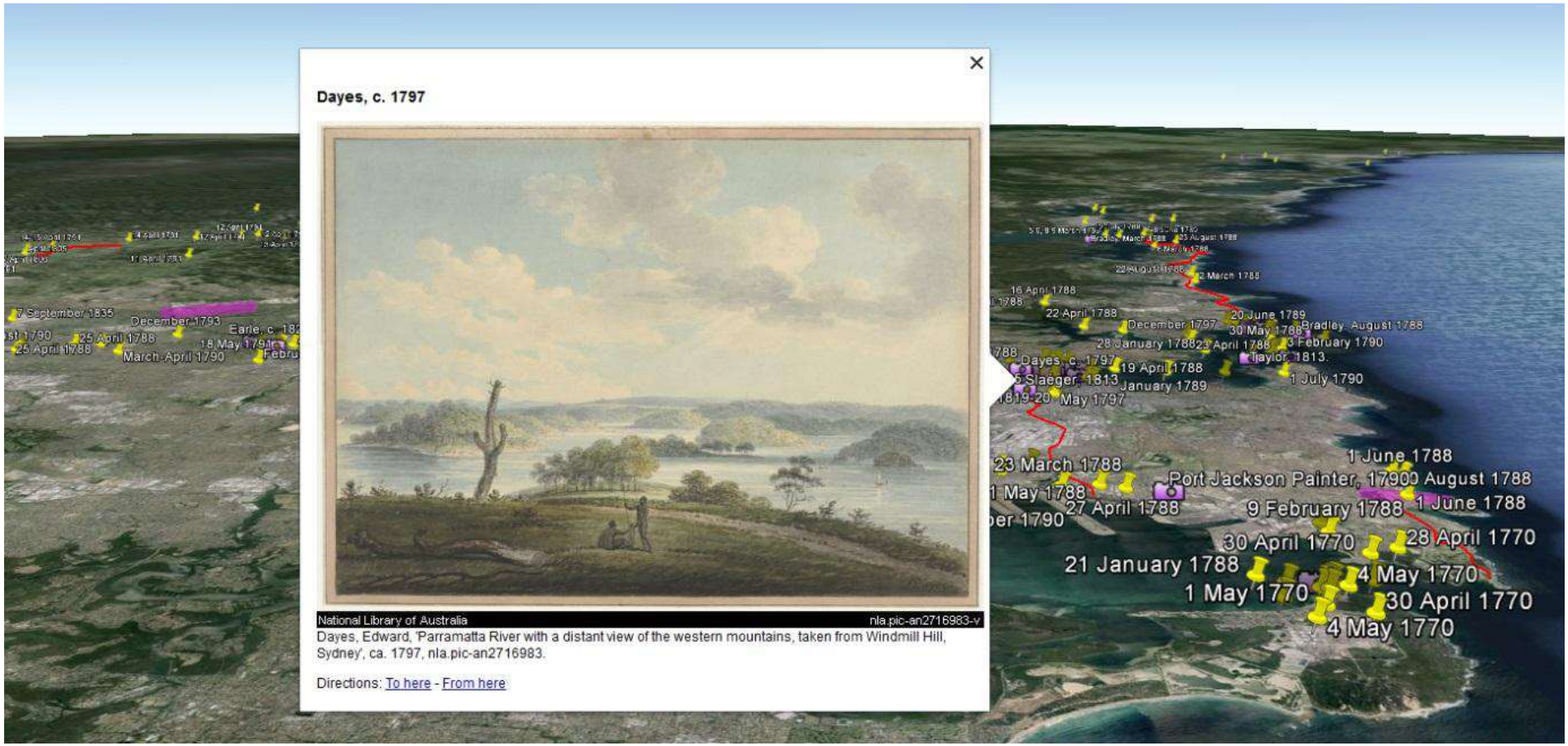

Figure A7 An example of some of the information wihtin AHMS' ethnographic mapping program

Appendix 4 Archaeological Background

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 Williams et al. 2012 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 100m^2 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 500m^2 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

Cumberland subregion

A total of 6,999 sites have been recorded on the OEH AHIMS database for the Cumberland Plain sub-region. 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 (n=1,056 or 15%). These findings are similar to the frequency of site types recorded for the Sydney region. The absence of rockshelters with art or deposit for the western Sydney area may be accounted for by the geology of the area which lacks sandstone escarpments and shelters. Other site types in western Sydney include stone quarries, non-human bone or organic material, shell, and water holes.

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 (1986) 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 (Kohen 1986). In short, Kohen (1986) argued that open artefact scatters are larger, more complex and more densely clustered along permanent creek and river lines. Kohen's (1986) 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 (JMCHM,1997) found that:

- 17 out of 61 excavated sites had no surface artefacts before excavation.
- 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 properly predicted on the basis of the surface evidence. 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.

Sydney Cataract subregion

Archaeological studies have been undertaken in this subregion since the early 1980s, but on a much lesser scale than the Cumberland subregion. The earliest investigations were focussed on Lucas Heights during the development of a waste disposal facility. Studies by Silcox, Brayshaw, Attenbrow & Negerevich, Koettig and McDonald recorded extensive numbers of sites in the vicinity of Bardens and Mill Creeks (Silcox, 1980; Brayshaw, 1982; Attenbrow & Negerevich, 1981; Koettig & McDonald, 1984). These sites were predominantly rockshelters containing art and/or deposits.

Investigations carried out at a number of the sites indicate that initial occupation of this area commenced relatively late in the Holocene period, that is, less than 3,000 years ago and continued until close to the time of European arrival. Cultural material present in excavated deposits reflects a predominantly 'inland' economy with minimal exploitation of estuarine resources (Navin Officer Heritage Consultants 1997: 4-45).

Similar findings occurred on surveys undertaken in Wedderburn by Smith & Crew and Sefton - an investigation of Yeoman's Estate located eight sites, including five rockshelters, two grinding grooves and a culturally modified tree (Smith & Crew, 1988; Smith, 1991; Sefton, 1981, 1982, 1986, 1987, 1990).

Of note was an extensive study of the Holsworthy Military Area as a possible location for the second Sydney airport in the late 1990's. Navin Officer built on extensive studies already undertaken of the military area by the Sydney Prehistory Group and Australian Museum Business Services. Before the field investigations, some 295 sites were documented (Navin Officer Heritage Consultants 1997: 4-57).

