5.3 Historical archaeological potential

The following steps have been completed in assessing the study area's potential for significant historical archaeological remains or relics:

- Review previous heritage studies and assessments relevant to the study area to locate previously identified archaeological sites.
- Assess historical maps and aerials extending across the entirety of the study area to identify new areas, not captured in previous studies, with evidence of historical development/disturbance.
- Prepare site development histories for identified 'Potential Archaeological Sites' (PAS).
- Use of site histories, historical maps and aerials to develop assessments of historical archaeological potential and significance for each PAS.

Existing heritage studies and assessments identified several archaeological sites relevant to the Project, including:

- Blaxland's Farm
- Blaxland's Crossing
- McMaster Field Station
- McGarvie Smith Farm
- Exeter House and Farm
- Fleurs Radio Telescope Site
- Upper Canal.

Although a number of archaeological sites were identified through the review of previous studies, further assessment of the project area was completed to determine whether any previously unidentified areas of archaeological potential may exist.

Major roadways and verges were assessed as likely to have been subject to significant disturbance during their construction and were not subject to detailed assessment. Across the remainder of the project area, 29 areas of interest were identified, mostly parks and reserves the proposed pipelines would pass through (Figure 114). Historical aerials, parish maps, subdivision plans and other historical plans available through Historical Land Records Viewer (NSW Land Registry Services), State Library NSW, TROVE, and NSW State Archive were georeferenced and overlaid on the 29 areas of interest.

Historical plans and aerials for each area of interest were subject to detailed assessment to identify whether historical development likely to have produced historical archaeological evidence of occupation and use was likely to have occurred. Where there was no evidence of historical development (which was most often the case), the site was assessed as having little or no historical archaeological potential. From the 29 areas of interest assessed in detail, three new sites were identified:

- Blaxland's Gardens;
- Lennox Reserve; and
- Lansvale Park.

All areas assessed as having some potential for historical archaeological remains were declared 'Potential Archaeological Sites' (PAS) and subjected to full assessments of archaeological potential and significance in the HAA (Appendix A). Ten PAS were identified within the study area, and a summary of each is presented below.

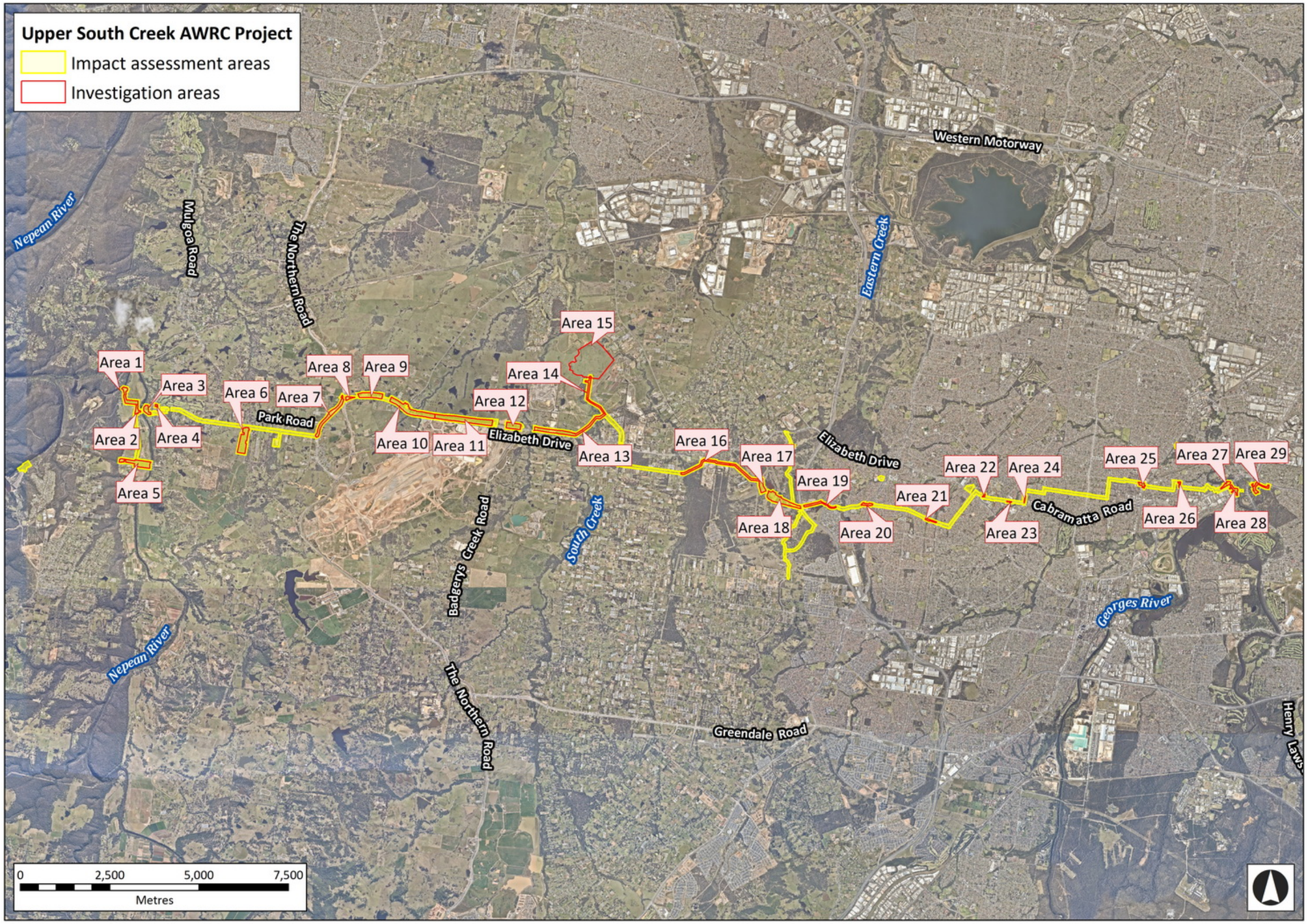

Figure 114. Areas assessed for historical archaeological remains as part of the baseline HAA contained in this SOHI. (Source: Near Map, Extent)

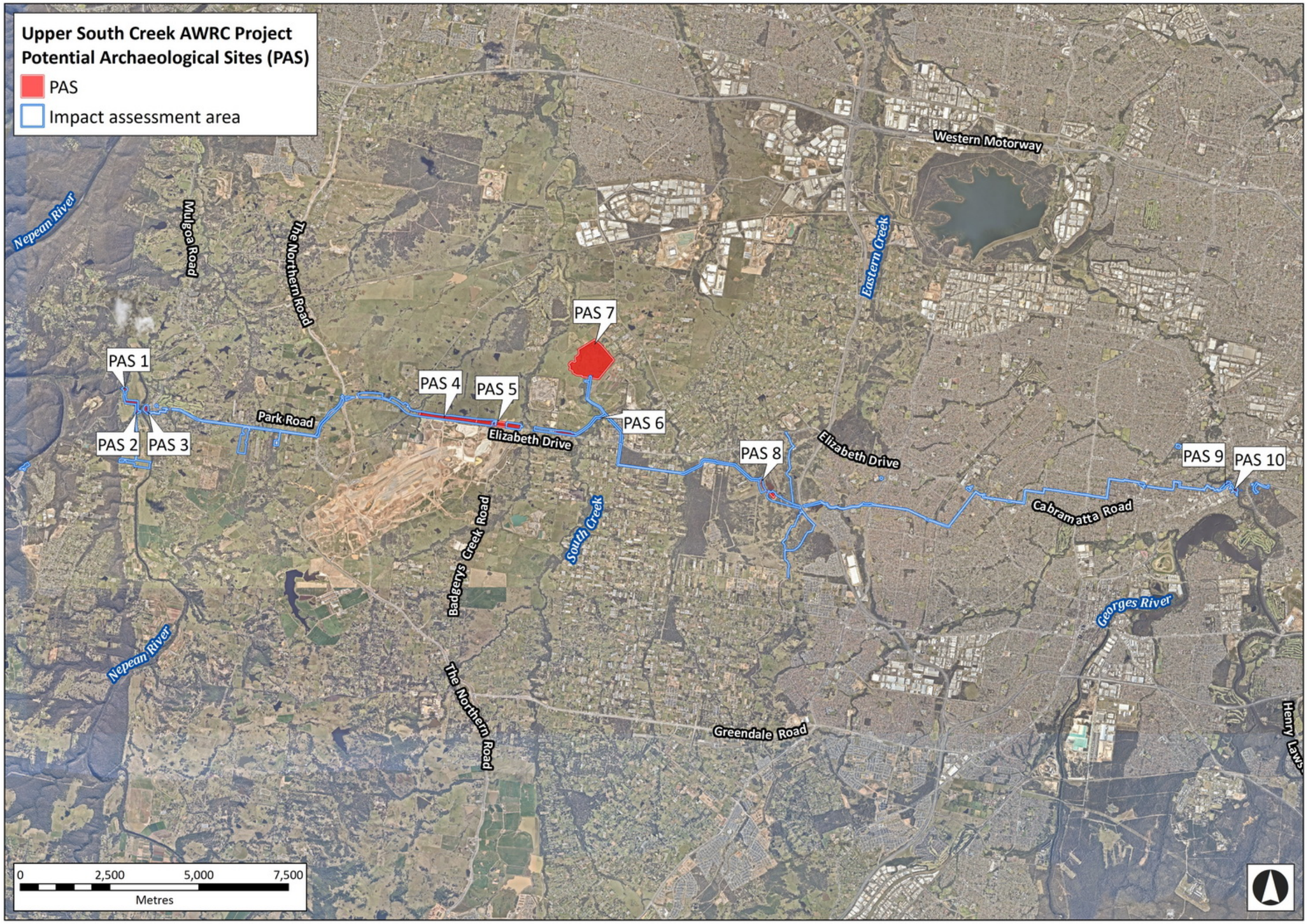

Figure 115. Potential Archaeological Sites (PAS) identified within the Project. Source: Near Map, Extent

5.3.1 PAS 1—Blaxland's Farm

Blaxland's Farm is located at 2595 Silverdale Road, Wallacia in the Wollondilly Shire Council local government area. The site comprises of land legally defined as Lot 1, DP1154130. The Nepean River extends along the east and northern boundary of the property. The site is currently listed on the Wollondilly LEP 2011 as 'Blaxland's Farm' (Item I269).

PAS 1 is situated within a large farm site with several buildings and structures dotted throughout the landscape. The eastern portion of the area is predominately cleared for farming purposes while the northwest portion remains densely vegetated. Significant landscape features include two large and old Bunya pines and terraces hill formations on the western slope west of the Project. There are a mix of native and exotic plantings along the banks of the Nepean River. The paddock consists of low-level grasses.

Governor Macquarie granted John Blaxland 6710 acres of land on 30 November 1813. John Blaxland and his brother Gregory were among the first settlers 'of unquestioned respectability to go to the colony' and established extensive commercial interests and landholdings in NSW (Australian Dictionary of Biography, 1966). By 1840 Blaxland had purchased seven additional parcels of land, bringing his total holdings to 9,885 acres. One of these parcels of land, allotted to Blaxland in 1825, was located at the confluence of the Nepean and Warragamba Rivers within the Project at Luddenham. At their farm estate, John and his son Edward built a dam, flour mill and brewery complex (O'Sullivan 1977, 1). Blaxland had commenced grinding wheat by 1830, and by 1834 was using a stone-built water mill powered by the dam constructed across the river (O'Sullivan 1977, 2). In 1839 Blaxland imported brewing coppers for a Brewhouse and Laundry, and by April that year the brewery was completed. A property valuation from 1840 provides insight into the range of additional activities occurring at the site, including the brewery with malting house and outbuildings, a barn, buildings from an 'old Establishment', large numbers of sheep, cows, horses and pigs, and substantial grain stores (O'Sullivan 1977, 3). Blaxland died in 1845 and the land was purchased by Sir Charles Nicholson in 1851 (O'Sullivan 1977, 2).

One account of the brewery describes it as a broad brewery complex, including a malthouse with brewing coppers, vats, steam engine, refrigerator, coolers, malt mill, cellars, casks and all brewing utensils, valued at £7,000. The brewery operated until at least 1847 and was substantially damaged during a large flood in 1853, though it wasn't until 1871 that flooding was substantial enough that the brewery was abandoned, with its stone blocks used 'in building a dwelling house on the hill opposite' (O'Sullivan 1977, 4).

The estate was put up for sale in 1859, and a plan of the proposed subdivision, which shows several of the structures associated with Blaxland's farm estate. Structures of note included an extensive brewery, 'a neat cottage residence, overseer's cottage, men's huts, yards, etc' and a water-powered flour mill (O'Sullivan 1977, 5). In 1841 the estate employed 69 people, 27 being free men, 13 being convicts, 19 women and 20 children (O'Sullivan 1977, 7).

The site was surveyed and described by O'Sullivan in 1977. Examination of the 1859 plan, as well as aerials dating to 1947 and 1955, has identified that the site has not been subject to modern disturbance. Detailed analysis of contemporary high-resolution aerials and LIDAR data indicates the presence of a range of subsurface demolished structures, including visible footings for what is likely the brewery and a four-room cottage, within the Project area. Archaeological survey of the site by Extent Heritage identified a range of extant ruins, including part of a two-level brewery building with fireplace and copper vat niche, remains of the mill on the waterfront, and extensive sandstone footings across much of the site, many of which were constructed into a terraced hillslope. These areas have high potential for archaeological remains associated with Blaxland's farm but are outside (to the west) of PAS 1, though PAS 1 is still likely to contain evidence of Blaxland's brewery and mill.

Summary of archaeological potential

Historical plans and the survey of the study area indicates that the core of the Blaxland's Farm site is situated immediately west of the current study area, and these areas have high to extant potential for historical archaeological evidence of the watermill and brewery. Evidence associated with convict accommodation is also most likely located to the west of the watermill and brewery, well outside of the current study area.

The study area likely contains evidence associated with Blaxland's brewery and operations of his Luddenham Estate from 1825, including land clearing and levelling. The southern part of the study area has moderate archaeological potential due to historical disturbance resulting from regular ploughing and cultivation following abandonment of the brewery. The northern part of the study area has moderate-high archaeological potential as it has not been subjected to any known historical disturbance, but fewer areas of historical modification or use were identified through analysis of LiDAR data or site survey.

The anticipated archaeological resource would include ancillary structures were constructed in association with the brewery and operation of Luddenham Estate, including cellars, a malthouse, stores, a steam mill, and stables for the working horses. Landscape evidence may include working yards, drains, and paths. A well or cistern would have been necessary to enable to flow of fresh water to the brewery, while cesspits may have been constructed to provide facilities to workers. Sealed artefact deposits might be anticipated within rubbish pits or dumps, accumulated on paved surfaces, in underfloor deposits, or discarded in wells, cesspits, cisterns or drains. There may also low-moderate to moderate potential for evidence of agricultural activities or cultivation, including ephemeral agricultural structures, field drains, palynological and ethnobotanical evidence of species grown, and plough marks.

The study area has low potential for archaeological evidence associated with use from 1788 to 1825 or after 1924.

Figure 116. View southwest to overview of Blaxland's Farm. (Extent, 2020)

Figure 117. View west towards the sloped hill. (Extent, 2020)

Figure 118. View inside ruined sandstone house to fireplace and remnant plaster render. (Extent, 2020)

Figure 119. View north along Nepean River to sandstone remains of flour mill. (Extent, 2020)

Figure 120. Sandstone remnants of brew house. Possible arch or lintel. (Extent, 2020)

Figure 121. Sandstone remnants of brew house. Archway opposite fireplace. (Extent, 2020)

Figure 122. Fireplace with carved inset above mantle. (Extent, 2020)

Figure 123. Carved sandstone window base (?) and walls within dense vegetation. (Extent, 2020)

Figure 124. Sandstone walls associated with brew house, hidden within dense vegetation. (Extent, 2020) (Extent, 2020)

Figure 125. Sandstone walls associated with brew house within dense vegetation. (Extent, 2020)

5.3.2 PAS 2—Blaxland's Garden

PAS 2 is located at 2720 Silverdale Road, Wallacia (Lot 12 DP 573571), within the Wollondilly LGA. It extends along the east side of Bents Basin Road. In the subdivision plan for Luddenham in 1859, this area is depicted as 'garden' within John Blaxland's Luddenham Estate. The analysis of historical aerials and plans identified that, beyond construction of Bents Basin Road, PAS 2 has generally been used as a paddock for grazing.

Summary of archaeological potential

Most of PAS 2 has moderate potential for historical archaeological evidence associated with the gardens established as part of John Blaxland's Luddenham Estate. PAS 2 was established as a clearly delineated early colonial garden and appears to have been subjected to little or no disturbance following the cease of cultivation activities. The anticipated archaeological resource includes evidence within garden soils (palynological and ethnobotanical evidence, plough marks, artefact deposits from kitchen scraps), ephemeral structures used to support crop cultivation or grazing activities, evidence of landscape modifications (field drains, fence lines, garden bed edging) and may potentially include isolated artefacts resulting from loss or discard. There is also low-moderate potential for evidence of early land clearing (burnt tree boles, wash deposits).

The western edge of PAS 2 has low archaeological potential as a result of construction of Bents Basin Road, as it is likely to have impacted or removed more ephemeral evidence associated with Blaxland's gardens.

5.3.3 PAS 3—Blaxland's Crossing

PAS 3 (Blaxland's Crossing) is located at 1A Shelley Road, Wallacia (Lot 36 DP 248614) within the Wollondilly LGA. Blaxland's Crossing is listed on Schedule 5 of the *Wollondilly LEP 2011* (Item I289). PAS 3 is associated with Luddenham Estate and may contain evidence of a causeway constructed of river pebbles when what is now Silverdale Road was constructed c.1827.

Summary of archaeological potential

Most of PAS 3 has low potential for archaeological evidence associated with land clearing (burnt tree boles, wash deposits) and grazing (fence lines, isolated artefacts resulting from loss and discard) in from 1827 through 1929 as part of Luddenham Estate. The northwest corner of PAS 3 also has moderate potential for archaeological evidence of earlier iterations of Silverdale Road and possibly the start of the Phase 2 Blaxland's Crossing rubble causeway and ford.

5.3.4 PAS 4—McMaster Field Station

The former McMaster Field Station is located at 1853-2109 Elizabeth Drive, Badgerys Creek, Lot 101 DP 848215. The Project is limited to the southern portion of the site along the Elizabeth Drive frontage. The site of McGarvie Smith farm formed part of a 500-acre land grant made in 1819 to William Johnson, a free settler who had first obtained land in Emu Plains in 1807 under military administration after the coup on Governor Bligh (Paul Davies Pty Ltd, 2007:14; CRM, 2019:27). The property was purchased in 1923 by the Commonwealth Government as land reserved for pastoral and agricultural research undertaken by CSIRO.

Summary of archaeological potential

PAS 4 has low potential for historical archaeological evidence associated with land clearing from c.1810 through 1923 (burnt tree boles, wash deposits) and ephemeral evidence of pastoral activities (ephemeral structures, and potentially isolated artefacts) from c.1810 through c.1990.

PAS 4 has low-moderate potential for landscaping evidence resulting from use from c.1810 through c.1990, including access tracks (gravel and/or paved), dams, and fence lines.

5.3.5 PAS 5—McGarvie Smith Farm

The former McGarvie Smith Farm is located at 1793-1951 Elizabeth Drive, Badgerys Creek, Lot 63 DP 1087838. As part of the Project, the impact area is limited to the southern portion of the site along the Elizabeth Drive frontage. McGarvie Smith Farm is listed on Schedule 5 of the *Penrith LEP 2014* (Item 857) and Schedule 2 of *SEPP (Western Sydney Parklands) 2020* (I1). It also formed part of the 500-acre land grant made to William Johnson (Paul Davies Pty Ltd, 2007:14; CRM, 2019:27) before being purchased by the CSIRO in 1936.

Summary of archaeological potential

Taking into consideration historical information presented above and analysis of visible, past land use, PAS 5 is assessed as having low potential to contain intact historical archaeological deposits and remains associated with any past use and occupation, with the exception of a vehicle track constructed between 1947 and 1961 and irrigation or drainage systems established in following construction of dams. As a result of disturbance in the twentieth century, there is low potential for archaeological evidence associated with initial land clearing and subsequent agricultural or pastoral uses in the nineteenth century.

5.3.6 PAS 6—Exeter House and Farm

The former Exeter Farm site is located at 1669-1723 Elizabeth Drive, Badgerys Creek, Lot 5 DP 860456. PAS 6 extends across the southern site boundary for the western half of the property, then extends to the northeast along South Creek.

Pas 6 includes part of the lands associated with Exeter House, which was the residence of James Badgery built c.1810. The lands owned by Badgery and his descendants are the source of the name 'Badgery's Creek'. Badgery was a racing enthusiast and stud-master of some skill. Badgery, along with William Emmett and Nicholas Bayly, played a notable role in the development of the racing industry in NSW (Paul Davies Pty Ltd, 2007). The main domicile at Exeter House was likely demolished prior to 1974, at which time it was partially excavated in a search for relics. An ancillary residence associated with Exeter House was demolished in 2010.

Summary of archaeological potential

PAS 6 formed part Badgery's Exeter farm, but no development or establishment of specialised cultivation areas or gardens in the early colonial phase were identified within the study area. The archaeological resource is likely sparse and widely dispersed across the greater landscape of Exeter Farm, with the core of the homestead and associated features being located to the north and west of the study area. PAS 6 has low potential for historical archaeological evidence of land clearing (burnt tree boles, wash deposits), may potentially include isolated artefacts lost or discarded during agricultural or pastoral use of the site, and ephemeral structures used to support crop cultivation or grazing activities. There is also low potential for evidence of landscaping and cultivation (field drains, fence lines, access tracks) from all phases of use.

5.3.7 PAS 7—Fleurs Radio Telescope Site

The former Fleurs Radio Telescope Site is located at 885A Mamre Road, Kemps Creek, Lot 21 DP 258414. PAS 7 is limited to the eastern half of the property. The site is listed on Schedule 5 of the *Penrith LEP 2014* (Item 832).

The land comprising Fleurs Station was first granted to Nicholas Bayly in 1805. Bayly had arrived in NSW in 1798 as a member of the NSW Corps, though he resigned in 1803. He also played a central role in the coup against Governor Bligh and was barred from public office by Governor Macquarie. Bayly accumulated over 2,500 acres of land in the Kemps Creek area, with the name 'Bayly Estate' applied to the entire combined estate. The house was built in 1814 and still exists in greatly modified form at 919-929 Mamre Road, Kemps Creek, to the east of the Project (CRM 2019, 51). The land was first leased by the CSIRO to establish a cross-antenna for use in radio astronomy research in 1956.

Summary of archaeological potential

The study area remained on the periphery of the former Fleurs Estate. PAS 7 has generally low potential for historical archaeological evidence associated with land clearing (burnt tree boles and wash deposits), landscaping (fence lines, dams, tracks), and pastoral activities (isolated artefacts) from the early nineteenth century through to the middle of the twentieth century. There is high potential for evidence of two timber bridges constructed crossing South Creek, likely in prior to the 1930s, including headwalls, spans, approaches, piers, struts, bolsters, and shoring in two localised areas along South Creek.

There is high potential for archaeological evidence of the Fleurs Radio Telescope Site, including subsurface cables, machinery foundations, service pits, remnants of staff accommodation, and structural evidence of the former telescopic arrays. This evidence is, however, likely highly fragmentary, truncated and of generally poor intactness and integrity as a result of site clearing and remediation in the early twenty-first century.

5.3.8 PAS 8—Upper Canal

The portion of the Upper Canal system comprising PAS 8 is located at Elizabeth Drive, Cecil Hills, and includes parts of Lots 11 and 12 DP 1055232. The Upper Canal is listed on the NSW SHR (SHR No. 01373), Schedule 5 of the Liverpool *LEP 2008* (Item 15), and Schedule 1 of the *SEPP (Western Sydney Parklands) 2009* (Item 7), which also includes the Liverpool Offtake Reservoir (Item 12).

The Upper Canal system was established in 1888 to provide water to Sydney. PAS 8 is located within Section 10 of the canal network within the 'Liverpool Dam Precinct' (Government Architects Office 2016, 186). Item 12 (cottage site) is an archaeological item, with the location of the former cottage marked by fencing, a tank stand and possible skid hut. Concrete footings, paths, a septic tank associated with the cottage and remnant garden plantings remain within the site (Government Architects Office 2016, 205). This archaeological item is located outside of and to the south of the Project.

Summary of archaeological potential

PAS 8 has low to no potential for historical archaeological evidence associated with Cecil Hills Farm (1816-1881), with the anticipated resource limited to evidence of land clearing, landscaping to accommodate grazing, and isolated artefacts resulting from loss or discard.

The areas within the immediate vicinity of the Upper Canal have low-moderate potential for historical evidence associated with operation and maintenance of the Upper Canal, including flumes, culverts, trash racks, control installations, and offtakes diverting to the Liverpool Dam. To the south and east of the Upper Canal, the site has low-moderate potential for evidence of cutting and filling to construct the Liverpool Dam, surfaces associated with former tracks, and high potential for remains of a c.1940 shed or maintenance structure.

5.3.9 PAS 9—Lennox Reserve

PAS 9 is located within Lennox Reserve on the Hume Highway, Canley Vale, within the Fairfield LGA (Lot A DP33027). Lennox Reserve is associated with construction of the Lansdowne Bridge, which spans Prospect Creek to the east of PAS 9. Lansdowne Bridge was constructed using convict labour between 1834 and 1836 and spans Prospect Creek to the east (RTA 2002:9).

Summary of archaeological potential

PAS 9 has low potential for ephemeral evidence of agricultural and pastoral activities prior to 1866, as a result of more intensive agricultural practices evident in the early twentieth century. The anticipated archaeological resource might include evidence of land clearing of land clearing (burnt tree boles, wash deposits), remains of ephemeral structures associated with agricultural or pastoral activities, isolated artefacts, and landscape evidence associated with cultivation (plough marks, palynological evidence, field drains) and grazing (fence lines).

There is high potential for evidence of a late-nineteenth or early-twentieth century cottage or agricultural outbuilding constructed along the northern edge of PAS 9. Anticipated archaeological remains may include structural evidence of the building (brick or sandstone footings, timber posts and beams, floor surfaces), and artefact deposits (rubbish pits, underfloor deposits, accumulated in gardens and yard surfaces).

While PAS 9 formed part of the property associated with the Greyhound Inn (established by emancipated convict James Bowler prior to 1830), all development associated with the inn (and associated artefact deposits) was focused west of PAS 9. The study area has low potential for archaeological evidence associated with the Greyhound Inn. Similarly, there is low potential for evidence of construction of the Lansdowne Bridge, as the bridge was located to the northeast a considerable distance from the study area.

5.3.10 PAS 10—Lansvale Park

The Project extends through several properties within Lansvale Park, including:

- 2-20 Hume Highway, Lansvale (Lot 1 DP 653719);
- 22-36 Hume Highway, Lansvale (Lot 10 DP 774392;
- Knight Street, Lansvale (Lots 1 and 2 DP 556916);
- 14 and 14A Knight Street, Lansvale (Lots 2 and 3 DP 561588); and
- 1B Day Street, Lansvale (Lots 1 and 2 DP 121121; Lot 5 DP 238490).

PAS 10 initially formed part of several plots of land granted to the Johnston family in the early nineteenth century, though their primary estate was in Annandale. Knight's Butcher Shop was established at the property in the 1880s or 1890s.

Summary of archaeological potential

PAS has generally low historical archaeological potential for evidence of pastoral activities through most of the nineteenth century, including evidence of land clearing (burnt tree boles, wash deposits), isolated artefacts resulting from loss or discard, and landscape modifications (fence lines, dams). There is also low potential for evidence of cultivation activities from the 1880s as part of Moreton's vineyard.

The site has moderate to high potential for historical archaeological evidence of Knight's Butcher Shop, associated outbuildings and features (slaughterhouses, cools rooms, sheds, stores, cesspit, well, cistern), a residence (likely as part of the shop), and sealed artefact deposits in underfloor spaces, rubbish pits, or as fill within cesspits, wells, cisterns and drains.

There is also moderate to high potential for a second structure constructed to the northwest of Knight's Butcher Shop, though the function of this structure has not yet been identified (likely a cottage or large outbuilding). Structural remains of the building (brick, sandstone or concrete footings, timber posts, beams, paved surfaces) might be anticipated, as well as ancillary features and sealed artefact deposits in surrounding yard spaces or as fill within wells, cisterns, cesspits or drains.

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6. Assessment of heritage significance

The NSW Heritage Manual was developed by the predecessors of Heritage NSW, Department of Premier and Cabinet (Heritage Office and former NSW Department of Urban Affairs and Planning) to provide the basis for an assessment of heritage significance of an item or place. This is achieved by evaluating the place or items significance in reference to specific criteria, which can be applied at a national, state or local level. The significance of the heritage items within the Project is assessed against these criteria below.

Table 8. NSW Heritage Assessment Criteria

Criteria	Definition
Criterion (a) - Historical	An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area);
Criterion (b) - Associative	An item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area);
Criterion (c) - Aesthetic	An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);
Criterion (d) - Social	An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;
Criterion (e) – Research/ Scientific	An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);
Criterion (f) - Rare	An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);
Criterion (g) - Representativeness	An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments. (or a class of the local area's cultural or natural places; or cultural or natural environments).

Bickford and Sullivan's questions

For archaeological items, the NSW heritage assessment criteria are supplemented by the established assessment framework that has been developed by Anne Bickford and Sharon Sullivan (1984), who set three fundamental questions to assist in determining the research potential of an archaeological site:

- Can the site contribute knowledge that no other resource can?
- Can the site contribute knowledge that no other site can?
- Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

6.1 Listed non-Aboriginal heritage items

6.1.1 Fleurs Radio Telescope Site (PAS 7)

The following Assessment and Statement of Significance is adapted from the Historic Period Resources Heritage Assessment prepared by CRM for the University of Sydney in 2019.

6.1.1.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The site of the Fleurs Field Station is located within a larger cultural landscape that reflects a long history of agriculture and pastoralism from the end of the eighteenth century onwards. The field station was part of one of the earliest and most significant properties in the region, the Fleurs Estate. Established in the early years of the nineteenth century this property was renowned for its agriculture, pastoral works, and viticulture and at the end of the nineteenth century and early years of the twentieth century for dairying. The landscape provides evidence of the natural assets that made this a successful property as well as the changes that were made to it to aid this earlier layer of European occupation and use. The development of the Fleurs Field Station here by the CSIRO was also a response to the natural assets of the place and the pattern of settlement that then characterised this region. There were large areas of relatively level land that could be utilised for the construction of the large telescope arrays as well as the supporting infrastructure. The density of population was sufficiently low to ensure that there was no interference in the radio transmissions that were vital to this field of astronomy. Like the partnership between the McGarvie Smith Farm and the CSIR, the Fleurs Field Station also benefitted from the relationship between the CSIRO and the University, brought about in no small part by the employment of three of the great innovators and pioneers of this technology at both institutions. The CSIRO laid the foundations of the field station and its legacy was carried on and expanded by the Department of Radiophysics at the University of Sydney. The Fleurs Field Station is pre-eminently important for its role in the development and innovation of radio astronomy in Australia. It was the site used for the construction of the three telescope arrays (Mills Cross, Chris Cross and the Shain Cross) that were breakthrough technologies adopted around the world. They facilitated the collection and analysis of a new scope of data for the exploration of the galaxy and beyond. They established Australia as a leader in this global field of scientific endeavour and innovation. The embodiment of these cultural values is in the results of the work and the legacy of technical innovation that has informed present-day investigation and outcomes. (CRM 2019, 114)
Criterion (b)	The Fleurs Field Station has particular associations with the CSIRO division of radio astronomy and that of the University of Sydney. It is particularly important as the place where Mills, Christiansen and Shain, pioneers of this technology were able to realise their research. It was also an important place of learning for students from the university. (CRM 2019, 115)
Criterion (c)	The open rural landscape has aesthetic values that derive from the pre-settlement landscape and its evolution as a rural estate over more than two hundred years. Within it the remnant technology of the arrays although minimal creates evocative landmarks. The parabolic antennas are particularly striking symbols that contrast with the soft landscape and provide clues to the past use. (CRM 2019, 115)

Criteria	Assessment
Criterion (d)	The site has values of contemporary social significance for the wider community of scientists because of the achievements and breakthroughs made here. (CRM 2019, 115)
Criterion (e)	The project area has some potential research values through the investigation of a small number of potential archaeological sites that may reveal some aspects of the nineteenth century history of the Fleurs Estate. This is located outside the impact assessment area for the Project. In respect of the archaeological resources of the astronomy field station as a means of investigation related to the prime cultural values of the place, the potential is less obvious. The majority of the physical works of the station have been comprehensively removed from the site; as an example, the two dish antennas are all that remain of well over sixty that once occupied the station. Virtually all the infrastructure above the ground has been removed with the exception of some sheds, a house, random foundations and piles of rubbish that appear to contains detritus from both the field station and older works such as fences and possibly buildings. There is likely to be an extensive sub-surface presence from the field station; the cables, services and hydraulics that enabled the above ground arrays to operate. This is given veracity by the numbers of places where conduits, services and trenching indicates this sub-surface resource. However, the potential for this material to be exploited as an investigative resource in relation to the function, technology and development of the field station is questionable. The possibility has been raised that this sub-surface material could be used to address issues such as the demonstration of phases of technological change and associated social issues. The latter is better addressed by other resources than archaeological evidence and investigation of the former raises the issue of what would be achieved other than confirming technological change which could be inferred from the nature of the place. If specific questions were raised by those technically competent to devise them it raises the issue of whether the fragmentary resources that remain at the site are capable of addressing them. This is also true of the importance assigned in the earlier study to the rubbish heaps that have accumulated around the site as a result of the clean-up programme of 2005. There are components of the telescopes in these piles but their ability to bring new knowledge to the place must be limited because of their fragmentation and disassociation from their contexts. This is less the case with those large elements that survive and have some degree of integrity, specifically the dish antennas. The extent of their scientific value at this time is their preservation of some aspects of the technology employed at the field station. It is unlikely that this has research value but a detailed and competent record of that technology could provide a meaningful objective. The conclusions of this analysis is that the remnant physical evidence of the Fleurs Field Station as a resource that could be explored in relation to the prime cultural value of the place, its technological innovation and acquisition of data is questionable. What remains on the site is unlikely to embody the principal cultural values of the place. This conclusion in respect to the resource as an investigative tool is clearly differentiated from the potential of this material to assist in interpreting that cultural value. (CRM 2019, 115-116)
Criterion (f)	The Fleurs Field Station is a rare site; few of the field stations remain and in the scope of its achievements and its role in the evolution of this technology it is unique. (CRM 2019, 116)
Criterion (g)	The site represents an important scientific achievement which is singular in its own right. (CRM 2019, 116)

6.1.1.2 Statement of significance

A revised statement of heritage significance of Fleurs Radio Telescope Site, taking into consideration of the previous heritage investigations and the site inspection for the current report is presented below.

The previous statement of significance presented in the Historic Period Resources Heritage Assessment prepared by CRM for the University of Sydney in 2019, assessed Fleurs Radio Telescope Site as potentially being of national heritage significance for the following reasons.

Historically, the site of Fleurs Field Station is located within a larger cultural landscape that reflects a long history of agriculture and pastoralism from the end of the eighteenth century onwards. The field station was part of one of the earliest and most significant properties in the region, the Fleurs Estate. Established in the early years of the nineteenth century this property was renowned for its agriculture, pastoral works, and viticulture and at the end of the nineteenth century and early years of the twentieth century for dairying.

The Fleurs Field Station is historically significant for its role in the development and innovation of radio astronomy in Australia. It was the site used for the construction of the three telescope arrays (Mills Cross, Chris Cross and Shain Cross) that were breakthrough technologies adopted around the world. They facilitated the collection and analysis of a new scope of data for the exploration of the galaxy and beyond. They established Australia as a leader in this global field of scientific endeavour and innovation. It was also an important place of learning for students from the University of Sydney, studying under the Department of Radiophysics.

The site has values of contemporary social significance for the wider community of scientists because of the achievements and breakthroughs made at the Fleurs Field Station. The embodiment of these cultural values are in the results of the work and the legacy of technical innovation that has informed present-day investigation and outcomes. The Fleurs Field Station is a rare site; few of the CSIRO field stations remain and in the scope of its achievements and its role in the evolution of this technology, it is unique.

The landscape has aesthetic values as an open rural landscape juxtaposed with remnant arrays. The parabolic antennas are evocative landmarks that provide evidence to the former use of the land. The aesthetic significance of the field station has been adversely impacted by the extensive removal of significant structures and elements. The extant fabric is limited to some sheds, a receiver house, scattered foundations and piles of rubbish that appear to contain detritus from both the field station and older works such as fences and possibly buildings.

There is likely to be an extensive sub-surface presence relating to the field station; the cables, services and hydraulics that enabled the above ground arrays to operate. This is given veracity by the number of places where conduits, services and trenching indicate this sub-surface resource. However, the potential for any of this material above or below ground to be exploited as an investigative resource in relation to the function, technology and development of the field station is questionable.

While this report agrees with these values, we do not believe the site, in its current presentation meets the threshold for national significance. The site represents a highly fragmented resource with limited material available to convey the principal values of the place. Although the extant parabolic antennas, buildings and landscape impressions contribute to our understanding and have the potential to assist in interpreting that cultural value of the place, they are not an intact representation of that significance. For these reasons, Fleurs Radio Telescope Site is significant at the local level for its historical, associative, aesthetic, social and rarity values.

Significance level: Local

6.1.1.3 Archaeological significance

The following assessment is drawn from Section 10.4 of the HAA (Appendix A).

Table 9. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Fleurs Estate one of the earliest and most significant properties in the region, renowned for its agriculture, pastoral works and viticulture, as well as dairying at the end of the nineteenth century. However, ephemeral evidence of land clearing and pastoral use would not be important in the course of pattern of cultural history in the region. The anticipated archaeological resource associated with Fleurs Estate **would not meet the threshold for significance** under this criterion. If the timber bridges in South Creek were associated with the earlier stages of Fleurs Estate (Phases 1 and 2) they would be significant as elements connecting a large and dispersed early estate. If the bridge were constructed in Phase 1 or 2 they would be of **state significance** under this criterion, while if they were constructed in Phase 3 they would be of **local significance** under this criterion. The Fleurs Field Station is of pre-eminent importance for its role in the development and innovation of radio astronomy in Australia. This significance is not, however, likely reflected in the anticipated truncated and disturbed archaeological remains associated with this use of the site. The archaeological resource associated with the Fleurs Field Station is **unlikely to meet the threshold for local significance** under this criterion.

Criterion	Assessment
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	Fleurs Estate was established by Nicholas Bayly, who was a member of the NSW Corps in the early days of the colony and played a central role in the coup against Governor Bligh. The Fleurs Field Station has associations with Mills, Christiansen and Shain, pioneers in radio astronomy, as well as the CSIRO division of radio astronomy and University of Sydney more broadly. As the site's archaeological resources are likely disturbed or truncated, the anticipated archaeological resource is unlikely to demonstrate these significant associations. The archaeological resource is unlikely to meet the threshold for local significance under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	CRM (2019) indicate that more than 99% of the site elements have been removed. The remnant service cables and structural footings of the telescope arrays are unlikely to demonstrate the high level of technical achievement accomplished at the Fleurs Field Station. Ephemeral evidence of grazing and pastoral land use in Phases 1 and 2 would not demonstrate aesthetic characteristics or technical achievement. The anticipated archaeological resource is unlikely to meet the threshold for local significance under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	No broader social or cultural group associations were identified with regard to the potential historical archaeological resource. The anticipated archaeological resource is unlikely to meet the threshold for local significance under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Disturbed ephemeral evidence of pastoral use and land clearing at Fleurs Estate is unlikely to yield new information to contribute to our understanding of cultural history in NSW or the local area. This resource is unlikely to meet the threshold for local significance under this criterion. If evidence of the timber bridges were associated with Fleurs Estate in Phases 1 or 2 they would provide insight into the construction techniques, materials and architectural design of early timber bridges in the colony. Evidence of timber bridges from Phases 1 or 2 would be of state significance under this criterion, while evidence of bridges from Phase 3 would be of local significance. Given the truncated and disturbed nature of the archaeological resource (as a result of extensive clearing and removal programs) sub-surface

Criterion	Assessment
	evidence of radio telescope function is unlikely to be legible enough to answer well considered specialist research questions. As well, the site (as part of both the CSIRO and University of Sydney) would be extensively documented, with the findings of archaeological investigations unlikely to add substantive new information. Any potential archaeological resource associated with Fleurs Field Station is unlikely to meet the threshold for local significance under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Evidence of land clearing and pastoral activities would not be considered rare within the area. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion. Intact evidence of early timber bridges is rare in NSW. If the bridges were constructed in Phases 1 or 2, they would be of **state significance** under this criterion. The Fleurs Field Station is a rare site in the context of NSW. The anticipated archaeological resource—disturbed evidence of services, mechanical mounts, service pits and concrete footings—would not be considered rare in the context of twentieth-century industrial sites. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The remaining anticipated archaeological resource is of poor intactness and integrity and unlikely to demonstrate the principal characteristics of any type of cultural place. This resource would be **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

The site was a research facility associated with both a university and government agency. The activities that occurred at the Fleurs Radio Telescope Site are likely very well documented, with those documents being relatively accessible. The site is unlikely to contribute knowledge no other resource can.

Early timber bridges on private estates were not thoroughly documented, and archaeological remains of timber bridges and their construction has the potential to contribute knowledge no other resource can.

Can the site contribute knowledge that no other site can?

The anticipated archaeological resource from the early nineteenth century through 1950s is limited to disturbed evidence of agricultural activities and landscape modifications. The site is unlikely to contribute knowledge that no other site can, and this resource type is not rare in the context of western Sydney or NSW more broadly.

Evidence of early timber bridges in NSW is a rare resource in NSW, and there was likely a certain amount of variability in design and construction across colonial estates and towns. Intact evidence of bridge construction could contribute knowledge that no other site can.

Archaeological evidence associated with the Fleurs Radio Telescope Site does comprise a rare resource, however the disturbed nature of the resource has rendered it unlikely to contribute new knowledge of the operations of the site, or the life of its occupants. The site is unlikely to contribute knowledge that no other site can.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Evidence of disturbed, ephemeral evidence of pastoral activities and landscape modifications from 1805 to 1954 is unlikely to provide useful input into substantive questions relating to Australian history or other major research questions.

