Review of Environmental Factors

Badgerys Creek Wastewater Stage 2 (November 2024)

Sydney WATER

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Determination

This Review of Environmental Factors (REF) assesses potential environmental impacts of Badgerys Creek Wastewater Phase 2. The REF was prepared under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), with Sydney Water both the proponent and determining authority.

The Sydney Water Project Manager is accountable for ensuring the proposal is carried out as described in this REF. Additional environmental impact assessment may be required if the scope of work or work methods described in this REF change significantly following determination.

Decision Statement

The main potential construction environmental impacts of the proposal are typical construction impacts such as erosion and sedimentation, vegetation removal, noise and dust, emissions, and traffic impacts. The proposal will also impact Aboriginal heritage which will require an Aboriginal Heritage Impact Permit (AHIP) under the *National Parks and Wildlife Act 1974*. During operation the potential impacts will be minor. The proposal will not be carried out in a declared area of outstanding biodiversity value and is not likely to significantly affect threatened species, populations or ecological communities, or their habitats. Therefore, a Species Impact Statement (SIS) and/or Biodiversity Development Assessment Report (BDAR) is not required.

Given the nature, scale and extent of impacts and implementation of the mitigation measures outlined in this REF, the proposal is unlikely to have a significant impact on the environment. Therefore, the proposal does not require an Environmental Impact Statement (EIS) and may proceed.

Certification

I certify that I have reviewed and endorsed this REF and, to the best of my knowledge, it is in accordance with the EP&A Act and the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation). The proposal has been considered against matters listed in section 171 (Appendix A) and the guidelines approved under section 170 of the EP&A Regulation. The information it contains is neither false nor misleading.

Prepared by:	Reviewed by:	Endorsed by:	Approved by:
[redacted]			
REF author Sydney Water Date: 19/11/2024	Snr Env Scientist Sydney Water Date: 19/11/2024	Senior Project Manager Sydney Water Date: 19/11/2024	[redacted] A/ Senior Manager Environment and Heritage Sydney Water Date: 25/11/24

1 Executive summary

Sydney Water plans to build the Badgerys Creek Stage 2 Wastewater Network (the proposal), to meet growing demand for servicing in the South West Growth Area.

Construction is expected to start early 2025 and take approximately two years. The proposal will be constructed in private property, Council and TfNSW land.

The proposal is in the suburbs of Badgerys Creek and Kemps Creek, in the local government areas (LGA) of Liverpool City Council (south of Elizabeth Drive) and Penrith City Council (north of Elizabeth Drive). The proposal crosses several development precincts. These include Badgerys Creek, Dwyer Road, Agri-business, Northern Gateway, Aerotropolis Core precinct and Western Sydney Airport precincts.

As part of this REF, several options and refinements to the design and construction methodology were made to minimise environmental impact. This includes the adoption of trenchless construction methods to avoid sensitive locations and disruptions to traffic. The construction footprint, including the location of construction compounds, was also optimised as far as practicable to reduce environmental impacts.

Much of the work area has been previously disturbed by road and utilities construction or cleared for agricultural purposes. The main construction environmental impacts associated with the proposal are construction impacts such as vegetation clearing, soil erosion, impacts to Aboriginal heritage, noise and traffic. A Construction Environmental Management Plan (CEMP) will be prepared by the contractor to mitigate potential environmental impacts during construction. During operation, the main impacts are associated with air quality and visual amenity.

The proposal will provide a reliable wastewater network that facilitates further development of the South West Growth Area and Western Sydney International Airport, aligned with the principles of ecologically sustainable development.

The main components of the proposal being assessed include:

- new wastewater pumping station SP1230
- approximately 10.6 km of gravity carriers
- approximately 1.8 km of pressure mains.

2 Introduction

2.1 Context

Sydney Water provides water, wastewater, recycled water and some stormwater services to over five million people. Sydney Water operate under the *Sydney Water Act 1994* and have three equal objectives to protect public health, protect the environment and be a successful business.

Sydney Water are a statutory State-owned corporation and are classified as a public authority, and a determining authority for the proposal under Division 5.1 of the EP&A Act. This REF assesses the potential environmental impacts associated with Badgerys Creek Wastewater Stage 2 and identifies mitigation measures that avoid or minimise potential impacts.

2.2 Proposal background and need

Table 2-1 summarises the proposal need, objectives and consideration of alternatives.