At the completion of the field inspections, Navin Officer documented over 800 archaeological sites in the Holsworthy Military Area. These sites were almost exclusively constrained to the deeply incised creek valleys and ravines running through the military area, and were comprised of isolated finds (n=37), artefact scatters (n=19), culturally modified trees (n=48), grinding grooves (n=185), open engraving sites (n=15), open sites and grinding grooves and engravings (n=10), rock shelters (n=659) (Navin Officer Heritage Consultants 1997: 5-14).

In 2002, Jim Kelton carried out an archaeological assessment of a proposed sewerage transfer from the Hoxton Park Release Area to the Liverpool Sewerage Treatment Plant (STP) (Central West Archaeology and Heritage Services, 2002). The development involved laying 7 kilometres of pipeline between the two locations using trenching and tunnelling methods. No Aboriginal sites or objects were located during the field survey. Two PADs, however, were identified adjacent to the corridor: on the northern and southern banks of Cabramatta Creek, Hoxton Park (adjacent to the Hinchinbrook Creek junction) and the northern bank and adjacent alluvial terrace of the second crossing of Cabramatta Creek (approximately 400 metres east of the Hinchinbrook Creek junction). More recently, Cultural Heritage Connections undertook a preliminary assessment of the proposed Southern Sydney Freight Line situated just west of the Georges River. This assessment, running from Macarthur to Ingleburn identified 17 archaeological sites in close proximity to the subject area. These sites were predominantly artefact scatters (n=10), culturally modified trees (n=5) and a potential archaeological deposit (Cultural Heritage Connections, 2006). No sites were recorded within the study area.

A4.2 A Review of Previous Assessments in the Region

Martin, S. (1986). Macarthur Region Aboriginal Heritage Study. Unpublished report to JRC Planning Services

In 1986 the NSW Department of Environment and Planning engaged Sarah Martin to undertake an Aboriginal Heritage study for incorporation into the Regional Environmental Plan. Specific aims included providing an inventory of known and predicted Aboriginal sites, the identification of specific areas of interest to the Aboriginal community, and provision of management recommendations.

The study area studied included the cities of Liverpool and Campbelltown, the Camden Municipality and Wollondilly Shire. The report includes a very detailed contact and post-contact history and a description of Aboriginal sites in the region. At the time, very few studies had been undertaken on the alluvial terraces along the Nepean River. Martin predicted that many of the sites in this environment had been destroyed by clearing, agriculture, and urban development; and that the visibility of the ground surface would be a significant constraint during field surveys. Sites found in this environment, however, had the potential to be of a significant age given the discovery of the 7,000 year old site at

Emu Plains. Martin therefore concluded that this landform had potential to contain stratified and dateable deposits of some antiquity.

Management priorities included: the conservation and management of sites of significance to the Aboriginal community and sites of scientific significance; and further archaeological research in the region to increase existing information available on the distribution, range and significance of Aboriginal sites. Implications for development included the need for test excavation along areas of undisturbed alluvial terrace on the Nepean and Georges Rivers.

In summary, this report identified undisturbed alluvial terraces situated along the Nepean and Georges Rivers that were likely to retain evidence of Aboriginal occupation.

Smith, L. (1989). Liverpool Land Release Areas: Archaeological Site Survey and Planning Study. Report to Liverpool City Council

Smith conducted a large archaeological site survey and planning study of release areas around Liverpool in 1989. The assessment examined approximately 2,700 hectares including parts of Hoxton Park, Cecil Park, West Hoxton, Prestons, Casula and Edmondson Park.

At the time, most of the land consisted of small rural / residential properties. Twenty-one previously unrecorded sites (nineteen artefact scatters and 2 scarred trees), and 5 isolated artefacts were located during the survey.

A predictive site location model was also developed for the Liverpool area. The model emphasised the association between site location and availability of water as follows:

- Sites will most commonly be found along permanent creeks and within and around swamp margins.
- Creek flats and banks are the topographical features most likely to contain sites.

A number of areas of archaeological potential and significance were identified, including the creek flats and floodplains of Hinchinbrook and Cabramatta Creek; and the creek flats and swamp margins surrounding Maxwells Creek.

Smith recommended that 100-150m either side of Cabramatta and Hinchinbrook Creeks be re-zoned as open space. She also concluded that archaeological surveys should be undertaken in areas containing permanent creek lines, swamps or tributaries of Hinchinbrook, Maxwells and Cabramatta Creeks, including sub-surface testing in areas with a high potential to contain in-situ archaeological material.

In summary, Smith's study identified creek flats and floodplains along permanent creeks, and swamp margins with creekflats and banks, as landforms likely to contain Aboriginal sites.

Corkill, T. (1992). Survey for Aboriginal Archaeological Sites at Narellan Vale, NSW. Report prepared for John M. Daly & Associates Pty Ltd on behalf of the Department of Housing by Haglund and Associates

Corkill was commissioned to conduct a survey on behalf of the Department of Housing for 60 hectares of land proposed for future development at Narellan Vale**.** The topography sloped gently down from north to south, intersected by two major watercourses with frequent farm dams. Most of the land had been cleared of native vegetation and turned into pasture. No archaeological sites or

isolated finds were found during the survey. However, Corkill noted that it was possible that stone artefacts may be present but were concealed by vegetation or located below the ground surface. It was concluded that no further archaeological investigation was required.

Australian Museum Business Services (AMBS). (2006). Harrington Park 2 and Mater Dei rezoning Project, Phase 2: Indigenous Heritage Assessment and conservation Strategy, report prepared for APP Corporation on behalf of Camden Council

AMBS was commissioned in 2006 by Camden Council to provide an archaeological assessment for a rezoning and development area in Harrington Park and Mater Dei, following an earlier preliminary assessment in 2004. The assessed land extended for approximately 5 km between Camden Valley Way and Mater Dei. Topographically, this land is dominated by a major ridge line centred on Crear Hill (elevation 150m). Crear Hill overlooks low lying areas along Narellan Creek to the south and towards the Nepean River to the west. Alluvial areas and tributaries are found around Narellan Creek and Cobbity Creek.