Similarly, highly disturbed and truncated evidence of the Fleurs Radiophysics Field Station is unlikely to contribute to major research questions.

Remains of the timber bridges, particularly if constructed in the early nineteenth century, would contribute to substantive research questions relating to transport and the management of large colonial estates.

Summary statement of archaeological significance

Disturbed ephemeral evidence of pastoral activities and landscape modifications associated with Fleurs Estate is unlikely to demonstrate any significant associations or provide new information relating to historical activities at the site. Most of the anticipated archaeological resource for Fleurs Estate is not likely to meet the threshold for local significance.

Evidence of the collapsed timber bridges on South Creek have the potential to demonstrate historical construction techniques, selection of building materials, and more broadly the management of the landscape on large colonial estates. If constructed prior to 1850, archaeological evidence of the timber bridges would be of state significance for their historical and research values, as well as their rarity. If the timber bridges were constructed after the 1850s, they would be of local significance for their historical and research values.

The Fleurs Radiophysics Field Station has been previously assessed as being a cultural landscape of national significance (CRM 2019:116). The landscape and former radio telescope installations have strong historical and associative values, as well as rarity. The resulting archaeological resource is, however, highly disturbed and truncated as a result of previous clearing activities and remediation. The associated archaeological resource does not sufficiently demonstrate historical significance or significant associations, nor is it likely to resolve any useful or insightful research questions. The archaeological resource associated with Fleurs Radiophysics Field Station is unlikely to meet the threshold for local significance.

6.1.2 McGarvie-Smith Farm (PAS 5)

The following Assessment and Statement of Significance is quoted from the Historic Period Resources Heritage Assessment prepared by CRM for the University of Sydney in 2019 with minor adjustments throughout.

6.1.2.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The site of the McGarvie Smith Farm has been associated with European occupation since the earliest years of the nineteenth century. It has evolved from a rural estate to farms of various sizes and purposes including the last, as a research facility. This evolution of the property is directly related to the environmental qualities of the place. Modifications made to the pre-settlement landscape reflect the specific needs, issues and outcomes required by the several owners. This is an evolved cultural landscape that explains and narrates the past history and its associations. The nineteenth and early twentieth century history of the place is representative of the larger regional rural pattern of pastoralism, agriculture and animal husbandry. The development of the McGarvie Smith Farm fitted into this regional profile but added a layer of science and education. In some ways this was a continuation of experimental works undertaken on the larger estate of Bayly Park in the later years of the nineteenth century but mostly it is a clear expression of twentieth century approaches to rural requirements. The McGarvie Smith Farm was innovative and for a time a unique place of education and practical experience. It attracted students from all over the country and the Commonwealth and was managed and run by influential people in this field of endeavour. The physical fabric of the place indicates these past uses and the structure of life at the farm. Over time the research objectives of the place grew to encompass issues that still have relevance today; water conservation and management. The farm was again, innovative in its experiments and outcomes. The landscape also contains elements that reference these works. The farm is also important for its relationship with the CSIR. This relationship, including the later form of the CSIRO, is important as an example of the longstanding close working relationships between the university and this organisation and the values accrued to both through shared objectives.
Criterion (b)	The McGarvie Smith Farm has particular associations with the McGarvie Smith Institute, the University of Sydney and its students and teachers of the Veterinary science department. It has secondary associations with the CSIRO.

Criteria	Assessment
Criterion (c)	McGarvie Smith Farm has aesthetic significance as a pastoral landscape with lake-like water bodies, native vegetation and a backdrop of green hills. There are aesthetic values in the open vistas of the farm and some of the structures within it create evocative landmarks. The barracks and the house adjoining and the silo in particular evoke the quality of the early school. This initial period of development is notable for the concerns of both the University and the CSIR that the additions made to these two sites (McGarvie Farm and the McMaster Field Station) have a unity of design; this was achieved with the assistance of the Department of Public Works.
Criterion (d)	The site has no particular values of contemporary social significance.
Criterion (e)	The area has some potential research values primarily through the investigation of archaeological sites. However, given the extremely fragmentary nature of the site with so much of its past improvements now removed, the value and outcomes of this research potential are limited and would largely be concerned with better defining specific places or works within the site. Exploitation of these resources is unlikely to provide a better understanding or narrative of the work of the site and its achievements and only a limited scope for addressing life at the farm beyond the evidence supplied by the equally limited archival resource.
Criterion (f)	The McGarvie Smith Farm was for many years the only institute of its type. Later the university expanded its holdings and much of the work undertaken here was parcelled to different university establishments. This was an important site for the development of pastoral and agricultural works and in some of its research projects, particularly water management, it was an early and important proponent of these methods.
Criterion (g)	The site represents specific academic and industry objectives of the University and its partners.

6.1.2.2 Statement of significance

McGarvie Smith Farm is significant at the local level for its historic, associative, and aesthetic values. The site of McGarvie Smith Farm is an evolved cultural landscape that has been shaped and modified by Europeans since the earliest years of the nineteenth century. It is significant for its role in education, practical experience and research associated with veterinarian practice and animal husbandry, as well as being an important site for the development of pastoral and agricultural works and in some of its research projects, particularly water management.

McGarvie Smith Farm is historically significant as an early farm turn research facility for veterinary students, established the CSIR. McGarvie-Smith Farm was purchased in 1936 by Sydney University in response to legislative reform which required veterinary practitioners to be accredited and registered. Between 1936 and 1940, McGarvie Smith Farm was expanded by Sydney University with assistance from the Department of Public Works. The farm was the first veterinary farm established by the University and was used for training on animal diseases and practices, and animal husbandry. During the late 1940s and early 1950s the range of works undertaken on the facility expanded to include the application of science to farm management. A key aspect of this work was H. J. Geddes' creation of the practice of water harvesting which involved constructing dams to contain water for farm use during dry periods. This also experienced with landscape design to optimise irregular rainfall through the gradual release of water into the soil.

The farms aesthetic value is embodied in the open vistas of the farm and some of the structures within it create evocative landmarks. The barracks and the house adjoining and the silo in particular evoke the quality of the early school. This initial period of development is notable for the concerns of both the University and the CSIR that the additions made to these two sites (McGarvie Farm and the McMaster Field Station) had a unity of design; this was achieved with the assistance of the Department of Public Works. It is reflected in those few buildings that survive from the first period of development in the 1930s.

The McGarvie Smith Farm was divided into large areas that were associated with specific aspects of the work undertaken there. Several of the buildings and sheds and archaeological sites that remain at McGarvie Smith Farm illustrate this aspect of the work including the silo, farm sheds, paddock divisions and archaeological sites including one likely to be a 1930s barn. However, what remains of the site is a very small percentage of what was there during the peak period of its activity.

Significance level: Local

6.1.2.3 Archaeological significance

The assessment of archaeological significance presented below is drawn from Section 8.4 of the HAA (Appendix A).

Table 10. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Ephemeral evidence of agricultural use and irrigation lines would not be important in the course of pattern of cultural history in the region. The anticipated archaeological resource is **unlikely to meet the threshold for significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	The anticipated historical archaeological resource within the study area is unlikely to demonstrate any significant historical associations with the site, such as with William Johnson or John Piper. The anticipated archaeological resource is **unlikely to meet the**

Criterion	Assessment
	threshold for local significance under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	The McGarvie Smith Farm was the site of many technological advances in the fields of animal husbandry and horticultural practices. These technical achievements are unlikely to be demonstrated by the anticipated archaeological resource in the study area, and is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	While community consultation has not been undertaken as part of this report, no associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Disturbed ephemeral evidence of agricultural activities and modern irrigation lines have low research potential and would not contribute to an understanding of the cultural history of the region. Any potential archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Evidence of agricultural activities would not be considered rare within the area. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The potential archaeological resource, limited to evidence of a modern irrigation system and disturbed ephemeral evidence of agricultural activities, would not be important in demonstrating the principal characteristics of a cultural place or environment. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

The site was a research facility associated with both a university and government agency. The activities that occurred on the McGarvie Smith Farm are likely very well documented, with those documents being relatively accessible. The site is unlikely to contribute knowledge no other resource can.

Can the site contribute knowledge that no other site can?

The anticipated archaeological resource is limited to disturbed evidence of agricultural activities and landscape modifications. The site is unlikely to contribute knowledge that no other site can, and this resource type is not rare in the context of western Sydney or NSW more broadly.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Evidence from the core of the McGarvie Smith Farm complex may answer substantive questions relating to the development of cutting-edge agricultural and pastoral practices in NSW and Australia. The anticipated resource within PAS 5 is limited to disturbed, ephemeral evidence of agricultural activities and landscape modifications. This resource is unlikely to provide useful input into substantive questions relating to Australian history of other major research questions.

Summary statement of archaeological significance

The anticipated archaeological resource along the southern boundary of the McGarvie Smith Farm site has little or no research potential as a result of extensive and intensive agricultural activities that would have impacted on or removed any ephemeral evidence associated with earlier phases of land use. The historical archaeological resource is unlikely to meet the threshold for local significance under any of the Heritage Council criteria.

6.1.3 Luddenham Road Alignment

The following Assessment and Statement of Significance is quoted from the Heritage NSW, State Heritage Inventory Listing Sheet for 'Luddenham Road Alignment' (last updated 2008).

6.1.3.1 Assessment of significance

Criteria	Assessment
Criterion (a)	Luddenham Road provides evidence of the early nineteenth century pastoral activities in the Penrith region, connecting the estates of Luddenham and Lee Holme owned by brothers John and Gregory Blaxland respectively. It continued to be an important link through the nineteenth century, connecting Bringelly with St Marys. The sparsely settled landscape around Luddenham Road and the surviving post and rail fencing continues to provide evidence of the predominant pastoral activities in the district in the nineteenth century through to the present time
Criterion (b)	The item does not meet this criterion.
Criterion (c)	The continuing rural character of Luddenham Road, characterised by the undulating traverse of the road, sparsely settled pastoral land and surviving timber post and rail fencing gives the road a high level of aesthetic appeal.
Criterion (d)	The item does not meet this criterion.
Criterion (e)	The item does not meet this criterion.
Criterion (f)	The item does not meet this criterion.

Criteria	Assessment
Criterion (g)	The item does not meet this criterion.

6.1.3.2 Statement of significance

Luddenham Road provides evidence of the early nineteenth century pastoral activities in the Penrith region, connecting the estates of Luddenham and Lee Holme owned by brothers John and Gregory Blaxland respectively. It continued to be an important link through the nineteenth century, connecting Bringelly with St Marys.

The sparsely settled landscape around Luddenham Road and the long surviving post and rail fencing continue to provide evidence of the predominant pastoral activities in the district in the nineteenth century through to the present time (2008) and give the road a high level of aesthetic appeal.

Significance level: Local

6.1.4 Showground

The following Assessment and Statement of Significance is quoted from the Heritage NSW, State Heritage Inventory Listing Sheet for 'Showground' (last updated 2005).

6.1.4.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The grounds demonstrate an important phase in the development of community services in the village and provide insight into the historic rural use of the area.
Criterion (b)	The item does not meet this criterion.
Criterion (c)	The showground is an excellent example of a traditional rural village show reserve in its collection of built structures and cleared landscape regime. The dispersal, materials, simple design and detailing, and scale of the built structures within cleared ground with mature shade trees collectively provide an item of high aesthetic values.
Criterion (d)	The showground reserve continues to function for community uses and demonstrates a pattern of continuous organised community events over generations.
Criterion (e)	The item does not meet this criterion.
Criterion (f)	The showgrounds is unique in regard to its age and degree of integrity in the LGA. It is a substantial showground reserve that is not evidenced elsewhere in the LGA.
Criterion (g)	The showground is representative of a late nineteenth century movement for the establishment of annual community agriculture, pastoral and handicraft focussed activity.

6.1.4.2 Statement of significance

The Luddenham showground is a unique example in the LGA of a traditional rural showground reserve. The grounds continue in use and contain a collection of traditional rural corrugated metal clad sheds and timber framed stands set within cleared ground with clusters of mature native and exotic shade trees. The reserve forms an integral component of Luddenham village and provides an item of high aesthetic and historic interest in the townscape which defines the northern edge of the village.

Significance level: Local

6.1.5 Luddenham Homestead Site

The following Assessment and Statement of Significance is quoted from the Heritage NSW, State Heritage Inventory Listing Sheet for 'Luddenham Homestead Site' (last updated 2008).

6.1.5.1 Assessment of significance

Criteria	Assessment
Criterion (a)	As the home of John Blaxland on his Luddenham estate, the site of the Luddenham homestead was the centre of activity in the area from 1813. The homestead continued to be the focus of pastoral activity through the nineteenth century when it was the home of George Wallace, the manager of the remaining part of the Luddenham estate in the 1850s and after whom Wallacia is named.
Criterion (b)	This site has high significance as the site of John Blaxland's Luddenham homestead established on his 1813 land grants.
Criterion (c)	The item does not meet this criterion.
Criterion (d)	The item does not meet this criterion.
Criterion (e)	The site of Luddenham homestead has high potential to provide further information about the use of the Luddenham estate from 1813 through the nineteenth century.
Criterion (f)	Sites with potential to provide information about the early settlement of New South Wales, and particularly associated with a significant family such as the Blaxlands are increasingly rare.
Criterion (g)	The item does not meet this criterion.

6.1.5.2 Statement of significance

As the home of John Blaxland on his Luddenham estate, the site of the Luddenham homestead was the centre of activity in the area from 1813. The homestead continued to be the focus of pastoral activity through the nineteenth century when it was the home of George Wallace, the manager of the remaining part of the Luddenham estate in the 1850s and after whom Wallacia is named.

Because there is no record of the land at the rear of the shops facing Mulgoa Road being developed for other purposes, the site of Luddenham homestead has high potential to provide further information about the use of the Luddenham estate from 1813 through the nineteenth century. Sites such as this with potential to provide information about the early settlement of New South Wales, and particularly associated with a significant family such as the Blaxlands are increasingly rare.

Significance level: Local

6.1.5.3 Archaeological significance

Test excavation by AHMS (now Extent) in 2010 identified that the site retained no archaeological potential as a result of extensive land cutting activities (AHMS 2011). The site has low to no potential to provide insight on activities relating to Luddenham Estate and the Blaxland family and is unlikely to have any remnant archaeological significance.

6.1.6 Warragamba Supply Scheme and Warragamba Emergency Scheme

The following Assessment and Statement of Significance is adapted from the from State Agency Register of Conservation and Heritage for WaterNSW for Warragamba Supply Scheme and the SHR listing sheet for 'Warragamba Emergency Scheme'.

6.1.6.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The Warragamba Supply Scheme has played a fundamental role in providing water to metropolitan Sydney. The dam, pipelines and associated infrastructure continue to predominate the supply to Sydney and is one of the largest of any type of dam in the world built specifically for an urban water supply. The Warragamba Supply Scheme was constructed over a protracted construction period which was directly affected by periods of government financial stringency as a result of the Second World War. The completion of the Scheme during this period was one of the major public works projects undertaken in the State.
Criterion (b)	The design and construction of Warragamba Supply Scheme was undertaken by the Construction Branch of the Water Board. The construction of the Dam drew upon the knowledge and experience of a number of the engineers including Stanley T Farnsworth (the first Engineer-in-Chief involved with the Scheme 1937-1948), (Sir) William Hudson (best known for his role in the Snowy Mountains Hydro Electricity Scheme, 1948-1949) and TB Nicol (1949-1961) who saw the project to completion. The picnic areas and in particular, Haviland Park is associated with S Haviland, former President of the Board, and Professor P Spooner who worked as the Board's consultant and influenced the 'civic' design of the park. The beautification works undertaken on completion of the dam are also associated with Australian artist Byram Mansell, who completed the ceramic murals which adorn the valve house and annexe and feature aboriginal styled motifs which were popular in the 1960s.
Criterion (c)	The Warragamba Supply Scheme contains a dam which is an outstanding example of a high, straight concrete gravity dam, the highest in Australia, built on sandstone foundations. The wall itself is an engineering work imbued with a sense of high aesthetic value expressed through its simple, stripped classical detailing, dignified character, crest piers and bridges and curve of the apron spillway set within the narrow gorge of the Warragamba River. Upstream of the dam wall this setting is characterised by the broad expanse of Lake Burragorang bordered by the cleared and green valley sides and natural topography. Downstream of the dam wall the setting is characterised by forested hillsides and river valley containing constructed elements such as the Emergency Scheme weir, Megarrity's Creek Bridge and Balance Reservoir which themselves are of aesthetic

Criteria	Assessment
	and technological merit. Collectively these elements form part of a significant and picturesque modified and natural landscape that largely demonstrates technological achievement incorporating new and innovative techniques. The works also demonstrate the Boards philosophy and ingenuity recycling and adapting equipment and fabric from earlier Board works and projects. The design and finishes of the crest, valve house and Hydro-electric Power Station were prepared by the engineers of the Water Board and demonstrates the clean lines associated with the post-war period, embracing the 'modern' aesthetic and concrete technology used in their construction. The architectural detailing evokes a sense of strength and dignity which is both appropriate and sits well in the context of the steep stone gorge. The decorative ceramics of the valve house and associated annexe also illustrate the popular taste and fashion of the period. The aesthetic character and scale of the dam in this setting is now highlighted by the auxiliary spillway constructed adjacent to the dam. The grounds associated with the dam, Haviland Park and terraced gardens in particular also demonstrates, in its layout and plantings, popular taste of the 1960s. Despite some alteration, particularly to Haviland Park, these elements generally retain their character and sense of the original layout.
Criterion (d)	The Dam is recognised by the National Trust of Australia (NSW) as being places which are part of the cultural environment of Australia, which has aesthetic, historical, architectural, archaeological, scientific, social significance for future generations, as well as for the present community of New South Wales.
Criterion (e)	The dam wall is an excellent example of gravity dam construction incorporating inspection galleries, contraction joints, and ground surface drainage system which demonstrate the emerging technology of the day. The methods incorporating ice and chilled water to form the mass concrete structure represents major innovations in Australia in terms of dam and general construction technology and provide further insight into inter-war and post war era construction practices.
Criterion (f)	This item is assessed as historically rare state-wide. The construction technique of mass concrete in the dam wall is a first and last in New South Wales in dam construction on this type and scale that also incorporates the original spillway.
Criterion (g)	The dam is representative of a type of gravity dam constructed in New South Wales by the Water Board. Key representative attributes of the Dam's design and construction include the use mass concrete on sandstone footings, use of a spillway set as part of the gravity wall, valve house and associated buildings designed and finished to a high standard, the use of an array of upstream intakes to regulate the quality of water supply, the internal inspection galleries and drainage system, deflection marks, the foundation and apron drainage system and the contraction joints. The construction technologies used at Warragamba represents a culmination of the technology and experience associated with dams constructed in New South Wales through to this period. Key representative attributes include the use of rope and cableways, the building of camps and township to house labourers and tradesmen, building of cottages to house salaried staff, the construction of terraced platforms for plant and machinery, mechanisation of concrete production, the construction of purpose built road of access to transport men, supplies and materials to the site, the building of permanent infrastructure such as water supply and the use of electricity to power plant, equipment and township. The rehabilitation of tracts of land scarred in the construction processes employed at the Dam through beautification works is representative of practices undertaken at other dams throughout New South Wales. Key representative attributes of this practice include utilising the former terraced construction platforms as picnic areas

Criteria	Assessment
	and lookouts, and utilising the former construction roads for vehicular access to the dam site and dam wall. The practice of ongoing maintenance of the dam wall and pipeline after completion through surveillance provided by staff is representative of procedures undertaken at other dams and weirs constructed in New South Wales. The upgrading of the equipment and ancillary monitoring and operating equipment is representative of modern day safe operating practice.

6.1.6.2 Statement of significance

The Warragamba Supply Scheme and Warragamba Emergency Scheme is significant at the local and state level for its historic, associative, aesthetic, social, and rarity values. It is one of the largest and most important water supply systems, that provides a secure water supply for the industrial, commercial, and residential demands of metropolitan Sydney. The Warragamba River was first sourced for water in 1940 with the construction of the Warragamba Emergency Scheme. The Warragamba Emergency Scheme was the first stage in the storage and extraction of water from the Warragamba River, and was preliminary to the Warragamba Dam and supply scheme.

The Warragamba Dam is aesthetically significant as a high, straight concrete gravity fed wall atop sandstone foundations. The aesthetic and technical values of the dam wall is enhanced by the post-war architectural expression of the crest, lift towers and Valve House which continue to be integral elements. At the time of their construction, the Warragamba Dam was the highest concrete gravity dam in the world constructed on stone foundations. The scale and use of mass concrete in the in the dam wall is unique in New South Wales. The design of the spillway incorporated in the wall and crest gates demonstrate a notable technological advancement and are possibly the only extant examples of their type in Australia.

The means of construction and infrastructure established for the construction of the dam, involved innovative techniques that were used for the first time in Australia, such as the pre-stressed concrete frame of the ice making plant and the use of circulated chilled water to cool the concrete being placed. The Dam contains in-situ items of post-war era water delivery technologies developed by the Water Board, such as lengths of pipes, emergency roller gate, trashracks and penstocks which in consideration to their scale and integrity are rare examples of their types. The welded mild steel delivery pipeline similarly represents a notable advance in construction technology for the period.

The Warragamba Supply Scheme also contains machinery and structures which are significant due to their relationship and role they played during the construction period, and which continue to demonstrate the means of construction and operations such as the Upper Tail Tower and remains of the Warragamba Suspension Bridge.

All components of the Emergency Scheme are excellent examples of the civil engineering skills of the times; the Balance Reservoir is particularly significant because it provides a stilling pool downstream of Warragamba Dam for the purpose of flood discharge; the group of five cottages associated with the construction of the dam are considered to be of high significance because they housed the operations staff between 1940 and 1959.

The dam is a regional landmark that has engendered beautification works undertaken from early in the construction phase to post completion of the dam for the use of local and general visiting public. The picnic areas in particular have strong associations with past management practices of the Water Board and Haviland Park in particular demonstrates the Board's recognition of the scale and importance of the dam and adoption of a more sophisticated approach to picnic area and park design and layout under the influence of specialist consultants such as Professor Spooner. The grounds of the dam are associated with the local and regional community of Sydney as a longstanding place of passive recreation.

Significance level: State

6.1.7 Bandstand

The following Statement of Significance is quoted from the Heritage NSW, State Heritage Inventory Listing Sheet for 'Bandstand' (last updated 2017)

6.1.7.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The item consists of a unique collection of monuments which provides evidence of the importance of the precinct's role in defence of the country and defence strategy in the twentieth century. The whole group presents a significant record of a major historical event having a profound influence on the development and social life of the area.
Criterion (b)	The item is associated with a number of significant persons who took part in the defence of Australia and are held in high esteem by the local residents.
Criterion (c)	The Bandstand is aesthetically distinctive and presents a local landmark.
Criterion (d)	The trophy Medium Mortar commemorates defence and victory in WWI and strongly contributes to the identity of the area and community's sense of place.
Criterion (e)	This item does not meet this criterion
Criterion (f)	The bandstand is unique of its type in the Fairfield City area.
Criterion (g)	The commemorative elements contained in the Park are collectively and individually representative of the practices of paying respects to defence and technology of the twentieth Century.

6.1.7.2 Statement of significance

Also known as War Memorial and Bandstand Memorial group. Cabravale Park War Memorial Group is of significance for people of the Fairfield City area for historical, aesthetic, associative, social, and reasons of rarity and representativeness. The unique collection of monuments provides evidence of the importance of the precinct's role in defence of the country and defence strategy in the twentieth century. The commemorative elements contained in the Park are collectively and individually representative of the practices of paying respects to defence and technology of the twentieth Century. They are associated with a number of significant persons who took part in the defence of Australia and are held in high esteem by the local residents. The Bandstand is aesthetically distinctive and presents a local landmark. The trophy Medium Mortar commemorates defence and victory in WWI and

strongly contributes to the identity of the area and community's sense of place. The whole group presents a significant record of a major historical event having a profound influence on the development and social life of the area. The bandstand is unique of its type in the Fairfield City area. All elements are in good condition and have high integrity.

Significance level: Local

6.1.8 Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (PAS 8)

The following Assessment and Statement of Significance is quoted from the Conservation Management Plan for the *Upper Canal Pheasants Nest to Prospect Reservoir,* prepared for WaterNSW by the Public Works Government Architect's Office in 2016 (pp.12-17).

6.1.8.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The Upper Canal, as part of the Upper Nepean Scheme, has been in use as a gravity-fed water supply system and a key part of Sydney's water supply without substantial alteration to its fabric since its completion in 1888. It operates in essentially the same way as was originally envisaged as a gravity-fed system utilising open canals and closed tunnels and aqueducts to transport water over a long distance. As a key component in the Upper Nepean Scheme, the Upper Canal is related to the major NSW historic theme of utilities. The provision of potable water is a first priority in any settlement and influences the success of all settlement building endeavours. The Upper Canal supported the development and expansion of Sydney, NSW's largest and most important settlement, particularly during the late nineteenth and early twentieth centuries, a period of rapid population growth and industrial development. The local water supplied from the Upper Canal also allowed the agricultural development of the areas along its route. The route of the Upper Canal is associated with a large number of early colonial estates, many of which have given the local areas their current names including Meadowvale, Beulah, Mount Gilead and its extant landmark mill ruin, Glenlee, Glen Alpine, Gledswood, Varroville, Denham Court, Ingleburn, Leppington, Horningsea Park and Horsley. The names of various elements along the Canal also record previous local names that no longer exist except within the Upper Canal easement, such as Molles Main and Devil's Back. For over half of its route the Canal follows, and at one-point crosses, the Old Cowpasture Road, which is one of the earliest European travel routes in Australia. The Upper Canal has state heritage significance under this criterion. These values are embodied in the: − key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges; − ongoing use of the Canal as a gravity fed water supply system for Sydney and a key element in the Upper Nepean Scheme; − names of the various sections of the Canal and individual elements within it; − rural landscape setting of the Canal and the topography that allowed it to operate as a gravity fed system.

Criteria	Assessment
Criterion (b)	The construction of the Upper Canal is strongly associated with Edward Orpen Moriarty, the head of the Harbours and Rivers Branch of the NSW Public Works Department who was a key figure in the development of plans for Sydney's water supply in the 1870s and 80s. The successful completion of the Canal and its continuation of use as a major element in Sydney's water supply system are a lasting testament to the professional capabilities of the late Victorian era generation of engineers of the Public Works Department including Moriarty. The operation of the Canal is strongly associated with the Board of Water Supply and Sewerage, established in 1888, but renamed the Metropolitan Water Sewerage and Drainage Board in 1924. The Board in both its incarnations was a powerful and influential government body throughout the late nineteenth and early to mid-twentieth centuries. The Upper Canal has state heritage significance under this criterion. These values are embodied in the: − key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges; − remaining fabric relating to the phase of upgrading flumes and bridges by the Metropolitan Water Sewerage and Drainage Board in the 1920s and 30s.
Criterion (c)	*Technical* The Upper Canal contributed to the major advance made by the Upper Nepean Scheme from depending on local water sources to harvesting water in upland catchment areas, storing it in major dams and transporting it to the city by means of major canals and pipelines. It is an excellent example of the ingenuity of late nineteenth century hydraulic engineering in particular for its design as a gravity-fed water supply system through difficult terrain. It illustrates the techniques of canal building (often at extremely small grades), the progress improvements in both pipe manufacture and pipeline construction and the construction of wrought iron aqueducts. The Upper Canal provides detailed and varied evidence of engineering construction techniques prior to the revolution inspired by reinforced concrete construction. Although concrete was later used to improve the durability of the System, much of the earlier technology is still evident along the Canal. It also provides extensive evidence of the evolution of engineering practice, such as the replacement of timber flumes by wrought iron flumes to be followed by concrete flumes. The early utilisation of concrete for many engineering purposes, also demonstrates the growing emergence of an engineering technology based upon man-made rather than natural materials. Many of the original control installations such as the 'Stoney gates', stop logs, penstocks, gate valves are still in service and continue to illustrate the technology of the original construction period of the Canal. Where these elements have been replaced it is generally with like technology using modern materials, thereby continuing the essential character of the Canal and its originally intended operation. *Aesthetic* Many of the surviving plantings along the Upper Canal function as major landmarks in the local rural landscape - either as strong linear designs (pine avenues) or distinctive small groups or solitary trees (Bunya and Hoop Pines). Plantings are used along the Canal to mark significant items of infrastructure and the arrival at Prospect Reservoir. The Canal itself is an impressive landscape element with its sandstone and concrete lined edges and serpentine route - based on gentle

Criteria	Assessment
	engineered curves - as it negotiates the complex topography along its route. In many sections it still retains its historic setting, although this is increasingly under threat from surrounding development for housing and light industry. The Upper Canal has state heritage significance under this criterion. These values are embodied in the: − key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges; − ongoing use of the Canal as a gravity fed water supply system for Sydney and a key element in the Upper Nepean Scheme; − rural landscape setting of the Canal and the topography that allowed it to operate as a gravity fed system; − the contrast of the grass and introduced plantings within the Canal corridor with the stone, concrete and brick structures of the Canal; − planned historic plantings within the Canal corridor including avenues of pines and cultural plantings associated with depots and cottages.
Criterion (d)	The social significance of the Upper Canal has not been formally assessed through community consultation. The Canal is not a public access area and many people, even in the local community are likely to be unaware of its existence and significance. Nevertheless, it is likely that the Canal has heritage significance under this criterion. The Canal is recognised by the NSW Heritage Council; the National Trust of Australia; and a number of local councils along its route. It is expected that engineering heritage groups in NSW and across Australia would have a strong interest in, and association with, the Canal as an outstanding and rare example of its type of late nineteenth century hydraulic engineering.
Criterion (e)	The Upper Canal is an outstanding benchmark site demonstrating a range of late nineteenth century engineering techniques and innovations in water supply technology, over a long distance in complex topography. There may be some historical archaeological evidence of the original construction camps, providing an insight into life for the construction workers in temporary accommodation in the late nineteenth century that is not available in historic sources. There may also be some limited archaeological evidence associated with life for the maintenance men and their families in cottages along the Canal easement. Aboriginal sites within the Canal easement are likely to contribute further information about Aboriginal people in the local area prior to the construction of the Canal in the 1880s. The Upper Canal passes through various remnant indigenous vegetation communities. These are likely to have scientific interest and require further specific study. The Upper Canal has local heritage significance under this criterion. These values are embodied in the: − key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges; − historical archaeological evidence at construction camp sites and cottage sites within the Canal corridor; − Aboriginal sites within the Canal corridor;

Criteria	Assessment
	− remnant native vegetation within the Canal corridor.
Criterion (f)	The Upper Canal has functioned as part of Sydney's main water supply system for 125 years and continues to do so. It has changed little in its operational principles since it was completed in 1888, continuing to operate as a gravity fed system, utilising open canals and closed tunnels and aqueducts to transport water over a long distance. The Canal is unique in NSW, being the only extensive gravity fed water supply canal system to supply a large city and its population with fresh water from a distant source in the hinterland. This type of water supply system also appears to be rare in Australia. The rarity of the Canal is enhanced by its integrity and its continuing operation largely using the original infrastructure built in the 1880s which still operates as originally intended. Such intact systems demonstrating an array of nineteenth century engineering techniques are rare. Surviving long avenues of single and mixed pine species as a late 19th/early 20th century landscape feature are becoming increasingly rare within the Cumberland Plain. The Upper Canal route has two such features - the mixed pine avenue at Kenny Hill and the lines of Stone Pines and Bunya Pines near the Old Cowpasture Road at Leppington. Winbourne at Mulgoa still has its impressive Stone Pine avenue while another early line of Stone Pines at Glen Lorne, off the Appin Road, has all but died out. Impressive lines of Bunya Pines remain at Bella Vista (Seven Hills) and at Horsley Park while at Prospect Reservoir there is the long-mixed avenue of Hoop and Bunya Pines. The Upper Canal has state heritage significance under this criterion. These values are embodied in the: − key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges; − ongoing use of the Canal as a gravity fed water supply system for Sydney and a key element in the Upper Nepean Scheme; − planned historic plantings within the Canal corridor, particularly the avenues of pines.
Criterion (g)	This criterion does not apply to this site, except with regard to the landscape plantings. The choice of plantings along the Canal route is representative of the later 19th / early 20th century period. Further research or investigation may reveal additional information relevant to this criterion.

6.1.8.2 Statement of significance

The Upper Canal has state heritage significance.

The Upper Canal, as part of the Upper Nepean Scheme, has been in use as a gravity-fed water supply system and a key part of Sydney's water supply without substantial alteration to its fabric since its completion in 1888. It operates in essentially the same way as was originally envisaged.

The Upper Canal is unique in NSW, being the only extensive gravity fed water supply canal system to supply a large city and its population with fresh water from a distant source in the hinterland. This type of water supply system also appears to be rare in Australia. The rarity of the Canal is enhanced by its integrity and its continuing operation largely using the original infrastructure built in the 1880s which still operates as originally intended. Such intact systems demonstrating an array of nineteenth century engineering techniques are rare.

As a key component in the Upper Nepean Scheme, the Upper Canal is related to the major NSW historic theme of utilities. The provision of potable water is a first priority in any settlement and influences the success of all settlement building endeavours. The Upper Canal supported the development and expansion of Sydney, NSW's largest and most important settlement, particularly during the late nineteenth and early twentieth centuries, a period of rapid population growth and industrial development.

It is an excellent example of the ingenuity of late nineteenth century hydraulic engineering, in particular for its design as a gravity-fed water supply system through difficult terrain. The Upper Canal is an outstanding benchmark site demonstrating a range of late nineteenth century engineering techniques and innovations in water supply technology, particularly techniques in use prior to the revolution inspired by reinforced concrete construction. Although concrete was later used to improve the durability of the Canal, much of the earlier technology is still evident along the Canal.

The Canal itself is an impressive landscape element with its sandstone and concrete lined edges and serpentine route - based on gentle engineered curves - as it negotiates the complex topography along its route. There are numerous areas of significant plantings along the route of the Canal, particularly some avenues of pines dating to the construction of the Canal. The Canal corridor is known to contain a range of historical archaeological sites associated with the construction and operation of the Canal as well as Aboriginal sites that pre-date the Canal's construction. These sites may contribute knowledge about the local area and the lives of the construction workers not available from other sources.

Significance level: State

6.1.8.3 Archaeological significance

The assessment of archaeological significance presented below is drawn from Section 11.4 of the HAA (Appendix A).

Table 11. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Archaeological evidence associated with the Upper Canal would demonstrate a significant development in the provision of fresh drinking water to the greater Sydney region. Provision of potable water is a central concern to any settlement, and this system operated for over 125 years without substantial alteration through to the twenty-first century. Archaeological evidence associated with the Upper Canal would be of **state significance** under this criterion.

Criterion	Assessment
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	Construction of the Upper Canal is strongly associated with Edward Orpen Moriarty, head of the Harbours and Rivers Branch of the NSW Public Works Department, who was a key figure in the development of plans for Sydney's water supply in the 1870s and 1880s. Operation of the Upper Canal is strongly associated with the Board of Water Supply and Sewerage (later Metropolitan Sewerage and Drainage Board), a powerful and influential government body (Government Architects Office 2016:14). Archaeological evidence of key original components of the Upper Canal would be of **state significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	The Upper Canal represents a major advance in the management of water sources, with detailed and varied engineering construction techniques established prior to the introduction of reinforced concrete. It demonstrates ingenious nineteenth-century hydraulic engineering, in particular for its design as a gravity-fed water supply system spanning difficult terrain (Government Architects Office 2016:14). Archaeological evidence associated with the Upper Canal would be of **state significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	A significance assessment has not been completed as part of this study, but no community or cultural groups with significant associations have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Elements directly associated with the original construction and operation of the Upper Canal could provide new insight into the functioning of the canal and its associations with the adjacent landscape. Evidence of the original construction of the Upper Canal would be of **state significance** under this criterion. Archaeological remains of two structures built in association with the Liverpool dam may provide some insight into their function and operations of the dam in the context of the Upper Canal. Evidence of changing elements within the Upper Canal would provide some insight into changing water management practices. These elements would be of **local significance** under this criterion.

Criterion	Assessment
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	A gravity-fed water system such as the Upper Canal is rare in the context of NSW and Australia more broadly. Archaeological evidence associated with the Upper Canal would be of **state significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	As part of a rare or uncommon resource, the anticipated archaeological resource would not be considered representative, and as such would be **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

As part of a major public infrastructure project, the Upper Canal system is likely very thoroughly documented in historical plans and project specifications, though infrastructure projects are not always constructed exactly to specification. Archaeological remains are likely to provide limited evidence of deviation from the final designs.

Can the site contribute knowledge that no other site can?

The Upper Canal is a rare resource and has the potential to contribute knowledge that no other site in NSW can regarding large-scale, gravity-fed water management systems from the nineteenth century. It has the potential to contribute knowledge that no other site can.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Access to fresh water is a key aspect of human life and human history, and the anticipated archaeological resource could provide knowledge relevant to major research questions relating to water management.

Summary statement of archaeological significance

The Upper Canal system was a feat of engineering and provided a consistent supply to the greater Sydney region utilising gravity-fed technology for over 125 years. Archaeological evidence associated with the early stages of construction and operation of the Upper Canal system would be of state significance for their historical, associative, technical and research values, as well as their rarity.

Archaeological evidence of progressive changes to the Upper Canal to enable its ongoing maintenance and use through the twentieth century is of local significance for its historical and research values.

6.1.9 Liverpool Offtake Reservoir

The following Assessment and Statement of Significance is quoted from the Heritage NSW, State Heritage Inventory Listing Sheet for 'Liverpool Offtake Reservoir' (last updated 2004)

Assessment of significance

Criteria	Assessment
Criterion (a)	The site demonstrates the growth of settlement in the Liverpool area in the late 19th century reflecting the needs of a growing urban centre for a major water supply system. As part of the Upper Nepean Scheme, Liverpool Offtake Reservoir demonstrates the history of the development of Sydney's fourth water supply source.
Criterion (b)	The item does not meet this criterion.
Criterion (c)	The site indicates a level of technical achievement being an example of a late 19th century hydraulic design and construction engineering project.
Criterion (d)	The item does not meet this criterion.
Criterion (e)	There is the potential to gain more information on the site from further architectural, archaeological and documentary research.
Criterion (f)	The site is the only one of its type in the Liverpool LGA and forms an important component of the Sydney's fourth water supply source.
Criterion (g)	The item does not meet this criterion.

Statement of significance

> Liverpool Offtake Reservoir demonstrates the growth of settlement in the Liverpool area in the late 19th century reflecting the needs of a growing urban centre for a major water supply system. As part of the Upper Nepean Scheme, it demonstrates the history of the development of Sydney's fourth water supply source. As an 19th century engineering project, the reservoir indicates a level of technical achievement in its design and construction. It is now a rare site type in the LGA. There is the potential to gain more information on the site from further architectural, archaeological and documentary research.

Significance level: Local

6.1.10 Blaxland's Farm (PAS 1)

The following Assessment and Statement of Significance is quoted from the Heritage NSW, State Heritage Inventory Listing Sheet for 'Blaxland's Farm'.

6.1.10.1 Assessment of significance

Criteria	Assessment
Criterion (a)	Blaxland's Farm is significant as a cultural landscape where the farm landscape together with the remains of the flour mill and the brewery provides important historical evidence of early agricultural processing activities in the colony and constitute an unusual survival of early farming technology.
Criterion (b)	The item does not meet this criterion.

Criteria	Assessment
Criterion (c)	The item does not meet this criterion.
Criterion (d)	The item does not meet this criterion.
Criterion (e)	The area has scientific significance because of the high potential of the sites to reveal information which is not available from the documentary sources. The full significance of the site is not yet fully understood.
Criterion (f)	This item is assessed as scientifically rare statewide.
Criterion (g)	This item is assessed as scientifically representative statewide.

6.1.10.2 Statement of significance

Blaxland's Farm is significant as a cultural landscape where the farm landscape together with the remains of the flour mill and the brewery provides important historical evidence of early agricultural processing activities in the colony and constitute an unusual survival of early farming technology. The area has scientific significance because of the high potential of the sites to reveal information which is not available from the documentary sources. The full significance of the site is not yet fully understood.

Significance level: State

6.1.10.3 Archaeological significance

The assessment of archaeological significance presented below is drawn from Section 4.4 of the HAA (Appendix A).

Table 12. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Blaxland's brewery is important as an early industrial site in colonial NSW established as part of a large colonial estate. Luddenham Estate was an enterprise undertaken by early free settlers with labour provided by a sizeable convict and free workforce, including women, children and possibly Aboriginal workers, which reflects the changing demographics of the colony through the early nineteenth century. Historical archaeological evidence associated with Luddenham Estate would be of **state significance** under this criterion. Archaeological evidence of adaptation to or improvements to the brewery later in the nineteenth century provides evidence of changing historical land use and activities in the region. Archaeological evidence of modification of the brewery buildings or agricultural activities in Phase 3 would be of **local significance** under this criterion.

Criterion	Assessment
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	The site has strong associations with John Blaxland and his brother Gregory. They were some of the first free settlers 'of unquestioned respectability to go to the colony' and established extensive commercial interests and landholdings in NSW (Australian Dictionary of Biography, 1966). Archaeological evidence associated with the Blaxlands would be of **state significance** under this criterion. The site is also associated with George Henry Cox, NSW politician and pastoralist. Archaeological evidence that could be clearly associated with Cox would be of **local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	It is not possible to anticipate the aesthetic qualities of archaeological remains prior to excavation, but on the basis of the remains surveyed (extensive sandstone footings), archaeological evidence within the study area **may meet the threshold for local and/or state significance** under this criterion. Blaxland's use of a steam mill to improve function of the brewery was an innovative technical achievement in a period where nearly all work was done by horses. In the 1840s, the Luddenham brewery was the only one in the Sydney region using steam power. Archaeological evidence of the steam mill would be of **state significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	While community consultation has not been undertaken as part of this report, no associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Historical archaeological evidence associated with Blaxland's brewery would provide insight into the operations of a colonial brewery, the techniques used in brewing, the association with other compatible industries on site, and activities undertaken as part of the brewing process (botting, washing, cooling, fermenting, etc). Evidence of the steam mill would show how steam power was adapted to assist the operation of the brewery. Sealed artefact deposits recovered from the site would provide insight into the lives and daily activities of workers (freed and convict) working on the site, including, diet, age, gender, ethnicity and occupations. Historical archaeological evidence associated with Luddenham Estate would be of **state significance** under this criterion.