Table 2-1 Proposal need, objectives and consideration of alternatives

Aspect	Relevance to proposal
Proposal need	The proposal is part of the Upper South Creek Wastewater program. The proposal is required to provide wastewater services to parts of Badgerys Creek, Dwyer Road, Agri-business, Northern Gateway and Aerotropolis Core precincts as well as the proposed Western Sydney Airport. The new wastewater infrastructure is dependent on the completion of adjacent catchment projects in planning or construction, to service the South West Growth Area (SWGA). All flows from the current proposal will ultimately connect to the Upper South Creek (USC) Advanced Water Recycling Centre (AWRC) and will be operated under the future USC system Environmental Protection Licence (EPL). Until the future USC system EPL is in place, a scheduled development work licence under s47 of the *Protection of the Environment Operations (POEO) Act 1997* will be required for construction of the proposal.
Proposal objectives	The proposal objective is to provide wastewater servicing for the growth expected within the Badgerys Creek catchment as part of the Western Sydney Aerotropolis Growth Area (WSAGA).
Consideration of alternatives/options	An options assessment process informed the design of the proposal. The process identified several alignment options. Sydney Water assessed these options to determine their feasibility and ultimately select the most appropriate option. Options were assessed against their ability to deliver the proposal objectives, technical feasibility, potential environmental impacts and performance, social and community outcomes, and cost. The presented

Aspect	Relevance to proposal
	proposal was selected as the preferred option as it would achieve the proposal objectives with an acceptable level of risk at the least cost.

2.3 Consideration of Ecologically Sustainable Development

Table 2-2 considers how the proposal aligns with the principles of ecologically sustainable development (ESD).

Table 2-2 Consideration of principles of ecologically sustainable development (ESD)

Principle	Proposal alignment
Precautionary principle - *if there are threats of serious or irreversible environmental damage, lack of scientific uncertainty should not be a reason for postponing measures to prevent environmental degradation. Public and private decisions should be guided by careful evaluation to avoid serious or irreversible damage to the environment where practicable, and an assessment of the risk-weighted consequences of various options.*	The proposal will not result in serious or irreversible environmental damage and mitigation measures have been designed to reduce scientific uncertainty relating to the proposal. The proposal has been designed to minimise impact to the environment by employing alternative construction methodologies (trenchless installation), minimising vegetation removal, and positioning infrastructure in previously disturbed areas such as road corridors where possible.
Inter-generational equity - *the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.*	The proposal will help to meet the needs of future generations by providing a reliable wastewater service.
Conservation of biological diversity and ecological integrity - *conservation of the biological diversity and ecological integrity should be a fundamental consideration in environmental planning and decision-making processes.*	The proposal will not significantly impact on biological diversity or impact ecological integrity. The proposal has been designed to avoid impacting significant vegetation where possible. Impacts to native vegetation will be offset where required.
Improved valuation, pricing and incentive mechanisms - *environmental factors should be included in the valuation of assets and services, such as 'polluter pays', the users of goods and services should pay prices based on the full life cycle costs (including use of natural resources and ultimate disposal of waste) and environmental goals*	The proposal will provide cost efficient use of resources and provide optimum outcomes for the community and environment.

3 Proposal description

3.1 Proposal details

Table 3-1 describes the proposal and

Figure 3-1 shows the location and key environmental constraints.

Table 3-1 Description of proposal

Aspect	Detailed description
Proposal description	The proposal includes: • new wastewater pumping station SP1230 • approximately 10.6 km of gravity carriers • approximately 1.8 km of pressure mains. Associated network infrastructure, including connection mains, will be delivered by developers and will be covered by separate environmental planning approvals.
Location and land ownership	The proposal is located within the SWGA, about 40 km south west of the Sydney CBD in the suburbs of Badgerys Creek and Kemps Creek, in the local government areas (LGAs) of Liverpool City Council (south of Elizabeth Drive) and Penrith City Council (north of Elizabeth Drive). The proposal is located on private property, Council and TfNSW land. SP1230 will be located within Lot 72 DP1277011. A portion of this lot will need to be acquired and an access easement established.
Site establishment and access tracks	Site establishment includes delineating the construction sites, storage and laydown areas, erosion and sediment controls, traffic management and vegetation removal. Site establishment may also include surveys, service location, geotechnical investigations or other investigations required prior to construction. It may also include service relocation where services are identified that may be affected. Access to the alignment and construction sites will generally be via existing roads and along the pipeline construction footprint. Temporary access tracks may be established where necessary. The location of these will be chosen by the contractor, in consultation with the landowner(s) and approved by Sydney Water's Project Manager as described in the mitigation measures in Section 6. Temporary access tracks will be removed at the completion of construction.
Ancillary facilities (compounds)	Construction compound(s) will likely be required to house site sheds, construction amenities and materials laydown. The exact location of these will be chosen by the contractor in consultation with the landowner(s) and approved by Sydney Water's Project Manager as described in the mitigation measures in Section 6.
Methodology	The construction phase of the proposal will include pressure mains, gravity mains, pumping station including overflow pipes, associated fittings, and vent shafts. The proposal area is shown in Figure 3-1. **Investigation/site establishment** The following activities may be required:

Aspect	Detailed description
	• investigative works including geotechnical, contamination and survey • soil sampling and waste classification. • site preparation works including: - establishing temporary compounds - installing erosion and sediment controls - traffic management measures - vegetation trimming/removal. **Pipelines** The wastewater pipelines would be installed underground using a combination of open excavation (trenching) and trenchless construction methods (horizontal directional drilling (HDD), horizontal auger boring (HAB) and microtunnelling). Open trenching will be used in areas that are accessible and have minimal environmental constraints. Trenchless methods will be used for difficult to access locations or environmentally sensitive areas. **Open trench construction** Open trenching construction will generally occur progressively where a section will be trenched, a section of pipe will be installed, and that section will then be backfilled and restored to pre-existing conditions. Installation dimensions will range from about 1 m to about 6.5 m deep and 1.2 m to 2 m wide. Construction by open trenching will involve: • stringing pipe sections along the construction corridor • excavating trenches, stockpiling spoil material beside the trench • benching or shoring up trenches, depending upon trench depths • spreading granular bedding material such as sand or gravel in the trench • installing a section of pipe in the trench • pressure/vacuum testing pipeline • backfilling trench with compacted bedding material and spoil • restoring disturbed areas and replacing topsoil • reinstating any areas where the road surface has been disturbed in accordance with the requirements of local council. **Trenchless construction** Trenchless techniques such as microtunnelling, HDD and HAB will be used to mitigate environmental impacts and avoid sensitive areas including key fish

Aspect	Detailed description
	habitat (KFH), waterways, heritage and biodiversity where specified, and some road crossings. Microtunnelling and HAB will involve the excavation of pits approximately 4 m by 6 m at either end of each trenchless section that serve as launch and receival points for the pipeline. HDD generally involves drilling from the surface. Excavation dimensions of HDD pits may be required and will be 4 m by 10 m. Pipes installed using trenchless techniques would be up to about 16 m deep. For drilling, a potable water source will be fed to the drill rig, which in turn will be fed to the drill head for lubrication. The drilling fluid will make its way back to the launch site of the drill rig progressively. The bore slurry would be pumped into a recycling unit where it would be agitated to remove clay cuttings and separate solids for off-site disposal to appropriately licensed EPA facility. Following the clay removal, the recycled fluid would be re-used and sent back to the bore head for lubrication. This cycle would continue for the duration of the drilling operation. Construction by horizontal directional drilling will involve: • stringing pipe at the receival pit • positioning directional drilling plant at the launch pit • drilling pilot hole from the surface at the launch pit to the receival pit • back reaming of pilot hole from receival pit to launch pit • pulling pipe back from the receival pit to the launch pit • grouting around the pipe • restoration around launch and receival pits. Construction by micro-tunnelling and horizontal auger boring will involve: • excavating launch and receival pits to the depth of the pipeline at either end of the microtunnelling sections (within the construction footprint) • shoring up pits using sheeting and bracing structures • lowering the drilling plant into the launch pit • lowering sections of pipe into the launch pit • using the plant to push the cutting head, followed by the sections of pipe, to the receival pit • managing waste generated from soil displacement • reinstating road pavement, road verge and vegetation where required. There will be vent shafts, maintenance holes, scour pits and air valves at various locations along the alignment. The construction area is anticipated to be up to 5 m x 5 m for ancillary structures and will be within the construction footprint of pits; all being located within the 50 m construction corridor. Vent shafts will be

Aspect	Detailed description
	about DN300 and will allow ventilation of odours form the mains into the atmosphere at an indicative height of 18 metres and maximum spacing of 400 m, subject to confirmation during detailed design. **Pumping station construction** One pumping station is proposed. Required excavations for construction are anticipated to be up to about 20 m below ground surface level. Construction of the pumping station will include emergency storage, odour control unit (OCU) and chemical dosing unit (CDU). An above ground electrical kiosk and switch room building are also proposed. SP1230 will consist of an in ground wet well, valve chamber and inlet maintenance hole. Construction of the pumping station will include: • installation of site boundary fencing and gates • installation of the pumps and equipment • bulk earthworks to establish required levels • piling and shoring works, dependant on excavation depths • installing emergency overflow pipelines, with headwall configuration using open trenching techniques • deep excavation works for the pumping station sub-structure • deep pipework installation via trenchless methods • installation of concrete structures including inlet maintenance hole, wet well, EST and valve chamber • backfill and installation of shallow pipework and discharge maintenance hole • installation of slab foundations for the OCU, switch room and substation and associated services • building and mechanical fit out works • permanent power supply works • site electrical works • access road, hardstand and ancillary works • site restoration and landscaping • testing and commissioning of the station. Construction of the proposal will involve vegetation clearing and excavation. The areas to be disturbed will include a construction corridor for trenched areas,