The assessment identified a total of thirty Aboriginal sites and six PADs. Two thirds of the sites were open camp sites with the remaining mostly isolated finds. Large sections of the land assessed by AMBS were rezoned for conservation, including 19 sites and five PADs. Land included within the revised development area contained 11 sites and one PAD. Six of these sites were assessed as having low significance due to their position in a disturbed landscape. Salvage of the remaining five sites and one PAD was recommended for areas where development impacts were likely to occur.

Two sites, which were not within the conservation zone and which were located in close proximity to the Camden Valley Way road corridor are described in further detail below. Site HPK-1 is an open campsite located approximately 200 m west of Camden Valley Way on a mid to lower slope running west off a broad ridgeline. One silicified tuff artefact and two quartz artefacts were identified at this location during the AMBS survey. The site had low to moderate significance in an area of moderate to high disturbance. It was recommended that should this site be directly impacted a Section 90 Consent to Destroy must be sought. HP-IF-2 was an isolated find, located approximately 600 m west of Camden Valley Way. It was a ground axe fragment located on a moderate slope running westward towards a dammed drainage line. It had low to moderate significance and was located in an area that was moderately disturbed. It was recommended that the artefact be conserved.

In summary, the landforms identified as containing archaeological deposits included a mid to lower slope off a ridgeline and a moderate slope near a drainage line. The majority of sites were generally identified within 100m of existing creeklines on most landforms, although predominately alluvial and lower slopes.

Jo McDonald Cultural Heritage Management Pty Ltd. (2007a). Archaeological Investigation of the Turner Road and Oran Park Precincts within the South West Growth Centre, Camden – Stage 1 Report. Report to APP on behalf of the Growth Centre Commission and Camden City Council

In 2007 Jo McDonald Cultural Heritage Management Pty Ltd was engaged by APP on behalf of the Growth Centres Commission (GCC) and Camden Council to perform a Stage 1 assessment of the Oran Park and Turner Road Precincts. This report was produced to identify existing information and knowledge gaps, as well as detailing further work needed in both Precincts.

Evidence from previous archaeological investigations, which are mostly surface surveys, identified a low density of sites, comprising mainly isolated artefacts and low density surface lithic scatters.

Sensitivity mapping was also performed on the two Precincts with the following classifications of zoning being used:

- Zone 1 is land with high potential for containing intact archaeological deposit;
- Zone 2 is land with good potential for containing intact archaeological deposit;
- Zone 3 is land with moderate potential for containing intact archaeological deposit; and
- Zone 4 is land with low potential for containing intact archaeological deposit.

Results of this can be seen in **Figures A8** and **A9**.

In conclusion the report recommends that both the Oran Park and Turner Road Precincts should be surveyed on foot so that the presence of surface archaeological sites can be identified. It also recommends that fieldwork should focus on areas of land that have a primarily agricultural land use and areas of cultural sensitivity in addition to areas of good-high potential archaeological deposits. Furthermore, as the land identified as having high potential for containing archaeological sites is located within the Denbigh curtilage, which is a part of the Precinct that has not been proposed for development, it is possible that this area could become a conservation area within the Oran Park Precinct.

Sensitive Data – Not for Public Exhibition

Figure A8. Map of archaeological sensitivity for Oran Park (source: JMCHM 2007a).

Sensitive Data – Not for Public Exhibition

Figure A8. Map of archaeological sensitivity for Turner Road (source: JMCHM 2007a).

Jo McDonald Cultural Heritage Management Pty Ltd. (2007b). Archaeological Investigation of the Oran Park Precinct within the South West Growth Centre, Camden – Stage 2 Report. Report for APP on behalf of the Growth Centre Commission and Camden City Council

In 2007 Jo McDonald Cultural Heritage Management Pty Ltd conducted a Stage 2 archaeological investigation of the Oran Park precinct for APP on behalf of the Growth Centre Commission and Camden City Council.

Archaeological survey was conducted both on foot and using a vehicle, where visibility was expected to be low. 44 sites were identified along with 4 potential archaeological deposits (PAD) within the study area (**Figure A10**). 4 of these sites had previously been recorded but were located for the purposes of the archaeological investigation. Five of the sites that had been previously within the Denbigh curtilage and all but 1 was relocated.Of the 39 previously unrecorded sites, 24 were located on the Oran Park Raceway side of the Northern Road (OPR) and 15 were located on the Denbigh side of the Northern Road (OPD or OPM, depending on their location in relation to the Denbigh property and the Macarthur Anglican School). The sites consisted of surface open lithic scatters (which were of a generally low density); isolated surface finds, scarred trees and flaked glass artefacts. Surface coverage was low due to the dense vegetation present.

In summary the potential for conservation within the study area is high with 15% of land being assessed as having high archaeological potential.

Sensitive Data – Not for Public Exhibition

Figure A10. Map of archaeological sites and sensitvity for Oran Park (source: JMCHM 2007b).

ENSR. (2009a, 2009b). Stage 1 Archaeological Test Excavations GCC Precincts Oran Park and Turner Road, South West Growth Centre, NSW. Draft report prepared for the Growth Centres Commission

ENSR Australia Pty Ltd was engaged by the NSW Growth Centres Commission (GCC) to conduct Stage 1 archaeological test excavations within the Oran Park Precinct and Turner Road Precinct near Narellan, south west Sydney. The overall aim of the project was to establish the nature, integrity, archaeological research value and cultural value of the archaeological deposits of four Aboriginal heritage conservation zones within the study area. To achieve this aim a 25m x 1m trench was excavated in each zone. Each of the areas excavated were situated along creek corridors including higher and lower order creeklines.

The excavations revealed a consistent distribution of Aboriginal flaked stone artefacts within the topsoil of the duplex soil profile in each area. No cultural features apart from stone artefacts were identified, although one burnt fragment of Hawkesbury sandstone was recovered. From the four 25m2 trenches, a total of 744 stone artefacts were recovered. These included 707 flaked stone artefacts, two unmodified manuports of flaking stone raw material and 35 shattered fragments of flaking stone.

The results of this report indicated that each of the second order creeks were associated with significant archaeological material, regardless of the integrity of the soil profile, and that useful archaeological deposits are likely to be present in all comparable areas with the exception of gross soil disturbance. The report recommended that Stage 2 excavations should test the assumption of greater complexity, density and significance in association with stream confluence and third order creeks.