Criterion	Assessment
	Evidence of cultivation and Blaxland's gardens, including palynological and ethnobotanical evidence, would provide evidence of crops grown for the estate and would be of **local significance** under this criterion. Archaeological evidence of modification, repair and adaption of the brewery buildings in Phase 3 would provide an understanding of improvements to brewing practices and help identify new activities occurring on site later in the nineteenth century. Archaeological evidence associated with the brewery and associated structures in Phase 3 would be of **local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Highly intact brewery complexes from the 1830s are rare in NSW and Australia more broadly. Historical archaeological evidence of Blaxland's brewery in Phase 2 would be of **state significance** under this criterion. Archaeological evidence for continued use of the brewery into the 1850s and 1860s during Phase 3 would still be considered rare in the context of the region and would be of **local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The anticipated archaeological resource **would not meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

The archaeological resource can provide information on the site likely overlooked by historical records, including the layout of the brewery, activity areas, and the daily lives of workers. Historical records are more likely to capture the output of the brewery as opposed to the process of production and the people involved in this production.

Similarly, paleoethnobotanical and palynological evidence of the gardens may provide insight into the crops grown in this part of Luddenham Estate and changes to the landscape as a result of colonisation and cultivation.

Archaeological evidence of repairs to and modification of the brewery buildings could provide evidence of technological changes and changing activities occurring on the site through the nineteenth century.

Can the site contribute knowledge that no other site can?

Early nineteenth-century breweries are rare in NSW and Australian more broadly. This site can provide knowledge relating to brewing processes and the lives of workers at the brewery in a way that few other sites could. This site would be comparable to the Carlton and United Breweries sites in Sydney and Melbourne, though the brewery in Sydney was substantially burnt, leaving little remnant evidence beyond the stables, a well and subterranean water tank, and the brewery in Melbourne was much later in date. This site has the potential to contribute significantly more information relating to colonial brewery practices. Its rural location on a substantial waterway may lead to interesting comparisons with the Carlton and United Brewery, as well as Thomas Ruchton's first brewery in Parramatta, as well as interstate breweries such as Cascades (South Hobart, TAS), Boags (Launceston, TAS), and West End (now South Australia) Brewing.

Palynological evidence and areas of cultivation are much more widely available at colonial sites in the region, and other sites could also provide new knowledge relating to colonial cultivation and land clearing practices.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Beer was an important resource widely consumed in the colony through the nineteenth century. Questions relating to brewing and the layout and function of industrial sites are applicable to the site, as are other substantive questions relating to Australian history, including convict labour.

Summary statement of archaeological significance

Blaxland's brewery at Luddenham Estate was a sizeable enterprise associated with a prominent NSW family producing beer in a rural area of the greater Sydney region in the early nineteenth century. Historical archaeological evidence associated with Blaxland's brewery at Luddenham Estate in Phase 2 (1825-1851) would be of state significance for its historical, associative and research values, as well as its rarity. Archaeological evidence of the steam mill at the brewery would also be of state significance for its technical values.

Historical archaeological evidence of Blaxland's gardens at Luddenham Estate, including palynological and paleoethnobotanical evidence, would demonstrate changing agricultural practices and crops being cultivated in western Sydney. Archaeological evidence of Blaxland's gardens would be of state significance for its historical values and local significance for its research values.

Archaeological remains of later use of Luddenham Estate, including repair to and modification of the brewery buildings, by Nicholson and Cox would be of local significance for its historical and research values. Archaeological evidence that could be associated with George Henry Cox would be of local significance for its associative values.

6.1.11 Blaxland's Crossing (PAS 3)

6.1.11.1 Archaeological significance

The following assessment of archaeological significance is drawn from Section 6.4 of the HAA (Appendix A).

Table 13. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Luddenham Estate was large colonial enterprise undertaken by early free settlers with labour provided by a sizeable convict and free workforce, including women, children and possibly Aboriginal workers, which reflects the changing demographics of the colony through the early nineteenth century. Archaeological evidence associated with grazing at Luddenham Estate is, however, likely to be highly fragmentary and disturbed and would be **unlikely to meet the threshold for local significance** under this criterion. Archaeological evidence of Blaxland's Crossing, including the causeway and 1859 timber bridge, is significant as the original crossing connecting the disparate portions of Luddenham Estate. The site still represents the only river crossing in Wallacia. Evidence of the causeway or bridge would be of **local significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	Luddenham Estate has strong associations with John Blaxland and his brother Gregory. They were some of the first free settlers 'of unquestioned respectability to go to the colony' and established extensive commercial interests and landholdings in NSW (Australian Dictionary of Biography, 1966). The anticipated archaeological resource, as relatively ephemeral evidence of cultivation and gardening, is unlikely to demonstrate these associations and is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	No technical achievements were identified within the study area, and ephemeral evidence of agricultural use is unlikely to demonstrate significant aesthetic characteristics. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW*	While community consultation has not been undertaken as part of this report, no associations with community or cultural groups have been identified. The anticipated archaeological resource

Criterion	Assessment
for social, cultural or spiritual reasons (or the local area).	is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Archaeological remains of the c.1827 road and approach to the bridge or causeway would provide insight into early colonial construction techniques and adaptation using locally sourced materials. Archaeological evidence of the road, bridge or causeway from Phases 2 or 3 would be of **local significance** under this criterion. Disturbed ephemeral evidence of agricultural activities would not contribute to an understanding of the cultural history of the region. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Evidence of stone causeways or timber bridges would be considered rare in the region and archaeological evidence associated with the bridge or causeway in Phases 2 or 3 would be of **local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The anticipated archaeological resource associated with the bridge or causeway would not be a sufficient enough sample to serve as a representative example, as only a small portion may extend within PAS 3.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

The site could contribute an understanding of materials and construction techniques used in establishing a relatively early colonial road, causeway and timber bridge not readily available from documentary sources.

Can the site contribute knowledge that no other site can?

Remnants of early roads are not rare, but evidence of the bridge and causeway could contribute knowledge relatively few other sites could.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Archaeological remains of the bridge, causeway and road could contribute knowledge relevant to broad research questions relating to transport, management of waterways, and early colonial thoroughfares.

Summary statement of archaeological significance

Historical archaeological evidence of a road and rubble causeway constructed c.1827, as well as a timber bridge constructed in 1859, would provide insight into early colonial thoroughfares and the traverse of large waterways and could be of local significance for its historical and research values. Evidence of the causeway and bridge would also be of local significance for its rarity.

Disturbed and ephemeral evidence of grazing and agricultural activities associated with Luddenham Estate would not meet the threshold for local significance.

6.2 Potential non-Aboriginal heritage items

6.2.1 Exeter Farm Archaeological Site (PAS 6)

The following Assessment and Statement of Significance is quoted from Roads and Maritime Services (RMS). *M12 Motorway Environmental Impact Statement* (2019, 546).

6.2.1.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The property was originally part of the Exeter Farm owned by James Badgery, and while the property ceased to belong to the family in the mid-1800s, the family gave the name to the adjacent creek and suburb. The whole property is therefore considered to be historically significant at a local level.
Criterion (b)	Exeter Farm is associated with James Badgery and his family.
Criterion (c)	The item does not meet this criterion
Criterion (d)	The item does not meet this criterion
Criterion (e)	Exeter Farm Archaeological Site may reveal evidence of early domestic agricultural use although recent conservation works have already yielded archaeological potential in the underfloor area of the house. The artefact scatter may be indicative of sub-surface deposits which would have potential to yield information about the previous use of the site.
Criterion (f)	The item does not meet this criterion
Criterion (g)	Despite the condition of the individual trees, the remnant hedge of Osage orange is a rare local example of an imported species being used as field markers and is indicative of that European practice.

6.2.1.2 Statement of significance

The property was originally part of the Exeter Farm owned by James Badgery, and while the property ceased to belong to the family in the mid-1800s, the family gave the name to the adjacent creek and suburb. The whole property is therefore considered to be historically significant at a local level. The artefact scatter may be indicative of sub-surface deposits which would have potential to yield information about the previous use of the site. Despite the condition of the individual trees, the remnant hedge of Osage orange is a rare local example

of an imported species being used as field markers and is indicative of that European practice.

Significance level: local

6.2.1.3 Archaeological significance

The assessment of archaeological significance presented below is drawn from Section 9.4 of the HAA (Appendix A). Note that, in comparison to the general site assessment presented in Section 6.2.1 above, it considers only the potential archaeological resource within the impact assessment area.

Table 14. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Exeter Farm was an early colonial homestead and estate in the region and holds significance in the context of regional development and cultural history. Intact evidence of historical cultivation and land management would demonstrate the transition to longstanding use as agricultural land after European invasion. Archaeological remains would be of **local significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	Exeter Farm is associated with James Badgery and his family. This association is unlikely to be demonstrated by the site's anticipated archaeological resource, and it is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	No technical achievements were identified within the study area, and ephemeral evidence of agricultural and pastoral use is unlikely to demonstrate significant aesthetic characteristics. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	While community consultation has not been undertaken as part of this report, no associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Ephemeral evidence of agricultural activities may provide insight into land management activities, crops cultivated and the management of livestock. Any potential archaeological resource would be of **local significance** under this criterion.
Criterion (f)	Evidence of agricultural activities would not be considered rare within the area. The anticipated archaeological resource is **unlikely to meet the**

Criterion	Assessment
An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).	**threshold for local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	Ephemeral evidence of agricultural activities would not be important in demonstrating the principal characteristics of a cultural place or environment. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

Evidence of land clearing, crops grown (ethnobotanical and palynological evidence) and management of animals would provide insight into activities at the site not readily available through other resources.

Can the site contribute knowledge that no other site can?

Evidence of colonial landscape modifications, grazing and land in cultivation is not rare in the greater Sydney region, and the knowledge this site might contribute could be gained at a range of other sites.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

The anticipated resource within PAS 6 is limited to ephemeral evidence of agricultural activities and landscape modifications. This resource is unlikely to provide useful input into substantive questions relating to Australian history or other major research questions.

Summary statement of archaeological significance

Exeter Farm comprises part of an early colonial landscape and estate, first granted to James Badgery in 1812. Ephemeral evidence of historical land clearing, cultivation of crops and management of grazing animals at Exeter Farm would be of local significance for its historical and research values.

6.2.2 Fleurs Aerodrome

The following Assessment and Statement of Significance is quoted from Roads and Maritime Services (RMS). *M12* Motorway *Environmental Impact Statement* (2019, 545).

6.2.2.1 Assessment of significance

Criteria	Assessment
Criterion (a)	Fleurs Aerodrome has historical significance as an operational aerodrome. Fleurs housed and serviced multiple flight squadrons throughout the war, dependant on the deployment needs of the group.

Criteria	Assessment
Criterion (b)	The item does not meet this criterion.
Criterion (c)	The item does not meet this criterion.
Criterion (d)	Fleurs Aerodrome retains its social significance due to the large number of men and women (many still with living memory) who worked on, and around the aerodrome during its WWII operations.
Criterion (e)	The item does not meet this criterion.
Criterion (f)	Fleurs Aerodrome was one of only two parent operational aerodromes in the Greater Sydney region, and had the largest number of satellite airfields of any of the operational aerodromes. It represents a rare surviving example of such an airfield in both the Sydney region and greater NSW.
Criterion (g)	The item does not meet this criterion.

6.2.2.2 Statement of significance

Fleurs Aerodrome represents an integral part of the RAAF defence of Australia and the larger US military strategy in the Asia-Pacific. An operational aerodrome, Fleurs housed and serviced multiple flight squadrons throughout the war, dependant on the deployment needs of the group. Fleurs Aerodrome retains its social significance due to the large number of men and women (many still with living memory) who worked on, and around the aerodrome during its WWII operations.

Fleurs Aerodrome was one of only two parent operational aerodromes in the Greater Sydney region, and had the largest number of satellite airfields of any of the operational aerodromes. It represents a rare surviving example of such an airfield in both the Sydney region and greater NSW.

Fleurs Aerodrome retains some integrity, despite subdivision and development (primarily agricultural and scientific) and enough general features remain to allow interpretation of its original usage.

Significance level: Local

6.2.3 McMaster Field Station (PAS 4)

The following Assessment and Statement of Significance is quoted from Roads and Maritime Services (RMS). *M12 Motorway Environmental Impact Statement* (2019, 545).

6.2.3.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The McMasters Field Station is of historical significance as an experimental enterprise by CSIRO in the 1930s. The site was acquired by the Commonwealth of Australia for a CSIRO animal health research station, which was used for a short time as a field station for research in astronomy.
Criterion (b)	The McMaster Field Station, an experimental enterprise by CSIRO in the 1930s, is associated with the University of Sydney's FD McMaster Building (a State heritage listed building), both named in honour of Sir Frederick Duncan McMaster. His original gift to CSIRO in 1929, for the construction of the Division of Animal Health's first

Criteria	Assessment
	laboratory, located at Sydney University, marked the beginning of a new era of veterinary research in Australia that saw Australia forge an international reputation for excellence in veterinary research.
Criterion (c)	The landscape has aesthetic significance as a culturally modified landscape for the purposes of CSIRO research. It includes cultivated fields, fence lines, dams and groves of trees.
Criterion (d)	The item does not meet this criterion.
Criterion (e)	The potential archaeology and intactness of this landscape rates it as moderately significant at a local or State level.
Criterion (f)	The item does not meet this criterion.
Criterion (g)	The farm is an example of an intact CSIRO experimental farm operating in the mid-twentieth century which was focussed on livestock research.

6.2.3.2 Statement of Significance

The McMaster Farm, an experimental enterprise by CSIRO in the 1930s, is associated with the University of Sydney's FD McMaster Building (a State heritage listed building), both named in honour of Sir Frederick Duncan McMaster. His original gift to CSIRO in 1929, for the construction of the Division of Animal Health's first laboratory, located at Sydney University, marked the beginning of a new era of veterinary research in Australia that saw Australia forge an international reputation for excellence in veterinary research. The landscape was culturally modified for the purposes of CSIRO research: cultivated fields, fence lines, dams and groves of trees. The potential archaeology and intactness of this landscape rates it as moderately significant at a local or State level. The farm is an example of an intact CSIRO experimental farm operating in the mid-twentieth century which was focussed on livestock research.

Significance level: Local

6.2.3.3 Archaeological significance

The assessment of archaeological significance presented below is drawn from Section 7.4 of the HAA (Appendix A). Note that is considers only the potential archaeological resource within the impact assessment area, not the entire site (as presented in Section 6.2.3 above).

Table 15. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	The DAH marked the beginning of a new era of veterinary research in Australia and led to the development of Australia's international reputation for excellence in veterinary research. The anticipated archaeological resource is unlikely to substantively demonstrate this significant phase of veterinary research. The archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Criterion	Assessment
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	The McMaster Field Station was named in honour of Sir Frederick Duncan McMaster, who originally made a gift to the CSIRO for construction of the DAH's first laboratory. The anticipated archaeological resource is unlikely to demonstrate this significant association. As no further associations were identified, the archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	McMaster Field Station is associated with several significant technical developments in the field of veterinary medicine and animal husbandry. The study area is outside of the core DAH complex where these developments would have occurred, and the archaeological resource is unlikely to demonstrate these technical achievements. The archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	The assessment of social significance has not been completed as part of this study. However, no potential cultural or social associations were identified during the course of this assessment, and the archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	The anticipated archaeological resource may provide insight into landscape use and modification in Phases 1 and 2, though similar evidence would be available through research documentation from the CSIRO and historical aerials. Most of the study area appears to have remained enclosed paddock since the nineteenth century. Any potential archaeological resource has limited research potential, as a relatively recent and well-documented site owned by a government agency. The archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Evidence of experimental veterinary medicine and animal husbandry is rare within the state of NSW, and Australia more broadly. The anticipated archaeological resource, generally limited to ephemeral evidence of agricultural activities on the periphery of the McMaster Field Station, is not rare in the context of the local area or NSW more broadly.

Criterion	Assessment
	The archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The archaeological resource is not substantive enough to be considered a representative example of any class of cultural place in NSW or the local area. The archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

The site was part of a government agency and a research facility. The activities that occurred on the McMaster Field Station are likely very well documented, with those documents being relatively accessible. The site is unlikely to contribute knowledge no other resource can.

Can the site contribute knowledge that no other site can?

The anticipated archaeological resource is limited to ephemeral evidence of pastoral activities and landscape modifications. The site is unlikely to contribute knowledge that no other site can, and this resource type is not rare in the context of western Sydney or NSW more broadly.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Evidence from the core of the DAH complex may answer substantive questions relating to the development of Australian veterinary medicine, but the anticipated resource within PAS 4 is limited to ephemeral evidence of agricultural activities and landscape modifications. This resource is unlikely to provide useful input into substantive questions relating to Australian history of other major research questions.

Summary statement of archaeological significance

While the McMaster Field Station site has been previously assessed as being of state or national significance for its historical, associative, and research values, as well as its rarity, any potential archaeological resource within PAS 4 is limited to ephemeral evidence of agricultural activities (likely limited to grazing) and landscape modifications (including access tracks, fence lines, and dams). The anticipated archaeological resource within PAS 4 is unlikely to demonstrate significant historical developments in veterinary medicine or the lives of the students and university staff who worked there. The anticipated archaeological resource is unlikely to meet the threshold for local significance.

6.2.4 South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape

The following Assessment and Statement of Significance is quoted from Roads and Maritime Services (RMS). M12 Motorway Environmental Impact Statement (2019, 143).

6.2.4.1 Assessment of significance

Criteria	Assessment
Criterion (a)	This item does not meet this criterion.
Criterion (b)	The item does not meet this criterion.
Criterion (c)	The scenic landscape is significant for its areas of remnant vegetation, presence of creeks and weirs and cultural landscapes associated with early homesteads.
Criterion (d)	The item does not meet this criterion.
Criterion (e)	The item does not meet this criterion.
Criterion (f)	Overall, it is likely that the entire scenic landscape is significant for its area of rural landscape. Traditional rural landscape is becoming increasingly uncommon in this region as more development occurs within the region; however, the small section of the landscape adjacent to the study area does not contain any weirs or creeks which are significant elements of the listing.
Criterion (g)	The item does not meet this criterion.

6.2.4.2 Statement of significance

The South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape is significant for the weirs and surrounds located at the confluences of Badgerys and Kemps Creek with South Creek, remnant vegetation along creeks and roads, cultural landscapes associated with early homesteads, and presence of overall traditional rural landscape. However, the small section of the landscape adjacent to the study area is limited in these elements. The study area comprises traditional rural landscape with open paddocks with occasional small trees located in the vicinity of buildings associated with Fleurs Radio Telescope site. The South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape is considered to have sufficient significance to fulfil the criteria for local listing.

Significance level: Local

6.2.5 South Creek Bridge

The following Assessment and Statement of Significance is quoted from Roads and Maritime Services (RMS). *M12 Motorway Environmental Impact Statement* (2019, 545)

6.2.5.1 Assessment of significance

Criteria	Assessment
Criterion (a)	The item does not meet this criterion.
Criterion (b)	The item does not meet this criterion.

Criteria	Assessment
Criterion (c)	The item does not meet this criterion.
Criterion (d)	The item does not meet this criterion.
Criterion (e)	The item does not meet this criterion.
Criterion (f)	The item does not meet this criterion.
Criterion (g)	The item does not meet this criterion.

6.2.5.2 Statement of significance

There is little evidence to indicate that South Creek Bridge formed part of an early route through this area. The item is considered to have insufficient significance to fulfil the criteria for State or local listing. The site is therefore not considered to be a heritage item and no further impact assessment is required.

Significance level: does not meet the criteria.

6.2.6 Blaxland's Gardens (PAS 2)

6.2.6.1 Archaeological Significance

The following assessment of historical archaeological significance is drawn from Section 5.4 of the HAA (Appendix A).

Table 16. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Luddenham Estate was a large colonial enterprise undertaken by early free settlers with labour provided by a sizeable convict and free workforce, including women, children and possibly Aboriginal workers, which reflects the changing demographics of the colony through the early nineteenth century. Archaeological evidence associated with Luddenham Estate and Blaxland's gardens would be of **state significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	Luddenham Estate has strong associations with John Blaxland and his brother Gregory. They were some of the first free settlers 'of unquestioned respectability to go to the colony' and established extensive commercial interests and landholdings in NSW (Australian Dictionary of Biography, 1966). The anticipated archaeological resource, as relatively ephemeral evidence of cultivation and gardening, is unlikely to demonstrate these associations and is **unlikely to meet the threshold for local significance** under this criterion.

Criterion	Assessment
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	No technical achievements were identified within the study area, and ephemeral evidence of agricultural use is unlikely to demonstrate significant aesthetic characteristics. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	While community consultation has not been undertaken as part of this report, no associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Ephemeral evidence associated with Blaxland's gardens may provide insight into early land clearing and establishment activities, the types of crops cultivated, management of water and irrigation, and the layout of the gardens. The anticipated archaeological resource would be of **state significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Defined garden areas in early colonial estates are increasingly uncommon in the greater Sydney region. The anticipated archaeological resource is also uncommon in that it appears to have been subjected to little or no disturbance since the cease of cultivation. The archaeological resource would be of **local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	Ephemeral evidence of agricultural activities would not be important in demonstrating the principal characteristics of a cultural place or environment. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

Evidence of land clearing, crops grown (ethnobotanical and palynological evidence) and layout of Blaxland's gardens would provide insight into activities at the site not readily available through other resources.

Can the site contribute knowledge that no other site can?

Evidence of clearly delineated early colonial gardens is not common in the greater Sydney region, particularly with the level of intactness anticipated within PAS 2, with comparative examples including Gledswood, Brush Farm, Camden Park Estate and Belgenny Farm. Other sites likely exist across NSW that could contribute similar knowledge with regard to gardens on nineteenth century colonial estates.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

The knowledge gained by examination of the site may contribute to general questions about food sources and cultivation in western Sydney, as well as management of (and adaptation to) the Australian landscape.

Summary statement of archaeological significance

PAS 2 is associated with Luddenham Estate and likely contains evidence of Blaxland's gardens established as a dedicated area of cultivation at the core of the colonial estate along the Nepean River. Evidence of land clearing, establishment and operation of the gardens, and landscape management techniques associated with Blaxland's Luddenham Estate would be of state significance for its historical and research values, and of local significance for its rarity.

6.2.7 Lennox Reserve (PAS 9)

6.2.7.1 Archaeological significance

The following assessment of historical archaeological significance is drawn from Section 12.4 of the HAA (Appendix A).

Table 17. Assessment of potential archaeological remains against the NSW Heritage Criteria

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Archaeological remains of a mid-to-late nineteenth century cottage or substantial agricultural outbuilding would demonstrate the process of historical development and life in the region. Archaeological remains would be significant at a **local level**. Ephemeral evidence of agricultural and pastoral use would not be important in the course of pattern of cultural history in the region. The anticipated archaeological resource is **unlikely to meet the threshold for significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	The anticipated historical archaeological resource within the study area is unlikely to demonstrate any significant historical associations. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	No technical achievements were identified within the study area, and ephemeral evidence of agricultural and pastoral use is unlikely to demonstrate significant aesthetic characteristics. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Criterion	Assessment
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	While community consultation has not been undertaken as part of this report, no associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Archaeological evidence of a mid to late-nineteenth century cottage or substantial agricultural outbuilding has the potential to provide insight into its construction, function, activities that occurred within and around the structure, as well as insight into the lives of the people living and/or working there, including class, gender, ethnicity, age and occupation. Archaeological evidence of a cottage or outbuilding would be of **local significance** under this criterion. Disturbed ephemeral evidence of agricultural activities has low research potential and would not contribute to an understanding of the cultural history of the region. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Evidence of agricultural activities and mid to late-nineteenth century cottages or outbuildings would not be considered rare within the area. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The function and age of the mid to late-nineteenth century structure within PAS 9 has not yet been identified, so unclear as to what it would be representative of. The site has been subject to little or no disturbance since it was demolished, so it is likely highly intact and of good integrity and would meet the threshold for **local significance** under this criterion. Disturbed ephemeral evidence of agricultural activities, would not be important in demonstrating the principal characteristics of a cultural place or environment. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

Archaeological remains of the mid to late-nineteenth century cottage or outbuilding can provide insight into the function of the structure, as well as the lives of the people living and/or working there. The review of historical documents for the site has identified that this information is currently limited from other resources.

Can the site contribute knowledge that no other site can?

The site is likely to contribute knowledge useful to the local area with regards to historical lifeways, construction techniques and activities occurring in the area, but would not be considered rare. There are likely other sites that would provide similar insight into mid to late-nineteenth century life in the region.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Archaeological remains from PAS 9 are likely to provide knowledge relating to general questions about human history and historical lifeways in Fairfield. As the nature of the archaeological resource (age and function of the structure) is not yet known, it is difficult to ascertain whether or not it would contribute to other major research questions.

Summary statement of archaeological significance

PAS 9 was associated with the family of emancipated convict James Bowler and predominantly used for grazing and cultivation from the 1830s onwards. Historical archaeological evidence of a mid to late-nineteenth century cottage or substantial agricultural outbuilding identified within the study area would be of local significance for its historical and research values, as well as potentially its representativeness, given its likely high levels of intactness and integrity. Disturbed ephemeral evidence of agricultural activities would be unlikely to meet the threshold for local significance.

6.2.8 Lansvale Park (PAS 10)

6.2.8.1 Archaeological significance

The following assessment of historical archaeological significance is drawn from Section 13.4 of the HAA (Appendix A).

Table 18. Assessment of potential archaeological remains against the NSW Heritage Criteria

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Archaeological remains of Knight's Butcher Shop would demonstrate the important role meat has played in Australian diet and the importance of local butcher's shops to regional towns. Archaeological evidence of Knight's Butcher Shop would be of local significance under this criterion. Archaeological remains of a mid-to-late nineteenth century cottage or substantial agricultural outbuilding would demonstrate the process of historical development and life in the region. Archaeological remains would be of **local significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	The anticipated historical archaeological resource within the study area is unlikely to demonstrate any significant historical associations with the site, such as with Captain George Johnston. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	No technical achievements were identified within the study area, and ephemeral evidence of agricultural and pastoral use is unlikely to demonstrate significant aesthetic characteristics. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	While community consultation has not been undertaken as part of this report, no associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Criterion	Assessment
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Historical archaeological evidence of Knight's Butcher Shop would provide insight into the functioning of a late nineteenth century butchery, as well as insight into the daily lives of the people who worked (and likely also lived) there. Evidence of Knight's Butcher Shop would be of **local significance** under this criterion. Archaeological evidence of a mid to late-nineteenth century cottage or substantial agricultural outbuilding has the potential to provide insight into its construction, function, activities that occurred within and around the structure, as well as insight into the lives of the people living and/or working there, including class, gender, ethnicity, age and occupation. Archaeological evidence of a cottage or outbuilding would be of **local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Archaeological evidence of a nineteenth-century butchery would be uncommon in the context of the Fairfield region. Archaeological evidence of Knight's Butcher Shop would be of **local significance** under this criterion. Evidence of a late-nineteenth century cottage or outbuilding would not be considered rare within the area. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	As a relatively uncommon example of specialist nineteenth century commerce, archaeological evidence of Knight's Butcher Shop would not serve as a good representative example. The function and age of the late-nineteenth century structure within PAS 10 has not yet been identified, so unclear as to what it would be representative of. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

Limited information regarding Knight's Butcher Shop was available through a source of historical documents. Archaeological remains and deposits associated with the shop have the potential to provide unique insight into the operations of the shop, as well as the daily lives of the people who lived and worked there.

Archaeological remains of the late-nineteenth century cottage or outbuilding can provide insight into the function of the structure, as well as the lives of the people living and/or working there. The review of historical documents for the site has identified that this information is currently limited from other resources.

Can the site contribute knowledge that no other site can?

There are not a large number of nineteenth century butcher shops in the region, particularly with the level of intactness anticipated within PAS 10 (given that the site was demolished and converted to a park). The site could contribute knowledge few other sites in the region could.

Remains of the cottage or outbuilding are likely to contribute knowledge useful to the local area with regards to historical lifeways, construction techniques and activities occurring in the area, but would not be considered rare. There are likely other sites that would provide similar insight into late nineteenth-century life in the region.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Archaeological remains from PAS 10 are likely to provide knowledge relating to general questions about diet, commerce, human history and historical lifeways in Fairfield.

Summary statement of archaeological significance

Historical archaeological evidence associated with Knight's Butcher Shop, likely established within PAS 10 in the 1880s or 1890s, would provide insight into a local commercial enterprise and source of an important dietary component for nineteenth-century Australians. Archaeological evidence of Knight's Butcher Shop would be of local significance for its historical and research values, as well as its rarity.

Historical archaeological evidence of a late-nineteenth century cottage or substantial agricultural outbuilding identified within PAS 10 would be of local significance for its historical and research values.

7. Options analysis

Treated water pipelines

The initially proposed placement of the treated water pipelines at the north end of Blaxland's Farm (PAS 1), as well as an associated discharge structure 15m by 5m in size, extended through the core of the brewery and mill complex established by Blaxland c.1830. This would have resulted in a major adverse impact and near complete destruction of a highly significant archaeological site (refer to Figure 126).

Following additional historical research and site survey, the placement of the pipelines and discharge structure was modified to avoid the core of the site, with the updated placement following the edge of the recorded extent of the site. This represents a significant improvement to anticipated impacts (refer to Figure 127).

The pipelines and discharge structure still extend through areas with moderate to moderate-high archaeological potential, though archaeological evidence is likely more dispersed in these area (being outside the core of the site), and they are more likely to have been impacted by twentieth century agricultural activities. This impact can be further reduced by archaeological testing in advance of construction to refine final placement of treated water pipelines to avoid significant structures or deposits.

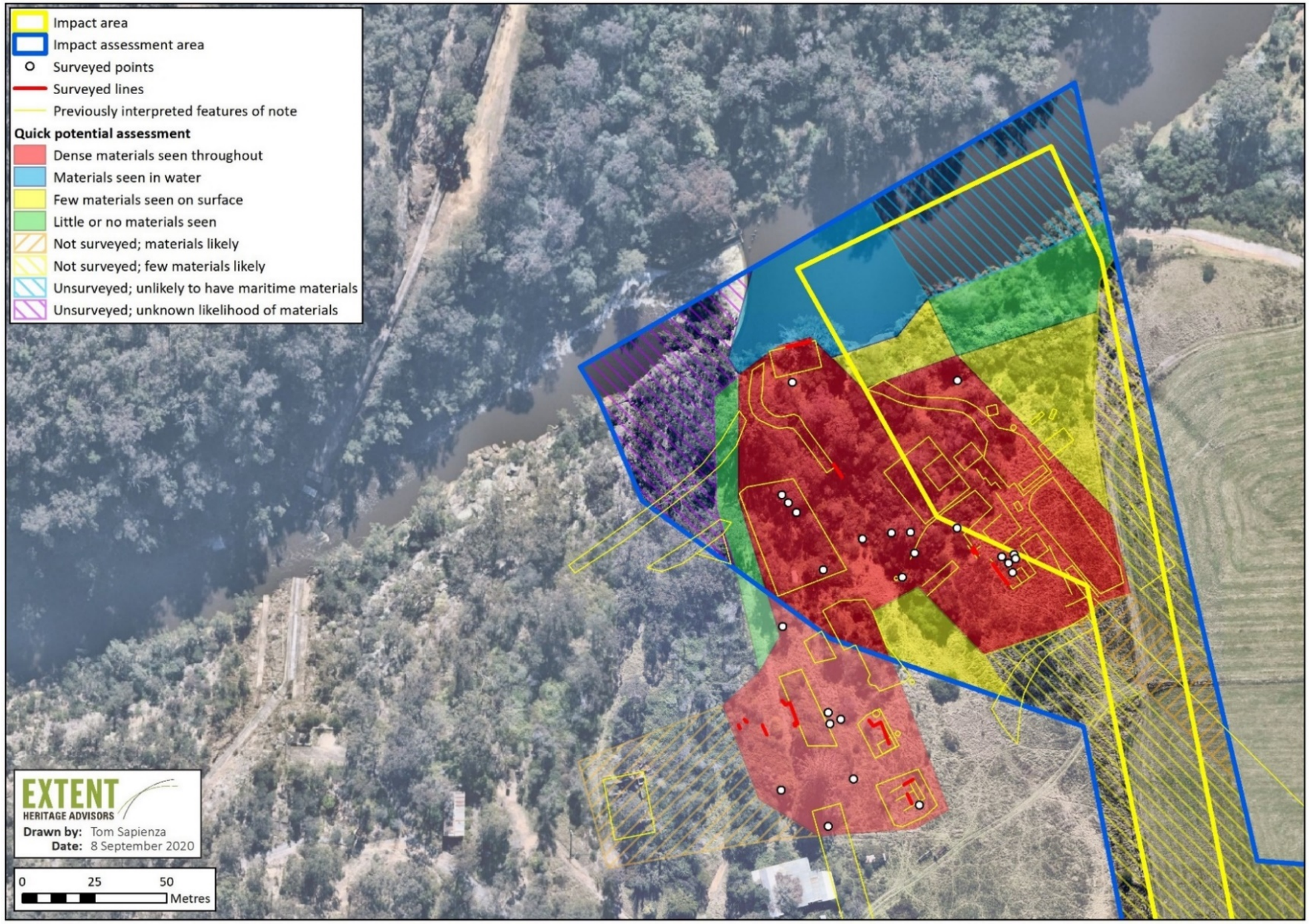

Figure 126. Plan of PAS 1 showing the original impact area with relation to assessed levels of historical archaeological potential. Note the area marked as having ‘high’ potential represents the core of the Luddenham Estate brewery and mill complex. Impacts on this red zone have been substantially reduced through redesign (see Figure 127). Source: Near Map, Sydney Water, Extent

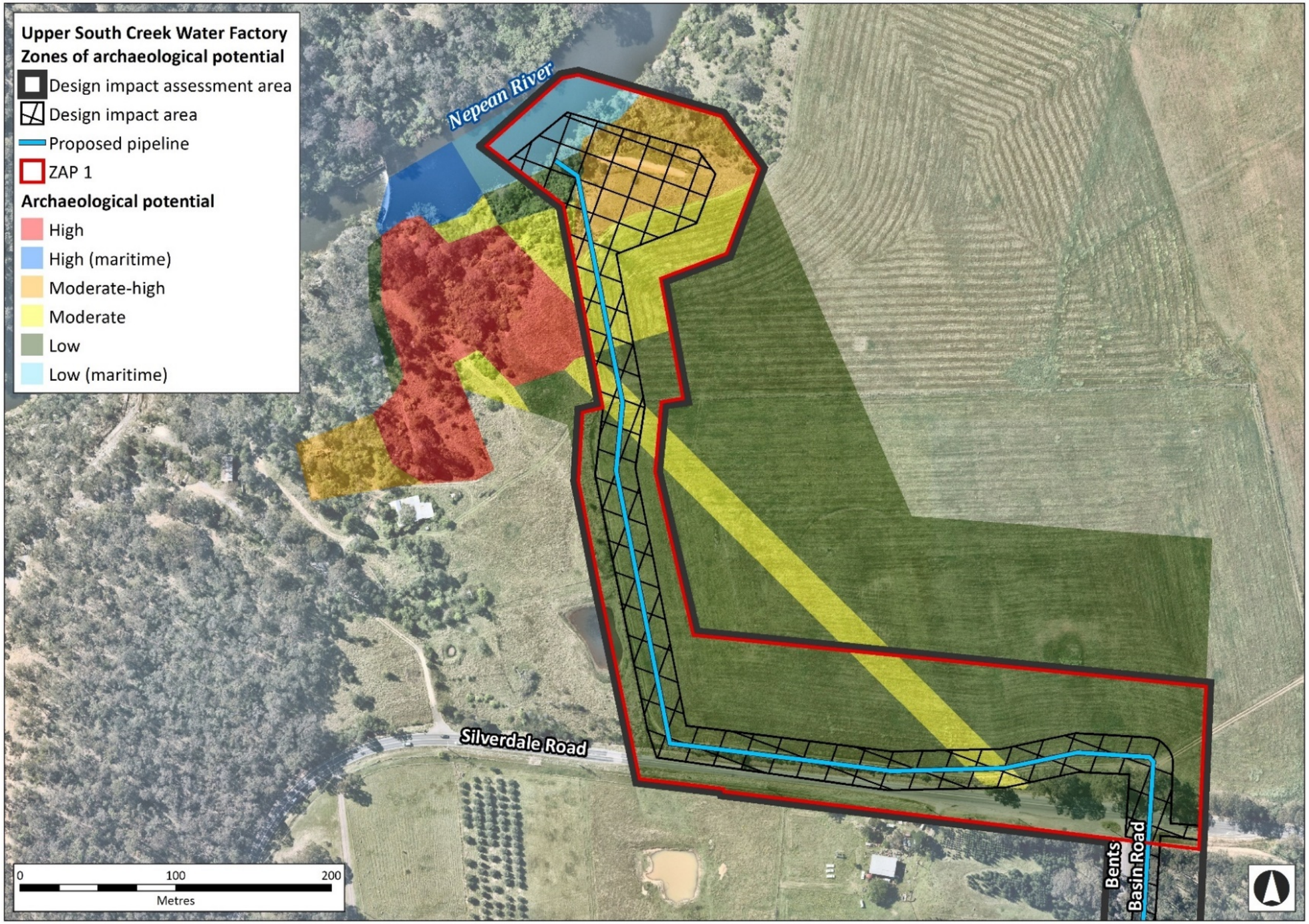

Figure 127. Plan of PAS 1 showing impact assessment areas with relation to assessed levels of historical archaeological potential. As compared to the original design (Figure 126), note that all impacts are now focused away from areas of high archaeological potential and the core of the Luddenham Estate brewery and mill complex. Source: Near Map, Sydney Water, Extent

8. Assessment of heritage impact

The following assessment of heritage impact is organised by heritage items. Against these items, the work is then differentiated between construction impacts (which can include temporary impacts and physical impacts), and operational impacts (long-term, ongoing activities). The assessment will also differentiate between built heritage items and historical archaeological items.

8.1 Advanced Water Recycling Centre

8.1.1 Proposed Works

Fleurs Radio Telescope Site is the proposed location of the Advanced Water Recycling Centre. The construction activities associated with the Centre consist of:

- site establishment including the installation of environmental controls, ancillary construction such as roads and fences, grubbing and removal of surface vegetation, demolition of existing buildings and contamination management;
- earthworks including cut and fill, temporary drainage and soil management controls and excavation of detention basins and underground infrastructure; and
- civil works and structural construction including the construction of roads and stormwater infrastructure and landscaping.

8.1.2 Fleurs Radio Telescope Site (PAS 7)

8.1.2.1 Construction Impacts

Built Heritage

The Fleurs Radio Telescope Site was highly significant for its role in the development and innovation of radio astronomy in Australia. The landscape of Fleurs Radio Telescope Site has endured several programs of removal and demolition throughout the 1990s and early 2000s. The existing landscape presents a highly fragmented landscape with little integrity for the original site configuration.

While only partially included within the curtilage of the Fleurs, the Centre is located on areas previously identified as containing 95% of the identified significant elements of this site. The construction of the centre will see a major transformation of this landscape, that will see the last remaining evidence of the sites' use removed. The removal of remnant fabric will have a major physical and visual impact on the cultural significance of Fleurs which is embodied in the cultural landscape and existing structures.

The construction of the Centre will materially affect the heritage significance of Fleurs through the loss of fabric that demonstrates the core heritage values of Fleurs Radio Telescope Site.

The loss of the remaining fabric on site will have a major impact on the heritage values connected to site, as they are evidence of the former use and achievement of the Fleurs Field Station that would no longer be transmissible. The report has recommended several mitigation methods to help alleviate these impacts and to provide ongoing recognition of the heritage significance of the site through archival recording and heritage interpretation. This effect on significance may warrant a reassessment of the site's curtilage for the LEP listing of the local heritage item.

Overall Impact: Major

Historical Archaeology

Construction of the Centre is occurring within PAS 7 (Fleurs Radio Telescope Site). Earthworks, excavation of detention basins and underground infrastructure likely to result in the removal of any historical archaeological remains within the impact area.

Most of PAS 7 has been assessed as having low potential for disturbed archaeological evidence of little significance associated with Fleurs Estate. There are two localised areas on South Creek with high potential for locally significant evidence of timber bridges.

The construction footprint of the Centre is confined within areas with low archaeological potential and is unlikely to impact on areas of high archaeological potential. Construction of the centre is unlikely to impact on significant historical archaeological remains.

Overall Impact: Negligible

8.1.2.2 Operation Impacts

The Centre, once constructed, will result in a permanent, major adverse impact to the landscape qualities that convey the cultural significance of the place. The operation of the Centre will not have an accumulated impact on this item. There are no operational impacts.

Similarly, any future works to increase the capacity the centre will see additional buildings associated with the operation of the facility aligned with the proposed design. The stage 2 design has been sympathetically designed to reduce the construction footprint and minimise any additional visual impacts. There are no additional operational impacts associated with this development.

Overall Impact: No change

8.1.3 South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape

8.1.3.1 Construction Impacts

Built Heritage

The construction of the Centre and its ancillary works, such as roads and fences, will require the removal of vegetation to a portion of the South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape. The heritage significance of the cultural landscape is embodied in the remnant vegetation, presence of creeks and weirs, and early homesteads in the landscape. This is predominately located to the north of the impact assessment area.

While the construction of the Centre will have a moderate impact on the rural landscape values of the item. This will be limited to an area planned for urban transformation. The construction the Centre is not an isolated development in the area, as the surrounding site prepares for the construction of the M12 and Western Sydney Airport, and more broadly the Western Sydney Aerotropolis. While, the works will have an initial visual impact, the development is consistent with the urban transformation of the area for the Western Sydney Aerotropolis.

The cultural landscape values of the South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape will be retained to the north of the impact assessment area where the core biodiversity values of the landscape will be retained and conserved.

Overall Impact: Moderate

Historical Archaeology

There is no historical archaeology potential associated with this site.

8.1.3.2 Operation Impacts

The Centre once constructed, will result in a permanent change to the landscape qualities of the South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape. The operation of the Centre will not have an accumulated impact on this item. There are no additional impacts associated with the operation of the facility.