Aspect	Detailed description
	including overflow pipelines, pits for trenchless sections, establishing construction compounds, and the pumping station site. Cleared material will be temporarily stored within the construction footprint and removed from the site if not suitable for reuse during restoration. The excavated material will generally be stockpiled adjacent to excavations and used as backfill. Topsoil will be stockpiled separately and then placed on top of backfilled sub soil.
Commissioning	Commissioning involves testing and running the new equipment to ensure it works correctly and is integrated with existing plant operations. The exact commissioning steps depend on the type of the equipment, but typically include: • testing utilities, telemetry and switchboards • inspection and performance testing of equipment, pipes, pumps and fittings • testing of any emergency systems in place.
Restoration	Non-operational areas of the work site will be restored to the pre-existing condition following construction in consultation with landowners. The Construction Environmental Management Plan (CEMP) will detail site restoration works to be undertaken once construction works are finished. Native vegetation removal will be replaced in consultation with Council and offset in accordance with the Sydney Water Biodiversity Offset Guideline. Any required revegetation will be carried out in accordance with Sydney Water procedure *SWEMS0025.11 Guideline for native revegetation following construction*. Site restoration activities would include: • backfilling of trenches • dismantling compounds, removal and disposal of waste material and removing construction signage • restoring ground cover and vegetation • restoration of road pavement surfaces and drainage • removing erosion and sediment control, fencing and traffic management measures.
Materials/ equipment	**Materials** Typical materials likely to be used include but are not limited to: • Polyethylene (PE) pipe for the pressure pipelines • GRP pipe for the gravity pipelines • pumps and other equipment

Aspect	Detailed description

- building materials, steel and timber
- fuel for minor plant and equipment
- topsoil, bitumen and concrete
- valves and other fixtures
- concrete for encasement
- granular materials
- reused excavated material for pipe trench fill.

Equipment

Typical equipment likely to be used includes but is not limited to:

- excavators
- rock breakers / jackhammers
- compactors
- padfoot roller / vibration roller
- slurry extractor
- concrete truck and pump
- concrete saws
- drill rig
- microtunneling / HDD equipment
- horizontal auger
- backhoe
- tipper trucks
- bogie / truck and dog
- light and heavy vehicles
- street sweeper
- water truck
- cranes
- generators
- air compressors
- skip bins
- dump trucks

Aspect	Detailed description
	• portable pumps and sediment tank • welding equipment and power • tools (various) • confined spaces safety equipment (eg gantry/davit) • site facilities and amenities • storage containers. Construction of the proposal will involve excavation, and while excavated material will generally be used as backfill, it is likely that there will be excess materials, including material generated from trenchless construction. The management of this and other waste material generated by construction is discussed in Section 6.
Work hours	Work and deliveries will be scheduled to occur during standard daytime hours of: • 7 am to 6 pm, Monday to Friday • 8 am to 1 pm, Saturdays. The proposal is expected to require work outside these hours, for safety and/or to reduce impacts to traffic during work in roads or delivery of oversize equipment. This has been assessed and mitigation measures are provided in Section 6.
Proposal timing	Construction is expected to start early 2025 and take about 24 months.
Operational requirements	Sewage treatment is a scheduled activity. The proposal will convey wastewater to the USC AWRC and will be operated under the future system EPL. Until the system EPL is established a scheduled development work licence will be required for construction of the proposal. Once operational, proposed pumping station will operate largely without the need for permanent presence at the site. The proposal will be subject to standard and routine maintenance activities such as inspections, testing and repairs as necessary.