Silcrete was the dominant raw material recovered from all four areas. However the presence of very small numbers of “exotic” white to light grey-brown coloured silcrete artefacts with a very fine fabric was found at each site. This was attributed by ENSR as being possibly derived from sources to the south of the Cumberland Plain and therefore an ‘exotic’ silcrete material brought into the area.

This report concluded that all sites had sufficiently intact materials to retain strong archaeological heritage value for their ability to demonstrate connections across country, and merit conservation of all four areas.

In summary all of the landforms investigated contained archaeological deposits, however the highest density of stone artefacts was identified at OP2 which were located between 60 and 80m from a relatively minor watercourse.

Wollondilly Development Site (Environmental Resources Management Australia 2008)

Environmental Resources Management Australia (ERM) undertook a constraints and opportunities mapping study for the proposed Wollondilly development site, comprising several properties adjacent to the town of Menangle covering an area of approximately 580 ha (ERM 2008:2). A search of the AHIMS database identified that no Aboriginal sites had previously been registered within the development site. Areas of high, moderate and low archaeological potential were mapped based on regional and local archaeological site patterning (**Figure A11**). In particular, land within 100m of the Nepean River was considered likely to have high heritage potential (ERM 2008:44).

Sensitive Data – Not for Public Exhibition

Figure A11 Aboriginal archaeological potential within the Wollondilly Development Site (ERM 2008:43)

Menangle Park Urban Release Area (Jo McDonald Cultural Heritage Management Pty Ltd 2010)

In 2010, an assessment of the Indigenous heritage values of the Menangle Park Urban Release Area was undertaken by Jo McDonald Cultural Heritage Management Pty Ltd (JMCDCHM) for the Menangle Park Draft Structure Plan. Twenty two archaeological sites were identified across a range of soil landscapes/geological units, landform elements and terrain (**Figure A12**) (JMCDCHM 2010:2, 12-13). Land use mapping identified area of good (Zone 1), moderate (zone 2), and low (or no) archaeological potential (Zone 3) (**Figure A13**). Areas of cultural sensitivity were identified during discussions with the Aboriginal community (JMCDCHM2010:7). Approximately one third (32.2%) of the Urban Release Area was found to have high levels of disturbance arising from previous land use activities, and over half (55%) was found to have moderate levels of disturbance (JMCDCHM 2010:5-6). A strong correlation between subsurface disturbance and surface artefact visibility was noted. Artefacts were rarely identified in undisturbed areas, or in areas with low levels of disturbance, as they remained buried in sediments below the aggrading land surface (JMCDCHM 2010:12).

Based on the results of the assessment, it was recommended that a conservation management strategy for the Menangle Park Urban Release Area should be based on both scientific and cultural (or social) values (JMCDCHM 2010:13). The following principles were identified for managing Indigenous heritage:

- Sites and/or landscapes with high archaeological potential or Aboriginal significance (particularly in threatened landscapes) should be avoided, retained and protected in open space;
- Sites and/or landscapes with moderate archaeological potential or Aboriginal significance should be avoided if possible and/or a range of management options considered, such as subsurface investigation to properly assess their scientific significance, covenants on Lots, creation of small open reserves, or Aboriginal Heritage Impact Permit (AHIP) application if necessary; and
- Sites and/or landscapes of low or no archaeological potential or Aboriginal significance do not require planning consideration or further archaeological investigation. If these areas cannot be avoided, and AHIP should be sought (JMCDCHM 2010:15-16).

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Sensitive Data – Not for Public Exhibition

Figure A12 Aboriginal sites identified in the Menangle Park Urban Release Area (JMCDCHM 2010:2).

Sensitive Data – Not for Public Exhibition

Figure A13 Archaeological and cultural sensitivity zones within the Menangle Park Urban Relase Area (JMCDCHM 2010:8). Note: White areas are Zone 2.

Godden Mackay Logan Heritage Consultants. (2012). East Leppington Precinct Planning Indigenous and Non-Indigenous Heritage Assessment. Report prepared for the NSW Department of Planning and Infrastructure

In 2012 Godden Mackay Logan Pty Ltd (GML) performed an Indigenous and Non-Indigenous Heritage Assessment of the East Leppington Precinct for the NSW Department of Planning and Infrastructure (DPI). The Heritage Assessment identifies items, places and objects of both Aboriginal and historic heritage significance; as well as assessing potential impacts on these items, places and objects by future developments and provides recommendations to ensure that significant heritage items are conserved for future generations.

The study is located in the Growth Centres East Leppington Precinct, which lies at the intersection of Camden Valley Way and Denham Court Road. It is bounded to the west by Camden Valley Way, to the south by St Andrews Road and to the north by the Sydney Water Canal. The assessment included a review of statutory and non-statutory heritage lists and registers, further historical research, field survey, archaeological test excavation, and archaeological investigation to identify both known and potential heritage items and places (**Figure A14**).

In summary, 533 test units were excavated with a total of 531 Aboriginal objects identified. 196 of the test units contained at least one Aboriginal object; the highest count within an individual test unit was 42 Aboriginal objects (**Figure A15**). Two of the test units contained burnt clay with carbon deposits possibly from a hearth, oven or fire pit. Four of the test units contained small deposits of red ochre, which was associated with an iron stone nodule. The historic heritage survey of the study area identified the Upper Canal (which is listed on the State Heritage Register) as one of the most significant heritage items within the Precinct. It also identified the remains of Leppington homestead as having potential State significance. Other heritage items included the sections of the Camden Valley Way and Denham Court Road and some early stone abutments, which were identified as the remains of an earlier crossing at Denham Court Road and Bonds Creek.

Noorumba Reserve, Rosemeadow (AHMS 2013)

In 2013, AHMS undertook an Aboriginal cultural heritage assessment of Noorumba Reserve, Rosemeadow (**Figure A16**). Five artefact scatters had previously been located within the reserve during previous investigations. Further targeted survey of areas with ground surface exposure identified an additional 72 artefacts. Artefacts were generally concentrated within 150m of a second order stream that drains to Menangle Creek, and were visible in areas with relatively shallow topsoil that had previously been subject to disturbance. It was noted that artefacts were also likely to be present in subsurface contexts which had not been disturbed, where surface artefacts may not necessarily have been recorded (AHMS 2013:8, 22)

Sensitive Data – Not for Public Exhibition

Figure A14. Map of archaeological potential for East Leppington (source: GML 2012).