Overall Impact: No change

8.2 Treated water and brine pipelines

8.2.1 Proposed works

The main construction technique for pipelines will be trenching, with trenches ranging from about 1.5 metres to 7 metres deep. Where trenching is required, the construction corridor will vary from 25 metres to 30 metres. Trenchless pipelines may be deeper depending on ground conditions and topography. Launch/receive pits for trenchless pipelines would be approximately 10 metres long and 5 metres wide.

Construction activities associated with pipeline construction would include:

- ancillary construction works including roads site compounds and fencing;
- trench excavation, including stockpiling of spoil material; and
- landscaping.

8.2.2 Fleurs Aerodrome

8.2.2.1 Construction Impacts

Built Heritage

Fleurs Aerodrome is a locally significant historical airfield used by the Richmond RAAF during World War II. The landscape of Fleurs Aerodrome is predominately grassed with a small section of bitumen over the original alignment, which allows for the interpretation of the sites' original use.

The trench alignment, connecting the treated water pipeline to the centre, will see a minor localised impact to landscaping alongside the bituminised section of the airfield. This will have a negligible impact to the heritage values of Fleurs Aerodrome. The location of the alignment has carefully considered the placement of the treated water pipeline and the heritage values of the Aerodrome. The impacts are restricted to areas characterised as grassed vegetation, which can be remediated post construction.

The placement of the pipeline ensures there is a negligible impact to the heritage significance of the item during the construction phase of the Project and enables its continued interpretation in the landscape.

Overall Impact: Negligible

Historical Archaeological Heritage

The work will not impact on an archaeological resource.

Overall Impact: No change

8.2.2.2 Operational Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Fleurs Aerodrome. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.3 McGarvie Smith Farm (PAS 5)

8.2.3.1 Construction Impacts

Built Heritage

The McGarvie-Smith Farm is significant for its use as a veterinary research centre for Sydney University since 1936, containing buildings that demonstrate the representative qualities of Inter-War research buildings. The dams along the southern boundary at McGarvie-Smith farm appear to one of the earliest examples of water harvesting used to optimise rainfall for the storage of water.

The pipelines will underbore the dams and fall within the curtilage of the anticipated widening of Elizabeth Drive. The open trenching and underboring required for the treated pipeline will see the removal of some established vegetation. It will have a minor and temporary impact to the rural landscape along Elizabeth Drive as the area will be revegetated where feasible, mitigating any long-term visual impacts of the construction. The works will have no impact to significant farm buildings.

Overall, the proposed alignment does not represent an adverse heritage impact to the broader heritage values of the site.

Overall Impact: Minor

Historical Archaeological Heritage

PAS 5 has low potential for archaeological remains unlikely to meet the threshold for local significance.

Installation of the treated water pipeline would result in little to no archaeological impact.

Overall Impact: Negligible

8.2.3.2 Operation Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting within the curtilage of McGarvie Smith Farm. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.4 McMaster Field Station (PAS 4)

8.2.4.1 Construction Impacts

Built Heritage

The proposed alignment for the treated water pipeline will have a minor impact to the land within the curtilage of the McMaster Field Station along Elizabeth Drive. The pipelines will underbore the dams that fall within the curtilage of the anticipated widening of Elizabeth Drive. The open trenching and underboring required for the treated pipeline will see the removal of some established vegetation. It will have a minor and temporary impact to the rural landscape along Elizabeth Drive as the area will be revegetated where feasible, mitigating any long-term visual impacts of the construction. The works will have no impact to significant farm buildings.

Overall, the proposed alignment does not represent an adverse heritage impact to the broader heritage values of the site.

Overall Impact: Minor

Historical Archaeological Heritage

PAS 4 has low to low-moderate potential for archaeological remains unlikely to meet the threshold for local significance.

Installation of the treated water pipeline would result in little to no archaeological impact.

Overall Impact: Negligible

8.2.4.2 Operational Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting within the curtilage of McMaster Field Station. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.5 Exeter Farm (PAS 6)

8.2.5.1 Construction Impacts

Built Heritage

This work will not impact on built heritage.

Overall Impact: No change

Historical Archaeology Heritage

PAS 6 has low potential for historical archaeological remains of local significance associated with Exeter Farm.

Installation of the Treated Water Pipeline will result in little to no archaeological impact.

Overall Impact: Negligible

8.2.5.2 Operational Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Exeter Farm. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.6 Luddenham Road Alignment

8.2.6.1 Construction Impacts

Built Heritage

The Luddenham Road alignment is a historically significant link for pastoral activities in the nineteenth century between Bringelly and St Marys. The road alignment has been modified over time and now comprises of a modern asphalted two-lane road.

The proposed alignment for the treated water pipeline will involve open trenching across Luddenham Road where it intersects Elizabeth Drive. As the work will not involve the physical modification of the alignment, nor do they affect the setting of the item, the proposed alignment is considered acceptable. The works will not change the landscape and do not represent an adverse impact to the heritage values of the Luddenham Road Alignment.

Overall Impact: Negligible

Historical Archaeology Heritage

This work will not impact on an archaeological resource.

Overall Impact: No change

8.2.6.2 Operational Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Luddenham Road Alignment. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.7 Luddenham Homestead

8.2.7.1 Construction Impacts

Built Heritage

Luddenham homestead was the home of John Blaxland and the centre of pastoral activity through the nineteenth century when it was the home of George Wallace, the manager of the remaining part of the Luddenham estate in the 1850s.

There are no built heritage impacts associated with the use of Luddenham homestead as a construction compound. The compound will be temporary in nature and removed upon the completion of the Project.

Overall Impact: No change

Historical Archaeological Assessment

The State Heritage Inventory states the site of Luddenham homestead has high potential to provide further information about the use of the Luddenham estate from 1813 through the nineteenth century. A program of archaeological test excavations undertaken by AHMS in 2010 and 2011 revealed extensive grading and level reduction had occurred during the 1980s demolition and construction of the current shopping centre, and concluded the works had removed any possible evidence of the occupation of Blaxland and the site was assessed as having low to negligible archaeological research potential. The archaeological record at the rear of the property was also found to not contain any archaeological evidence of significant structures or activities.

The proposed works are unlikely to impact upon any significant structures or activities associated with Blaxland's occupation. This site will be used as a construction compound for the Project. There will be no ongoing operational use of this site after construction.

Overall Impact: Negligible

8.2.7.2 Operational Impacts

This site will be used as a temporary construction compound for the Project. There will be no ongoing operational use of this site after completion of the Project.

Overall Impact: No change

8.2.8 Luddenham Showground

8.2.8.1 Construction Impacts

Built Heritage

The Luddenham showground is significant as a traditional rural showground reserve, which contains a number of mature native and exotic trees within its curtilage and along Park Road.

The open trenching and pipeline are restricted to the road verge of Park Road and will avoid impacts to significant landscape elements associated with the showground. There are no physical or visual impacts associated with the proposed works. The construction of the pipeline does not represent an adverse heritage impact to the core values of the showground.

Overall Impact: Negligible

Historical Archaeological Heritage

The work will not impact on an archaeological resource.

Overall Impact: No change

8.2.8.2 Operation Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Luddenham Showground. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.9 Blaxland's Farm (PAS 1)

8.2.9.1 Construction Impacts

Built Heritage

Blaxland's Farm is a significant cultural landscape that provides important historical evidence of early agricultural processing activities that from 1830s. The core area of Blaxland's farm contains a number of archaeological features associated with Blaxland's farm estate, including an extensive brewery, 'a neat cottage residence, overseer's cottage, men's huts, yards, etc' and a water-powered flour mill.

Works within the assessment area will have no impact on any built heritage. The proposed works with the Blaxland's farm curtilage include open trenching for the installation and construction of the treated water pipeline with a release outlet upstream of Wallacia Weir, and air valves along Silverdale Road. The Project has considered the location of sensitive areas such as extant built features and avoided impact to these areas by limiting works east of the core of the Blaxland's farm site.

The works will have a moderate impact to the landscape along the banks of the Nepean River for the construction of the discharge outlet. This will, however, be in a localised area along the Nepean River and remediated upon completion of the works. The discharge outlet itself will be quite a small feature (10m x 5m approximately in size) within the wider landscape.

The works are considered to be acceptable, with no long-term impacts to the heritage significance of Blaxland's Farm.

Overall Impact: Negligible

Historical Archaeological Heritage

The original placement of the treated water pipelines and discharge outlet to the Nepean River went through the core of the Blaxland Farm site where extant archaeological remains (ruins) were visible from the surface during survey and detailed assessment of aerial photographs. This would have resulted in a major adverse impact to archaeological remains assessed as being of state significance. Redesign of the water pipeline and discharge outlet locations has moved them to the east into areas of moderate to moderate-high potential for historical archaeological evidence of Blaxland's Farm. These areas are more likely to have been disturbed by twentieth-century agricultural practices and seem to be toward the margins of the site.

Trenching to accommodate the treated water pipelines and associated construction activities still represents a moderate adverse impact to what is a highly intact and extensive early colonial archaeological site. With appropriate archaeological management, however, these impacts can be sufficiently mitigated. The treated water pipeline, once constructed and in operation, has the potential to raise water surface depths and increase flow velocities. However, the hydrology modelling has assessed these increases to be negligible, and as such the impact on heritage features along the river front (including the archaeological features relating to the mill site) would also be negligible.

Overall Impact: Moderate to major

8.2.9.2 Operational Impacts

The treated water pipeline, once constructed and in operation, has the potential to raise water surface depths and increase flow velocities. However, the hydrology modelling has assessed these increases to be negligible, and as such the impact on heritage features along the river front (including the archaeological features relating to the mill site) would also be negligible.

Overall Impact: Negligible

8.2.10 Blaxland's Garden (PAS 2)

8.2.10.1 Construction Impacts

Built Heritage

This work will not impact on built heritage.

Overall Impact: No change

Historical Archaeological Heritage

This area is depicted as 'garden' in 1859 subdivision plans. The area has the potential to yield archaeological evidence of agricultural practices at Blaxland's Luddenham Estate, including palynological and archaeobotanical evidence within former garden soils. There is also moderate potential for unrecorded outbuildings associated with operation of the garden, including sheds, cottages, and stores.

Trenching to enable installation of the treated water pipelines would result in a localised impact to the site's archaeological resources. Construction activities in the surrounding areas also have the potential to impact on archaeological evidence of local or state significance.

Overall Impact: Minor to moderate

8.2.10.2 Operational Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Blaxland's Garden. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.11 Blaxland's Crossing (PAS 3)

8.2.11.1 Construction Impacts

Built Heritage

This work will not impact built heritage.

Overall Impact: No change

Historical Archaeological Heritage

Installation of the treated water pipeline is likely to result in the removal of historical archaeological evidence of local significance associated with an early colonial roadway, as well as potentially a causeway and timber bridge. This would result in a partial loss of these sites, as they would be anticipated to extend further to the west to the edge of (as well as partly within) the Nepean River.

Overall Impact: Minor to moderate

8.2.11.2 Operational Impacts

The Treated Water Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Blaxland's Crossing. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.12 Warragamba Supply Scheme and Warragamba Emergency Scheme

8.2.12.1 Construction Impacts

Built Heritage

Major elements that relate to the Emergency Scheme include the weir, a 10-cable cableway, sheds, batching plants, roads, electrical substation, chlorination plant, maintenance staff accommodation, balance reservoir, Megarrity's bridge, water pumping station, tunnels, and associated pipelines. Key features within the landscape that collectively embody the values of the supply system include the Warragamba Dam foundation and wall drainage systems, and the post-war architectural expression of the crest, lift towers and Valve House.

The environmental flow pipeline will extend from Bents Basin Road via a trenchless method of construction where it will connect to a release location on the Warragamba River upstream of the Warragamba Weir, downstream from the Warragamba dam wall. An indicative representation of these headwalls will involve the construction of concrete culverts and headwalls with areas of rock riprap aprons and gabion walls, with an associated access road. The release location is located outside the SHR curtilage of the Warragamba Emergency Scheme. There are no direct or indirect impacts on significant elements associated with the construction of the environmental flow pipeline and release location.

The concrete headwalls of the discharge outlet are very small structures relative to any of the larger built structures such as buildings, residences, and including Warragamba Dam itself. As such, they will have a minor impact on the views and settings that contribute to the values of the area.

The work is considered to have a minor, but acceptable impact to the landscape values of Warragamba Supply Scheme and Warragamba Emergency Scheme. The proposed works include the addition of other water related infrastructure consistent with the operational use of Warragamba. The proposed location of the discharge outlet and pipeline balances the functional and technical requirements of the Project with the established heritage values. Mitigations to reduce the visual impacts of the works would include limiting the area of impact including areas of riprap as much as possible, and revegetation at every opportunity to screen the structures without impacting the functionality and operation of the outlet. The new works will not reduce the legibility of the Warragamba Supply Scheme and Warragamba Emergency Scheme or impact upon the heritage values of that site.

Overall Impact: Minor

Historical Archaeological Impacts

The works will not impact an archaeological resource.

Overall Impact: No change

8.2.12.2 Operational Impacts

The environmental flows pipeline once constructed and in operation will be a predominately subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape or setting. There are no additional impacts associated with the operation of this pipeline.

The operation of the discharge outlet will require ongoing access for the maintenance and operation of the asset. Access to the discharge location will make use of existing access roads. There are no additional impacts associated with access for the operational use of the discharge location.

Overall Impact: No change

8.2.13 Cabravale Memorial Park - Bandstand

8.2.13.1 Construction Impacts

Built Heritage

The park is of cultural significance as a place of remembrance for the local community. The commemorative elements are significant features that are enhanced by the broader park landscape and character of Cabravale Memorial Park.

The works within Cabravale Memorial Park will involve site access via the gravelled avenues off Railway Parade. The works have been carefully planned to avoid the heritage curtilage of the war memorial and make use of open spaces and existing access roads to reduce any impacts to the landscaped setting of the park.

The use of existing access roads will not involve any widening, resurfacing or vegetation trimming. The access roads will have no impact to built heritage or archaeological resources.

Although the establishment of a trenchless method of construction will require some landscape clearing before works, this impact will be mitigated through the revegetation of the landscape with the replanting of a compatible ecological community.

The works are considered to have a minor and reversible impact.

Overall Impact: Minor

Historical Archaeological Impacts

The works will not impact an archaeological resource.

8.2.13.2 Operational Impacts

The Brine Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Cabravale Memorial Park and Bandstand. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.14 Upper Canal and Liverpool Offtake Reservoir (PAS 8)

8.2.14.1 Construction Impacts

Built Heritage

The canal has remained in use as a gravity fed water supply system since its completion in 1888. Not only is the canal a significant piece of nineteenth century engineering but an impressive landscape element.

The brine pipeline will underbore Section 10 of the Upper Canal in the suburb of Cecil Hills. The transition from open trenching to underboring will include one launch and receive pad, and a compound area for the laydown of materials. The underbore will be located approximately six (6) metres below the base of the Canal and comply with WaterNSW Guidelines. At the completion of these works, there will be no above ground structures associated with this work.

The methodology developed in this area has balanced the functional and technical requirements of the Project with heritage values. The underbore is designed to be much deeper than the canal itself, at a safe structural distance to ensure there is no physical impact to the canal. As such, the overall impact on the significance values of the Upper Canal is minor.

The construction and installation will have some temporary impacts to the immediate landscape that is part of the Canal and Reservoir; however, this will be remediated upon completion of the work. There are no long-term impacts on the aesthetic qualities of the Upper Canal associated with this work.

Access to the construction site will make use of existing access roads through Western Sydney Parklands and the Upper Canal corridor. There is no widening, resurfacing or vegetation trimming required to use the existing access tracks. Use of the access roads will have no impact to built heritage or archaeological resources.

There is no change to significant fabric associated with this scope of work. Therefore, the works are considered to have a minor and reversible impact on the heritage significance of the Upper Canal and Liverpool Reservoir.

Overall Impact: Minor

Historical Archaeological Heritage

The area spanning the Upper Canal will be under bored to a depth of 7 in metres. While under boring is unlikely to impact on significant archaeological remains, excavation of entry and exit pits would result in removal of any significant archaeological remains within their footprints. Similarly, trenching in areas of low-moderate potential may result in removal of significant historical archaeological remains.

Trenching will likely result in the removal of historical archaeological remains of local significance associated with an outbuilding constructed to support the operations of the Upper Canal.

Overall Impact: Minor

8.2.14.2 Operational Impacts

The Brine Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting within the curtilage of the Upper Canal or Liverpool Offtake Reservoir. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.15 Lennox Reserve (PAS 9)

8.2.15.1 Construction Impacts

Built Heritage

The work will not impact built heritage.

Overall Impact: No change

Historical Archaeological Heritage

Trenching to install the brine pipeline would result in partial or complete removal of significant archaeological evidence associated with a mid to late-nineteenth century cottage or large outbuilding.

Overall Impact: Minor to moderate

8.2.15.2 Operational Impacts

The Brine Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Lennox Reserve. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.16 Lansvale Park (PAS 10)

8.2.16.1 Construction Impacts

Built Heritage

This work will not impact built heritage.

Overall Impact: No change

Historical Archaeological Heritage

Trenching to install the brine pipeline would extend through the centre of two historical structures, one associated with Knight's Butcher Shop, the other an unidentified late nineteenth-century cottage or outbuilding, and result in the removal of any associated archaeological evidence.

Installation of the brine pipeline through PAS 10 would result in an adverse impact to the study area's archaeological resources.

Overall Impact: Minor to moderate

8.2.16.2 Operational Impacts

The Brine Pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Lennox Reserve. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.2.17 Summary of Impacts

Heritage Site	Construction impact	Operational Impacts
Fleurs Radio Telescope Site (PAS 7)		
Built Heritage	Major	No change
Historical Archaeological	Negligible	
South, Kemps and Badgerys Creeks Confluence Scenic Landscape		
Built Heritage	Moderate	No change
Historical Archaeological	Negligible	
Fleurs Aerodrome		
Built Heritage	Negligible	No change
Historical Archaeological	No change	
McGarvie Smith Farm		
Built Heritage	Minor	No change
Historical Archaeological	Negligible	
McMaster Field Station		
Built Heritage	Minor	No change
Historical Archaeological	Negligible	
Exeter Farm		
Built Heritage	No change	No change
Historical Archaeological	Negligible	
Luddenham Road Alignment		
Built Heritage	Negligible	No change
Historical Archaeological	No change	
Luddenham Homestead		

Heritage Site	Construction impact	Operational Impacts
Built Heritage	No change	No change
Historical Archaeological	Negligible	
Luddenham Showground		
Built Heritage	Negligible	No change
Historical Archaeological	No change	
Blaxland's Farm		
Built Heritage	Negligible	Negligible
Historical Archaeological	Moderate to major	
Blaxland's Garden		
Built Heritage	No change	No change
Historical Archaeological	Minor to moderate	
Blaxland's Crossing		
Built Heritage	No change	No change
Historical Archaeological	Minor to moderate	
Warragamba Supply Scheme and Warragamba Emergency Supply		
Built Heritage	Minor	No change
Historical Archaeological	No change	
Cabravale Memorial Park - Bandstand		
Built Heritage	Minor	No change
Historical Archaeological	No change	
Upper Canal and Liverpool Offtake Reservoir		
Built Heritage	Minor	No change
Historical Archaeological	Minor	
Lennox Reserve		
Built Heritage	No change	No change
Historical Archaeological	Minor to moderate	
Lansvale Park		
Built Heritage	No change	No change
Historical Archaeological	Minor to moderate	

8.3 Impacts to heritage in the vicinity

Overall, the Project will have a negligible impact to items identified as heritage in the vicinity, this includes:

- St. Andrews Anglican Church (Former)
- “Bayly Park” – house
- Park Road Conservation Area

No heritage fabric or landscape elements of these items will be impacted.

Where a potential impact is anticipated, an assessment has been included below.

8.3.1 Wallacia Hotel

8.3.1.1 Construction Impacts

The Wallacia Hotel is an excellent example of an inter-war country resort style hotel in the Stockbroker’s Tudor style. Historically the building demonstrates leisure activities associated with the development that occurred in Wallacia throughout the 1920s and 1930s.

The Wallacia Hotel is located in the vicinity of the compound proposed for the Luddenham Homestead Site. The compound will be temporary and located to the rear of Wallacia Hotel. The compound does not represent an adverse impact to the Wallacia Hotel heritage values. The hotel will remain a prominent and landmark building in the streetscape.

Overall Impact: No change

8.3.1.2 Operational Impacts

There are no long-term adverse impacts associated with this work.

Overall Impact: No change

8.3.2 Wallacia Weir

8.3.2.1 Construction Impacts

Wallacia Weir is historically associated with John Blaxland’s estate located at the confluence of the Nepean and Warragamba Rivers. The first dam constructed during Blaxland’s occupation was wooden and built along with the flour mill and brewery complex. This was replaced in 1911 with a sandstone weir. The wall of the Weir is remains sandstone with concrete abutments on the northern side of the riverbank.

The Nepean River discharge outlet is located upstream of Wallacia Weir. The construction of the proposed outlet will have no direct or indirect impacts on the weir. Although the construction will see an increase of water level, this will have a negligible impact on the actual structure and surrounding landscape.

The proposed works are considered acceptable.

Overall Impact: Negligible

8.3.2.2 Operational Impacts

The treated water pipeline and discharge outlet, once constructed and in operation, have the potential to raise water surface depths and increase flow velocities. However, the hydrology modelling has assessed these increases to be negligible, and as such the impact on heritage features along the river front would also be negligible.

Overall Impact: Negligible

8.3.3 Greater Blue Mountains World Heritage Area

The Greater Blue Mountains World Heritage Area is located immediately west of the impact assessment area on the Warragamba River and Nepean River. Due to the release locations at the Nepean River, there will be an increase in the wetted perimeter of the Nepean River. The increased inundation has the potential to have a minor, indirect impact on the natural heritage values of the Greater Blue Mountains.

Impacts to the Greater Blue Mountains National Park are based on predicative modelling informed by hydrology and biodiversity assessments. The reports have concluded that the release of treated water upstream of Wallacia Weir on the Nepean River will see an impact on a small percentage of forage habitat for Swift Parrots and Regent Honeyeaters. Mapping of important areas has indicated the Project will not impact upon any known breeding locations and is unlikely to have a significant impact to either species.

This is subject to a separate assessment and report currently being prepared by EMM Consulting.

8.3.4 Lansdowne House

8.3.4.1 Construction Impacts

Built Heritage

The historic house known as ‘Lansdowne’ located at 7 Henry Lawson Drive is a highly modified Federation Bungalow that neighbours Lansdowne Reserve. The Project will terminate in Lansdowne Reserve when the Brine Pipeline connects to the Malabar wastewater system. This will be achieved through open trenching after underboring the Prospect Creek. The proposed work will not have an adverse impact on the building, nor will it have a long-term adversely impact the landscape setting of Lansdowne Reserve.

There are no direct or indirect impacts associated with these works on the heritage significance of the residence. The works are considered acceptable and do not represent an adverse impact.

Overall Impact: No change

8.3.4.2 Operational Impacts

The brine pipeline, once constructed, will be a subsurface feature. The operational pipeline will have no further, ongoing impact to the structures, landscape and setting of Lansdowne Reserve. There are no additional impacts associated with the operation of this pipeline.

Overall Impact: No change

8.4 Impacts to views and settings

A series of photomontages have been prepared for this Project to visually communicate the likely long-term impacts of the Project on the landscape character and setting of Fleurs Radio Telescope Site (refer below to section 8.4.1). This formed a part of the Landscape Character and Visual Impact Assessment (LCVIA) prepared by Aurecon and Arup. Due to the topography of the landscape, it was not feasible to prepare photomontages of the Nepean River discharge outlet at Wallacia Weir and the Warragamba discharge outlet on the Warragamba River.

The Landscape Character and Visual Impact Assessment (LCVIA) prepared for the Project identified and assessed ten (10) key viewpoints surrounding the Centre. The matrix used to define the impact ratings is based on landscape character sensitivity and landscape magnitude of change. The LCVIA states:

> Landscape character sensitivity refers to the value placed on the overall quality of a Landscape Character Zone (LCZ) based on a number of characteristics including amenity, vegetation, urban development, and land use. Sensitivity is then rated on the extent to which the LCZ can absorb change as a result of the Project. Landscape sensitivity considers:
>
> - Inherent landscape value in terms of condition, perpetual qualities, cultural importance, and any specific values that may apply, such as landscape planning designations.
>
> - Whether the changes would fit-in with or the changes would be visually absorbed into the scale, landform, land use, pattern, texture of the existing landscape.
>
> landscape magnitude of change refers to the nature, scale and duration of change that would affect a landscape character. Magnitude considers the following factors:
>
> - The scale of change, regarding the loss or addition of features in the view and changes in its composition.
>
> - Degree of contrast or integration based on scale and form, height, colour and texture.
>
> - Duration of the change: short, medium, long term permanent or temporary.
>
> - The angle and distance of the Project from the character zone. (LVCIA, 7-9)

The landscape character assessment for the Centre considered the Landscape Character Zone (LCZ) as having moderate sensitivity and assessed the magnitude of change as high. Noting the Project will introduce new large-scale elements into the existing setting and remove historic fabric. The scale of the Centre will be considerable without landscape mitigation to reduce the level of impact. From a heritage perspective, this is considered to have a major impact on the heritage character of Fleurs Radio Telescope Site and will remove key views associated with the site.

To mitigate this impact, landscaping around the Centre will form an integral part of the design process to reduce the visual prominence of the Centre in the landscape. A number of tree plantings to screen the facility have been proposed, as well careful planning for the cladding materials of the Centre to ensure a visually recessive colour palette is incorporated in the detail design. This will be assisted by the inclusion of heritage interpretation that explores the significance of Fleurs Radio Telescope Site.

There are no long-term visual impacts associated with the construction and operation of the pipelines. The brine and treated water pipelines are subsurface features with no visual impact to the character or setting. The pipelines will have no impact to significant historical views.

Short-term visual impacts associated with the pipelines will occur during the construction phase of the Project. The loss of vegetation will have a temporary moderate adverse visual impact on the landscape and setting of heritage items affected by this stage of work. This impact will be mitigated through the revegetating of the relevant ecological community to the area affected on a like for like basis. Although the type of vegetation planted will be confined to low level plantings to avoid replanting trees with root system that could damage the infrastructure below. The revegetation of affected landscapes reduces the impact to the character and setting of the area and ensures there are no long-term adverse impacts associated with the construction works.

8.4.1 Photomontages

8.4.1.1 The Advanced Water Recycling Centre

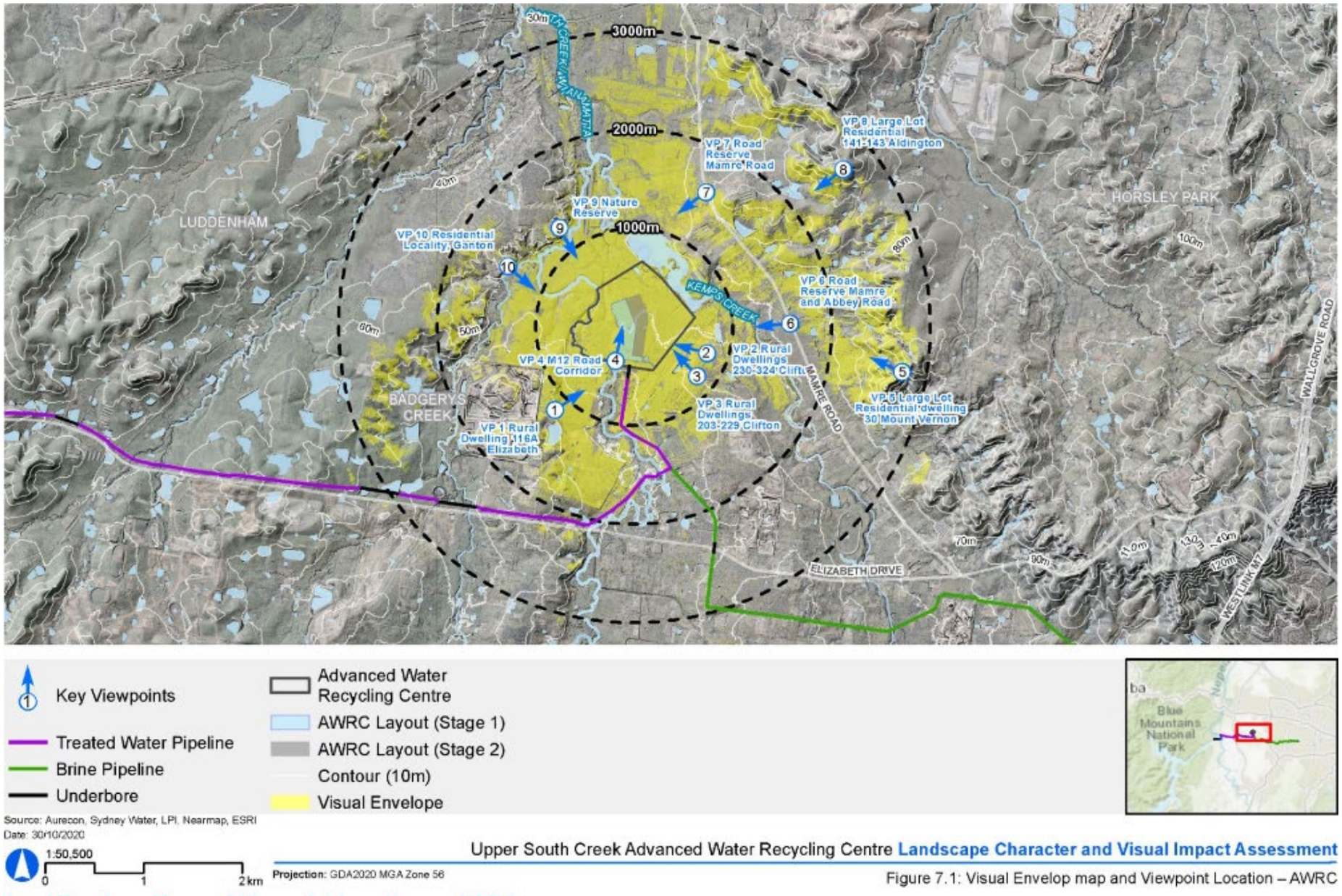

Figure 128. Overview of the location of the viewpoints. (Source: Upper South Creek Centre – LCVIA, p.64

Viewpoint 1- 1669A Elizabeth Drive Badgerys Creek	
Direction:	Looking north-east towards proposed facility
Distance from Centre:	800m

Figure 129. Existing view (Source: Upper South Creek AWRC – LCVIA, p.66)

Figure 130. Indicative photomontage (Source: Upper South Creek AWRC – LCVIA, p.67)

Viewpoint 2 - 230-234 Clifton Avenue Kemps Creek	
Direction:	Looking north-west towards proposed facility
Distance from Centre:	400m

Figure 131. Existing view (Source: Source: Upper South Creek AWRC – LCVIA, p.69)

Figure 132. Indicative photomontage (Source: Upper South Creek AWRC – LCVIA, p.71)

Viewpoint 3 - 203-229 Clifton Avenue Kemps Creek	
Direction:	Looking north-west towards proposed facility
Distance from CENTRE:	540m

Figure 133. Existing view ((Source: Upper South Creek AWRC – LCVIA, p.73)

Figure 134. Indicative photomontage (Source: Upper South Creek AWRC – LCVIA, p.74)

Viewpoint 4 - Fleurs Farm – M12 road corridor	
Direction:	Looking north towards proposed facility
Distance from CENTRE:	60m

Figure 135. Existing view (Source: Upper South Creek AWRC – LCVIA p.76)

Figure 136. Indicative photomontage (Source: Upper South Creek AWRC – LCVIA, p.77)

Viewpoint 5 - 30 Mount Vernon Road Mount Vernon	
Direction:	Looking west towards proposed facility
Distance from CENTRE:	2.6km

Figure 137. Existing view. (Source: Upper South Creek AWRC – LCVIA, p.79)

Figure 138. Indicative photomontage. (Source: Upper South Creek AWRC – LCVIA, p.80)

Viewpoint 6 - Corner of Mamre Road and Abbey Road	
Direction:	Looking west towards proposed facilty
Distance from CENTRE:	1.4km

Figure 139. Existing view. (Source: Upper South Creek AWRC– LCVIA, p.83)

Figure 140. Indicative photomontage (Source: Upper South Creek AWRC – LCVIA, p.84)

Viewpoint 7 – 845a Mamre Road, Kemps Creek	
Direction:	Looking south-west towards proposed facility
Distance from CENTRE:	1.2 km

Figure 141. Existing view (Source: Upper South Creek AWRC – LCVIA, p.86)

Figure 142. Indicative photomontage (Source: Upper South Creek AWRC – LCVIA, p.87).

Viewpoint 8 - 141-143 Aldington Road, Kemps Creek	
Direction:	Looking south-west towards proposed facility
Distance from CENTRE:	2.4 km

Figure 143. Existing view. (Source: Upper South Creek AWRC – LCVIA, p.89).

Figure 144. Indicative photomontage (Source: Upper South Creek AWRC – LCVIA, p.90).

Viewpoint 9 - 1 Ganton Way, Luddenham	
Direction:	Looking south east towards proposed facility
Distance from CENTRE:	1.1 km

Figure 145. Existing view. (Source: Upper South Creek AWRC– LCVIA, p.92).

Figure 146. Indicative photomontage. (Source: Upper South Creek AWRC – LCVIA, p.93).

Viewpoint 10 - 16 Ganton Way, Luddenham	
Direction:	Looking south-east towards the proposed facility
Distance from CENTRE:	1.1km

Figure 147. Existing location. (Source: Upper South Creek AWRC – LCVIA, p.95).

Figure 148. Indicative photomontage. (Source: Upper South Creek AWRC – LCVIA, p.96).

8.5 Impacts from noise and vibration

A Noise and Vibration Impact Assessment (NVIA) has been prepared to assess the potential risk to heritage sensitive receivers associated with the construction of the Project. Heritage sensitive receivers identified were selected based on their distance to ground disturbing works. The heritage items identified included the Upper Canal, Blaxland's Farm, the Bandstand at Cabravale Memorial Park, Park Road Heritage Conservation Area (HCA), Wallacia Hotel and St Andrews Church.

This assessment was informed by the German standard *DIN 4150 – Part 3 'Structural vibration in buildings – Effects on Structure'* which is recognised to be conservative and for the purpose of assessing structurally sensitive buildings. The assessment stipulated heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. In conclusion, the report stated there are no highly vibration sensitive structures located in the vicinity of the Project.

8.6 Cumulative impacts

There are a number of major projects within the region that will transform the rural character of the southwest Sydney that relate to air, road, rail, and water infrastructure. This chapter will provide a high-level assessment of the cumulative non-Aboriginal heritage impacts based on the most current and publicly available information on major projects occurring in the region. The identified projects below are relevant to the consideration of cumulative non-Aboriginal heritage impacts as they are located within the vicinity of the Project.

First and foremost, the area will be transformed significantly over the coming decades with the development of the Aerotropolis, a new city centre in Bringelly with several precincts planned for the surrounding suburbs. The Western Sydney Aerotropolis will surround the site of the new international Airport in Badgerys Creek. The Western Sydney International Airport will act as a catalyst for this development and is currently under construction with the first runway set to open in 2026. The region will also gain its first rail link with the construction of the Sydney Metro-Western Sydney Airport line from St Marys to the Aerotropolis Core precinct. There are also major road links proposed with the construction of the M12 and Outer Sydney Orbital. In anticipation of the increased growth in the area, there are also a number of major road upgrades planned for the Northern Road and Elizabeth Drive.

Major water infrastructure projects in the area to consider include the raising of the Warragamba Dam wall for flood mitigation. Raising the dam wall is intended to provide 'airspace' in a dedicated flood mitigation zone approximately fourteen metres above the current full water supply level.

This assessment considers the Project holistically and recognises that a conscious effort towards the best practice approach of "as much as necessary, as little as possible' has been adopted to reduce the impacts of the Project on heritage items and project outcomes of other major infrastructure works.

8.6.1.1 M12 Motorway

Transport for NSW (TfNSW) is preparing to construct and operate the M12 Motorway Project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network. The M12 Motorway is expected to be opened to traffic prior to opening of the Western Sydney Airport. The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres. The M12 road alignment traverses large land parcels that were historically used for a range of activities, including agricultural and astronomical research.

The Non-Aboriginal Heritage Assessment Report (Oct 2019) prepared by the Jacobs-Arcadis Joint Venture to support the Environmental Impact Statement (EIS) for the M12 Motorway project identified 8 heritage items and potential heritage items that also cross over with our project area. These are:

- McGarvie Smith Farm
- Fleurs Radio Telescope
- Luddenham Road Alignment
- Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
- McMaster Field Station
- Fleurs Aerodrome
- Exeter Farm Archaeological Site
- South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape

Table 19. Summary of cumulative impacts associated with M12.

	Impacts associated with M12	Cumulative impact relevant to project
McGarvie Smith Farm	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report state: ▪ Construction of dual carriageway motorway with two lanes in each direction and access road to the planned Western Sydney Airport at Badgerys Creek would result in demolition of several buildings at the site. A construction laydown area located on the property, to the west of the carriageway, would physically alter the landscape of the heritage item. The laydown area would be used for stockpiling of material and earthworks and construction support. ▪ The construction of the road would result in the demolition of several buildings and a silo at the site. ▪ In addition, the project would alter the landscape of the site which includes features such as dams and demonstrates a general rural nature. ▪ As the project bisects the entire property from north to south, the site's landscape context and overall layout would be diminished. ▪ The demolition of the three buildings and silo would reduce the relatively intact nature of the heritage item, impacting on the ability to understand its layout and principal characteristics. The demolition of the buildings would reduce the historical significance of the site through the reduction in the examples of structures constructed over the entire history of the site. The bisection of the site would also reduce the intactness of the heritage item and subsequently its principal characteristics.	McGarvie Smith Farm will have direct and indirect impacts with the construction of the M12 that will result in a major adverse impact through the removal of key heritage elements associated with the farm. The construction and installation of the treated pipelines for the Project is considered to be minor. The Project will involve under boring and open trenching in an area along Elizabeth Drive in the vicinity of dams used for water harvesting. The proposed works will have a minor and temporary impact to the rural landscape along Elizabeth Drive and will not see the loss of significant built features. The Project will have a minor cumulative impact on the heritage significance of McGarvie Smith Farm.

	Impacts associated with M12	Cumulative impact relevant to project
Fleurs Radio Telescope	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report state: ▪ Construction of dual carriageway motorway with two lanes in each direction. The proposed works bisects the Fleurs Radio Telescope site from west to east on the southern boundary of the site. One element of the Shain Cross would be demolished by the project. A set of installations, including cables, signal boxes, dishes and the location of an excavated antenna, from the FST are also within the project area, but not within the construction footprint. ▪ The project would require the removal of one element of the Shain Cross (SC01), which reduces the intactness of the array, however the rest of the remaining elements of the overall Fleurs Radio Telescope site would be avoided. Therefore, the overall significance of the site, including its historical significance, principal characteristics, potential to yield information, would be retained.	Fleurs Radio Telescope Site will have direct and indirect impacts with the construction of M12. The construction footprint of the M12 is limited to the southern boundary of the site, on an east-west axis and will require the partial demolition of the Shain Cross array. This impact has been assessed as having a minor impact on the heritage significance of the item. The cumulative impact associated with the Project's construction of the advanced water recycling centre is major. The demolition of key elements will involve the permanent and irreversible loss of significant fabric that relates the core heritage values of Fleurs Radio Telescope Site. This will also have an impact on the site's interpretative potential, which will be compromised by the construction of both projects with the loss of significant landscape elements and the original layout of the cross arrays.
Luddenham Road Alignment	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report states: ▪ Construction of dual carriageway motorway with two lanes in each direction on a bridge over Luddenham Road. ▪ While the motorway intersects with the curtilage of the heritage item, there would be no physical works within the curtilage. The roadway should therefore not be physically impacted by the construction or operation of the proposed motorway, and consequently the significance of the Luddenham Road alignment would also not be impacted.	While the pipelines will intersect the curtilage of the heritage item, the works will not impact on the alignment. The proposed works will have a negligible cumulative impact to the heritage significance of Luddenham Road Alignment.

	Impacts associated with M12	Cumulative impact relevant to project
Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report states: ▪ The grade separated interchange is located over the Upper Canal System pipeline that is below the ground to the southwest and northeast of the intersection. As such, the construction would not directly impact on the pipeline in this location. The above ground component of the Upper Canal System in this location, Tunnel Shaft 4, is located in the existing M7 central road median. The Tunnel Shaft 4 is located in an area of that would not be subject to impacts. ▪ The proposed works within the heritage curtilage of the Upper Canal System are not planned to physically impact the heritage item as the motorway in this location is a raised structure, and any potential impacts are able to be prevented through implementation of protective measures. Additionally, there would be no impact on views to the heritage item. As such, the level of impact on the heritage item would be negligible during construction and operation.	While the brine pipeline will intersect the curtilage of the heritage item, the works will not physically impact the significant fabric or landscaping associated with the Upper Canal and Liverpool Offtake Reservoir. The works will be located below ground and have no impact to views of the heritage item. The proposed works will have a negligible cumulative impact to the heritage significance of Upper Canal.

	Impacts associated with M12	Cumulative impact relevant to project
McMaster Field Station	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report states: ▪ The project involves construction of dual carriageway motorway with two lanes in each direction and access road to the Western Sydney Airport which overlaps with various elements of the site. The proposed road construction overlaps with a large portion of the McMaster Field Station, which would require ground disturbing works to occur in locations where there are dams and other landscape modifications, and concrete remnants that are important elements of the heritage item. The identified buildings are located a minimum distance of 36 metres from the project's operation footprint. However, a construction ancillary facility (AF3) located on the property to the east of the carriageway, has potential to impact the complex of buildings, including animal pens and stockyards. The ancillary facility would be used for bridges construction support, material and earthworks stockpile, possible workshop for plant servicing, double-handling laydown and outpost site office (secondary compound). The buildings at the site would not be demolished but may be reused as office and other similar facilities during construction. ▪ The project would directly impact on a large section through the centre of the curtilage of the McMaster Field Station. The proposed carriageway would involve ground disturbing works that would physically damage or destroy the existing dams, other modified landscape elements and trees on the property. ▪ The proposed works within McMaster Field Station would be of medium-large scale and moderate intensity, with some of the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be major.	Though work associated with M12 will result in removal of key heritage elements. The cumulative impacts associated with the Project that will arise from the construction and installation of the treated pipelines is considered minor. In comparison to the M12 project, the open trenching and under boring required for the treated pipeline will have a minor and temporary impact to the rural landscape along Elizabeth Drive. This will not see the loss of significant built features.