Figure 3-1 Location of proposal, CPCP and Key Fish Habitat mapping

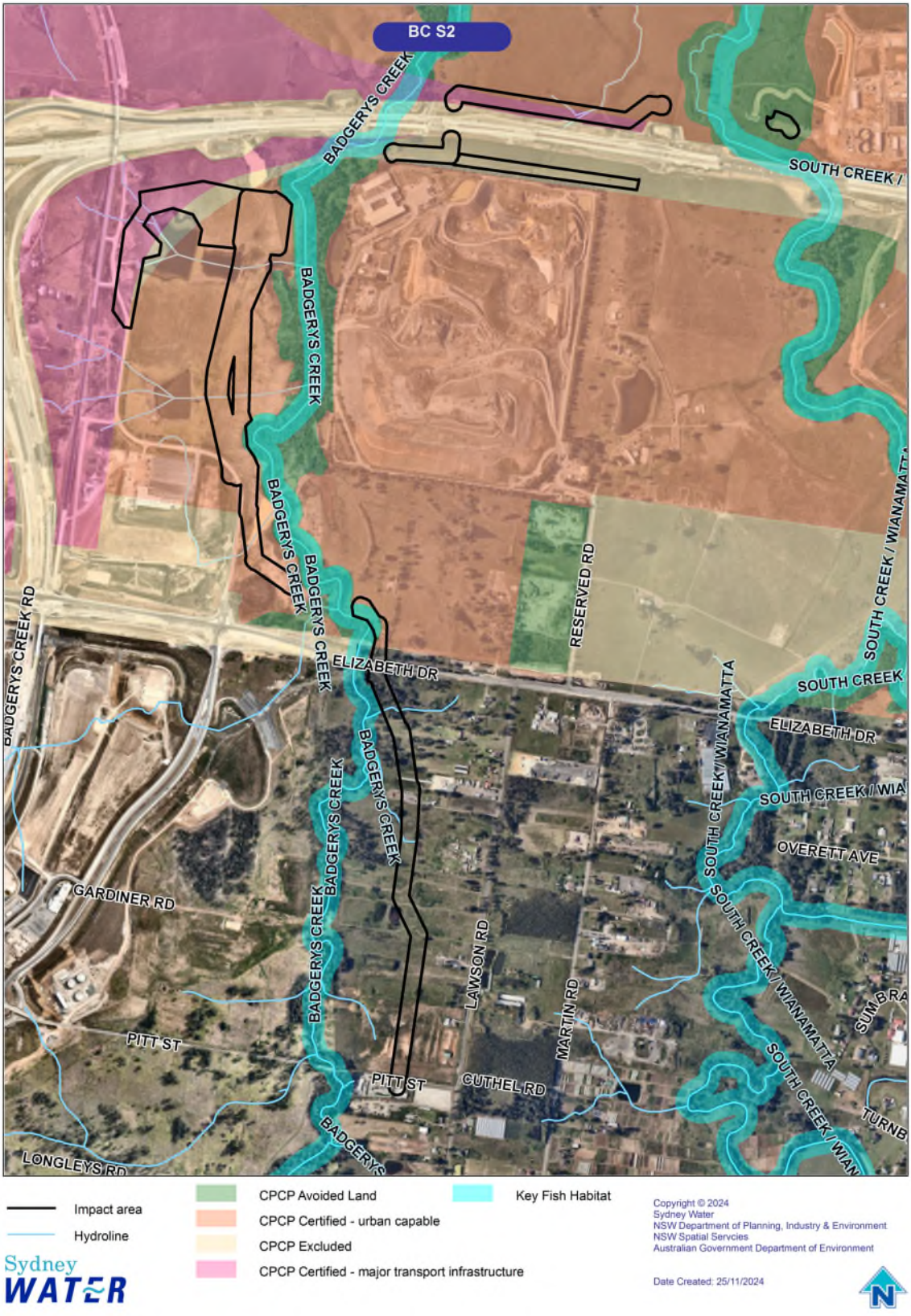


Figure 3-2 Location of proposal and potential key ecological constraints (mapped vegetation data)