Sensitive Data – Not for Public Exhibition

Figure A15. Map of archaeological excavations at East Leppington (source: GML 2012).

Sensitive Data – Not for Public Exhibition

Figure A16 Aboriginal site extents and artefact locations at Noorumba Reserve, Rosemeadow (AHMS 2013:23)

Macquariedale Road, Appin (Heritage Concepts 2007; Mary Dallas Consulting Archaeologists 2014)

Heritage Concepts Pty Ltd undertook an assessment of Aboriginal archaeological and cultural heritage values for Lot 1 DP 209779, Lot 1 DP 558807 and Lot 201 DP 749272, Macquariedale Road, Appin, for a proposed rezoning application (Heritage Concepts Pty Ltd 2007:9). The study area was divided into three survey zones based on landscape units (plateau, benched sandstone side slopes, and creek bank). Approximately 33% of the study area was surveyed, with estimated effective survey coverage of between 8-16%. Average ground surface visibility ranged between 20-36%; however, the eastern bank of Ousdale Creek was highly vegetated and ground surface visibility within this zone was considered very poor (0-9%) (Heritage Concepts Pty Ltd 2007:42). Four Aboriginal sites were identified, including one stone artefact scatter, one isolated find, and one glass artefact on the plateau (called AP_A1, AP_A2 and AP_A4, respectively), and one isolated find on the benched side slopes (AP_A3) (**Figure**). All the stone artefacts recorded were manufactured from milky quartz. The glass artefact was from a dark green champagne bottle and had three small flake scars; however, it could not be determined if the modifications were Aboriginal in origin. All the artefacts were assessed as having low archaeological significance, as they were found along tracks in areas with active erosional possesses, and were considered unlikely to be in their original depositional context (Heritage Concepts Pty Ltd 2007:ii-iii, 49-50). It was considered that there may be potential for

Mary Dallas Consulting Archaeologists prepared an updated Due Diligence assessment for the eastern part of the Macquariedale Road study area (Lot 1 DP209779, Lot 1 DP558807 and Lot 4 DP1160566, 40 Appin Road and 55 Macquariedale Road, Appin). Two isolated stone artefacts, a quartz flaked piece and a red/brown silcrete flaked piece, were identified in relatively disturbed areas along a track adjacent to a tributary of Ousedale Creek. As these artefacts were within 50m of sites previously registered by Heritage Concepts, they were considered to be part of a site complex (Ousdale Crk Artefact Scatter) and the site card for AP_A2 was updated to reflect this (Mary Dallas Consulting Archaeologists 2014:15).

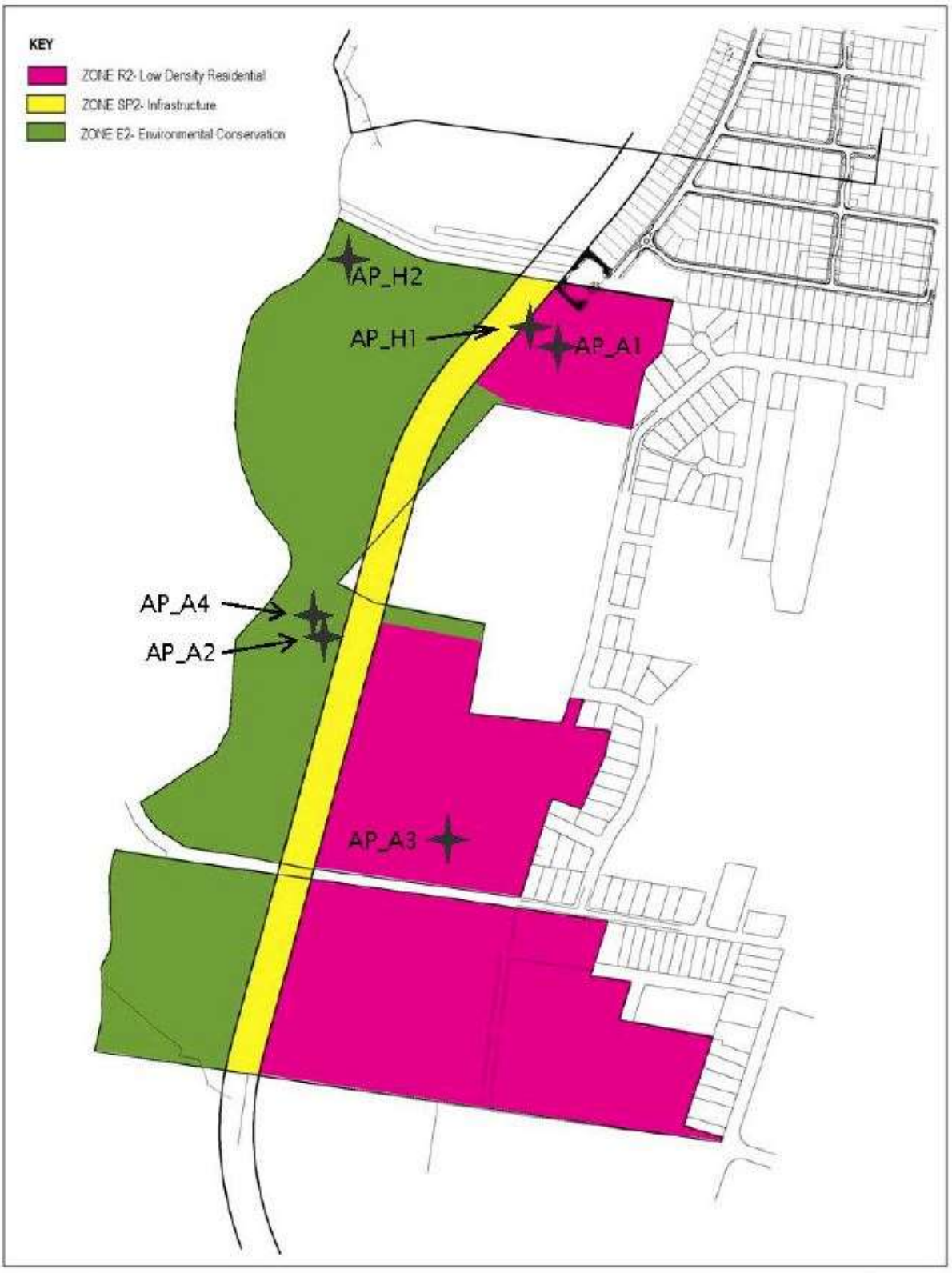

Figure A17 Aboriginal and historic archaeological sites identifed within the Macquariedale Road study area (Heritage Concepts 2007:43).