	Impacts associated with M12	Cumulative impact relevant to project
Fleurs Aerodrome	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report states: ▪ Construction of a dual carriageway motorway with two lanes in each direction would bisect the Fleurs Aerodrome site curtilage. The construction footprint extends over the grassed middle section of the Fleurs Aerodrome, while the project area includes sections of bitumen runway and grassed areas to the south, and grassed areas to the north. About 446 metres of the project area and 100 metres of the M12 construction footprint overlap with the Fleurs Aerodrome. ▪ While the project would have a direct impact on a portion of the site, the impacts are confined to the middle grassed section of the aerodrome, avoiding the southern bituminised and northern grassed sections. It is likely that the northern end of the aerodrome contains building remnants as observed previously by Aurecon (2016). ▪ The bisection of the site however would reduce the intactness of the Fleurs Aerodrome and the ability of the site to be understood as a whole, essentially dividing the airstrip into sections, and diminishing its linear and continuous nature. This would impact on the site's principal characteristics, historical significance and rarity as an operational WWI aerodrome. ▪ The proposed works within the Fleurs Aerodrome would be of medium-large scale and moderate intensity, with the changes being permanent and irreversible. As such, the level of impact on the heritage item overall would be major.	The proposed works will intersect underneath the southern end of the aerodrome to continue north to the proposed advanced water recycling centre. The open trenching required for the pipeline will have a minor impact on a small section of the aerodrome for the construction of the pipeline. This will have a negligible cumulative impact on the heritage significance of the item, as the works are located in an area already compromised by the construction footprint of the M12.

	Impacts associated with M12	Cumulative impact relevant to project
Exeter Farm Archaeological Site	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report states: ▪ This Exeter Farm archaeological site is located about 50 metres outside to the south of the M12 construction footprint. Currently there are no construction works within the curtilage of the site. Vehicle movements, temporary compounds and lay-down areas, and other early and/or enabling activities may occur in the vicinity of the site. ▪ There are no works planned to occur within the curtilage of the Exeter Farm archaeological site, therefore there would be no construction impacts to the item. Due to the distance of the motorway from the site, there would also no operational impacts to the heritage item. As such, the level of impact on the heritage item would be negligible during construction and operation.	The Exeter Farm Archaeological Site located at Lot 1, DP 74574 is outside of the Project. The proposed works will have a negligible cumulative impact to the heritage significance of the Exeter Farm archaeological site.
South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape	The summarised impacts quoted from the EIS Non-Aboriginal Heritage Assessment Report states: ▪ There are no works planned to occur within the curtilage of the South, Kemps and Badgerys Creek Scenic Landscape, however there is the potential for indirect impacts to the hydrology of South Creek, and visual impacts to the heritage landscape. These impacts would also continue during operation. There would be no direct physical impacts on the heritage item, the visual impacts have been minimised as much as possible through project design, and the hydrological impacts are minor and localised and able to be prevented through the implementation of management measures. As such the level of impact on this heritage item, during construction and operation would be negligible.	The Advanced Water Recycling Centre is located within the southern portion of the South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape. The Project will have a moderate cumulative impact on the heritage values of the landscape.

8.6.1.2 Western Sydney Aerotropolis

The Western Sydney Aerotropolis Plan (WSAP) has identified ten precincts for the future character and connectivity of the area based on the environmental opportunities and constraints of each area. The breadth and scale of the urban redevelopment envisioned for the Aerotropolis will see major cumulative impacts on the broad heritage values of the area with long term material impacts to landscapes historically significant as a predominately rural landscape.

The Project is a necessary infrastructure to support this urban transition. While the cumulative impacts of the Aerotropolis are considered to be major. Given the scale of change that is planned for the area, the Advanced Water Recycling Centre will make a small contribution to this landscape.

8.6.1.3 Western Sydney Airport

The Australian Government is progressing the construction of the Western Sydney International Airport on the 1,780 hectares of commonwealth owned land in Badgerys Creek. The airport was planned with the intention of catering to the increased demand for air travel and provide additional aviation capacity in the Sydney region, as well as provide economic and employment opportunities to the area.

The EIS prepared for the Western Sydney Airport indicated that all 20 heritage items identified within the construction footprint of the airport site will be demolished and removed to facilitate the construction of the airport.

While there are no heritage sites within the Project's assessment area that overlap with the Western Sydney Airport, the cumulative impact associated with the construction of the Advanced Water Recycling Centre will have major impact on the landscape character of the wider area. The construction of the pipelines is considered negligible in comparison to the other major projects in the area, given they will be a subsurface infrastructure element once operational.

8.6.1.4 Sydney Metro-Western Sydney Airport line

The Sydney Metro- Western Sydney Airport will form an integral part of the of the development associated with the Western Sydney Aerotropolis and Western Sydney Airport. The project includes six new metro stations extending from St Marys to the core of aerotropolis. There are no heritage sites within the Project's assessment area that overlap with the metro line. The Project will have a negligible impact on the broader changes associated with the Sydney Metro development.

8.6.1.5 Elizabeth Drive Upgrade

Elizabeth Drive is an approximately 14 kilometres long, two lane undivided road that extends from the M7 Motorway to Badgerys Creek. The roadway at present has no footpaths or median strips. Future projected and planned growth in the region requires increased capacity on Elizabeth Drive. The widening of Elizabeth Drive will intersect the heritage curtilage of known and potential heritage items within the Project, including McGarvie-Smith Farm, McMaster Field Station, and Exeter House.

The Project intends to align with the future planned, widened Elizabeth Drive. The treated pipeline will be form one of many services located below ground within this development. The construction and installation of the treated pipelines will have a negligible cumulative impact on the landscape and heritage significance of the heritage items along Elizabeth Drive.

8.6.1.6 Potential Warragamba Dam Raising

The potential raising of the Warragamba Dam wall for flood mitigation is intended to provide 'airspace' in a dedicated flood mitigation zone approximately fourteen metres above the current full water supply level. There are a number of potential heritage impacts associated with the modification dam wall that will have a direct impact on the heritage values of Warragamba Dam and other known heritage items in the vicinity.

While the Project will intersect the heritage curtilage of the Warragamba Supply Scheme and introduce a new built element into the landscape, the work will have a negligible impact in comparison to the impacts associated with the potential Warragamba Dam Raising. There are no accumulative impacts associated with this Project.

8.7 Compliance with Conservation Management Plan (CMP) policies

The only CMP relevant to the Project relates to the Upper Canal. The following policies are quoted from the 'Upper Canal Pheasants Nest to Prospect Reservoir Conservation Management Plan' prepared by Government Architects Office in 2016.

Table 20. Policies from Upper Canal CMP.

CMP Policy	Discussion
Policy 9. *Ensure the significance of the Upper Canal and the key heritage management requirements relating to it are included in all SCA policy and procedure documents governing operation of the Canal and major works planning.*	The proposed works will have no impacts on the significance of the Upper Canal.
Policy 10. *Conserve surviving historic landscape features associated with the Canal, particularly the avenues of pines, cultural plantings at cottage and depot sites and historic plantings associated with the intersection of the Canal with old travel routes.*	The proposed works will have no physical impact on the Upper Canal itself, or any permanent impacts to any significant landscape features.
Policy 36. *Make decisions requiring change to the Upper Canal with a clear understanding of the implications for the identified heritage values of the Canal and seek to minimise negative heritage impacts.*	The options analysis has considered ways to mitigate and avoid any impacts to the canal. The proposed works are consistent with this policy.

CMP Policy	Discussion
Policy 66. *When installing below ground services, avoid areas of identified historical or Aboriginal archaeological potential and avoid impacts to elements of Exceptional heritage significance.*	The options analysis has considered ways to mitigate and avoid any impacts to the canal. The proposed works are consistent with this policy.
Policy 71. *Where excavation is unavoidable, seek advice from a suitably qualified and experienced historical or Aboriginal archaeologist early in the planning stages for any work and undertake historical archaeological and Aboriginal cultural heritage assessment as appropriate.*	The baseline HAA in this SOHI has considered the archaeological impacts to the Upper Canal (see Appendix A). The works are considered appropriate and to have a minor and reversible impact on the heritage significance of the Upper Canal.

9. Recommendations

9.1 Mitigation measures

9.1.1 General

- Prior to works, a heritage induction should be delivered to all site contractors and supervisors involved working within a heritage curtilage or undertaking ground disturbance works. The induction will:
    - Brief contractors on the heritage sensitively of the site;
    - Inform them of any recommended mitigation measures or controls required,
    - Help contractors identify unexpected archaeological finds,
    - Make them aware of their obligations under the Heritage Act, and
    - Establish an 'unexpected finds protocol' to ensure works halt and an archaeologist is immediately contacted in case of unexpected finds.
- No materials are to be stockpiled against heritage buildings or items.
- Any accidental damage to heritage items is to be treated as an incident, with appropriate recording and notification.
- All areas effected by works must be cleaned and made good by contractors after they have completed works.
- Where impacts to landscape are unavoidable, a process of remediating landscapes on a like for like basis should be employed.
- Any alteration to the heritage character of an item or landscape should consider the historic character of the area and treatments and finishes within the detailed design. Subtle integration of these elements to the new design may assist in minimising potential aesthetic impacts and complement the character of the surrounding area.
- For areas with high pedestrian or road traffic, it is recommended temporary interpretive hoarding is used to provide the public with an opportunity to learn about the historical sites captured in the Project's impact assessment area during the construction phase. Potential sites available include compound sites located at Luddenham Homestead Site and Cabravale Memorial Park, as well as at Blaxland's Farm at Silverdale Road.

9.1.2 Built heritage

Provided the general mitigation measures are implemented there are few site-specific mitigation measures required, as there are no long-term impacts associated with the Project. Where site specific mitigations are required, they have been identified below.

Cabravale Memorial Park

- Contractors must be briefed on the heritage sensitive nature of the site and informed of any recommended mitigation measures or controls required, prior to works starting.
- It is recommended that a 'heritage protection zone' is adopted around key features and mature trees within the Cabravale Memorial Park. This will include:
    - Fencing around the Bandstand, 170mm Minenwerfer and Vietnam War Comradeship memorial to provide a safe buffer between the construction works and heritage monuments.
    - Protective zones around mature trees to ensure there is no impact to roots,
    - The Bandstand, 170mm Minenwerfer and Vietnam War Comradeship memorial are designated as 'no go zones', and
    - The measures are mapped and included in the CEMP.
- Where possible, existing roads and access tracks should be utilised. Where this is not possible and driving directly over grassed areas is required, some surface material can be applied to the ground cover to spread loads and prevent destruction of these areas.
- Any damage to the landscape is to be remediated upon completion of the work.

Upper Canal and Liverpool Offtake Reservoir

- Any accidental damage to heritage items is to be treated as an incident, with appropriate recording and notification for notification to WaterNSW and Heritage NSW.

Archival recording of Fleurs Radio Telescope Site

- Our assessment has found that the remaining fabric on site is integral to the site's narrative and therefore its heritage significance and have recommended that the site is archivally recorded. Prior to the removal of works on identified historic elements related to the Fleurs Radio Telescope site, it is recommended that a photographic archival recording be conducted of these elements be undertaken, with particular reference to buildings, remnant equipment and the parabolic antennae. The photographic archival recording is to be undertaken by an experienced heritage consultant and in accordance with the *Photographic Recording of Heritage Items using Film or Digital Capture*, NSW Heritage Office, 2006.
- It is recommended the heritage interpretation devices for Fleurs Radio Telescope Site outlined in the Heritage Interpretation Framework prepared by Extent Heritage in November 2020 be implemented as a part of this Project.

Heritage Interpretation

A Heritage Interpretation Framework was prepared for the Project to guide a cohesive and well-considered approach to interpretation of significant elements and sites within the impact assessment area of the Project. This approach provided an understanding of the various opportunities for interpretation for the Project that best highlight the heritage significance of places and elements. Following this, a Heritage Interpretation Plan should be prepared to further develop the concepts through to fabrication and implementation.

The heritage interpretation for this Project considered the following opportunities:

- Landscaping, structure plan and road alignments of/within the Centre to incorporate historic features such as the radio telescope arrays.
- Public Art installation within the Centre. There is the opportunity to create soundscapes as a form of public art that use sound and noise as the medium of the artwork. Integrated with sculptural art, opportunities include interpreting the sound of birds in the antennas at Fleurs, the wind whistling through the metal elements of the dishes, and the sound of water from the creeks and channels to create a soundscape landscape.
- Retention of two parabolic antennas as an interpretative installation.
- Collect a meaningful assemblage of historic material/equipment and historic resources i.e. photographs that relates to the radio telescope functions of the site, and creation of a heritage display within the Centre.
- Prepare digital resources (such as printable material or audio histories) that are available for download by the general public which will further promote the heritage significance of the place to a wider audience. This will be particularly effective for expressing the historical significance of sites such as Fleurs radio telescope, Fleurs Aerodrome, and the McGarvie-Smith/McMaster Field Station/former CSIRO research facilities.
- Prepare an oral history of the Fleurs Field Station as part of the recording of Fleurs Radio Telescope Site.

Finally, given the broader development context of the immediate area in terms of large scale infrastructure and urban planning projects, the interpretation for this Project should aim to achieve a cohesive approach with the heritage interpretation objectives that may have been developed for other projects within the area. Such as the development of M12 Motorway and Western Sydney Aerotropolis.

9.1.3 Historical archaeology

A summary of recommended mitigation strategies by PAS is presented in Table 21.

Table 21. Recommended mitigation strategies by PAS.

PAS	Archaeological potential	Archaeological significance	Recommended mitigation
1 (Blaxland's Farm)	Moderate to moderate-high	State	Archaeological testing to inform detailed design and further works. Archaeological salvage excavation of remains of local or state significance within the impact area.
	Low	State or local	Works to proceed under an 'unexpected finds protocol'.
2 (Blaxland's Gardens)	Moderate	State or local	Archaeological testing to confirm assessed levels of potential and significance. Archaeological salvage excavation of remains of local or state significance within the impact area.
	Low	State or local	Works to proceed under an 'unexpected finds protocol'.
3 (Blaxland's Crossing)	Moderate	Local	Archaeological testing to confirm assessed levels of potential and significance. Archaeological salvage excavation of remains of local or state significance within the impact area.
	Low	Unlikely to meet the threshold for local significance	Works to proceed under an 'unexpected finds protocol'.
4 (McMaster Field Station)	Low to low-moderate	Unlikely to meet the threshold for local significance	Works to proceed under an 'unexpected finds protocol'.
5 (McGarvie Smith Farm)	Low	Unlikely to meet the threshold for local significance	Works to proceed under an 'unexpected finds protocol'.
6 (Exeter House and Farm)	Low	Local	Works to proceed under an 'unexpected finds protocol'.
7 (Fleurs Radiophysics Field Station)	Low	Unlikely to meet the threshold for local significance	Works to proceed under an 'unexpected finds protocol'.
8 (Upper Canal)	Low-moderate	State or local	Archaeological monitoring of ground disturbance in areas of low-moderate potential.
	High	Local	Avoid impacts in areas of high potential, if possible. Archaeological salvage excavation of remains of local significance within the impact area.

PAS	Archaeological potential	Archaeological significance	Recommended mitigation
	Low	Local	Works to proceed under an 'unexpected finds protocol'.
9 (Lennox Reserve)	High	Local	Avoid impacts in areas of high potential, if possible. If impact cannot be avoided, complete archaeological testing to confirm potential and significance. Archaeological salvage excavation of remains of local or state significance within the impact area.
	Low	Local	Works to proceed under an 'unexpected finds protocol'.
10 (Lansvale Park)	Moderate to high	Local	Archaeological testing to confirm potential and significance. Archaeological salvage excavation of remains of local or state significance within the impact area.
	Low	Local	Works to proceed under an 'unexpected finds protocol'.

A brief description of each strategy, and relevant sites, is presented below.

Avoidance

Three sites present the opportunity for minor redesign to avoid impact to areas of moderate to high archaeological potential:

- PAS 3 (Blaxland's Crossing);
- PAS 8 (Upper Canal); and
- PAS 9 (Lansvale Park).

Avoiding impacts in areas of high archaeological potential as will render it unnecessary to complete archaeological test and/or salvage excavation of associated deposits and features. As the areas of high potential are just within the current impact assessment area, it is recommended that detailed design considers the opportunity to avoid ground disturbance in these areas of moderate to high archaeological potential.

Test excavation

Test excavation enables the confirmation of the assessed levels of historical archaeological potential and significance. Completion of test excavation at key sites will enable more certainty in estimating project costs and timeframes, minimising disruption or delays to the construction program. In light of this, test excavation must be completed as part of early works, or at least in advance of construction stage works in identified sites. Should test excavation uncover evidence of substantial historical archaeological remains, their management would include one of the following:

- Salvage after thorough recording
- Archaeological monitoring
- An avoidance strategy.

Testing to inform further archaeological requirements is recommended for the following sites:

- PAS 1 (Blaxland's Farm)
- PAS 2 (Blaxland's Gardens)
- PAS 3 (Blaxland's Crossing) (if impacts cannot be completely avoided by redesign)
- PAS 9 (Lennox Reserve) (if impacts cannot be completely avoided by redesign)
- PAS 10 (Lansvale Park).

Archaeological testing will only be triggered if areas of moderate or high potential for historical archaeological remains of at least local significance will be impacted. Archaeological testing must be completed in accordance with the Archaeological Research Design and Excavation Methodology (ARDEM) (Appendix A of the HAA).

PAS 1 extends through a highly significant archaeological site. Archaeological testing of PAS 1 should be completed in the earliest instance to inform detailed design of the treated water pipelines and discharge structures, enabling avoidance of significant structures or deposits where possible.

PAS 1 (Blaxland's Farm) and PAS 2 (Blaxland's Gardens) are also situated within areas of Aboriginal archaeological sensitivity (KNC Consulting 2021:46). Historical archaeological test excavation of these sites should be coordinated with Aboriginal archaeological test or salvage excavations to ensure holistic management of each site's archaeological resources.

Salvage excavation

Salvage excavation would be completed prior to or as part of the construction program. It would enable detailed recording and analysis of archaeological remains of at least local significance, ensuring that their research potential is fully realised.

The need for archaeological salvage excavations would be informed by the results of archaeological testing for the PAS identified in 14.4.2. It is anticipated that salvage excavations may be required at the following sites:

- PAS 1 (Blaxland's Farm)
- PAS 2 (Blaxland's Gardens)
- PAS 3 (Blaxland's Crossing)
- PAS 7 (Upper Canal)
- PAS 9 (Lennox Reserve)
- PAS 10 (Lansvale Park).

If impacts cannot be avoided by redesign, salvage excavation of a localised area of high archaeological potential in PAS 8 (Upper Canal) is recommended in advance of or during construction works.

Salvage excavations must be completed in accordance with the ARDEM. Sufficient time must be allowed for in the construction program to ensure that significant archaeological remains are thoroughly recorded, and their research potential realised.

Archaeological monitoring

Monitoring is completed during the construction program and enables archaeological recording to be completed as construction works proceed, with a mechanical excavator working under the guidance of the archaeological excavation director.

Archaeological monitoring of ground disturbance must be completed in areas of low-moderate potential within PAS 8 (Upper Canal).

Further PAS may require archaeological monitoring, and this will be informed by the results of archaeological test excavations. Archaeological monitoring must be completed in accordance with the ARDEM.

Unexpected finds protocol

An unexpected finds protocol, developed in accordance with the requirements of Sydney Water, should be established and delivered as part of a heritage induction. The unexpected finds protocol should establish a cease works and reporting procedure in the instance that unanticipated archaeological remains are uncovered during construction works. It will also provide a basic understanding of archaeological materials to help contractors understand what might constitute an archaeological find. This mitigates the risk of unanticipated archaeological remains of local or state significance being destroyed without proper archaeological recording and investigation.

The documented, hands-on heritage induction would also assist contractors with identifying what may qualify as an unexpected archaeological find as they work.

Management of Aboriginal objects

In the event that any Aboriginal objects are identified during historical archaeological investigations they should be managed in accordance with the management measures specified in the Upper South Creek Aboriginal Cultural Heritage Assessment (KNC 2021).

Note that where areas of non-Aboriginal heritage identified for excavation overlap with areas of potential Aboriginal heritage identified for investigation, as identified in the Upper South Creek Aboriginal Cultural Heritage Assessment (KNC 2021), excavation works will be consistent with the Aboriginal heritage salvage excavation methodology. The Aboriginal and non-Aboriginal excavation methodologies should be developed in consultation with each other.

Post-excavation reporting

The excavation director would prepare a post-excavation report that presents a detailed description of the works performed and their results, illustrated by photographs, survey plans, and an artefact catalogue, as appropriate. The report would include a response to research questions developed for the study area, as well as individual ZAPs.

Preparation of the post-excavation report would include:

- Artefact cleaning, sorting and cataloguing;
- Processing of scientific samples;
- Digitisation of site records and plans;
- A description of the results of the investigation, including a discussion of the nature of the archaeological remains recorded;
- A response to the research questions developed for the study area;
- The results of any post-excavation analysis undertaken, including artefact or sample analysis;
- Site records, including artefact catalogues, measured drawings, and photographs, where appropriate;
- Conclusions relating to the nature and extent of surviving archaeological remains; and
- Identification of the repository for material recovered from the site.

The final archive of archaeological material should consist of all site records produced throughout the physical investigation, which may include context sheets, artefact sheets, photographs, drawings, and artefacts (inventoried, boxed, labelled, and catalogued), as well as a final copy of the post-excavation report.

Interpretation and public engagement

In addition to archaeological investigation, mitigation measures may also include interpretation of the archaeological evidence found during archaeological investigations. Interpretation would communicate the history and significance of the site to the community throughout various mediums as determined, appropriate to the significance of the resource found. Interpretation may include digital media, signage or some other type of interpretation considered to be appropriate for the relevant sites.

Significant archaeological finds must be included in the interpretation developed for the site(s). A range of appropriate mediums could be used to communicate the history and significance of select sites, including through signage, digital media, ground inlays or other forms of interpretation appropriate to the site.

Where safe and feasible to do so, open days could be hosted during archaeological excavations, particularly for those completed in parks and reserves, to enable community engagement outcomes. Preparation and distribution of brochures or booklets may further support these community engagement initiatives.

Artefact assemblage and site documents

A repository must be identified and nominated for the storage of the artefact assemblage resulting from archaeological investigations. A copy of the final post-excavation report and all excavation documents must accompany the artefact assemblage.

Consideration should be given to lodging digital copies of the site documents, including artefact catalogue, with an open-access repository to enable future research of the resulting archaeological record.

10. Conclusion

This SOHI has considered the impact of the construction and installation of the Centre proposed to service the South West and Western Sydney Aerotropolis Growth Areas. The Project will involve a range of construction types, from open-trenching to under-boring, micro-tunnelling and launch pits, and ancillary works such as the installation of temporary work compounds and access roads. This SOHI has assessed the proposed works of the Project against the heritage significance of the heritage items within and in the vicinity, as well as potential heritage items.

10.1 Built heritage

This assessment established that works associated with the construction and operation of the Upper South Creek Advanced Water Recycling Centre will have a minor and inconsequential impacts on heritage items impacted by underboring and open trenching. The works required to construct the treated water and brine pipelines will, where possible, see the remediation of the landscape on a like-for-like basis. This will have a positive outcome on the landscape character and setting of heritage items within this Project by reducing and mitigating the long-term impacts associated with construction of the treated water and brine pipelines.

Construction of the Centre on the site of 'Fleurs Radio Telescope Site' will have a major impact on heritage significance of this item. While the Project will see the removal of buildings and impressions in the landscape that visually communicate the former use of the site, the Project will have the opportunity to retain key features of the site and interpret the significance of the site. Important mitigation measures include archivally record the site pre-construction works to give a final detailed recording of the site. Future mitigations to reduce the visual prominence of the factory include detailed landscaping to screen the facility paired with considered architectural materials that are visually recessive.

Provided the mitigation measures outlined in Section 9 above are implemented and adhered to, the Project is considered acceptable.

10.2 Historical archaeology

The assessment of existing heritage studies and detailed review of historical plans and aerials for the impact assessment area identified 10 Potential Archaeological Sites (PAS), including:

- PAS 1 (Blaxland's Farm), which has moderate to moderate-high potential for state significant archaeology associated with John Blaxland's brewery and mill complex at Luddenham Estate from c.1830.
- PAS 2 (Blaxland's Gardens), which has moderate potential for archaeological evidence of local or state significance associated with early colonial gardens at Luddenham Estate.
- PAS 3 (Blaxland's Crossing), which has a localised area of moderate potential for locally significant archaeological evidence of an early colonial road, causeway and timber bridge.

- PAS 4 (McMaster Field Station), which has low-moderate potential for disturbed and ephemeral archaeological evidence of grazing and cultivation which is unlikely to meet the threshold for local significance.
- PAS 5 (McGarvie Smith Farm), which has low potential for disturbed and truncated historical archaeological evidence associated with agricultural activities which is unlikely to meet the threshold for local significance.
- PAS 6 (Exeter Farm), which has low potential for historical archaeological evidence of local significance associated with James Badgery's c.1812 Exeter Farm.
- PAS 7 (Fleurs Radiophysics Field Station), most of which has low to high potential for disturbed archaeological evidence from all phases of use unlikely to meet the threshold for local significance. There are two localised areas with high potential for archaeological evidence of local or state significance associated with two timber bridges on South Creek.
- PAS 8 (Upper Canal), which has low-moderate potential for archaeological evidence of local or state significance associated with the Upper Canal system. There is one localised area with high potential for archaeological remains of local significance.
- PAS 9 (Lennox Reserve), most of which has low potential for archaeological evidence of local significance associated with ephemeral agricultural use. A localised area within ZAP 9 has high potential for archaeological evidence of local significance associated with a mid to late-nineteenth cottage or substantial outbuilding.
- PAS 10 (Lansvale Park), which has moderate to high potential for archaeological evidence of local significance associated with a late nineteenth-century butcher's shop and separate cottage or large outbuilding.

The impact assessment has identified that historical archaeological remains of at least local significance will be impacted at the following PAS:

- PAS 1 (Blaxland's Farm)
- PAS 2 (Blaxland's Gardens)
- PAS 3 (Blaxland's Crossing)
- PAS 8 (Upper Canal)
- PAS 9 (Lennox Reserve)
- PAS 10 (Lansvale Park).

The proposed works will result in a moderate to major impact to PAS 1, a moderate impact to PAS 2, a minor to moderate impact to PAS 3, 9 and 10, and a minor impact to PAS 8. The proposed works will result in a negligible impact to the remaining PAS.

To mitigate the impacts of the Project, archaeological investigations must be completed at PAS 1, 2, 3, 8, 9, and 10. These works must be completed in accordance with ARDEM developed to satisfy SEAR 25 (attached at Appendix A of the HAA).

The mitigation strategies presented at Section 9.13 must be enacted to ensure appropriate management of the study area's historical archaeological resources.

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Appendix A. Upper South Creek Advanced Water Recycling Centre, Historical Archaeological Assessment

Prepared by Extent Heritage, 2021.

EXTENT

HERITAGE ADVISORS
TO AUSTRALIA AND
THE ASIA PACIFIC

Upper South Creek Advanced Water Recycling Centre Project

Historical Archaeological Assessment

Prepared for Sydney Water

June 2021—Final

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Executive summary

Extent Heritage Pty Ltd (Extent Heritage) has been engaged by Sydney Water to prepare a Historical Archaeological Assessment (HAA) for the construction of a wastewater treatment plant, known as the Upper South Creek Advanced Water Recycling Centre (hereafter 'the Centre'), Western Sydney. The works will also include the construction of a treated water pipeline to discharge into the Nepean and Warragamba Rivers, and a brine pipeline to connect to the Malabar wastewater system at Lansdowne. The Centre and the associated treated water and brine pipelines will be referred to through this report as the 'project'.

The project is State Significant Infrastructure (SSI) and is being assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (NSW) (EPA Act). The Planning Secretary's Environmental Assessment Requirements (SEARs) have been issued for the project (SSI-8609189) and include requirements for historical archaeology.

This HAA has been prepared in accordance with SEAR 25, which requires the following:

> A historical archaeological assessment prepared by a suitably qualified historical archaeologist in accordance with the guidelines *Archaeological Assessment* (1996) and *Assessing Significance for Historical Archaeological Sites and Relics* (2009). This assessment should identify what relics, if any, are likely to be present, assess their significance and consider the impacts from the project on this potential archaeological resource. Where impact is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations or salvage programme.

Desktop historical archaeological assessment of the study area identified ten Potential Archaeological Sites (PAS) with the potential to be impacted by the project. A summary of archaeological potential, significance, impact assessment and recommended mitigation for each PAS is presented in the table below. Note that some PAS have multiple levels of archaeological potential, and this relates to distinct areas of each PAS which are illustrated with regard to potential impacts in Section 14 of this report.

The project has the potential to impact on archaeological relics of local or state significance in six PAS. As harm cannot be avoided in whole or part of these sites, an Archaeological Research Design and Excavation Methodology (ARDEM) has been prepared to guide archaeological excavations required to mitigate the impacts of the project (Appendix A).

The strategies outlined below should be enacted to ensure sufficient mitigation of the impacts to significant historical archaeological resources as a result of the proposed project.

Table i. Assessment of impacts arising from the proposed works and recommended mitigation.

Potential Archaeological Site	Archaeological potential	Archaeological significance	Impact discussion	Recommended mitigation
Treated water pipelines				
1 (Blaxland's Farm)	Moderate to moderate-high	State	The initially proposed placement of the treated water pipelines at the north end of PAS 1, as well as an associated discharge structure 15m by 5m in size, extended through the core of the brewery and mill complex established by Blaxland c.1830. This would have resulted in a major adverse impact and near complete destruction of a highly significant archaeological site. Following additional historical research and site survey, the placement of the pipelines and discharge structure was modified to avoid the core of the site, with the updated placement following the edge of the recorded extent of the site. This represents a significant improvement to anticipated impacts. The pipelines and discharge structure still extend through areas with moderate to moderate-high archaeological potential, though archaeological evidence is likely more dispersed in these area (being outside the core of the site), and they are more likely to have been impacted by twentieth century agricultural activities. This impact can be further reduced by archaeological testing in advance of construction to refine final placement of treated water pipelines to avoid significant structures or deposits. The project will still, however, result in an adverse impact to the site's historical archaeological resources, and these impacts must be mitigated.	Archaeological testing to inform detailed design and further works. Archaeological salvage excavation of remains of local or state significance within the impact area.

Potential Archaeological Site	Archaeological potential	Archaeological significance	Impact discussion	Recommended mitigation
	Low	State or local	Installation of the treated water pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.[1]
2 (Blaxland's Gardens)	Moderate	State or local	Within the impact area, installation of the treated water pipeline would result in complete removal of archaeological remains of local or state significance associated with Blaxland's gardens at Luddenham Estate. This would result in partial loss of the Blaxland's gardens site. This would result in an adverse impact to the study area's archaeological resources, and these impacts must be mitigated.	Archaeological testing to confirm assessed levels of potential and significance. Archaeological salvage excavation of remains of local or state significance within the impact area.
	Low	State or local	Installation of the treated water pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.
3 (Blaxland's Crossing)	Moderate	Local	Installation of the treated water pipeline is likely to result in the localised removal of historical archaeological evidence of local significance associated with an early colonial roadway, as well as potentially a causeway and timber bridge. This would result in a partial loss of these sites, as they would be anticipated to extend further to the west to the edge of (as well as partly within) the Nepean River.	Archaeological monitoring of ground disturbance in areas of moderate potential.
	Low	Unlikely to meet the threshold for local significance	Installation of the treated water pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.
4 (McMaster Field Station)	Low to low-moderate	Unlikely to meet the threshold	Installation of the treated water pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.

[1] An 'unexpected finds protocol' establishes a procedure to stop works and report to the responsible archaeologist if potential archaeological remains are found. It also outlines what might archaeological remains might look like to assist with identification.

Potential Archaeological Site	Archaeological potential	Archaeological significance	Impact discussion	Recommended mitigation
		for local significance		
5 (McGarvie Smith Farm)	Low	Unlikely to meet the threshold for local significance	Installation of the treated water pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.
6 (Exeter House and Farm)	Low	Local	Installation of the treated water pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.
The Centre				
7 (Fleurs Radio Telescope Site)	Low	Unlikely to meet the threshold for local significance	Bulk earthworks and trenching associated with construction of the centre is unlikely to impact on significant historical archaeological remains. These works will result in little or no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.
	High	Local or state	Construction of the centre may extend into areas with the potential for historical archaeological evidence of the timber bridges on South Creek. Care should be taken during the construction program to ensure that these areas are clearly delineated and subject to an exclusion zone to ensure no unintended impacts occur.	Avoid impacts in areas of high potential. Archaeological salvage excavation of remains of local or state significance within the impact area if impacts cannot be avoided.
Brine pipelines				
8 (Upper Canal)	Low-moderate	State or local	The area spanning the Upper Canal will be under bored to a depth of about 7 metres. While under boring is unlikely to impact on significant archaeological remains, excavation of entry and exit pits would result in removal of any significant archaeological remains within their footprints. Similarly, trenching in areas of low-moderate potential may result in removal of significant historical archaeological remains.	Archaeological monitoring of ground disturbance in areas of low-moderate potential.

Potential Archaeological Site	Archaeological potential	Archaeological significance	Impact discussion	Recommended mitigation
			Overall, the brine pipeline may have a minor adverse archaeological impact and should be mitigated.	
	High	Local	Trenching will likely result in the removal of historical archaeological remains of local significance associated with an outbuilding constructed to support the operations of the Upper Canal. This would result in an adverse impact to the study area's archaeological resources, and these impacts must be mitigated.	Avoid impacts in areas of high potential, if possible. Archaeological salvage excavation of remains of local significance within the impact area.
	Low	Local	Installation of the brine pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.
9 (Lennox Reserve)	High	Local	Trenching to install the brine pipeline would result in partial or complete removal of significant archaeological evidence associated with a mid to late-nineteenth century cottage or large outbuilding.	Avoid impacts in areas of high potential, if possible. If impact cannot be avoided, complete archaeological testing to confirm potential and significance. Archaeological salvage excavation of remains of local or state significance within the impact area.
	Low	Local	Installation of the brine pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.
10 (Lansvale Park)	Moderate to high	Local	Trenching to install the brine pipeline would extend through the centre of two historical structures, one associated with Knight's Butcher Shop, the other an unidentified late nineteenth-century cottage or outbuilding, and result in the removal of any associated archaeological evidence.	Archaeological testing to confirm potential and significance. Archaeological salvage excavation of remains of local

Potential Archaeological Site	Archaeological potential	Archaeological significance	Impact discussion	Recommended mitigation
			Installation of the brine pipeline through PAS 10 would result in an adverse impact to the study area's archaeological resources.	or state significance within the impact area.
	Low	Local	Installation of the brine pipeline in these areas would result in little to no archaeological impact.	Works to proceed under an 'unexpected finds protocol'.

Mitigation strategies

The significance of the historical archaeological resources that may still survive within the study area is primarily based on its research potential and ability to tell the story about the site. Therefore, the adverse impact of the proposed project could be mitigated by appropriate archaeological investigation, recording and interpretation for the benefit of the general public and future generations.

A range of mitigation strategies have been presented in the table above. A brief description of each strategy, and relevant sites, is presented below.

Avoidance

Three sites present the opportunity for immediate minor redesign to avoid impact to areas of moderate to high archaeological potential:

- PAS 3 (Blaxland's Crossing)
- PAS 8 (Upper Canal)
- PAS 7 (Fleur's Radio Telescope Site)
- PAS 9 (Lansvale Park).

Avoiding impacts in areas of high archaeological potential as will render it unnecessary to complete archaeological test and/or salvage excavation of associated deposits and features. As the areas of high potential are just within the current study area, detailed design should consider the opportunity to avoid ground disturbance in areas of moderate to high archaeological potential.

Test excavation

Test excavation enables the confirmation of the assessed levels of historical archaeological potential and significance. Completion of test excavation at key sites will enable more certainty in estimating project costs and timeframes, minimising disruption or delays to the construction program. Should test excavation uncover evidence of substantial historical archaeological remains, their management would include one of the following:

- Salvage after thorough recording;
- Archaeological monitoring; or
- An avoidance strategy.

Testing to inform further archaeological requirements is recommended for the following sites:

- PAS 1 (Blaxland's Farm)

- PAS 2 (Blaxland's Gardens)
- PAS 9 (Lennox Reserve) (if impacts cannot be completely avoided by redesign)
- PAS 10 (Lansvale Park).

Archaeological testing will only be triggered if areas of with moderate or high potential for historical archaeological remains of at least local significance will be impacted. Archaeological testing must be completed in accordance with the Archaeological Research Design and Excavation Methodology (ARDEM) (Appendix A).

PAS 1 extends through a highly significant archaeological site. Archaeological testing of PAS 1 should be completed in the earliest instance to inform detailed design of the treated water pipelines and discharge structures, enabling avoidance of significant structures or deposits where possible.

PAS 1 (Blaxland's Farm) and PAS 2 (Blaxland's Gardens) are also situated within areas of Aboriginal archaeological sensitivity (KNC Consulting 2020:46). Historical archaeological test excavation of these sites should be coordinated with Aboriginal archaeological test or salvage excavations to ensure holistic management of each PAS's archaeological resources.

Salvage excavation

Salvage excavation would be completed prior to or as part of the construction program. It would enable detailed recording and analysis of archaeological remains of at least local significance, ensuring that their research potential is fully realised.

The need for archaeological salvage excavations would be informed by the results of archaeological testing for the PAS identified in 14.4.2. It is anticipated that salvage excavations may be required at the following sites:

- PAS 1 (Blaxland's Farm)
- PAS 2 (Blaxland's Gardens)
- PAS 8 (Upper Canal)
- PAS 9 (Lennox Reserve)
- PAS 10 (Lansvale Park).

If impacts cannot be avoided by redesign, salvage excavation of localised areas of high archaeological potential in PAS 7 (Fleur's Radio Telescope Site) and PAS 8 (Upper Canal) is recommended in advance of or during construction works.

Salvage excavations must be completed in accordance with the ARDEM. Sufficient time must be allowed for in the construction program to ensure that significant archaeological remains are thoroughly recorded, and their research potential realised.

Archaeological monitoring

Monitoring is completed during the construction program and enables archaeological recording to be completed as construction works proceed, with a mechanical excavator working under the guidance of the archaeological excavation director.

Archaeological monitoring of ground disturbance must be completed in areas of moderate potential within PAS 3 (Blaxland's Crossing) and low-moderate potential within PAS 8 (Upper Canal).

Further PAS may require archaeological monitoring, and this will be informed by the results of archaeological test excavations. Archaeological monitoring must be completed in accordance with the ARDEM.

Unexpected finds protocol

An unexpected finds protocol should be established and delivered as part of a heritage induction. The unexpected finds protocol should establish a cease works and reporting procedure in the instance that unanticipated archaeological remains are uncovered during construction works. It will also provide a basic understanding of archaeological materials to help contractors understand what might constitute an archaeological find. This mitigates the risk of unanticipated archaeological remains of local or state significance being destroyed without proper archaeological recording and investigation.

The documented, hands-on heritage induction would also assist contractors with identifying what may qualify as an unexpected archaeological find as they work.

Management of Aboriginal objects

In the event that any Aboriginal objects are identified during historical archaeological investigations they should be managed in accordance with the management measures specified in the Upper South Creek Aboriginal Cultural Heritage Assessment (KNC 2021).

Note that where areas of non-Aboriginal heritage identified for excavation overlap with areas of potential Aboriginal heritage identified for investigation, as identified in the Upper South Creek Aboriginal Cultural Heritage Assessment (Kelleher Nightingale, 2021), excavation works will be consistent with the Aboriginal heritage salvage excavation methodology. The Aboriginal and non-Aboriginal excavation methodologies should be developed in consultation with each other.

Post-excavation reporting

The excavation director would prepare a post-excavation report that presents a detailed description of the works performed and their results, illustrated by photographs, survey plans, and an artefact catalogue, as appropriate. The report would include a response to research questions developed for the study area, as well as individual PASs.

Preparation of the post-excavation report would include:

- Artefact cleaning, sorting and cataloguing;
- Processing of scientific samples;
- Digitisation of site records and plans;
- A description of the results of the investigation, including a discussion of the nature of the archaeological remains recorded;
- A response to the research questions developed for the study area;
- The results of any post-excavation analysis undertaken, including artefact or sample analysis;
- Site records, including artefact catalogues, measured drawings, and photographs, where appropriate;
- Conclusions relating to the nature and extent of surviving archaeological remains; and
- Identification of the repository for material recovered from the site.

The final archive of archaeological material should consist of all site records produced throughout the physical investigation, which may include context sheets, artefact sheets, photographs, drawings, and artefacts (inventoried, boxed, labelled, and catalogued), as well as a final copy of the post-excavation report.

Interpretation and public engagement

In addition to archaeological investigation, mitigation measures may also include interpretation of the archaeological evidence found during archaeological investigations. Interpretation would communicate the history and significance of the site to the community throughout various mediums as determined, appropriate to the significance of the resource found. Interpretation may include digital media, signage or some other type of interpretation considered to be appropriate for the relevant sites.

Significant archaeological finds must be included in the interpretation developed for the site(s). A range of appropriate mediums could be used to communicate the history and significance of select sites, including through signage, digital media, ground inlays or other forms of interpretation appropriate to the site.

Consideration should be given to hosting open days during archaeological excavations, particularly for those completed in parks and reserves, to enable community engagement outcomes. Preparation and distribution of brochures or booklets may further support these community engagement initiatives.

Artefact assemblage and site documents

A repository must be identified and nominated for the storage of the artefact assemblage resulting from archaeological investigations. A copy of the final post-excavation report and all excavation documents must accompany the artefact assemblage.

Consideration should be given to lodging digital copies of the site documents, including artefact catalogue, with an open-access repository to enable future research of the resulting archaeological record.

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1. Introduction

1.1 Project initiation

Extent Heritage Pty Ltd (Extent Heritage) has been engaged by Sydney Water to prepare a Historical Archaeological Assessment (HAA) for the construction of a wastewater treatment plant, known as the Upper South Creek Advanced Water Recycling Centre (hereafter 'the Centre'), Western Sydney. The works will also include the construction of treated water pipelines to discharge into the Nepean and Warragamba Rivers, and brine pipelines to connect to the Malabar wastewater system at Lansdowne. The Centre and the associated treated water and brine pipelines will be referred to through this report as the 'project'.