Figure 3-3 Location of proposal and key heritage constraints

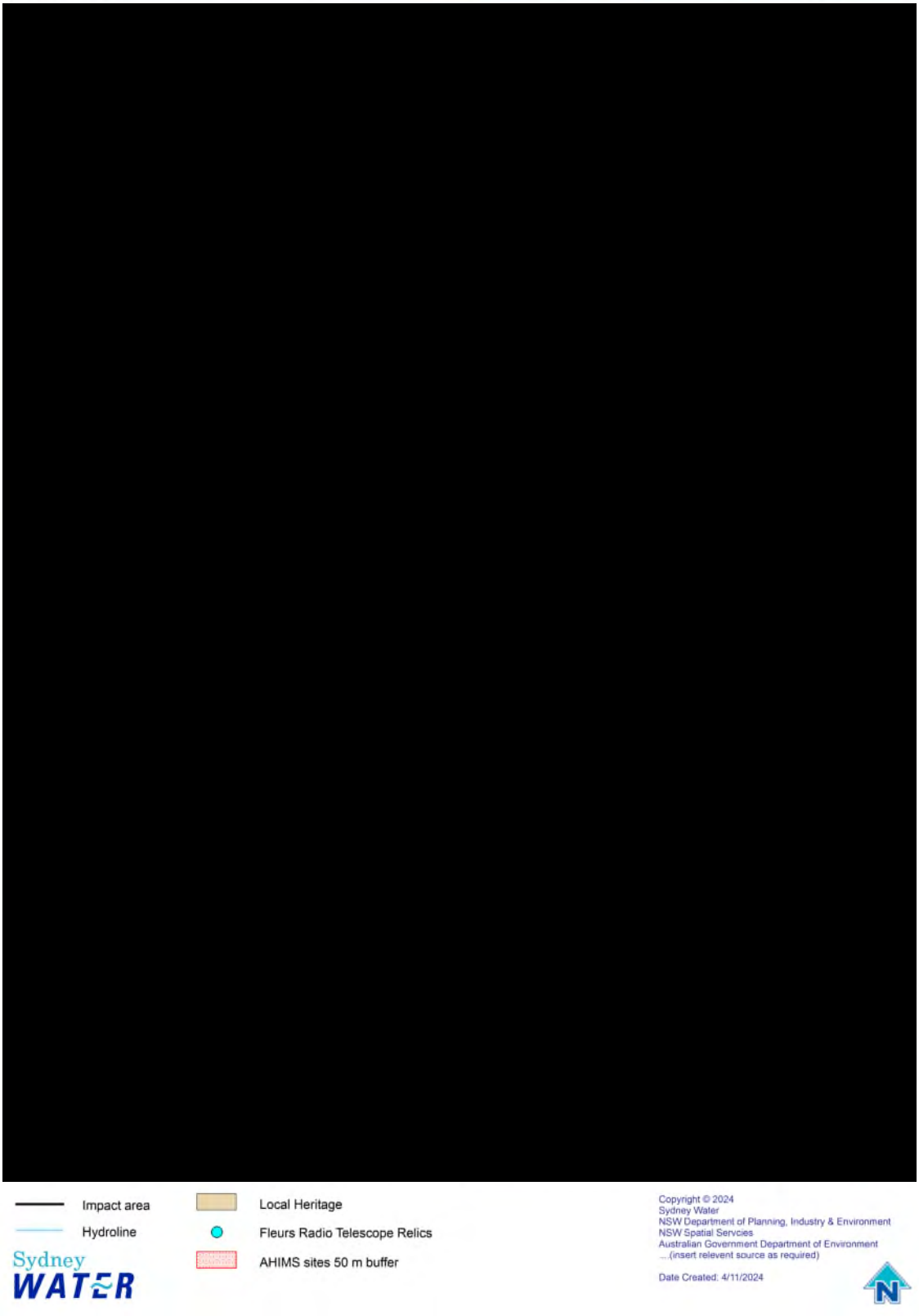


Figure 3-4 Fleurs Radio Telescope Relic No-Go zones

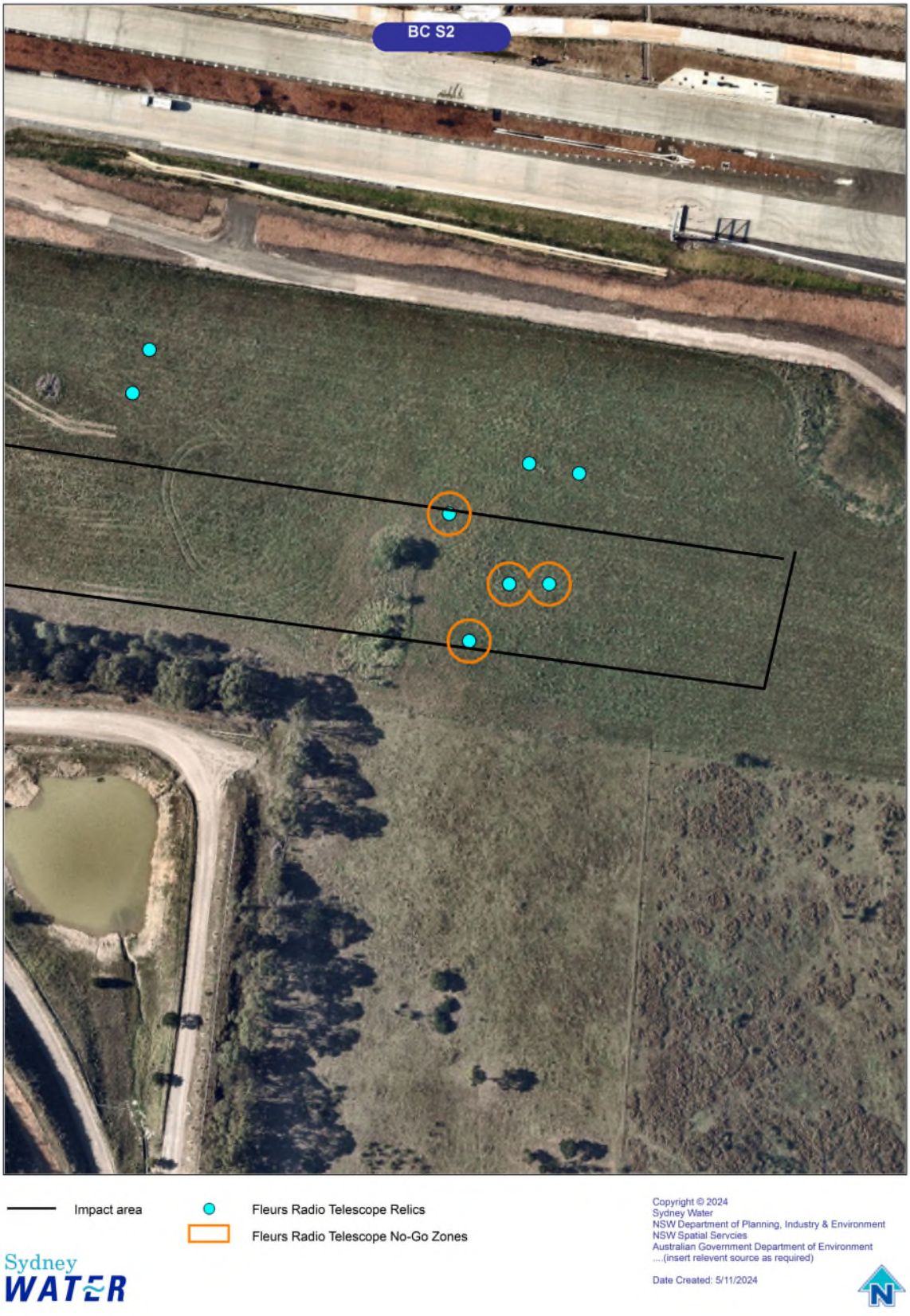


Figure 3-5 Avoided Land (HBV mapping), ENV and Certified land mapping within proposal area



3.2 Impact area and changes to the scope of work

The assessed impact area comprises a 25 m buffer around pipeline alignments (50 m corridor) and the footprint for the pumping station. The impact area also includes new access roads and launch/receival pits of about 50 m by 50 m for trenchless sections. The final alignment, including the construction footprint and precise location of pits, may change based on further design or construction planning.

The proposal shown in this REF is indicative and based on the latest concept design at the time of REF preparation. The final proposal may change based on detailed design and/ or construction planning. The general mitigation measures outline when changes to the proposal trigger supplementary environmental impact assessment. If required, further assessment must be prepared in accordance with SWEMS0019.

An addendum is not required provided the change:

- remains within the study area of the REF and has no net additional environmental impact; or
- is outside the study area of the REF but reduces the overall environmental impact of the proposal (subsection 5.4(a) of the Act).

Changes to the proposal outside the study area can only occur:

- to reduce impacts to biodiversity, heritage or human amenity; or
- to avoid engineering (for example, geological, topographical) constraints; and
- after consultation with any potentially affected landowners and relevant agencies.

The Contractor will demonstrate in writing how the changes meet these requirements, for approval by Sydney Water's Project Manager, in consultation with the environmental and community representatives.

4 Consultation

4.1 Community and stakeholder consultation