Appin Road, Mt Gilead (Campbelltown City Council 2015)

Navin Officer undertook an Aboriginal archaeological assessment of Part Lot 1 and Part Lot 2 DP 807555, and Lots 59 and 61 DP 752042, Appin Road, Mt Gilead, as part of a planning proposal by the landowners to rezone the area to permit low density residential development (**Figure A18**). Twelve Aboriginal sites were identified, comprising five artefact sites (three artefact scatters and two isolated finds), one culturally modified tree, and six Potential Archaeological Deposits (PADs) (Campbelltown City Council 2015).

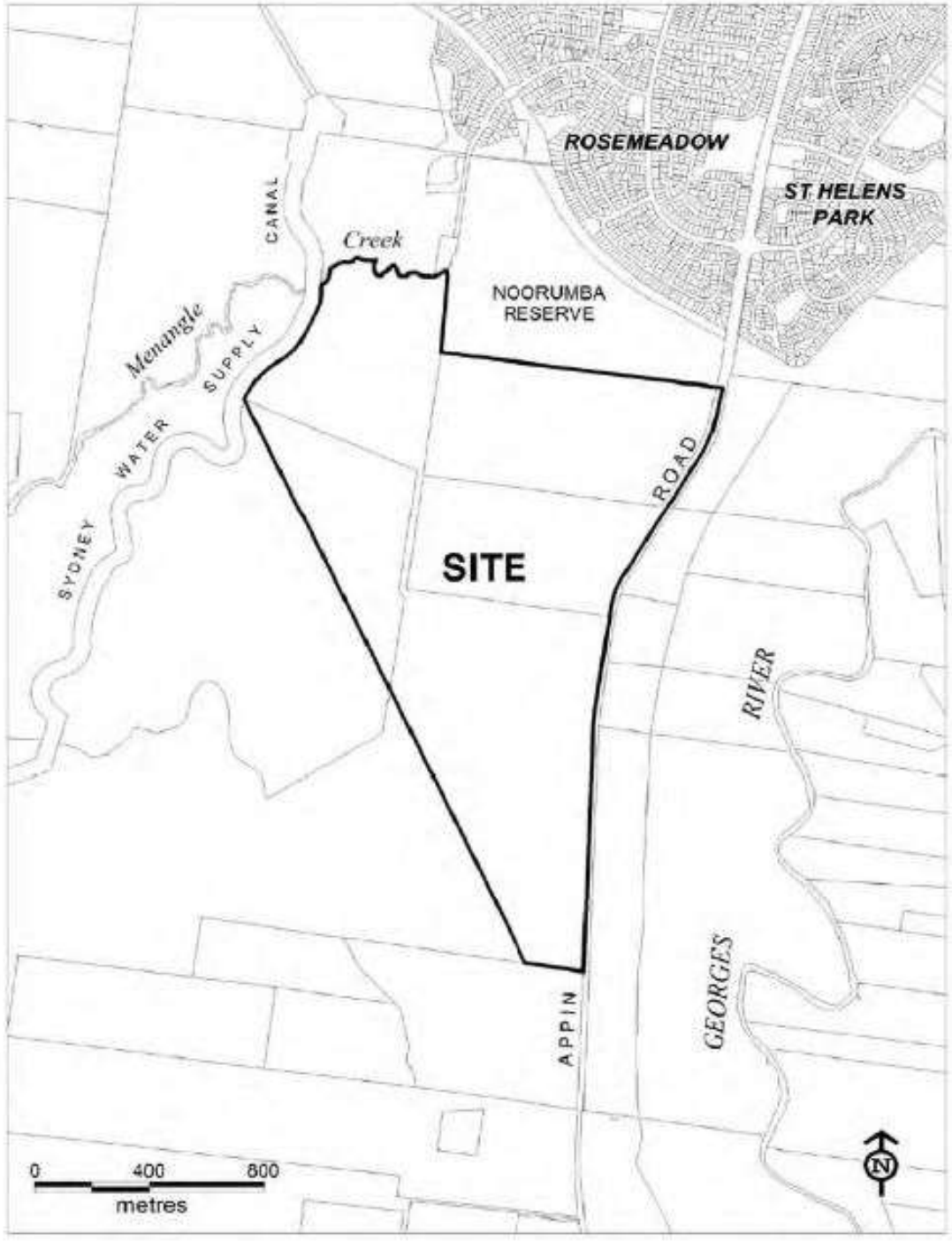

Figure A18 Mt Gilead Planning Proposal site map (Campbelltown City Council 2015)

Wilton Junction (Kayandel Archaeological Services 2014)

Kayandel Archaeological Services undertook an Aboriginal Cultural Heritage Assessment of the Wilton Junction area, for proposed rezoning. The study area covers more than more than 2,700ha, and includes the village of Wilton and suburb of Bingara Gorge Figure (Kayandel Archaeological Services 2014:1). It was noted that forty nine Aboriginal sites had previously identified within the study area. The survey identified thirty additional sites, including seven artefacts scatters, ten isolated finds, eight rock shelters with associated Potential Archaeological Deposit (PAD) or artefacts, and five scarred trees (**Figure A19**). Stone artefacts were located on lower and mid slopes, and were manufactured from a range of material, including quartz, quartzite, chert, tuff, and silcrete. The rock shelters were identified in gullies in areas where Hawkesbury Sandstone outcrops. The scarred trees were identified on elevated landforms such as ridges, mid slopes and upper slopes (Kayandel Archaeological Services 2014:68-76). Approximately half the study area was considered to have moderate to high levels of disturbance, and consequently reduced archaeological potential (Kayandel Archaeological Services 2014:84).