The project is State Significant Infrastructure (SSI) and is being assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (NSW) (EPA Act). The Planning Secretary's Environmental Assessment Requirements (SEARs) have been issued for the project (SSI-8609189) and include requirements for historical archaeology.

This HAA has been prepared in accordance with SEAR 25, which requires the following:

> A historical archaeological assessment prepared by a suitably qualified historical archaeologist in accordance with the guidelines *Archaeological Assessment* (1996) and *Assessing Significance for Historical Archaeological Sites and Relics* (2009). This assessment should identify what relics, if any, are likely to be present, assess their significance and consider the impacts from the project on this potential archaeological resource. Where impact is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations or salvage programme.

1.2 Project description

Sydney Water proposes to deliver new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas in stages, with Stage 1 comprising:

- Building and operating the Centre to treat an average dry weather flow of up to 50ML per day.
- Building all pipelines to their ultimate capacity, but only operating them to transport and release volumes produced by the Stage 1 Centre.

The timing and scale of future stages will be phased to respond to drivers including population growth rate and the most efficient way for Sydney Water to optimise its wastewater systems.

Advanced Water Recycling Centre

- A wastewater treatment plant with the capacity to treat up to 50 ML of wastewater per day, with ultimate capacity of up to 100ML per day.

- The Advanced Water Recycling Centre will produce:
    - High-quality treated water suitable for a range of uses including recycling and environmental flows.
    - Renewable energy, including through the capturing of heat for cogeneration.
    - Biosolids suitable for beneficial reuse.
    - Brine, as a by-product of reverse osmosis treatment.

Treated water pipelines

- A pipeline about 17 km long from the Advanced Water Recycling Centre to the Nepean River at Wallacia Weir, for the release of treated water.
- Infrastructure from the Advanced Water Recycling Centre to South Creek to release excess treated water and wet weather flows.
- A pipeline about five kilometres long from the main treated water pipeline at Wallacia to a location between the Warragamba Dam and Warragamba Weir, to release high-quality treated water to the Warragamba River as environmental flows.

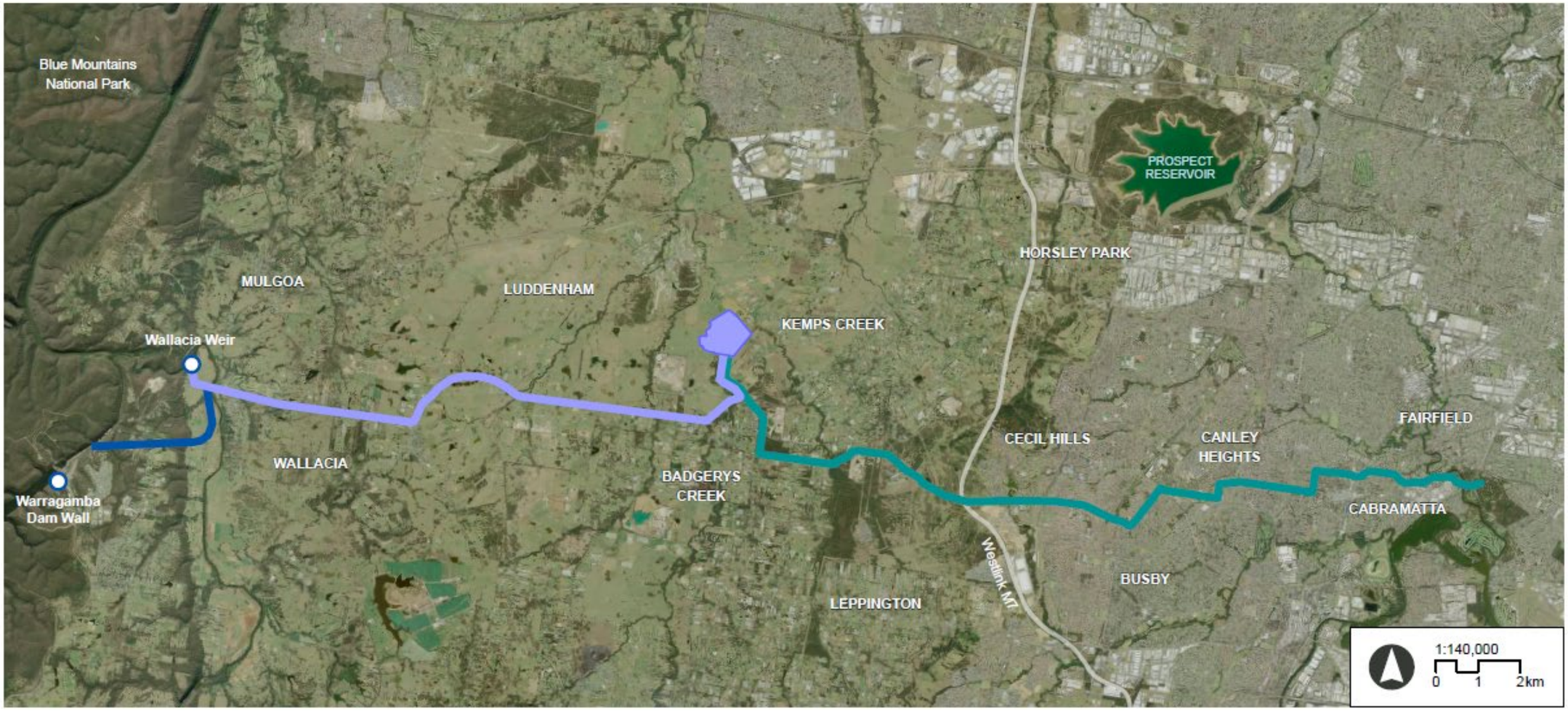
Brine pipeline

A pipeline about 24 km long that transfers brine from the Advanced Water Recycling Centre to Lansdowne, in south-west Sydney, where it connects to Sydney Water's existing Malabar wastewater network.

1.3 Study area

The study area for the project extends across Western Sydney (Figure 1). For the purpose of this report, the 'study area' refers to the 'impact assessment area' boundaries provided by Sydney Water for the project. The Centre is on part of Lot 21 DP 258414, in Kemps Creek.

The associated treated water and brine pipelines will extend from the centre at Kemps Creek to the Malabar wastewater system at Lansdowne in the east, and discharge into the Nepean and Warragamba Rivers in the west. This work will extend through multiple LGAs including, from east to west: Canterbury-Bankstown, Fairfield, Liverpool, Penrith and Wollondilly.



Projection: GDA 1994 MGA Zone 56
Project infrastructure locations are indicative and will be refined during design

Figure 1. Plan showing the location of the study area. Source: Sydney Water

1.4 Objectives

This report has been prepared to satisfy the requirements of SEAR 25 for SSI-8609189. Table 1 below outlines each requirement included in SEAR 25 and the relevant section in which it is addressed.

Table 1. Response to the historical archaeological requirements of SEAR 25.

Secretary's requirement	Where addressed in this HAA
Prepared by a suitably qualified historical archaeologist	Section 1.6 (Author identification)
Prepared in accordance with *Archaeological Assessment* (1996) and *Assessing Significance for Historical Archaeological Sites and Relics* (2009)	Section 3.1 (Approach)
Identify what relics, if any, are likely to be present	Section 3.3 (Areas assessed) Section 3.4 (Zones of archaeological potential) Sections 4.3, 5.3, 6.3, 7.3, 8.3, 9.3, 10.3, 11.3, 12.3, 13.3 (Potential archaeological resource)
Assess their significance	Section 3.5 (Significance assessment) Sections 4.4, 5.4, 6.4, 7.4, 8.4, 9.4, 10.4, 11.4, 12.4, 13.4 (Assessment of significance)
Consider the impacts from the project on this potential archaeological resource	Section 14 (Impact assessment)
Appropriate mitigation strategy based on significance of relics	Section 15.2 (Recommendations)
Research Design and Excavation Methodology to be prepared where harm cannot be avoided	Appendix A

1.5 Limitations

- Areas assessed as having the potential for historical archaeological remains were inspected and photographed by Francesca McMaster of Extent Heritage on 15 and 16 October, as well as 4 November 2020, where it was possible to gain access. One site (Blaxland's Farm) was inspected and photographed by Jennifer Jones-Travers, Tom Sapienza, Eleanor Banaag and Kim Watson of Extent Heritage on 1 September 2020.
- No physical archaeological investigations were undertaken for the preparation of this report.
- Areas where impacts are limited to primary transport corridors (main roads and highways) and verges have not been subjected to detailed examinations. This report assumes that these areas have been previously disturbed during road construction, repair and installation of other major services.

- The historical overview for each area of archaeological potential provides sufficient historical background to satisfy SEAR 25 and provide an understanding of the place in order to assess archaeological potential and significance.

1.6 Author identification

This HAA has been prepared by Dr Jennifer Jones-Travers (senior associate) and Francesca McMaster (heritage advisor) with maps prepared by Tom Sapienza (GIS specialist and senior heritage advisor). It has been reviewed by Anita Yousif (associate director and national technical lead, historical archaeology).

Anita Yousif is an approved Excavation Director for sites of local and state significance with over 20 years' experience who fully satisfies all requirements of the NSW Heritage Council's *Excavation Director Criteria* (2019), as well as the current President of the Australasian Society for Historical Archaeology. Jennifer Jones-Travers is an approved Excavation Director for sites of local significance and some sites of state significance with over 16 years' experience and a PhD specialising in Australian historical archaeology. She is the current Member with Expertise in Archaeology on the Tasmanian Heritage Council.

1.7 Acknowledgments

We wish to acknowledge the assistance of Jude Gregory from Sydney Water in preparing this HAA.

1.8 Glossary

Key acronyms and terms adopted in this HAA are presented in Table 1 below.

Table 2. Key terms and acronyms used in this HAA.

Term	Meaning
ARDEM	Archaeological Research Design and Excavation Methodology
HAA	Historical Archaeological Assessment
LEP	Local Environmental Plan
NHL	National Heritage List
SEAR	Secretary's Environmental Assessment Requirement
SEPP	State Environmental Planning Policy
SHR	State Heritage Register (NSW)
WHL	World Heritage List

2. Planning context

2.1 Key heritage legislation

Historical archaeology in New South Wales is protected by Commonwealth and State legislation, as well as regulations provided by local government. Of relevance to the project are:

- *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth);
- *Environmental Planning and Assessment Act 1979* (NSW); and
- *Heritage Act 1977* (NSW).

Details of these key pieces of legislation as are included in Section 3 of the Statement of Heritage Impact (SoHI) for the project developed by Extent Heritage (2021). Specific legislation relating to historical archaeological 'relics' in NSW not included in the SoHI is presented below, as are the details of current heritage listings relevant to the project area's historical archaeological resources.

2.1.1 Heritage Act 1977 (NSW)

The *Heritage Act 1977* (NSW) (the Heritage Act) is designed to conserve the environmental heritage of New South Wales and regulate development impacts on the state's heritage assets. Significant historical archaeological features are afforded automatic statutory protection by the 'relics' provisions of the Act. A 'relic' is defined as:

> any deposit, artefact, object or material evidence that:
>
> a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
>
> b) is of State or local heritage significance.

In accordance with section 139(1) of the Heritage Act, it is an offence to disturb or excavate land, where this may affect a relic, without an approval or excavation permit issued by the Heritage Council of NSW, or an endorsed 'exemption' or 'exception' to disturb or expose and destroy a relic. Sites which may contain archaeological relics are usually managed under sections 140 and 141 of the Heritage Act, though sites listed on the State Heritage Register (SHR), are managed under sections 60 and 63 of the Heritage Act.

As the project is designed State Significant Infrastructure (SSI), the requirement for approvals under section 63 or 141 of the Heritage Act is effectively 'switched off'. The approach to managing significant historical archaeological resources in NSW is still, however, informed by the guidelines established by the Heritage Council of NSW and Heritage NSW, including *Archaeological Assessment* (1996) and *Assessing Significance for Historical Archaeological Sites and Relics* (2009).

2.2 Heritage listings

Table 3 presents a summary of all statutory heritage listings relevant to the project.

Table 3. Summary of statutory heritage listings relevant to the study area's archaeological resources.

Register/Listing	Item Listed (Y/N)	Item Name	Item number
National Heritage List	Y	Greater Blue Mountain World Heritage Area	No ID
Commonwealth Heritage List	N	-	-
State Heritage Register	Y	Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	01373
State Agency Heritage and Conservation Register	Y (Water NSW)	Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	-
		Warragamba Water Supply	-
SEPP Western Sydney Parklands 2009	Y	Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	7
		Liverpool Offtake Reservoir	12
Liverpool LEP 2008	Y	Sydney Water Supply Upper Canal	15
Penrith LEP 2014	Y	The Fleurs Radio Telescope Site	832
		McGarvie-Smith Farm	857
		Luddenham Homestead Site*	A849
Wollondilly LEP 2011	Y	Blaxland's Farm	I269
	Y	Blaxland's Crossing	I289
SEPP Western Sydney Aerotropolis 2020	Y	McGarvie Smith Farm	I1
		Luddenham Road alignment	I8
		The Fleurs Radio Telescope site	I5
		Showground	I15

*Test excavation by AHMS (now Extent) in 2010 identified that the site retained no archaeological potential as a result of extensive land cutting activities (AHMS 2011).

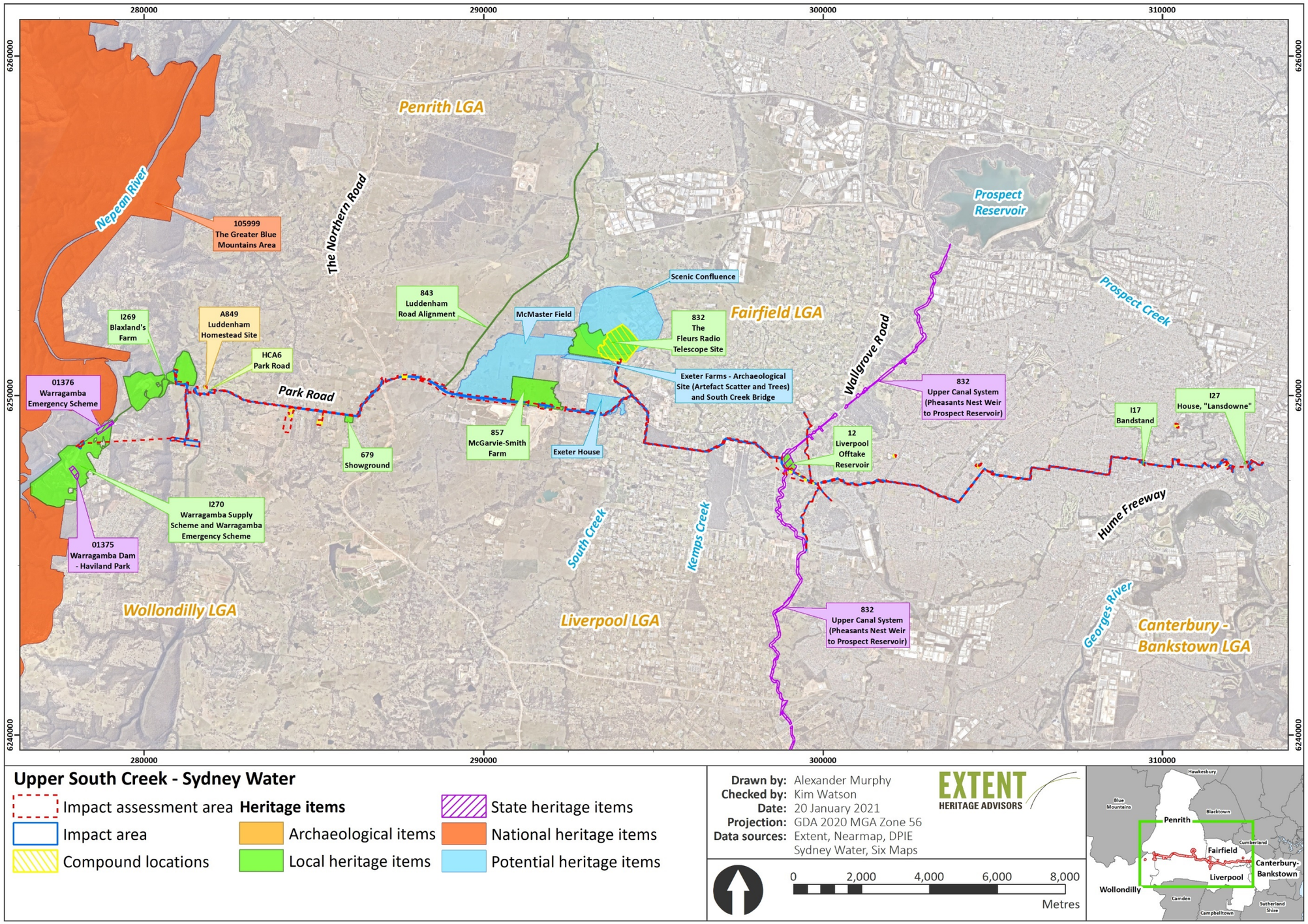


Figure 2. Overview of all known and potential heritage sites that intersect the project.

3. Methodology

3.1 Approach

The following steps have been completed in assessing the study area's potential for significant historical archaeological remains or relics:

- Review previous heritage studies and assessments relevant to the study area to locate previously identified archaeological sites.
- Assess historical maps and aerials extending across the entirety of the study area to identify new areas, not captured in previous studies, with evidence of historical development/disturbance.
- Prepare site development histories for identified 'Potential Archaeological Sites' (PAS).
- Use of site histories, historical maps and aerials to develop assessments of historical archaeological potential and significance for each PAS.

An assessment of archaeological impacts arising from the project is provided in Section 14, which also provides a series of mitigation measures to ensure appropriate strategies are in place to avoid, reduce or mitigate impacts arising from the project.

3.2 Previous reports and investigations

A large number of previous heritage studies and assessments have been reviewed to assist with identifying areas with the potential for archaeological relics, including the following:

- AECOM (2019), 'Upper South Creek water recycling plant: Aboriginal and historical heritage desktop constraints analysis', report prepared for Sydney Water, August 2019.
- Cultural Resources Management (2019), 'Historic period resources—University of Sydney west Sydney lands, Badgerys Creek Farm Centre, Elizabeth Drive, Badgerys Creek', report prepared for University of Sydney, April 2019.
- Edward Higginbotham and Associates (1993) 'Historical archaeology report, Fairfield City heritage study, volume 4', report prepared for Perumal Murphy Wu Pty Ltd.
- Kass, T. (1993) 'Thematic history of Fairfield, Fairfield City heritage study, volume 1', report prepared for Perumal Murphy Wu Pty Ltd.
- Neustein and Associates (1992) 'Liverpool Heritage Study, Part 1', report prepared for Liverpool City Council, April 1992.
- Paul Davies Pty Ltd (2007) 'Penrith Heritage Study Volume 3 – Locality Assessment', report prepared for Penrith City Council, November 2007.

- PPK Consultants Pty Ltd (1993), 'Elizabeth Drive landfill proposal to accept general solid waste: Environmental Impact Statement, Volume 1', prepared for Pacific Waste Management.
- Roads and Maritime Services (2019), 'M12 Motorway environmental impact statement, appendix J, non-Aboriginal heritage assessment', report prepared October 2019.
- RPS (2016), 'Western Sydney Airport EIS: European and other heritage technical report', report prepared for Department of Infrastructure and Regional Development, August 2016.
- Extent Heritage (2020), 'Western Sydney Aerotropolis initial precincts: Aboriginal and non-Aboriginal cultural heritage assessment', report prepared for Western Sydney Planning Partnership, December 2020.
- O'Sullivan, C (1977), 'John Blaxland's Luddenham Estate, including the Mulgoa Industrial Site', unpublished report prepared by the Workers' Educational Association of NSW.

Each of these studies was reviewed to determine whether any previously identified archaeological sites within the study area. Potential archaeological sites described within these studies relevant to the project include:

- Blaxland's Farm
- Blaxland's Crossing
- McMaster Field Station
- McGarvie Smith Farm
- Exeter House and Farm
- Fleurs Radio Telescope Site
- Upper Canal.

3.3 Areas assessed

Although a number of sites were identified through the review of previous studies, further assessment of the study area was completed to determine whether any previously unidentified areas of archaeological potential may exist.

Major roadways and verges were assessed as likely to have been subject to significant disturbance during their construction and were not subject to detailed assessment. Across the remainder of the study area, 29 areas of interest were identified, mostly parks and reserves the proposed pipelines would pass through (Figure 3). Historical aerials, parish maps, subdivision plans and other historical plans available through Historical Land Records Viewer (NSW Land Registry Services), State Library NSW, TROVE, and NSW State Archive were georeferenced and overlaid on the 29 areas of interest.

Historical plans and aerials for each area of interest were subject to detailed assessment to identify whether historical development likely to have produced historical archaeological evidence of occupation and use was likely to have occurred. Where there was no evidence of historical development (which was most often the case), the site was assessed as having little or no historical archaeological potential. From the 29 areas of interest assessed in detail, three new sites were identified:

- Blaxland's Gardens
- Lennox Reserve
- Lansvale Park.

All areas assessed as having some potential for historical archaeological remains were declared 'Potential Archaeological Sites' (PAS) and subjected to full assessments of archaeological potential and significance as part of this HAA.

3.4 Potential archaeological sites (PAS)

The ten PAS identified were subject to additional historical research, including more detailed examinations of maps and plans to enable preparation of archaeological zoning plans within the study area (Figure 4). The boundary for each PAS reflects the extent of the impact assessment area (and the project study area), not the anticipated extent of the related archaeological site. Delineation of the full extent of each site beyond the study area is outside the scope of this HAA.

Historical title searches were completed to determine changes in land use and ownership, and each accessible site was inspected to assess current ground conditions and identify any extant archaeological evidence (artefact scatters, visible footings) or modern landscape modifications (cutting, filling, trenching).

Succinct HAAs have been prepared for each PAS and are presented in Sections 4 through 13. Listed and potential heritage listings relevant to the PAS are presented in Figure 5.

3.5 Significance assessment

Archaeological significance refers to the heritage significance of known or potential archaeological remains. While they remain an integral component of the overall significance of a place, it is necessary to assess the archaeological resources of a site independently from above ground and other heritage elements. Assessment of archaeological significance is more challenging as the extent and nature of the archaeological features is often unknown and judgement is usually formulated on the basis of expected or potential attributes.

3.5.1 NSW heritage criteria

The significance assessment of each PAS's archaeological resource was carried out by applying criteria expressed in the publication *Assessing Significance for Historical Archaeological Sites and 'Relics*, prepared by the Heritage Branch, formerly Department of

Planning (NSW) (now Heritage NSW, Department of Premier and Cabinet) in December 2009. A table responding to each of the seven heritage criteria is presented for each PAS in Sections 4.4.1, 5.4.1, 6.4.1, 7.4.1, 8.4.1, 9.4.1, 10.4.1, 11.4.1, 12.4.1, and 13.4.1.

3.5.2 Bickford and Sullivan's questions

The NSW heritage assessment criteria are supplemented by the established assessment framework that has been developed by Anne Bickford and Sharon Sullivan (1984), who set three fundamental questions to assist in determining the research potential of an archaeological site:

- Can the site contribute knowledge that no other resource can?
- Can the site contribute knowledge that no other site can?
- Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

A response to these three questions is provided for each PAS in Sections 4.4.2, 5.4.2, 6.4.2, 7.4.2, 8.4.2, 9.4.2, 10.4.2, 11.4.2, 12.4.2, and 13.4.2.

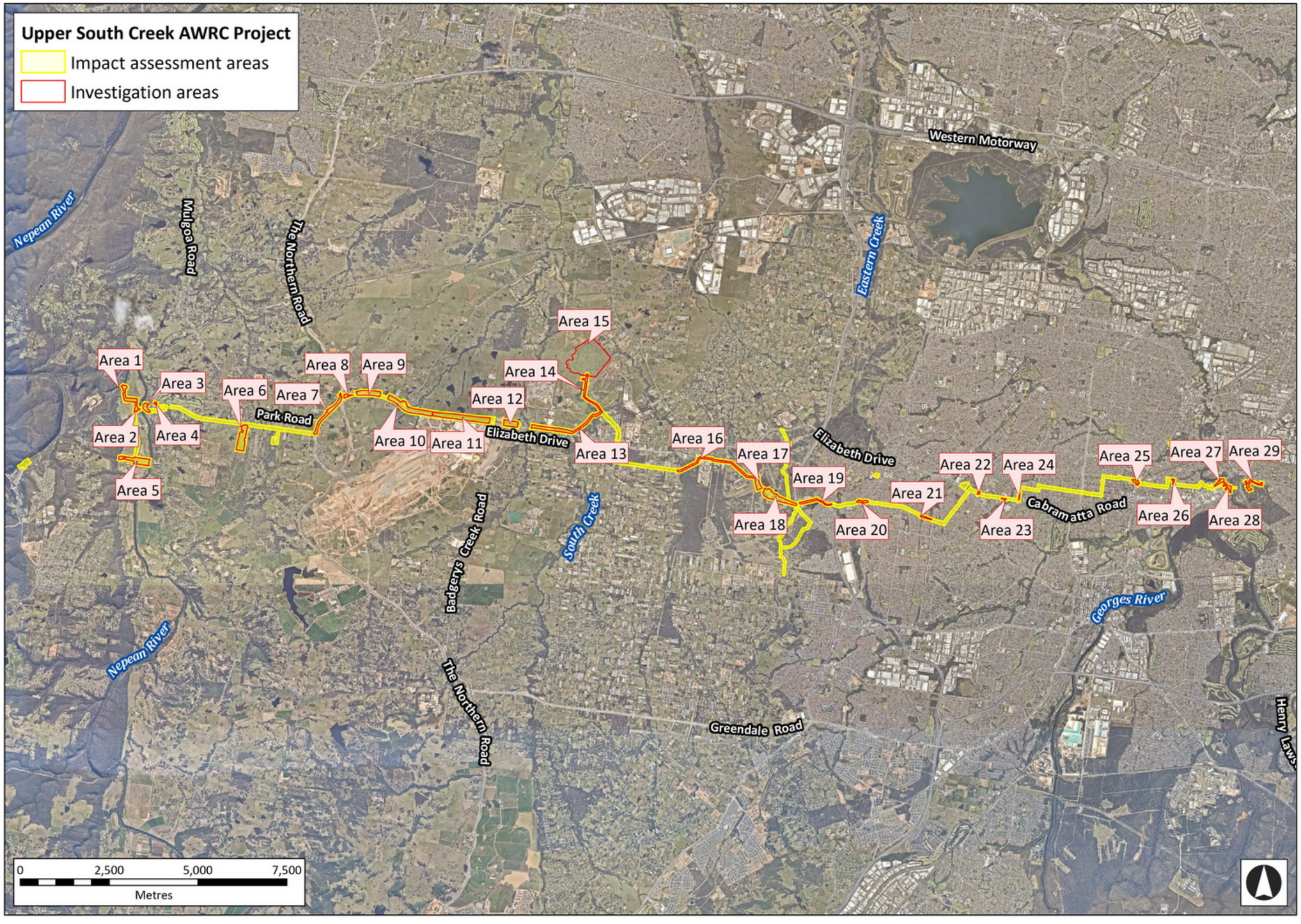


Figure 3. Plan of the study area showing the 29 areas subject to more detailed assessment of historical plans and aerials as part of preparation of this HAA. Source: Near Map, Sydney Water, Extent

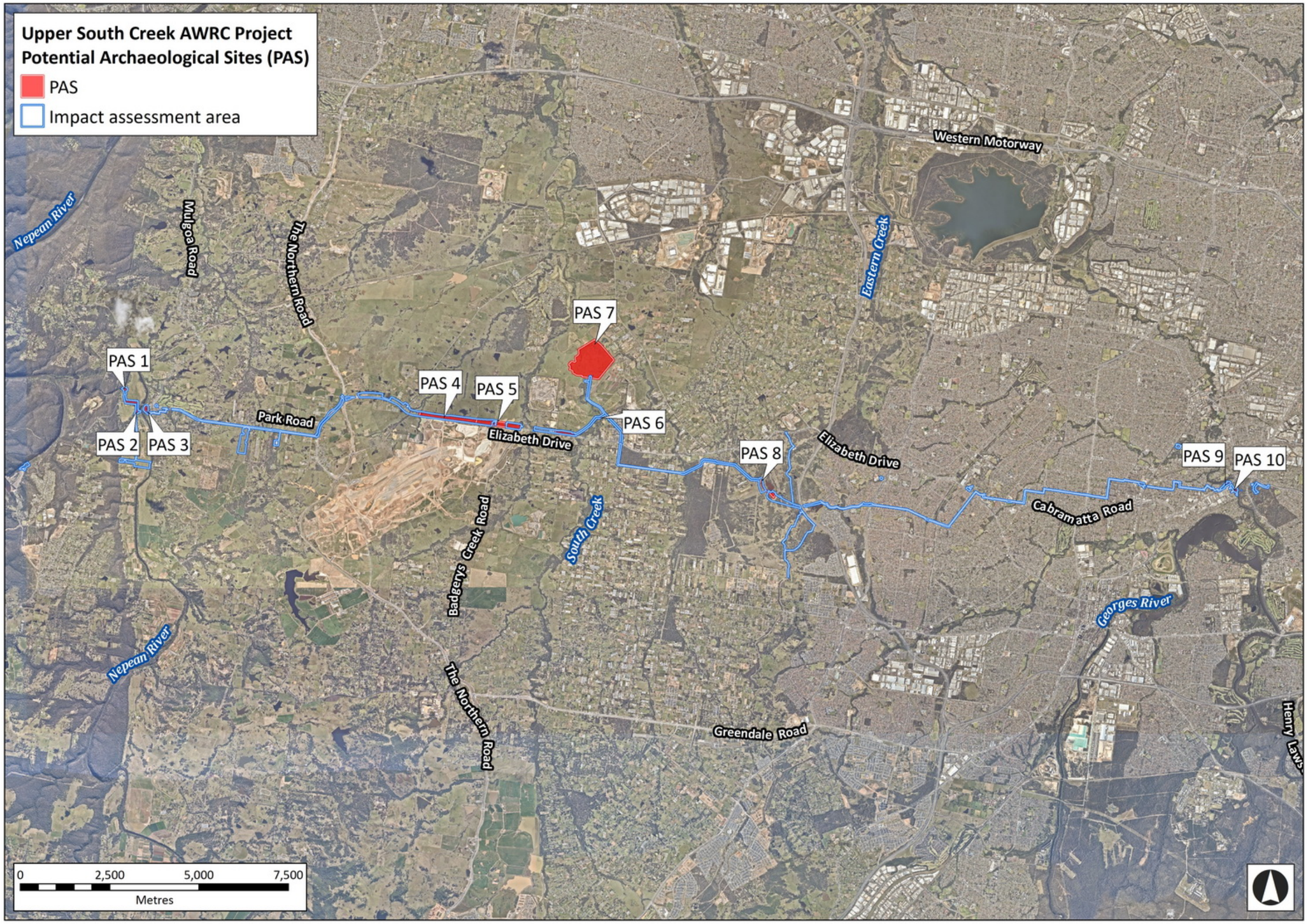


Figure 4. Ten PAS identified during the assessment of the study area and subject to detailed assessment as part of this HAA. Source: Near Map, Sydney Water, Extent

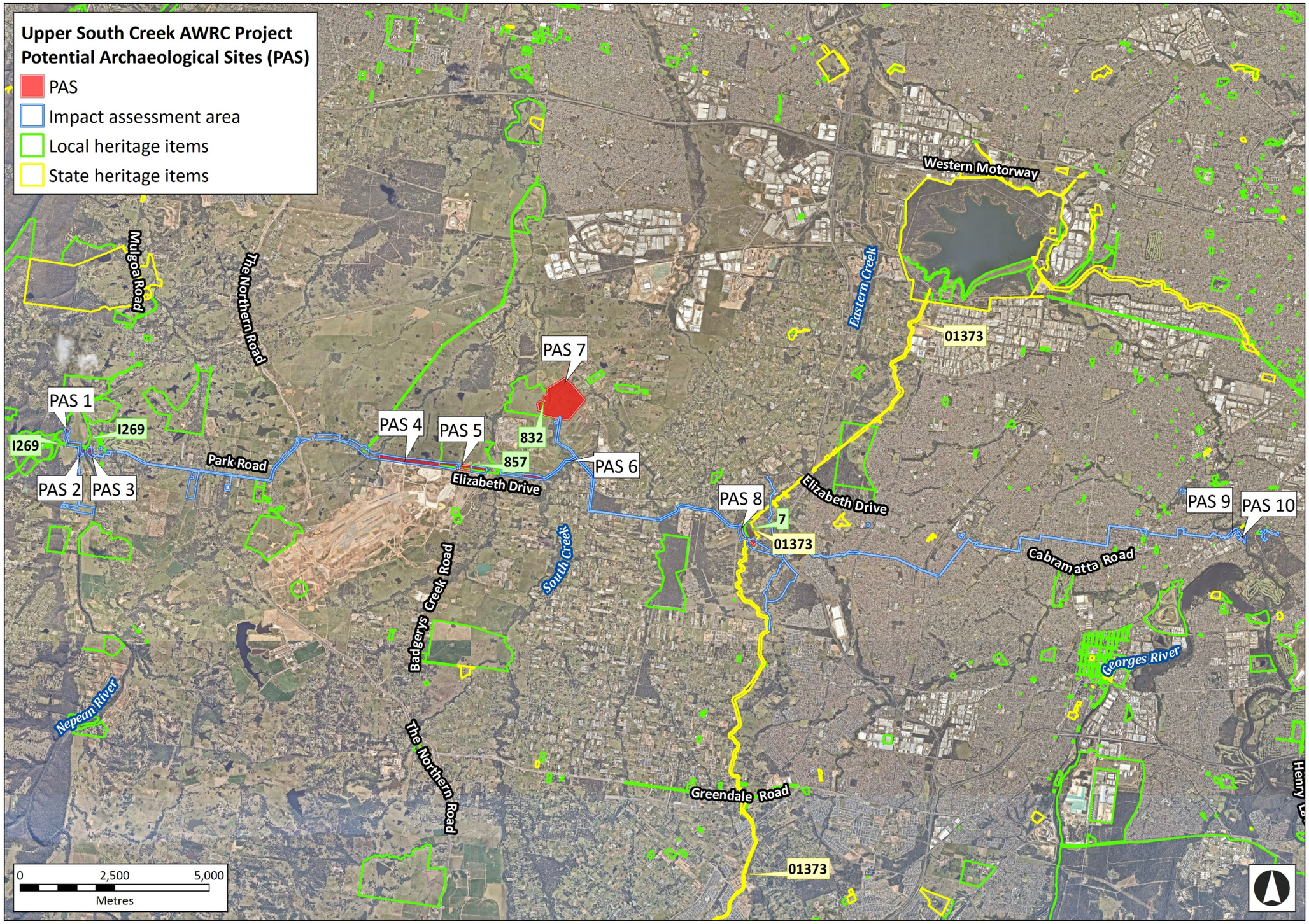


Figure 5. Heritage listings relevant to identified PAS within the study area. Source: Extent, Near Map, DPIE

4. PAS 1—Blaxland's Farm

4.1 Overview

PAS 1 (Blaxland's Farm) is located at 2595 Silverdale Road, Wallacia (Lot 1 DP 1154130), within the Wollondilly Shire Council LGA (Figure 6). It is currently listed on the *Wollondilly LEP 2011* (Item I269).

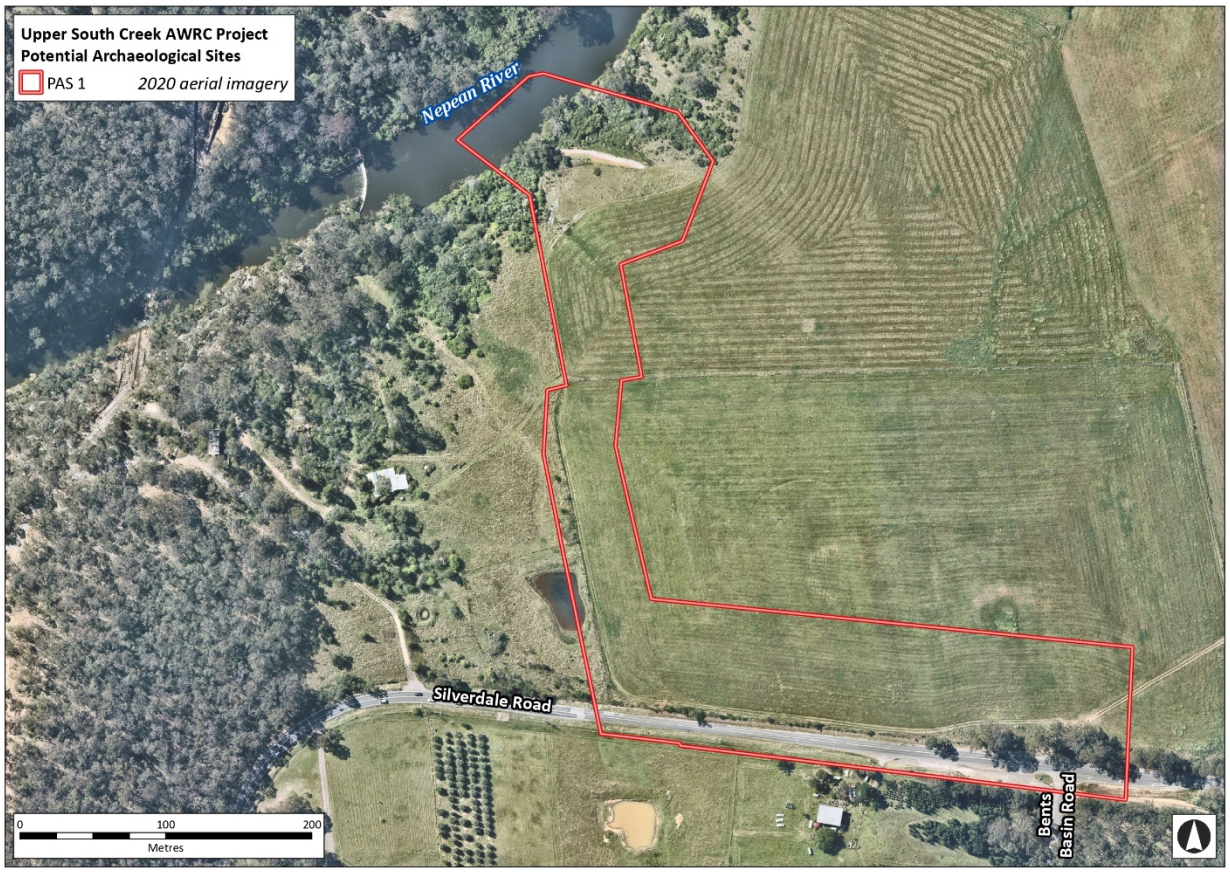


Figure 6. Location and extent of PAS 1. Source: LPI, Extent

4.2 Historical development

John Blaxland was born on 4 January 1769 at Fordwich, Thent, England, and was educated at King's School in Canterbury. By 1804 he had decided to sell his land in England to begin a pastoral enterprise in the colony of New South Wales. His brother Gregory Blaxland and family sailed for Sydney, followed by John and his family who arrived in Sydney in April 1807. The brothers wanted to establish a distillery as early as 1807 but were opposed by Governor Bligh, and John was later involved with the overthrow of Bligh as a result of several disagreements with the governor. The brothers operated a slaughtering and butchering business in Sydney during their early years in the colony, though this partnership ended in August 1813 (O'Sullivan 1977:16).

John Blaxland was granted 6,710 acres of land in November 1813 by Governor Macquarie, within this initial grant spanning across an area bounded to the west by the Nepean River and to the east by the western branch of South Creek. Blaxland continued to acquire and clear land for pastoral and agricultural uses, and by 1840 he had purchased seven additional plots of land, resulting in an estate totaling 9,885 acres. The study area is comprised of one of these purchases, being an 800-acre parcel of land located at the confluence of the Nepean and Warragamba Rivers first allotted to Blaxland in 1825 by Governor Brisbane. The land was paid for and a deed granted on 8 March 1831 (O'Sullivan 1977:1). The sum of the land acquired by Blaxland formed his Luddenham Estate, named after his family estate in England. Luddenham was only one of four large estates owned by John Blaxland, the others being:

- Newington in Parramatta (1,410 acres) where Blaxland lived, had a large saltworks, a meat works and blanket factory;
- Gannon Plains (15,692 acres); and
- Fordwich on the Wollombi Break (12,000 acres) which also included a flour mill, saw mills and a dairy (O'Sullivan 1977:16).

The Blaxland brothers, John and Gregory, focused on establishing a pastoral industry in Australia, much to the frustration of Governor Macquarie who was clearly vexed that 'they ha[d] turned their whole attention to the lazy object of raising cattle' (in O'Sullivan 1977:1). Luddenham became renowned for its cattle and horses, and by 1827 a public road was built through the estate, for which Blaxland was compensated by construction of a two to three rail fence built on either side of the road (O'Sullivan 1977:2).

Blaxland had commenced grinding wheat at Luddenham by 1830, and by 1834 was using a stone-built water mill powered by a dam built across the river, described as follows:

> …at the point where the river makes its exit from the Mulgoa Valley, and at the mouth of a high precipitous rocky gorge; a strong wooden dam formed of heavy beams bolted together, supported with great logs of timber as stays, and packed with earth and stones. (18)

The dam remained standing in 1876, though it had been slowly rotting away. The mill was reportedly constructed of timber on sandstone footings.

Blaxland imported two copper vats from England in 1839, and by April that year both the flour mill and brewery had been established at Luddenham with a total value of £5,000. A valuation of the entire Luddenham property was completed on 5 March 1840 and provides insight into the activities occurring on the property. Table 4 presents an overview of key components.