Our approach to community and stakeholder consultation is guided by Sydney Water's community and stakeholder engagement guidelines.

Stakeholder and community engagement is a planned process of initiating and maintaining relationships with external parties who have an interest in our activities. Community and stakeholder engagement:

- enables us to explain strategy, policy, proposals, proposal or programs
- gives the community and stakeholders the opportunity to share their knowledge, issues and concerns
- enables us to understand community and stakeholder views in our decision-making processes alongside safety, environment, economic, technical and operational factors.

The nature, scale and extent of the proposal's potential impact has been evaluated in this REF. If our work impacts the community in some way, Sydney Water will consult with affected groups throughout the proposal. This includes engaging the broader community and stakeholders during plan or strategy development or before making key decisions.

Sydney Water will also provide local councils with reasonable notice when the works will commence. Local council(s) will be consulted about matters identified in environmental planning instruments (refer Section 4.2 below). This includes public safety issues, temporary works on council land, and full or partial road closures of council managed roads.

Sydney Water has consulted with a range of stakeholders regarding the proposal, these include:

- briefings with Government and Regulatory entities: Local Councils, Department of Primary Industries and Regional Development (DPIRD), Western Parkland City Authority (WPCA) and Local Aboriginal Land Councils
- regular discussions with developers and landowners directly impacted by the proposal
- working with landowners to facilitate access for site investigations
- ongoing phone and emails between Sydney Water and landowners
- landowner meetings and discussions with landowners impacted by partial acquisition for the pumping station location.