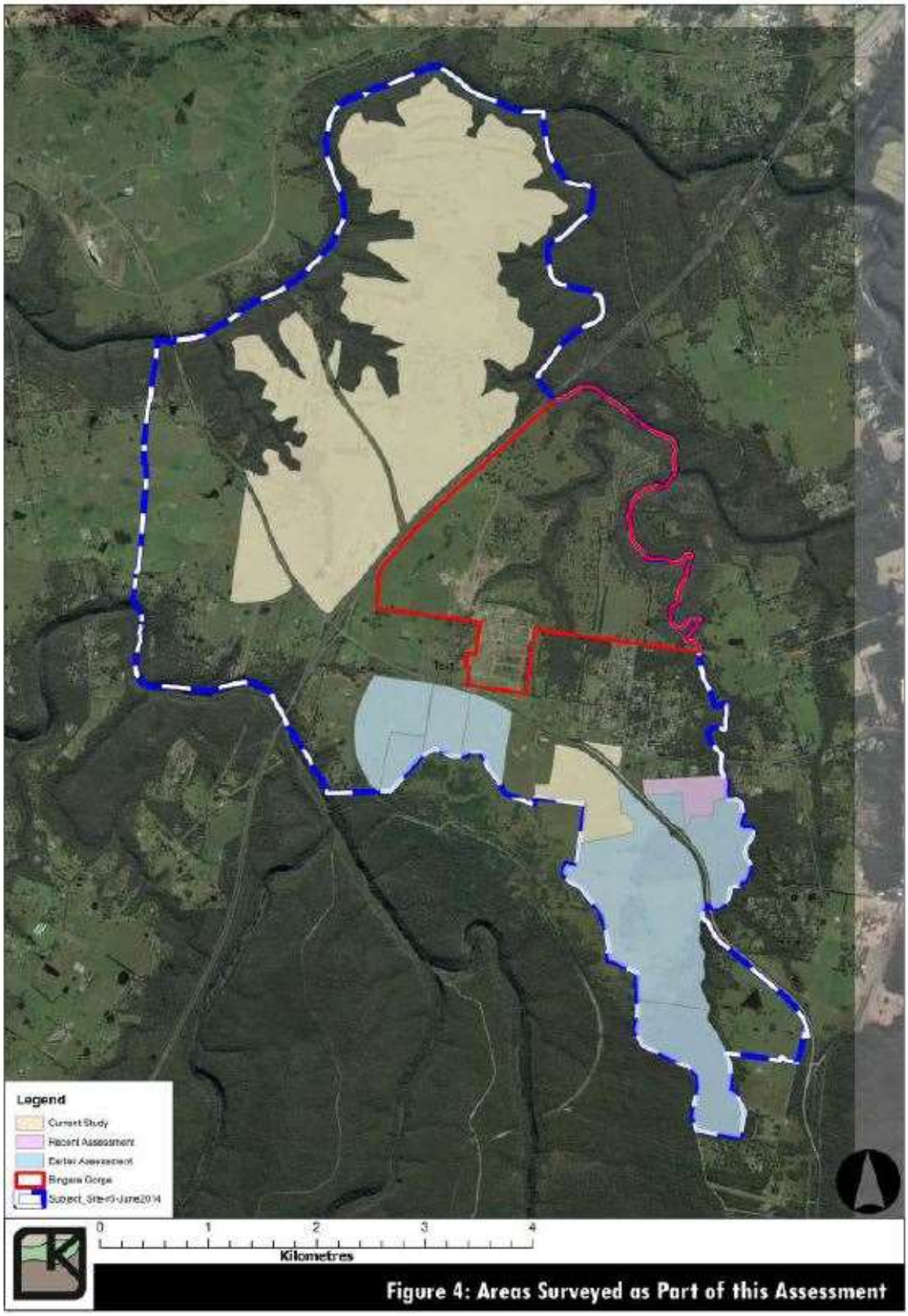

Figure A19 Areas surveyed within the Wilton Junction study area (Kayandel Archaeological Services 2014:24)

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 GMIA is provided in **Table A6**. Other fe**a**tures or types of Aboriginal cultural sites that do not necessarily leave physical evidence may exist or have once existed in the GMIA however such sites have not previously been recorded reflecting the archaeological focus of the past studies.. 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. The preliminary cultural values mapping exercise with Aboriginal people (see section ???) provides evidence that such places exist with a number of sites including a massacre site and a story place (natural mythological site) being identified.

Table A6 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 GMIA. The models combine key environmental variables (**Section A6.4**) 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 GMIA. 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 GMIA 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**).

Of the 253 sites within the GMIA, 163 were used in the development of the model and the remaining 100 were used to test the model. These 100 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 A8** 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.

Table A8: GIS data and the environmental attributes used for the archaeological predictive models

Attribute	Source	Dataset Name	Weighting used in Model
Native vegetation extents	NSW Department of Planning and Environment	Southeast NSW Native Vegetation Classification and Mapping - SCIVI VIS_ID 2230	Cleared land: 0 Native vegetation areas: +1
Land use	NSW Department of Planning and Environment	NSW Landuse v1	Mining areas, irrigated pastureland, farm dams, degraded grazing land, turf farming areas: -1 Other grazing, windbreaks, conservation tree lots, abandoned horticulture areas with regrowth: +1 Conservation land, grazing land that has only recently been cleared, native forests and national parks: +2
Soils	NSW Department of Planning and Environment	Soil Landscapes of the Wollongong-Port Hacking 1:100,000 sheets	Disturbed terrain and erosional soils: -1 Alluvial, colluvial and residual soils: +1
Stream order*	NSW Department of Planning and Environment	Strahler stream order	Within 250 metres of 2nd order: +1 Within 250 metres of 3rd – 7th order: +2
Distance from streams*	AHMS-derived data built from stream data	N/A	More than 250 metres from waterways: -1 Within 50-100 metres of any waterway: +1
Average slope	AHMS-derived data built from contours provided by NSW Department of Planning and Environment	N/A	Average slope was built from raster elevation data generated from contours with 2m intervals. Slopes were generated at 2m raster grid sizes and cubic resampled to 10m as an initial generalisation. Focal statistics using a rectangular neighbourhood and an area of 100m2 were used to average the slope across large areas in order to reveal landscape-level trends in slope. Slopes less than 16 degrees: +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 A8**. 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 A8** 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, general land use and road networks only.