Table 4. Improvements to land at Luddenham by 5 March 1840

Element	Value (£)
Water mill and dam	1800. 0. 0.
Brewery, malting house and outbuildings attached	2750. 0. 0
Barn and threshing machine	100. 0. 0

Element	Value (£)
Bridge over the river	200. 0. 0
Buildings of old Establishment	100. 0. 0
One wagon	50. 0. 0
Three hay carts	16. 0. 0
One horse cart and one dray	16. 0. 0
One bullock dray	12. 0. 0
One timber carriage	12. 0. 0
Two rollers	3. 0. 0
Five ploughs	17. 10. 0
92 brood mares and young horses	3,220. 0. 0
One entire horse candidate	388. 0. 0
Eight working horses	320. 0. 0
194 head milk cows and young stock	970. 0. 0
28 working oxen	224. 0. 0
827 ewes various ages in lamb	1,033. 15. 0
495 young sheep	371. 5. 0
35 rams	70. 0. 0
100 pigs young and old	100. 0. 0
Harnesses for three teams bullocks	10. 0. 0
Harnesses for two teams horses	10. 0. 0
3000 bushels wheat in stock	1,500. 0. 0
150 tons hay	975. 0. 0

In addition to the items listed in the inventory, another account describes 'A brewery and Malthouse with Brewing Coppers, Vats, Steam engine, Refrigerator, Coolers, Malt mill, Casks and all Brewing Utensils valued at £7000' (*Blaxland Papers 1824-1883,* p 89). A large labour force operated at Luddenham under John Blaxland, and in 1841 the estate employed 69 people, including 27 freemen, 13 convicts, 19 women and 20 children (O'Sullivan 1977:7). Blaxland's son Edward lived at and managed the Luddenham Estate from at least 1839 to 1851 (O'Sullivan 1977:16).

Historical records indicate that the brewery operated at least between 1844 and 1847, though it was damaged by flooding in 1852 or 1853 and rendered inoperable due to flooding by 1871 (O'Sullivan 1977:4). According to local oral history, some of the stones from the brewery were

recycled to construct a cottage on the hill to the west of the site in the late nineteenth century (O'Sullivan 1977:12).

John Blaxland's relatives in England were recorded as having 'lived in expensive style' (Hoison 1936:2), eventually having to mortgage the Luddenham property in England in 1842. A similar fate befell the Australian Luddenham Estate, which was mortgaged in 1830, 1841 and 1842. John Blaxland died in 1845 and on 31 October 1851 the Australian Trust Company sold the Estate to Sir Charles Nicholson. Luddenham Estate was subdivided in 1859, and George Henry and Archibald Bell Cox purchased the land including the study area in 1861 (O'Sullivan 1977:1-2). George Henry Cox was a politician, pastoralist and sheep breeder born in Mulgoa in 1824. He declared the first rural municipality in NSW (Mudgee) and became its first mayor (Teale 1969).

Descriptions of the land sold included the following summary of 'improvements' made to the site:

> The buildings consist of those large premises known as the 'Brewery', which were erected at an immense cost by the Messrs/ Blaxland being built out of cut stone containing brewhouse, malt house, stores, cellars, etc. There are also two neat cottage residences, an excellent flour mill, men's huts, yards and a number of outbuildings.

The Primary Application (31007) for the land was made by William Edward Baines, farmer, on 18 September 1931, and this application provides some insight into land transfer activities associated with the property. Through the later parts of the nineteenth century, the estate became known as 'Mulgoa Forest'. Thomas Icely and Caroline Lawson became mortgagees of the property on 23 February 1869 and the land was purchased by James Edward Baines on 1 January 1871. William Edward Baines, likely the same person who made the Primary Application, took ownership of the property on 19 November 1912.

William Edward Baines still owned the property in 1942, but several lots were annexed from the property through the 1950s and 1960s, reducing the overall size of Baines' landholdings (Vol. 5355 Folio 216). Several easements were established through Baines' property, including water sewerage and drainage board easements and a 'right of way' (road) (Vol. 4501 Folio 209). Further easements were made to the Metropolitan Water Sewerage and Drainage Board in 1962, followed by resumption of land for easement of a transmission line in 1964. These easements are situated to the south and west of the study area. The land was purchased by John Ruth Fowler, Headmaster, and Lionel Rupert Fowler, Pharmacist, in 1965 (Vol. 8125 Folio 77). The property remains in the possession of the Fowler family.

No development has occurred within the study area since Blaxland's mill and brewery were abandoned in the 1860s or 1870s and it has generally remained as agricultural land near the edge of the Nepean River, as illustrated by an aerials photograph of the site in 1955 (Figure 8).

Historical aerial photographs of the study area provide evidence of the lack of development within the study area. The north end of the site, and the core of the mill and brewery complex, has remained outside of agricultural activity areas, and as such has been subjected to little or no historical impacts. Most of the study area has, however, been subject to regular cultivation

and ploughing. Aerial photographs from dry periods (where grass coverage was low) provide evidence of former structures on the site, with footings of a cottage and large rectilinear building evident in aerial photographs from 2010.

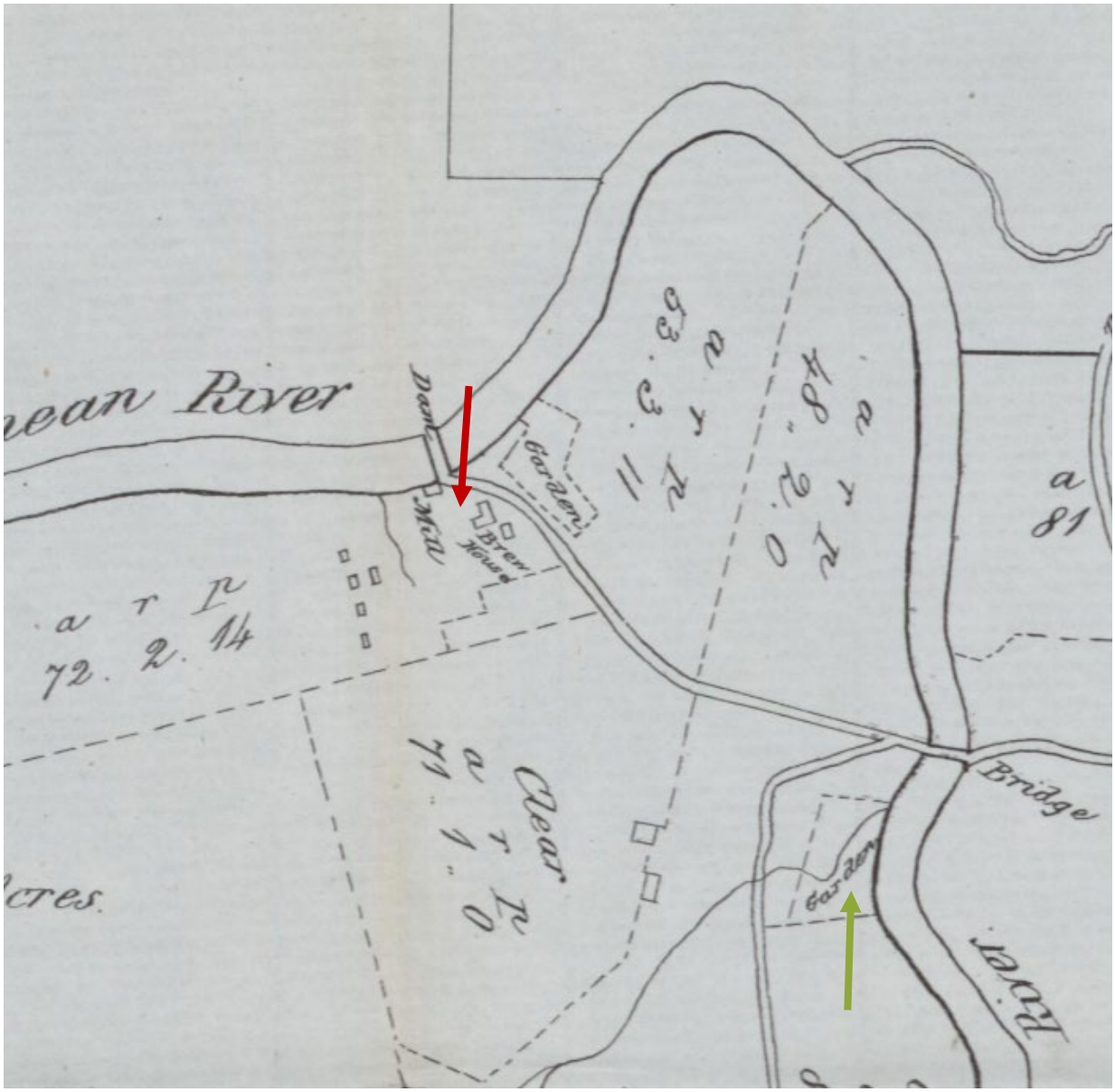


Figure 7. Extract from the 1859 'Luddenham Estate Central and Western Divisions' subdivision plan. Approximate location of PAS 1, with brew house, mill and dam, marked with a red arrow. The approximate location of PAS 2 (discussed in detail in Section 5) is marked with a green arrow. Source: SLNSW

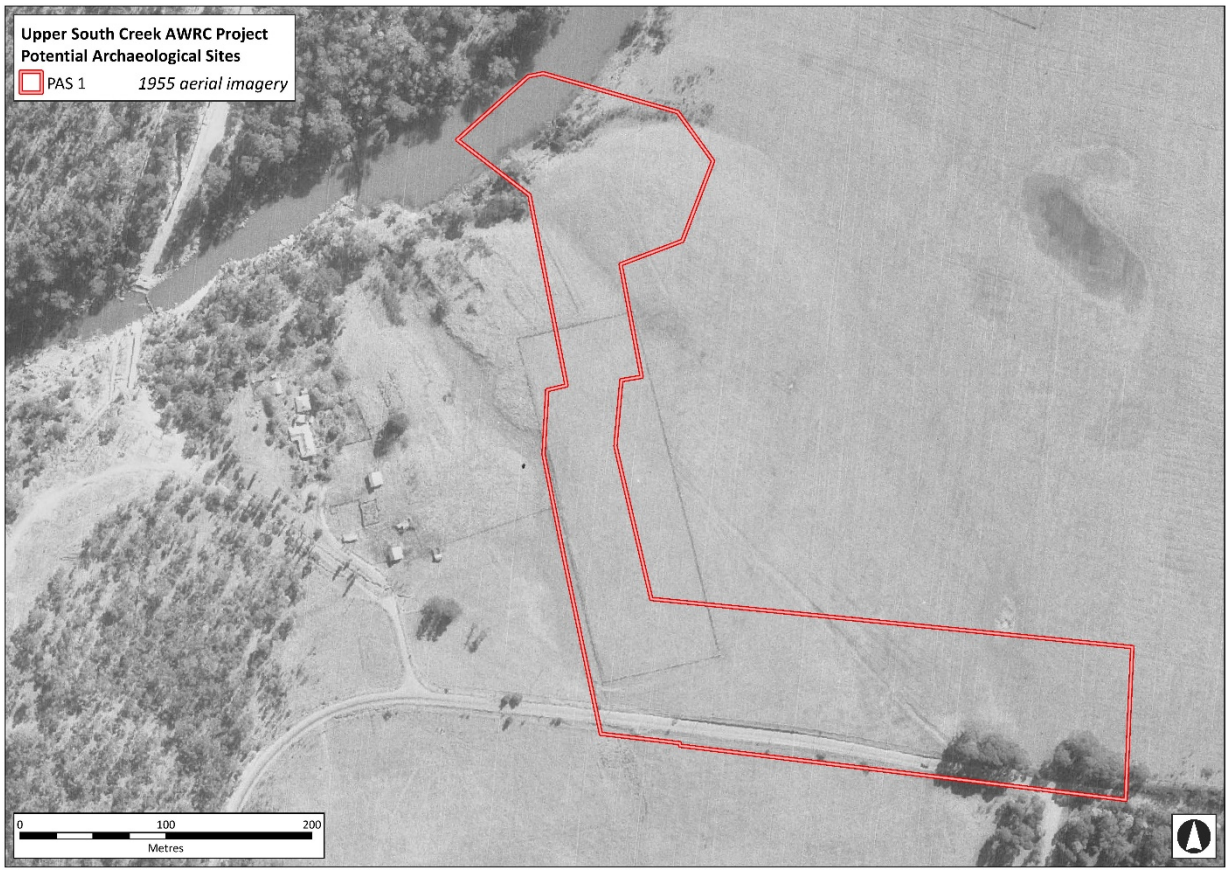


Figure 8. Aerial from 1955 illustrating the lack of development in PAS 1. Source: LPI, Extent

4.3 Potential archaeological resource

4.3.1 Previous reports and investigations

The site was surveyed in 1977 by the Workers' Educational Association of NSW, under the guidance of Professor Ian Jack and Maureen Byrnes (O'Sullivan 1977). The survey completed identified several structures at the site, including the brewery complex and mill identified during Extent's surveys in 2020.

Images of the site indicate that it was not overgrown at the time, as it is now, greatly improving visibility and accessibility of archaeological remains. A building identified as a 'piggery' and large, nearly square sandstone building identified as the brewery with internal divisions and window bases were surveyed and planned in detail as part of the project.

4.3.2 Analysis of LiDAR data

LiDAR data was provided by Sydney Water for the study area. Analysis of this data with Digital Elevation Modelling (DEM) provided an indication of several areas of interest which were targeted during the site inspection. This includes areas cut or levelled in association with construction of buildings, carving of channels, excavation (and later collapse) of cellars.

The findings of the LiDAR data analysis are presented in Figure 9.

4.3.3 Site inspection

Two site inspections were completed, the first on 1 September 2020 and the second on 15 October 2020. The first site inspection identified extensive extant archaeological ruins, with sandstone footings, walls, steps and fireplace pieces observed in areas of dense bush, as well as along a terraced hill slope further to the west.

Findings from the survey are presented in Figure 10. The following observations were made about PAS 1:

- Sandstone footings identified as likely belonging to Blaxland's mill were observed fronting the Nepean River. A large tree was growing on the ruins, though it has since died.
- The areas fronting the river covered with dense shrubs and vines contains high concentrations of sandstone footings and walls.
- The area is characterised by linear breaks in the slope, and these areas were consistently found to contain stone footing remnants.
- A small number of the footings found were recorded by a surveyor, though the density of vegetation and irregular terrain made it difficult to relocate all footings.
- Remains of one of the brewery buildings was recovered.
    - It consisted of a sandstone hearth/fireplace with holes drilled through the top, the upper surface of which contained a curved recess suitable for placement of a copper vat.
    - Sandstock bricks were found along the sides of the fireplace, indicating a brick superstructure or a brick enclosure to the copper vat, which is consistent with traditional brewing methods (O'Sullivan 1977:18).
    - The building had at least two levels, with the hearth/fireplace representing the ground or first floors, with a cellar or ground floor beneath it. The level beneath had arches on two sides of the room, one with wrought iron bars across it. This is consistent with the layout of nineteenth-century brewing practices, which relied on gravity to power as many processes as possible. Coppers were generally located on upper floors, at least 11 feet from the ground. Breweries were buildings with at least two stories, and cooling would occur on the level below the coppers (O'Sullivan 1977: 9-10).
- Further to the west of the brewery structure and mill, a terraced hillslope extending downhill to the east was surveyed.
- This hillslope contained multiple terraced levels, and several of these contained linear sandstone footings, often along the evident break in slope.

- At least two very long structures were identified on the hillslope. These may relate to the cluster of small structures west of the brewery/mill complex in the 1859 subdivision plan. They may relate to the convict barracks and overseers' cottages that formerly existed on site, or possibly stables for the brewery horses.

- A ruined sandstone cottage was observed on the hill further to the west of the hill and study area. It appeared to have been constructed of recycled materials, including sandstone blocks and sandstone bricks, as well as repairs with machine-made bricks. This is likely the building noted to have been constructed from the ruins of the brewery after 1871 (O'Sullivan 1977:12).

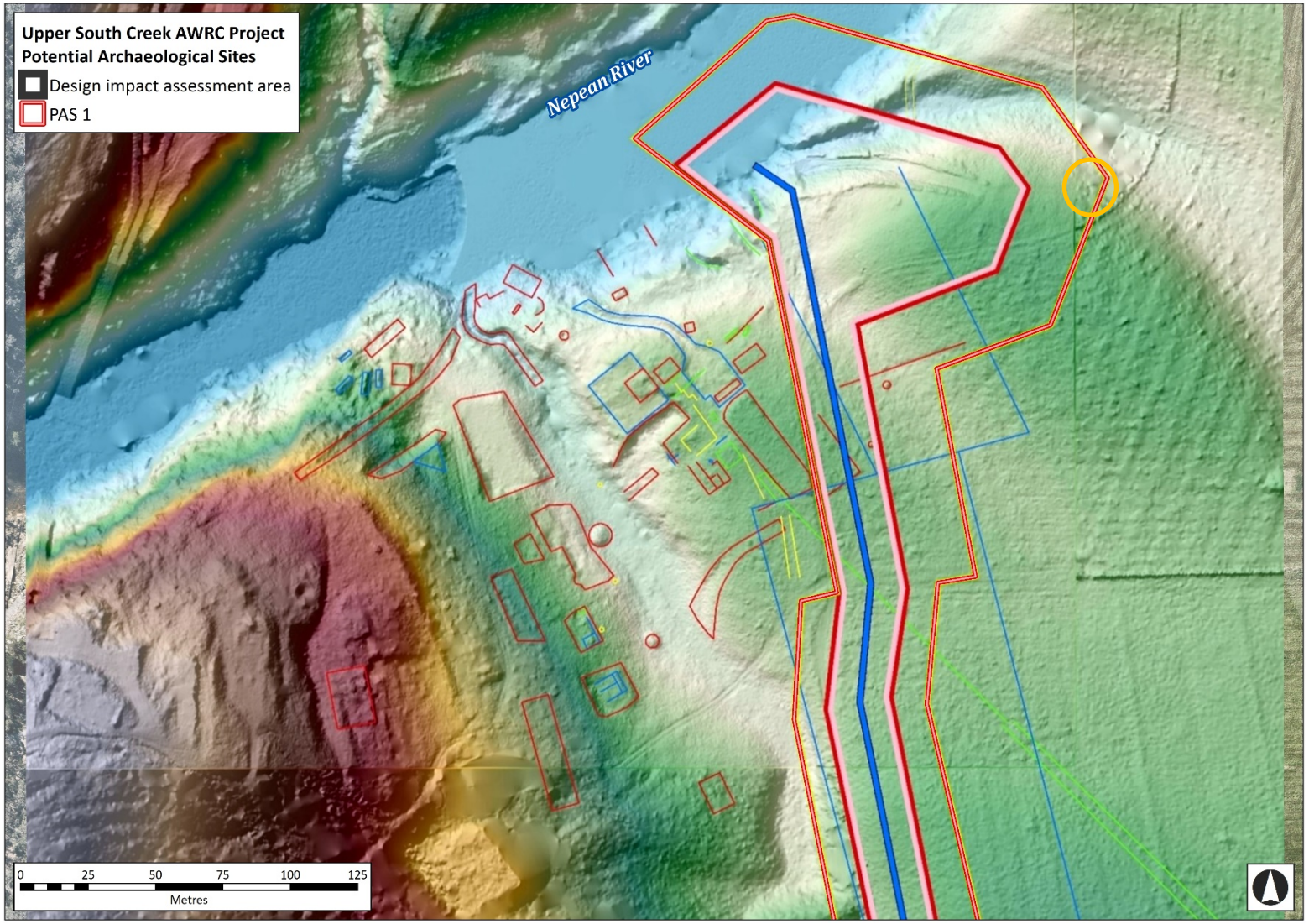


Figure 9. Areas of interest identified during analysis of LiDAR data and DEM for the study area, the coloured lines represent anomalies in the LiDAR data. Building footings visible in aerial photographs circled in orange. Source: Near Map, Sydney Water, Extent

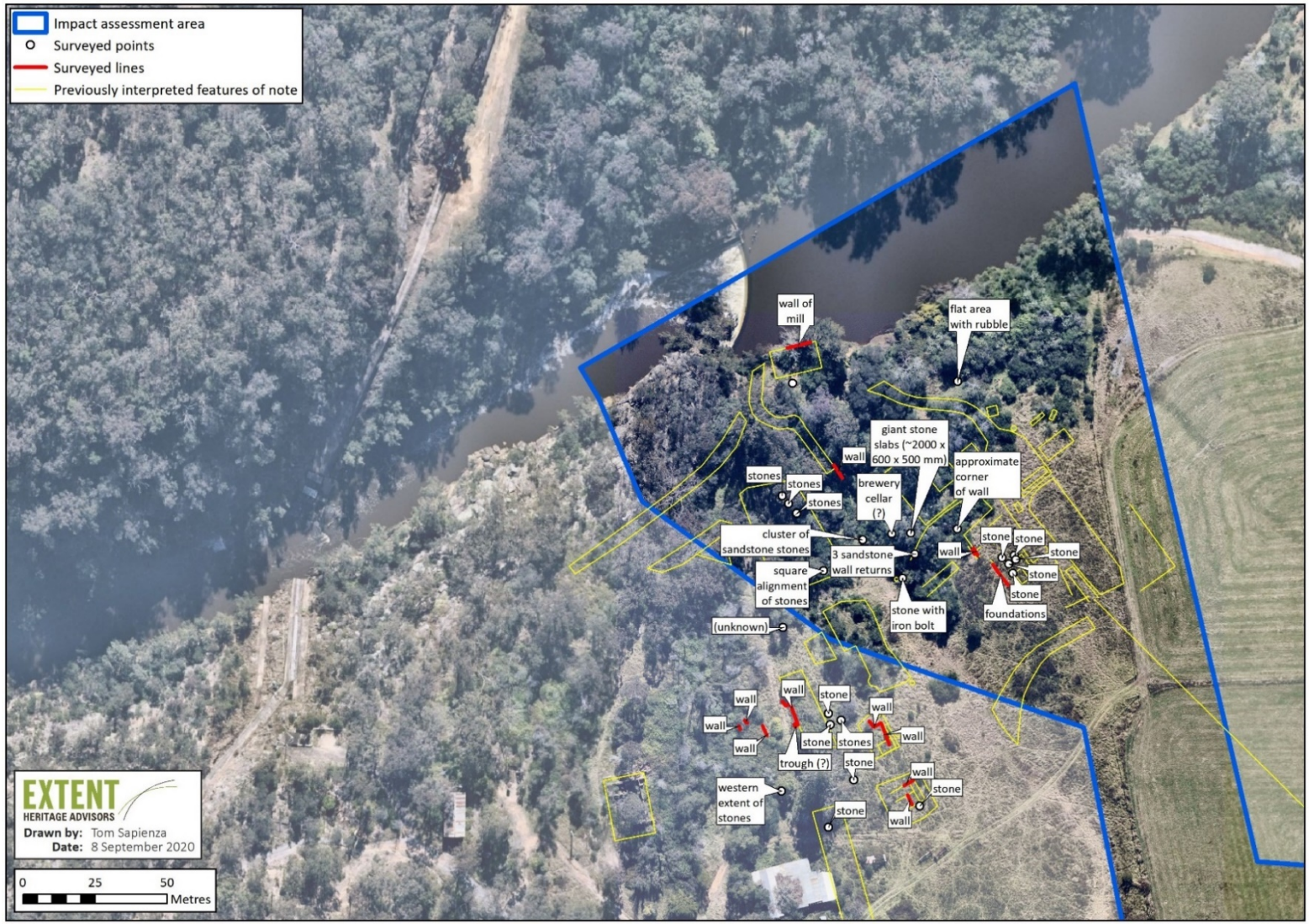


Figure 10. Result of archaeological survey on 1 September 2020 marked in red, additional features noted through LiDAR analysis marked in yellow. The blue boundary reflects the original extent of PAS 1 but the site boundary was amended to reduce impact following the results of survey. Source: Near Map, Extent

Figure 11. Sandstone mill ruins (Blaxland's mill), note the large tree that has grown (and died) since they were abandoned, view to southeast.

Figure 12. Note the proximity of the mill ruins to the river, relatively close to the proposed outlet, view to east.

Figure 13. More detail of sandstone mill footings, bonded with coarse sand and shell mortar, view to south.

Figure 14. Overview of the mill ruins, view to southeast.

Figure 15. Fireplace from brewery building with carved inset above mantle for copper vat (marked with orange arrow).

Figure 16. Archway associated with potential cellar beneath fireplace at brewery, alternately ground floor.

Figure 17. Inset for copper vat marked.

Figure 18. Iron bars in archway opposite brewery fireplace in cellar/ground floor.

Figure 19. Sandstone wall with two returns, approximate location marked by surveyor.

Figure 20. Carved sandstone archway or lintel.

Figure 21. Scatter of sandstone rubble in a small clearing.

Figure 22. Another large sandstone wall and return in heavily vegetated area.

Figure 23. More sandstone walls in heavily vegetated area.

Figure 24. Carved sandstone window base (?) and walls in heavily vegetated area.

Figure 25. Potential sandstone stairs in heavily vegetated area.

Figure 26. Sandstone footings on terraced hillslope.

Figure 27. Linear sandstone footing and rubble on terraced hillslope.

Figure 28. Sandstone feature, possibly part of a fireplace base, on terraced hillslope.

Figure 29. Sandstone feature, similar to a small trough, on terraced hillslope.

Figure 30. Ruined house at top of hill, sandstone and two forms of brick (sandstock and machine made) appear evident.

Figure 31. Overview of ruined house at top of hill, sandstone construction.

The second inspection of the study area was completed to assess current ground conditions and identify further extant archaeological remains. The following observations were made:

- Site is overgrown with low level shrubs and long grass, outside of the ploughed area of ground.

- Access track down to water/pumping point has been graded into hill side creating significant road cut on the south-western side and a mound of earth pushed up by the grader along the northeastern side.
- Three irregular sandstone pieces were observed on the northeastern side, it is possible that were deposited there during the road grading.
- On the northern side of the access track is what appears to be a natural gully. This gully becomes increasingly steep as it approaches the river, though the slope is far more gradual on the eastern side closer to plowed area of paddock.
- The cleared area of south of the access track was covered in long grass making visibility poor.
- The area was undulating with a gentle slope towards the river, northward.
- At the southern extent of the study area, close to the access track into site, imported sandstone and gravels had been used to create a sort of culvert over a run off area.
- Along the northern boundary of this cleared area, above the access track, was an east-to-west oriented linear mound, though no structural material was observed around the mound.
- No archaeological remains, footings or artefact deposits were noted within the area surveyed.

4.3.4 Phases of development

The following phases of development were identified for the study area:

- Phase 1: 1788-1825 (Ephemeral Use)
- Phase 2: 1825-1851 (Luddenham Estate)
- Phase 3: 1851-1911 (Nicholson and Cox)
- Phase 4: 1912-1964 (Mulgoa Forest Estate)
- Phase 5: 1965-Present (Fowler's Estate).

Phase 1: 1788-1825 (Ephemeral Use)

No development was identified within the study area during this phase of use. Potential archaeological evidence would reflect ephemeral use, and may potentially include artefacts lost or discarded while traversing the study area on survey or expedition.

Phase 2: 1825-1851 (Luddenham Estate)

A wide range of activities occurred within this phase of use. Blaxland purchased and cleared the land, cutting and filling landforms to create terraces and prepare the site for construction. This work was completed by convicts, who would have been housed in the convict barracks or

overseers' cottages, likely west of the study area. Associated archaeological remains might include structural remains of the barracks or cottages, outbuildings (external kitchens, cesspits, wells, sheds, stores), landscaping evidence (yard surfaces, drains, fences), and sealed artefact deposits within wells, cesspits, rubbish pits or underfloor deposits that resulted from the large number of people including children on-site during Phase 2.

Blaxland was grinding wheat at the site by 1830, and the stone water-powered mill and dam were completed by 1834. Blaxland had imported copper vats from England in 1839, suggesting that the brewery was under construction or completed. Structural remains associated with the brewery include the brewhouse, malt house, stores, cellars, fresh water sources (cisterns, wells), and a steam mill. Associated landscaping evidence would likely include surfaces of working yards, drains, and fences.

The study area was also situated within (or in proximity to) an area marked as 'Gardens' in the 1859 plan. There may also be evidence of cultivation activities within the study area. A range of other identified structures built at the industrial part of Luddenham Estate include two large barn and stables, though a range of other agricultural or industrial outbuildings were likely also constructed to enable the success of Blaxland's industrial enterprises.

Phase 3: 1851-1911 (Nicholson and Cox)

The brewery continued in use until at least 1871, under the ownership of Nicholson (1851-1861) and Cox (1851-1911), having been damaged repeatedly by flooding. The water-powered mill likely suffered a similar fate, being located in close proximity to the water.

No further development was identified in the study area during these phases of use. Potential archaeological evidence would be associated with expansion of or repair to the brewery complex and water mill following flooding episodes, or possibly to introduce new improvements in brewing techniques.

Archaeological evidence may also include structural remains of new outbuildings, conversion of convict accommodation following cessation of transportation, sealed artefact deposits in rubbish pits, wells, cesspits, and cisterns, and landscaping evidence, including fences, yard surfaces, and drains.

The complex was mostly abandoned by 1871, with partial demolition occurring as building materials were recovered and recycled for new structures, including the cottage west of the study area.

Phase 4: 1912-1964 (Mulgoa Forest Estate)

No development was identified within the study area, though some of the land south and west of the study area was annexed for water/sewerage, power and transport easements.

The southern part of the study area was located in a field under regular cultivation, and this may have resulted in some disturbance to historical archaeological remains or deposits within the upper 300mm to 400mm of the current ground surface. No disturbance was identified in the northern part of the study area.

Phase 5: 1965-Present (Fowler's Estate)

No development was identified within the study area during this phase.

As with Phase 4, ploughing and cultivation of the southern part of the study area may have resulted in some disturbance to historical archaeological remains or deposits within the upper 300mm or 400mm of the current ground surface.

4.3.5 Historical archaeological potential

Historical plans and the survey of the study area indicates that the core of the Blaxland's Farm site is situated immediately west of the current study area, and these areas have high to extant potential for historical archaeological evidence of the watermill and brewery. Evidence associated with convict accommodation is also most likely located to the west of the watermill and brewery, well outside of the current study area.

The study area likely contains evidence associated with Blaxland's brewery and operations of his Luddenham Estate in Phases 2 and 3, including land clearing and levelling. The southern part of the study area has moderate archaeological potential due to historical disturbance resulting from regular ploughing and cultivation following abandonment of the brewery. The northern part of the study area has moderate-high archaeological potential as it has not been subjected to any known historical disturbance, but fewer areas of historical modification or use were identified through analysis of LiDAR data or site survey.

The anticipated archaeological resource would include ancillary structures were constructed in association with the brewery and operation of Luddenham Estate, including cellars, a malthouse, stores, a steam mill, and stables for the working horses. Landscape evidence may include working yards, drains, and paths. A well or cistern would have been necessary to enable to flow of fresh water to the brewery, while cesspits may have been constructed to provide facilities to workers. Sealed artefact deposits might be anticipated within rubbish pits or dumps, accumulated on paved surfaces, in underfloor deposits, or discarded in wells, cesspits, cisterns or drains. There may also low-moderate to moderate potential for evidence of agricultural activities or cultivation, including ephemeral agricultural structures, field drains, palynological and ethnobotanical evidence of species grown, and plough marks.

The study area has low potential for archaeological evidence associated with use in Phases 1, 4 or 5.

4.4 Assessment of significance

4.4.1 NSW Heritage Criteria

Table 5 outlines the assessment of potential historical archaeological remains with regard to the NSW Heritage Criteria.

Table 5. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Blaxland's brewery is important as an early industrial site in colonial NSW established as part of a large colonial estate. Luddenham Estate was an enterprise undertaken by early free settlers with labour provided by a sizeable convict and free workforce, including women, children and possibly Aboriginal workers, which reflects the changing demographics of the colony through the early nineteenth century. Historical archaeological evidence associated with Luddenham Estate would be of **state significance** under this criterion. Archaeological evidence of adaptation to or improvements to the brewery later in the nineteenth century provides evidence of changing historical land use and activities in the region. Archaeological evidence of modification of the brewery buildings or agricultural activities in Phase 3 would be of **local significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	The site has strong associations with John Blaxland and his brother Gregory. They were some of the first free settlers 'of unquestioned respectability to go to the colony' and established extensive commercial interests and landholdings in NSW (Australian Dictionary of Biography, 1966). Archaeological evidence associated with the Blaxlands would be of **state significance** under this criterion. The site is also associated with George Henry Cox, NSW politician and pastoralist. Archaeological evidence that could be clearly associated with Cox would be of **local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	It is not possible to anticipate the aesthetic qualities of archaeological remains prior to excavation, but on the basis of the remains surveyed (extensive sandstone footings), archaeological evidence within the study area **may meet the threshold for local and/or state significance** under this criterion. Blaxland's use of a steam mill to improve function of the brewery was an innovative technical achievement in a period where nearly all work was done by horses. In the 1840s, the Luddenham brewery was the only one in the Sydney region using steam power. Archaeological evidence of the steam mill would be of **state significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	No associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Historical archaeological evidence associated with Blaxland's brewery would provide insight into the operations of a colonial brewery, the techniques used in brewing, the association with other compatible industries on site, and activities undertaken as part of the brewing process (botting, washing, cooling, fermenting, etc). Evidence of the steam mill would show how steam power was adapted to assist the operation of the brewery. Sealed

Criterion	Assessment
	artefact deposits recovered from the site would provide insight into the lives and daily activities of workers (freed and convict) working on the site, including, diet, age, gender, ethnicity and occupations. Historical archaeological evidence associated with Luddenham Estate would be of **state significance** under this criterion. Evidence of cultivation and Blaxland's gardens, including palynological and ethnobotanical evidence, would provide evidence of crops grown for the estate and would be of **local significance** under this criterion. Archaeological evidence of modification, repair and adaption of the brewery buildings in Phase 3 would provide an understanding of improvements to brewing practices and help identify new activities occurring on site later in the nineteenth century. Archaeological evidence associated with the brewery and associated structures in Phase 3 would be of **local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Highly intact brewery complexes from the 1830s are rare in NSW and Australia more broadly. Historical archaeological evidence of Blaxland's brewery in Phase 2 would be of **state significance** under this criterion. Archaeological evidence for continued use of the brewery into the 1850s and 1860s during Phase 3 would still be considered rare in the context of the region and would be of **local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The anticipated archaeological resource **would not meet the threshold for local significance** under this criterion.

4.4.2 Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

The archaeological resource can provide information on the site likely overlooked by historical records, including the layout of the brewery, activity areas, and the daily lives of workers. Historical records are more likely to capture the output of the brewery as opposed to the process of production and the people involved in this production.

Similarly, paleoethnobotanical and palynological evidence of the gardens may provide insight into the crops grown in this part of Luddenham Estate and changes to the landscape as a result of colonisation and cultivation.

Archaeological evidence of repairs to and modification of the brewery buildings could provide evidence of technological changes and changing activities occurring on the site through the nineteenth century.

Can the site contribute knowledge that no other site can?

Early nineteenth-century breweries are rare in NSW and Australian more broadly. This site can provide knowledge relating to brewing processes and the lives of workers at the brewery in a way that few other sites could. This site would be comparable to the Carlton and United Breweries sites in Sydney and Melbourne, though the brewery in Sydney was substantially burnt, leaving little remnant evidence beyond the stables, a well and subterranean water tank, and the brewery in Melbourne was much later in date. This site has the potential to contribute significantly more information relating to colonial brewery practices. Its rural location on a substantial waterway may lead to interesting comparisons with the Carlton and United Brewery, as well as Thomas Ruchton's first brewery in Parramatta, as well as interstate breweries such as Cascades (South Hobart, TAS), Boags (Launceston, TAS), and West End (now South Australia) Brewing.

Palynological evidence and areas of cultivation are much more widely available at colonial sites in the region, and other sites could also provide new knowledge relating to colonial cultivation and land clearing practices.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Beer was an important resource widely consumed in the colony through the nineteenth century. Questions relating to brewing and the layout and function of industrial sites are applicable to the site, as are other substantive questions relating to Australian history, including convict labour.

4.4.3 Summary statement of archaeological significance

Blaxland's brewery at Luddenham Estate was a sizeable enterprise associated with a prominent NSW family producing beer in a rural area of the greater Sydney region in the early nineteenth century. Historical archaeological evidence associated with Blaxland's brewery at Luddenham Estate in Phase 2 (1825-1851) would be of state significance for its historical, associative and research values, as well as its rarity. Archaeological evidence of the steam mill at the brewery would also be of state significance for its technical values.

Historical archaeological evidence of Blaxland's gardens at Luddenham Estate, including palynological and paleoethnobotanical evidence, would demonstrate changing agricultural practices and crops being cultivated in western Sydney. Archaeological evidence of Blaxland's gardens would be of state significance for its historical values and local significance for its research values.

Archaeological remains of later use of Luddenham Estate, including repair to and modification of the brewery buildings, by Nicholson and Cox would be of local significance for its historical and research values. Archaeological evidence that could be associated with George Henry Cox would be of local significance for its associative values.

4.5 Conclusion

The northern end of PAS 1 has moderate to moderate-high potential for historical archaeological evidence of state significance associated with John Blaxland's brewery complex on the Nepean River established c.1830. The remainder of PAS 1 has low potential for historical archaeological evidence of local or state significance associated with Blaxland's gardens at Luddenham Estate.

Figure 32 presents an overview of areas with the potential for historical archaeological remains of state significance within the study area, while Table 6 presents a summary of the anticipated historical archaeological resource.

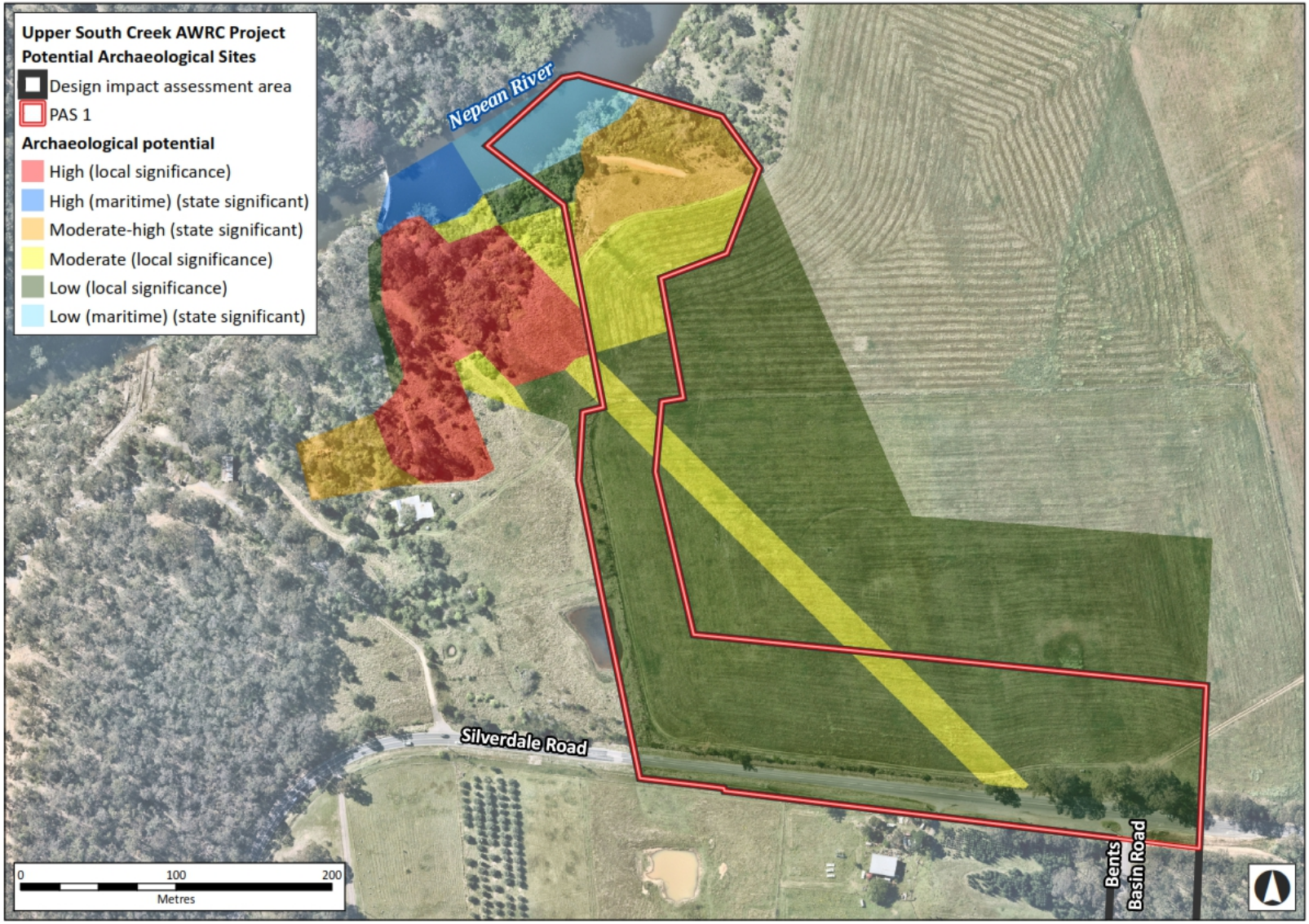


Figure 32. Assessed levels of historical archaeological potential and significance within and adjacent to PAS 1. Source: Near Map, Extent

Table 6. Summary of potential historical archaeological remains within PAS 1.

Phase	Site feature or activities	Potential remains	Location	Likelihood of survival
1: 1788–1825	Loss or discard of materials during ephemeral use, such as survey or exploration	Isolated artefacts	All of PAS 1	Low
2: 1825–1851	Land clearing and levelling	Tree boles Wash deposits Cutting and filling episodes	North part of PAS 1	Moderate
			South part of PAS 1	Low-moderate
	Blaxland's brewery	Brewhouse Malt house Steam mill Stables Agricultural and industrial outbuildings (barns, piggery, stores, sheds, etc.)	North part of PAS 1	Moderate-high
			South part of PAS 1	Moderate
2:1825-1851 and 3: 1851-1911	Sealed artefact deposits (rubbish disposal)	Underfloor deposits Cut and filled rubbish pits Dumping into low-lying areas Fills in wells, cesspits, drains and cisterns Accumulated on paved surfaces	North part of PAS 1	Moderate-high
			South part of PAS 1	Moderate
	Landscaping	Drains Paths Yards or working surfaces (paved or unpaved)	North part of PAS 1	Moderate-high
			South part of PAS 1	Moderate

Phase	Site feature or activities	Potential remains	Location	Likelihood of survival
	Agricultural use and cultivation	Field drains Ephemeral agricultural structures Palynological and ethnobotanical evidence Isolated artefacts	North part of PAS 1	Moderate
			South part of PAS 1	Low-moderate
3: 1851-1911	Repair, extension and adaption of existing brewery buildings	Sandstone and brick footings Postholes indicating re-alignment Demolition rubble, wash debris	North part of PAS 1	Moderate-high
			South part of PAS 1	Moderate
	New agricultural or industrial structures	Barns Piggeries Stores Sheds	North part of PAS 1	Moderate
			South part of PAS 1	Low-moderate
4: 1911–1964 and 5: 1965-Present	Agricultural use and cultivation	Field drains Ephemeral agricultural structures Palynological and ethnobotanical evidence Isolated artefacts Services	All of PAS 1	Low-moderate

5. PAS 2—Blaxland's Gardens

5.1 Overview

PAS 2 (Blaxland's Gardens) is located at 2720 Silverdale Road, Wallacia (Lot 12 DP 573571), within the Wollondilly Shire Council LGA (Figure 33).

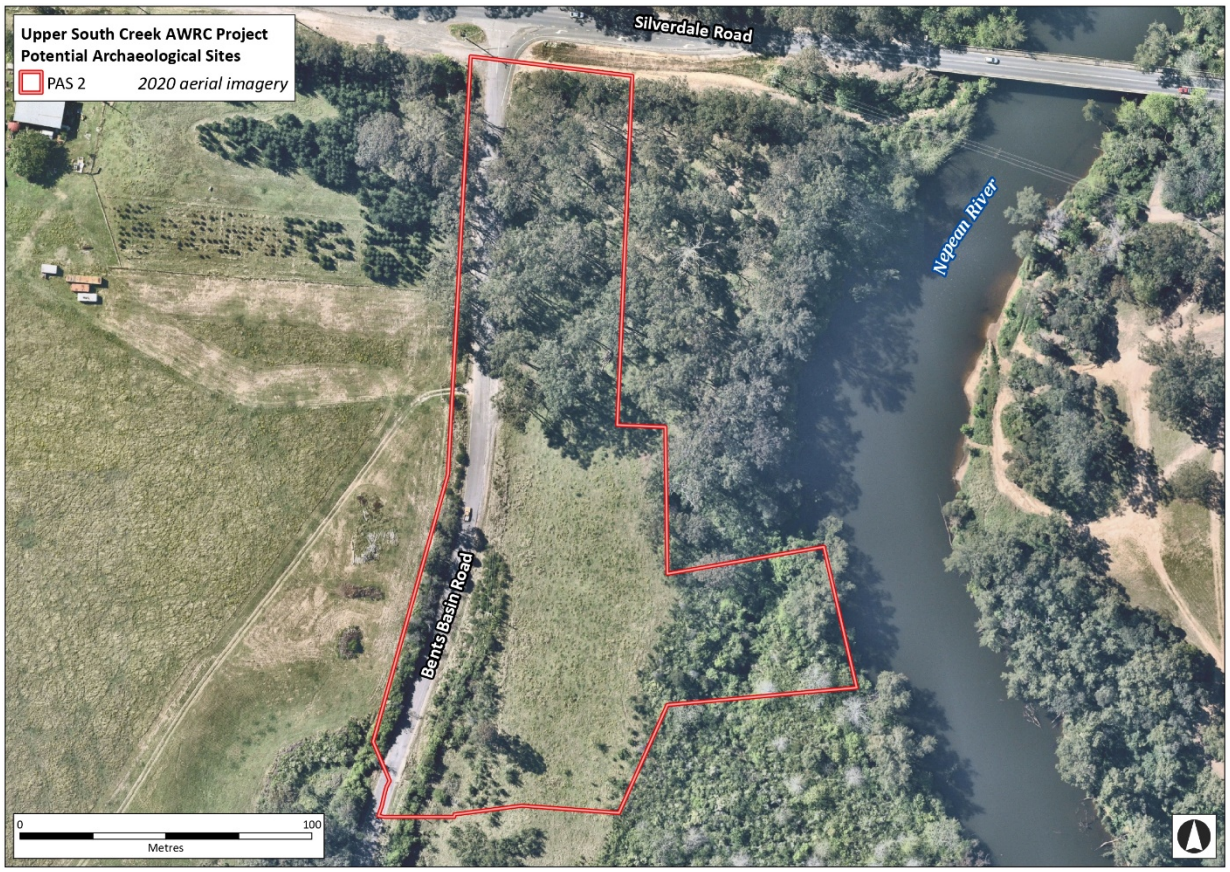


Figure 33. Location and extent of PAS 2. Source: LPI, Extent

5.2 Historical development

Date	Event
1804	John Blaxland sold his land in England to begin a pastoral enterprise in the colony of New South Wales, with his family landing in Sydney in April 1807 (O'Sullivan 1977:16).
November 1813	John Blaxland is granted 6,710 acres of land by Governor Macquarie, with the initial grant spanning an area bounded to the west by the Nepean River and to the east by the western branch of South Creek.
1825	Blaxland was allotted an 800-acre parcel of land located at the confluence of the Nepean and Warragamba Rivers (including PAS 2) by Governor Brisbane (O'Sullivan 1977:1).

Date	Event
	This land and six other parcels accumulated prior to 1840 comprised Blaxland's Luddenham Estate.
1827	A public road was built through Luddenham Estate (now Silverdale Road), for which Blaxland was compensated by construction of a two to three rail fence on either side of the road (O'Sullivan 1977:2).
1859	A subdivision plan of Luddenham Estate shows PAS 2 as being situated within an area marked 'Garden' on the plan, with two structures situated to the west.
1861	George Henry and Archibald Cox purchased land including the study area (O'Sullivan 1977:1-2). George Henry Cox was a politician, pastoralist and sheep breeder born in Mulgoa in 1824. He declared the first rural municipality in NSW (Mudgee) and became its first mayor (Teale 1969).
1909	A plan of the site in 1909 shows no identified historical development within PAS 2, though it does present it as being in close proximity to Silverdale Road and Wallacia Bridge (also referred to as 'Blaxland's Crossing').
1929	A plan of the site in 1929 shows the establishment of a road along the western edge of the site (now Bent Basin Road), as well as a telegraph or telephone line extending north-south through PAS 2.
1955	An aerial photograph of PAS 2 illustrates the continued lack of development within the study area. PAS 2 remained a partially cleared area adjacent to the Nepean River.

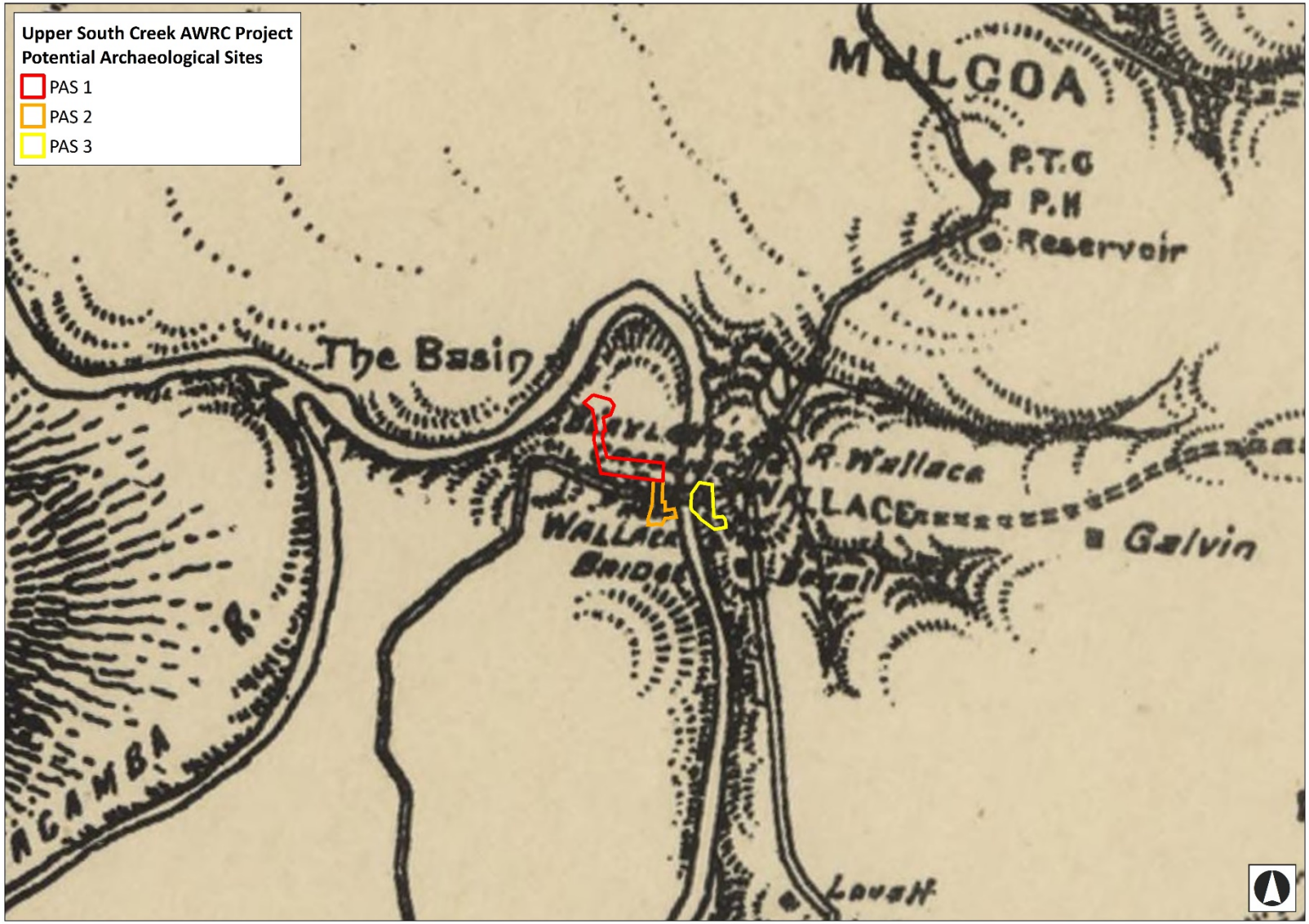


Figure 34. ‘Map of Manoeuvre Areas Liverpool, 1906’ with PAS 1 through 3 marked. Source: LPI, Extent

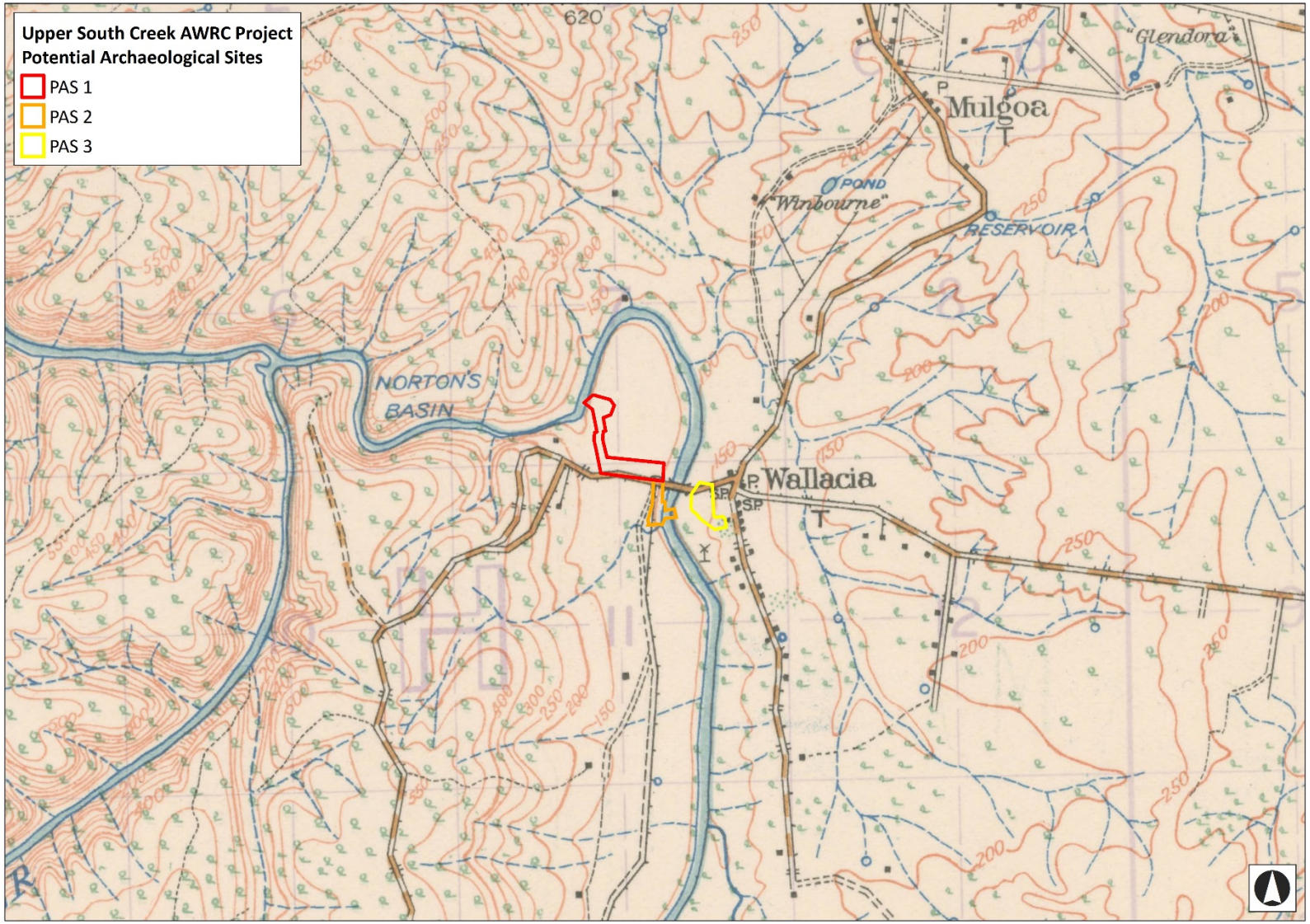


Figure 35. 'Liverpool, New South Wales', plan of contours and hydrology (1929) with PAS 1 through 3 marked. Source: LPI, Extent

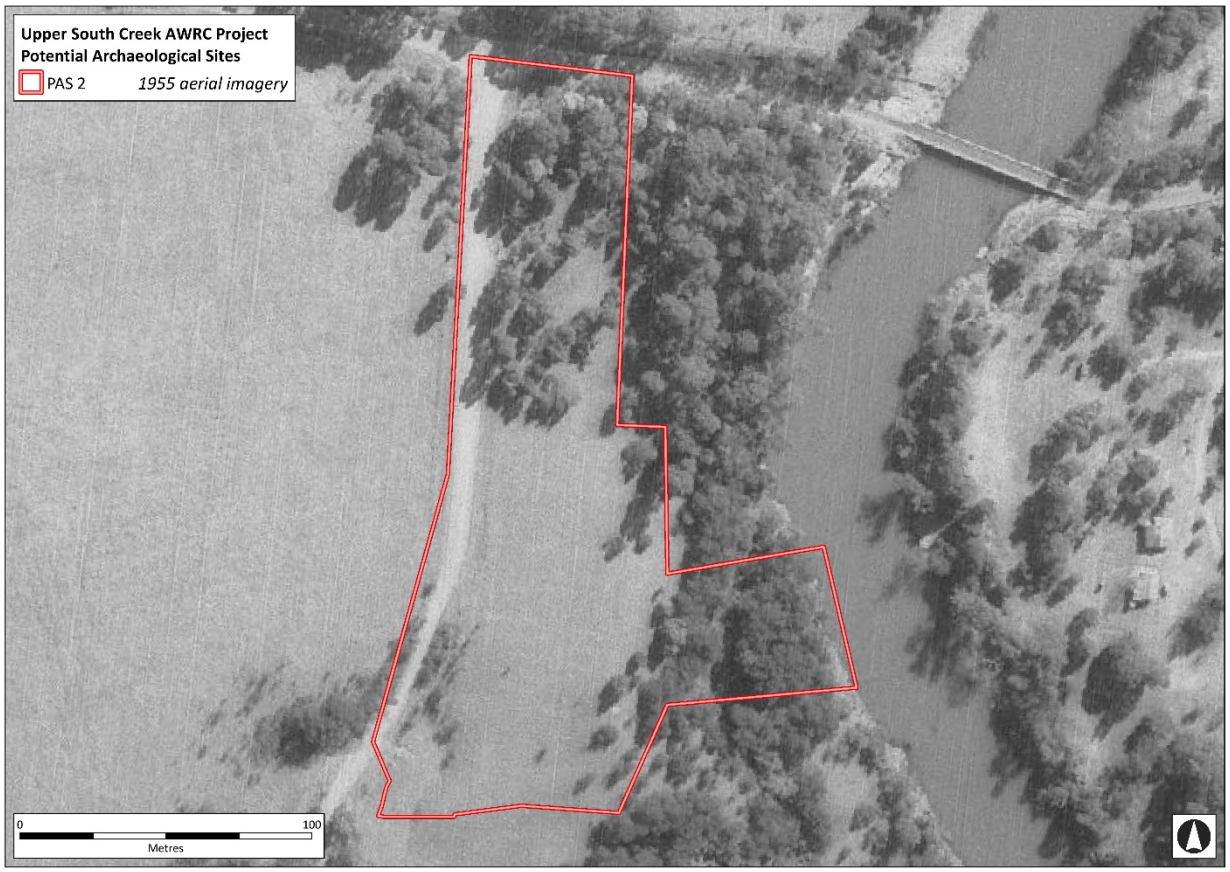


Figure 36. Aerial photograph of PAS 2 in 1955, illustrating the lack of historical development. Source: LPI, Extent

5.3 Potential archaeological resource

5.3.1 Site inspection

A site inspection of the area was completed on 4 November 2020. The following observations were made:

- The area is bounded by Silverdale Road to the north, Bents Basin Road to the west, Nepean River to the east and Baines Creek to the south.
- The site is vegetated with thick grass, mature trees at the northern end and low shrubs throughout, particularly along at the south end Baines Creek and the Nepean River to the east. The thick grass made visibility low.
- The area is fenced with three and four strand barb wire and star picket fencing along Silverdale Road, Nepean River and Bents Basin Road.
- The ground level was relatively flat and level across the much of the area, sloping down towards Baines Creek to the south with two terraces before reaching the creek gully.

- The southern half of the site was free of large trees while the northern half contained mature trees with signs of recent clearing of low shrubs in the area in the form of piles of dead branches, sticks and shrubs.
- No archaeological remains, footings or artefact deposits were noted during the site inspection.

Figure 37. View to north of north western side of area.

Figure 38. View to south of southern half of study area.

Figure 39. View north from southern end of study area showing gradual slope down towards Baines Creek.

Figure 40. View to east of trees lining bank of Nepean River.

5.3.2 Phases of development

The following phases of development were identified with regard to PAS 2:

- Phase 1: 1812-1859 (Blaxland's Gardens, Luddenham Estate)
- Phase 2: 1859-Present (Ephemeral land use).

Phase 1: 1812-1859 (Blaxland's Gardens, Luddenham Estate)

During this phase of use the site was cleared of most native vegetation, and much of it was established as a garden for Luddenham Estate. Anticipated archaeological remains would include evidence of land clearing (burnt tree boles, wash deposits), gardens and areas of cultivation (plough marks, palynological evidence, artefacts resulting from discard of rubbish and food scraps into garden soil), and landscaping evidence (fence lines, field drains).

Historical plans indicate that a small but consistent water channel flowed through the centre of the garden. There is likely evidence of water management features to enable irrigation using this waterway.

Phase 2: 1859-Present (Ephemeral land use)

Bents Basin Road was established on the western edge of PAS 2 during this phase, and cultivation of the land appears to have ceased, with the site used as a paddock for grazing. Construction of the road is likely to have impacted or removed evidence from Phase 1 within its footprint. Telegraph or telephone poles were also established within the site and may have caused localised impacts to archaeological remains. No further development was identified during Phase 2, with most of the site remaining an open paddock wedged between two roads and a river.

5.3.3 Historical archaeological potential

Most of PAS 2 has moderate potential for historical archaeological evidence associated with the gardens established as part of John Blaxland's Luddenham Estate. The study area was established as a delineated early colonial garden and appears to have been subjected to little or no disturbance following the cease of cultivation activities. The anticipated archaeological resource includes evidence within garden soils (palynological and ethnobotanical evidence, plough marks, artefact deposits from kitchen scraps), ephemeral structures used to support crop cultivation or grazing activities, evidence of landscape modifications (field drains, fence lines, garden bed edging) and may potentially include isolated artefacts resulting from loss or discard. There is also low-moderate potential for evidence of early land clearing (burnt tree boles, wash deposits).

The western edge of the study area has low archaeological potential as a result of construction of Bents Basin Road, as it is likely to have impacted or removed more ephemeral evidence associated with Blaxland's gardens.

5.4 Assessment of significance

5.4.1 NSW Heritage Criteria

Table 7 below considers the significance of the site's historical archaeological resources in response to the NSW Heritage Criteria.

Table 7. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Luddenham Estate was a large colonial enterprise undertaken by early free settlers with labour provided by a sizeable convict and free workforce, including women, children and possibly Aboriginal workers, which reflects the changing demographics of the colony through the early nineteenth century. Archaeological evidence associated with Luddenham Estate and Blaxland's gardens would be of **state significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	Luddenham Estate has strong associations with John Blaxland and his brother Gregory. They were some of the first free settlers 'of unquestioned respectability to go to the colony' and established extensive commercial interests and landholdings in NSW (Australian Dictionary of Biography, 1966). The anticipated archaeological resource, as relatively ephemeral evidence of cultivation and gardening, is unlikely to demonstrate these associations and is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (c) *An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).*	No technical achievements were identified within the study area, and ephemeral evidence of agricultural use is unlikely to demonstrate significant aesthetic characteristics. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	No associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Ephemeral evidence associated with Blaxland's gardens may provide insight into early land clearing and establishment activities, the types of crops cultivated, management of water and irrigation, and the layout of the gardens. The anticipated archaeological resource would be of **state significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Defined garden areas in early colonial estates are increasingly uncommon in the greater Sydney region. The anticipated archaeological resource is also uncommon in that it appears to have been subjected to little or no disturbance since the cease of cultivation. The archaeological resource would be of **local significance** under this criterion.

Criterion	Assessment
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	Ephemeral evidence of agricultural activities would not be important in demonstrating the principal characteristics of a cultural place or environment. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.

5.4.2 Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

Evidence of land clearing, crops grown (ethnobotanical and palynological evidence) and layout of Blaxland's gardens would provide insight into activities at the site not readily available through other resources.

Can the site contribute knowledge that no other site can?

Evidence of clearly delineated early colonial gardens is not common in the greater Sydney region, particularly with the level of intactness anticipated within PAS 2, with comparative examples including Gledswood, Brush Farm, Camden Park Estate and Belgenny Farm. Other sites likely exist across NSW that could contribute similar knowledge with regard to gardens on nineteenth century colonial estates.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

The knowledge gained by examination of the site may contribute to general questions about food sources and cultivation in western Sydney, as well as management of (and adaptation to) the Australian landscape.

5.4.3 Summary statement of archaeological significance

PAS 2 is associated with Luddenham Estate and likely contains evidence of Blaxland's gardens established as a dedicated area of cultivation at the core of the colonial estate along the Nepean River. Evidence of land clearing, establishment and operation of the gardens, and landscape management techniques associated with Blaxland's Luddenham Estate would be of state significance for its historical and research values, and of local significance for its rarity.

5.5 Conclusion

PAS 2 has moderate potential for archaeological evidence of state significance associated with Blaxland's gardens at Luddenham Estate (Figure 41). The area along the western edge of PAS 2, within the footprint of Bents Basin Road, has low historical archaeological potential.

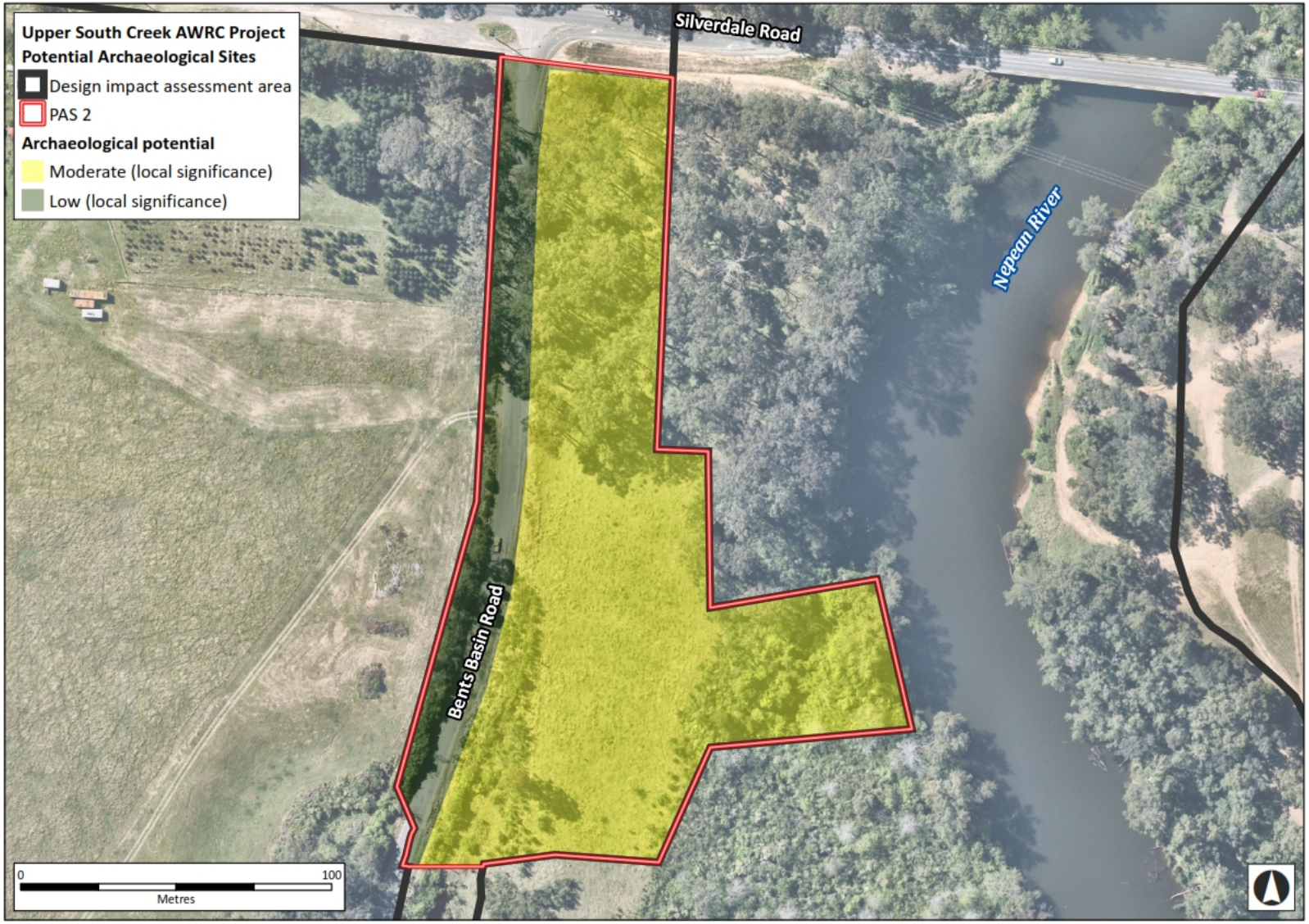


Figure 41. Assessed levels of historical archaeological potential and significance for PAS 2. Source: Near Map, Sydney Water, Extent

6. PAS 3—Blaxland's Crossing

6.1 Overview

PAS 3 (Blaxland's Crossing) is located at 1A Shelley Road, Wallacia (Lot 36 DP 248614) within the Penrith City Council LGA (Figure 42). Blaxland's Crossing is listed on Schedule 5 of the *Wollondilly LEP 2011* (Item I289).

Figure 42. Location and extent of PAS 3. Source: LPI, Extent

6.2 Historical development

Date	Event
1804	John Blaxland sold his land in England to begin a pastoral enterprise in the colony of New South Wales, with his family landing in Sydney in April 1807 (O'Sullivan 1977:16).
November 1813	John Blaxland was granted 6,710 acres of land by Governor Macquarie, including PAS 3, with the initial grant spanning an area bounded to the west by the Nepean River and to the east by the western branch of South Creek. This land and six other parcels accumulated prior to 1840 comprised Blaxland's Luddenham Estate.

Date	Event
1827	A public road (now Silverdale Road) was built through Luddenham Estate, for which Blaxland was compensated by construction of a two to three rail fence on either side of the road (O'Sullivan 1977:2) (Figure 43). A crossing associated with this road was likely constructed around this time and referred to as 'Blaxland's Crossing'. The crossing was a ford roughly paved by bringing up river pebbles and consolidating them to form a causeway (JRC Planning 1991).
c1850	The original crossing was replaced by a bridge constructed c.1850 (JRC Planning 1991) (Figure 44).
1859	A subdivision plan of Luddenham Estate shows PAS 3 as being situated in the vicinity of an area marked 'Bridge', with no other development identified.
1906	A regional plan, while somewhat difficult to discern, does not appear to show any development within PAS 3 (Figure 34). Photographs showing areas near the study area indicate early use for recreational purposes, with a large number of people gathered near the river's edge in images taken between 1900 and 1927 (Figure 44).
1929	Another historical regional plan that shows the general location of structures does not show any development within PAS 3 (Figure 35) but identifies ample development along Greendale Road to the east. The line of what is now Silverdale Road extends through the north end of PAS 3.
1955	An aerial photograph of PAS 3 shows development within the study area along the Silverdale Road frontage, as well as along the western boundary down to the south end of the site (Figure 45 and Figure 46). Historical images of the site show active use for recreation from the early twentieth century. The buildings depicted in the historical aerial may represent a range of public amenities (shade structures, picnic enclosures), services (restaurants, guesthouses) and residences. The property north of PAS 3, on the opposite side of Silverdale Street, appears to have been used as a campsite, with a single service building and tents scattered across the property visible in aerial photographs. The line of the original roadway and creek crossing is evident and remains marked by telephone or electrical lines spanning the Nepean River.
Late twentieth century	The line of Silverdale Road was amended and moved to the north of PAS 3, forming its northern boundary. A new bridge was constructed as part of this new alignment, with the c.1850 bridge demolished. All structures built between 1929 and 1955 within PAS 3 were demolished, with the site declared a reserve (Fowler Reserve).

Figure 43. View toward Nepean River from Wallacia taken February 1918 showing post and rail fence consistent with that erected for John Blaxland, as well as further fence lines adjacent to the river. Source: SLNSW

Figure 44. Photo of the Wallacia Bridge taken between 1900 and 1927, prior to construction of the new bridge currently spanning the Nepean River. There are a large number of people near the banks of the river adjacent to PAS 3 (marked with a white arrow). Source: SLNSW

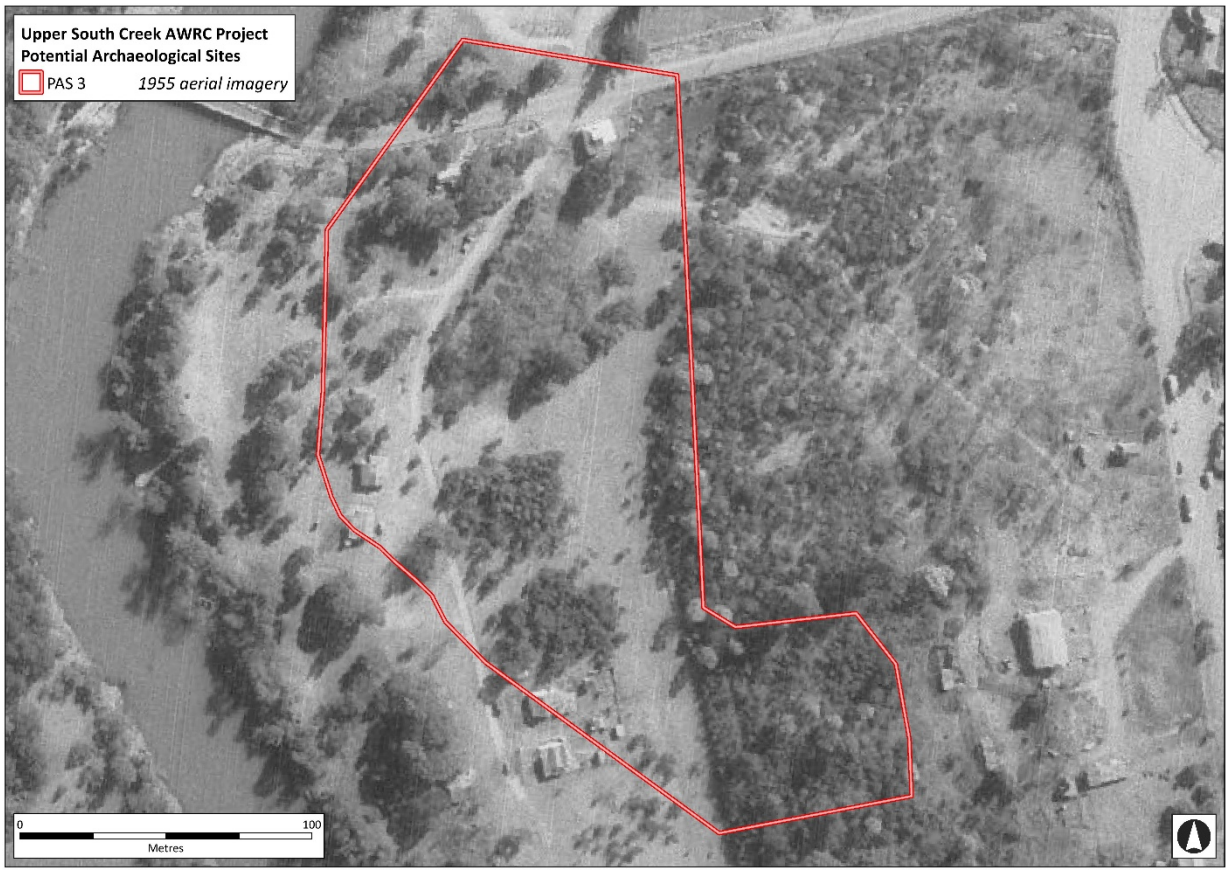


Figure 45. Aerial photograph of PAS 3 in 1955 showing the locations of historical development within the study area. Source: LPI, Extent

Figure 46. View to east looking toward PAS 3 from the Wallacia Bridge in 1934. Note the roofline of a structure visible fronting Silverdale from within the study area (marked with a green arrow). Source: SLNSW

6.3 Potential archaeological resource

6.3.1 Site inspection

A site inspection of the area was completed on 15 October 2020. The following observations were made:

- The area, known as Fowler Reserve, is bounded by Silverdale Road to the north, the Nepean River to the west, dense riverside vegetation to the south and a steep rise to Wallacia township to the east.
- The area is generally level and with slight build up around areas of thick shrubbery and mature trees and subtle cut down where dirt roadways have been established. The ground slopes gradually towards the Nepean River on the western side before dropping sharply along the riverbank. This drop was observed to typically be between 1 to 2m.
- The area is heavily vegetated with mature trees throughout the park, along the Nepean River and along Silverdale Road. There are also large expanses of short grass, particularly in southern half of the area. Dirt roadways extend through parts of the western and northern sides of the area and a cricket pitch has been laid in the grassed area to the south.
- An ablutions block is situated on the northern side of the area, in proximity to Silverdale Road.
- Along the river bank the soil transitions from a compact sandy silt to a softer riverside silty sand.
- On approach to the Silverdale Road Bridge, crossing the Nepean River, the ground has been significantly raised to the level of the bridge. This is visible along the north-western boundary of the study area.
- No archaeological remains, footings or artefact deposits were noted during the site inspection.

Figure 47. View south from Silverdale Road entrance to Fowler Reserve.

Figure 48. View west towards Nepean River, note gradual slope down to riverside.

Figure 49. View south along riverbank of Nepean River showing drop of ground level down to water level.

Figure 50. View east across playing field towards steep rise with Wallacia township beyond.

Figure 51. View north across playing field area.

Figure 52. View south into Fowler Reserve showing mature trees and dirt roadway.

6.3.2 Phases of development

The following phases of development were identified with regard to PAS 3:

- Phase 1: 1788-1827 (Ephemeral use)
- Phase 2: 1827-1859 (Blaxland's Crossing)
- Phase 3: 1859-1929 (Wallacia Bridge)
- Phase 4: 1930-c.1970 (Residential development)
- Phase 5: c.1970-Present (Fowler Reserve).

Phase 1: 1788-1827 (Ephemeral Use)

No development was identified within the study area during this phase of use. Archaeological evidence would reflect ephemeral use, include artefacts lost or discarded while traversing the study area on survey or expedition.

Phase 2: 1827-1859 (Blaxland's Crossing)

The road now known as Silverdale Road was established through Luddenham Estate and extended through the north end of PAS 3 and fence lines associated with Luddenham Estate were likely established on both sides of the road. The associated Blaxland's Crossing was constructed to just to the west of PAS 3.

The 1859 subdivision plan of Luddenham does not indicate any development within PAS associated with Luddenham Estate, suggesting that it was likely cleared and used for grazing.

Phase 3: 1859-1929 (Wallacia Bridge)

A new bridge was constructed to the west of PAS 3 in 1859, with the causeway associated with the original Blaxland's Crossing partially demolished.

No further development was identified within PAS 3, which appears to have remained vacant in plans of the site from 1906 and 1929 (Figure 34 and Figure 35).

Phase 4: 1930-c.1970 (Residential development)

Several structures, potentially a combination of recreation facilities (public and private) and residences were constructed within PAS 3 during this phase of use, predominantly fronting Silverdale Road or along the western boundary of the study area overlooking the Nepean River. Construction of these structures is likely to have impacted on archaeological evidence from Phases 2 and 3, particularly along the Silverdale Road frontage.

Phase 5: c.1970-Present (Fowler Reserve)

The facilities and residences constructed in Phase 4 were demolished and PAS 3 was converted to a public reserve, though it likely served informally as a public reserve from the start of the twentieth century.

The alignment of Silverdale Road was modified and moved to the north edge of PAS 3, while a new bridge was constructed in a location consistent with this new alignment and the c.1850 bridge demolished.

6.3.3 Historical archaeological potential

Most of PAS 3 has low potential for archaeological evidence associated with land clearing (burnt tree boles, wash deposits) and grazing (fence lines, isolated artefacts resulting from loss and discard) in Phases 2 and 3 as part of Luddenham Estate. The northwest corner of PAS 3 also has moderate potential for archaeological evidence of earlier iterations of Silverdale Road and possibly the start of the Phase 2 Blaxland's Crossing rubble causeway and ford.

6.4 Assessment of significance

6.4.1 NSW Heritage Criteria

Table 8 below considers the significance of the site's historical archaeological resources in response to the NSW Heritage Criteria.

Table 8. Assessment of potential archaeological remains against the NSW Heritage Criteria.

Criterion	Assessment
Criterion (a) *An item is important to the course, or pattern, of NSW's cultural or natural history (or the local area).*	Luddenham Estate was large colonial enterprise undertaken by early free settlers with labour provided by a sizeable convict and free workforce, including women, children and possibly Aboriginal workers, which reflects the changing demographics of the colony through the early nineteenth century. Archaeological evidence associated with grazing at Luddenham Estate is, however, likely to be highly fragmentary and disturbed and would be **unlikely to meet the threshold for local significance** under this criterion. Archaeological evidence of Blaxland's Crossing, including the causeway and 1859 timber bridge, is significant as the original crossing connecting the disparate portions of Luddenham Estate. The site still represents the only river crossing in Wallacia. Evidence of the causeway or bridge would be of **local significance** under this criterion.
Criterion (b) *An item has strong or special association with the life or works of a person, or group of persons, of importance to NSW's cultural or natural history (or the local area).*	Luddenham Estate has strong associations with John Blaxland and his brother Gregory. They were some of the first free settlers 'of unquestioned respectability to go to the colony' and established extensive commercial interests and landholdings in NSW (Australian Dictionary of Biography, 1966). The anticipated archaeological resource, as relatively ephemeral evidence of cultivation and gardening, is unlikely to demonstrate these associations and is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (c)	No technical achievements were identified within the study area, and ephemeral evidence of agricultural use is unlikely to

Criterion	Assessment
An item is important in demonstrating aesthetic characteristics and/or a high degree of technical achievement in NSW (or the local area).	demonstrate significant aesthetic characteristics. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (d) *An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area).*	No associations with community or cultural groups have been identified. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (e) *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area).*	Archaeological remains of the c.1827 road and approach to the bridge or causeway would provide insight into early colonial construction techniques and adaptation using locally sourced materials. Archaeological evidence of the road, bridge or causeway from Phases 2 or 3 would be of **local significance** under this criterion. Disturbed ephemeral evidence of agricultural activities would not contribute to an understanding of the cultural history of the region. The anticipated archaeological resource is **unlikely to meet the threshold for local significance** under this criterion.
Criterion (f) *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area).*	Evidence of stone causeways or timber bridges would be considered rare in the region and archaeological evidence associated with the bridge or causeway in Phases 2 or 3 would be of **local significance** under this criterion.
Criterion (g) *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).*	The anticipated archaeological resource associated with the bridge or causeway would not be a sufficient enough sample to serve as a representative example, as only a small portion may extend within PAS 3.

6.4.2 Bickford and Sullivan's questions

Can the site contribute knowledge that no other resource can?

The site could contribute an understanding of materials and construction techniques used in establishing a relatively early colonial road, causeway and timber bridge not readily available from documentary sources.

Can the site contribute knowledge that no other site can?

Remnants of early roads are not rare, but evidence of the bridge and causeway could contribute knowledge relatively few other sites could.

Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

Archaeological remains of the bridge, causeway and road could contribute knowledge relevant to broad research questions relating to transport, management of waterways, and early colonial thoroughfares.

6.4.3 Summary statement of archaeological significance

Historical archaeological evidence of a road and rubble causeway constructed c.1827, as well as a timber bridge constructed in 1859, would provide insight into early colonial thoroughfares and the traverse of large waterways and could be of local significance for its historical and research values. Evidence of the causeway and bridge would also be of local significance for its rarity.

Disturbed and ephemeral evidence of grazing and agricultural activities associated with Luddenham Estate would not meet the threshold for local significance.

6.5 Conclusion

PAS 3 has moderate potential for historical archaeological evidence of local significance in one localised area in its northwest corner (Figure 53). The remainder of the site has low potential for archaeological evidence of low significance, unlikely to meet the threshold for local significance.