Once the models were developed with the numerical ranking for each spatial grid square, areas of very likely, likely, unlikely and very unlikely 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 very likely 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 and low areas were developed to capture any data that fell outside of 5-8, and included 3 and 4, while 0-2 were consider of negligible potential and encompassed the rest of the GMIA.

6.8 Testing the Models

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. The data revealed that some 57 out of 100 sites (57%) fall within areas of moderate or high archaeological sensitivity (**Table A9**). When incorporating low areas, some 68 (68%) of the data is encompassed within the top three zones of sensitivity. When using the entire dataset, values of 146 (58%) for areas of high and moderate, and 184 (73%) for areas of high, moderate and low were achieved (**Table A9**).

These results indicate that the model is effective, with values in the order of 55-75% being considered satisfactory for modelling purposes. Ideally, the archaeological ranking zones would shifted 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 A9: Testing of the model using all AHIMS data obtained for this study.

Ranking	# of testing data subset (n=100)	% of testing data subset (n=100)	# of all sites (n=323)	% of all sites (n=323)
Negligible	32	32	69	27.27
Low	11	11	38	15.02
Moderate	33	33	79	31.23
High	24	24	67	26.48
Total	100	100	323	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 close correlation, both highlights the importance of the major river systems, including Nepean, Cataract and Georges Rivers, and other tributaries such as Allens and Wallandoola creeks (**Figure A20**). Our model perhaps has a slightly higher amount of low or very unlikely potential in areas between major creek systems, while the OEH model has greater information on existing disturbance (which it considered to have 100% impact on heritage, which our model does not). Overall, however, despite minor difference, the two

models show close correlation and provides an additional level of reliability to the model produced as part of this study.

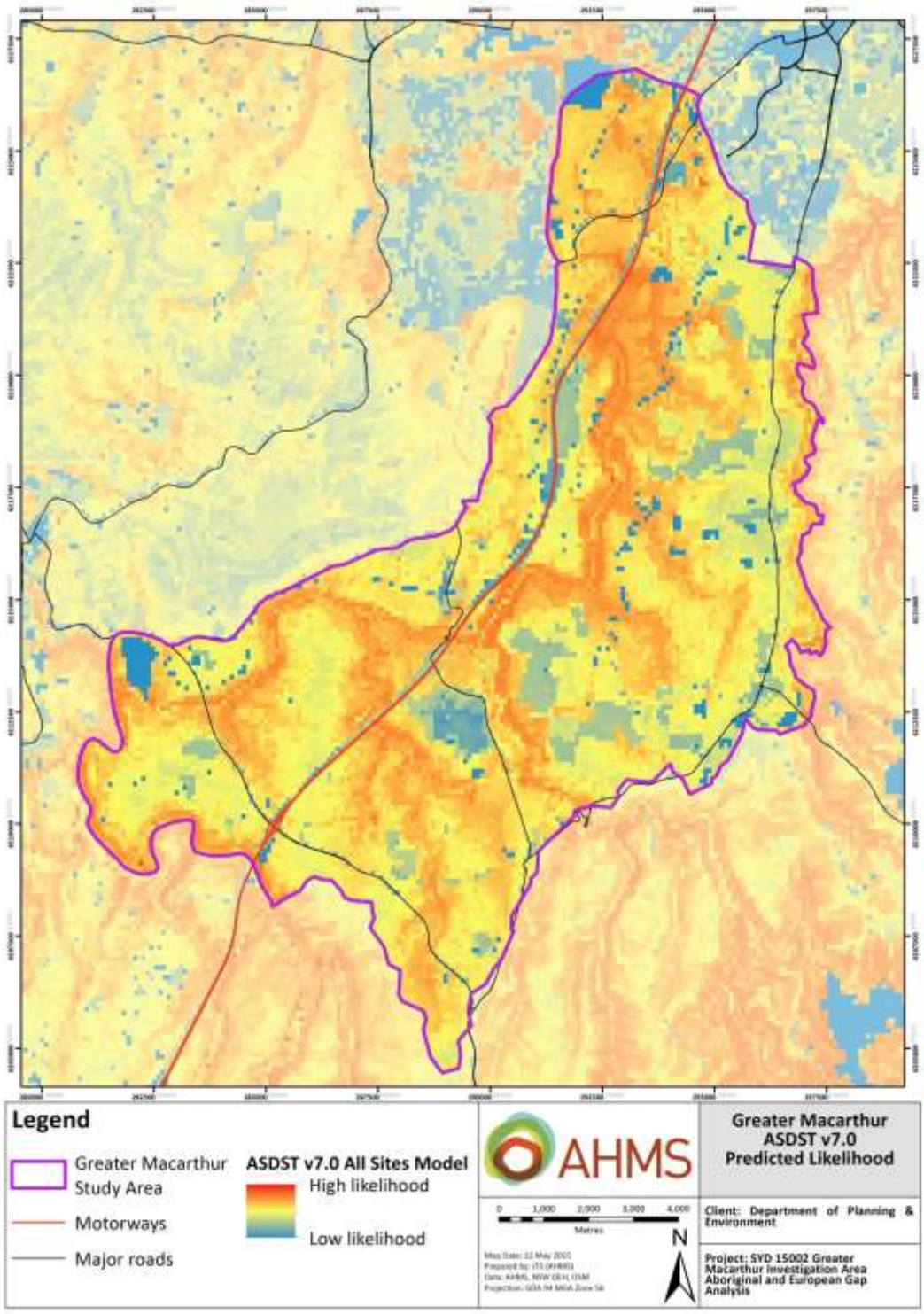

Figure A20. Predictive archaeological map of the GMIA by OEH's Aboriginal heritage due diligence support tool. High sensitivity is identified by darker colours; lower sensitivity by lighter colours. (Source: http://www.environment.nsw.gov.au/licences/AboriginalSitesDecisionSupportTool.htm).

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 695 (63%) 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. The absence of a specific GIS layer for current urban activities such as roads, urban areas and/or services, restricted the input into the models. While disturbance through soil landscape and vegetation have been considered, the existing urban environment was not specifically included in the model and so some areas in the model identified as very high, high and/or moderate may warrant revision should this information become available.
- 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 20 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.
- 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 Lower Hunter Valley. Additional investigations, studies, excavations and assessments undertaken in these areas should be used to provide input into and revise the models as appropriate.