Further consultation will be undertaken with council and property owners regarding construction activities, access and easements required for the proposal. The broader community will also be informed of the proposed infrastructure and construction activities.

4.2 Consultation required under State Environmental Planning Policies and other legislation

Sydney Water must consult with councils and other authorities for work in sensitive locations or where the work may impact other agencies' infrastructure or land. This is specified in the State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP).

The proposal involves underboring within Key Fish Habitat beneath Badgerys Creek and Wianamatta South Creek. DPIRD Fisheries were notified under s.199 of the *Fisheries Management Act (1994)* on 6 September 2024 regarding the proposal as the proposed underboring meets the definition of dredging under the Act. DPIRD responded on 3 October and have no objections to the proposed works, provided Sydney Water follow their suggested environmental mitigation measures (refer to Section 6 and Appendix B).

Sydney Water has consulted with the Western Parkland City Authority on 6 September 2024 as the proposal has a capital investment value of over $30 million and is in the Western City operational area. No response was received.

Sydney Water's Wastewater and Environment (WW&E) Custodians and Major Projects team consulted with the EPA regarding the USC AWRC and network EPL requirements under the *Protection of the Environment Operations Act 1997*. The EPA confirmed that a scheduled development work licence will be required for construction of any network, where the works are not connecting to an existing licenced system. This REF must be provided to the EPA as part of the scheduled developed work licence application. EPL requirements are further discussed in Section 6.2.2.

5 Legislative requirements

5.1 Strategic context

5.1.1 Greater Sydney Region Plan

The Greater Sydney Region Plan – A Metropolis of Three Cities (Greater Sydney Commission, 2018) is a long-term strategic plan for the Greater Sydney area. The plan focuses on developing a more liveable, productive, and sustainable city by dividing the metropolitan area into three interconnected cities: the Western Parkland City, the Central River City, and the Eastern Harbour City.

The Plan sets a 40-year vision (to 2056) and establishes a 20-year plan to manage population growth and change for Greater Sydney in the context of social, economic and environmental matters. It aims to create new jobs, provide more housing choices, improve transport connectivity, and enhance the natural and built environment. The Plan is structured around the following key strategies:

- infrastructure and collaboration – including investing in water and wastewater infrastructure
- liveability
- productivity
- sustainability.

The proposal directly supports the first key strategy area by State government investment through Sydney Water's delivery of critical wastewater infrastructure in future growth areas. It also supports the other key strategies by improving and expanding wastewater servicing to enhance liveability for current and future populations, enables development and greater productivity opportunities, and improves sustainability of the region by connecting existing wastewater infrastructure to an integrated water cycle. Specifically, the proposal is located within the Western Parkland City which is discussed further below.

5.1.2 Enabling development, home and job growth in the Western Parkland City

Greater Sydney's population is forecast to reach eight million people over the next 40 years, and about half of those people are expected to be living west of Parramatta. Much of this growth will occur in the Western Parkland City, driven by the new Western Sydney International Airport.

Over the coming years, the region is set to become the economic powerhouse of Greater Sydney. This area will need commercial and industrial developments to host the businesses, residential areas to house the workforce and infrastructure to service their access and utility needs.

The NSW Government's vision for the Western Parkland City is focused on creating jobs, a highly skilled workforce and an innovation economy. However, it also seeks to support a landscape-led approach to new urban communities that will create quality places for the community, keep water resources in the catchment to protect the local climate from heat island effects, value Aboriginal

and non-Aboriginal heritage and support the emerging circular economy. Development of the Western Parkland City presents a significant opportunity to maximise productivity, liveability and sustainability.

In the Western Parkland City, the Western Sydney Aerotropolis Growth Area (WSAGA) and SWGA are expected to be home to up to 650,000 people by 2056. Most of the WSAGA and SWGA are not serviced by Sydney Water and use on-site systems such as septic tanks. The proposed new urban communities require water and wastewater services to be established to support the anticipated population growth and economic productivity, and to provide equitable servicing across Sydney's metropolitan areas.

New water and wastewater services also bring considerable opportunity to maintain treated water in the local context, enhance the quality of public spaces, the health of the community and environment, and be a focal point for a new circular economy.

In developing a new wastewater service for the region, the proposal is focused on achieving the best outcome for Western Sydney, and therefore for Greater Sydney more broadly. The proposal will enable growth and development of the region and offer wastewater services that our customers expect.

5.1.3 Greater Sydney Water Strategy

The NSW Government developed the Greater Sydney Water Strategy (DPE, 2022b), which establishes a direction for delivering sustainable and resilient water services to Greater Sydney for the next 20 to 40 years. The strategy sets out priorities and actions for the delivery of water infrastructure into the future to support a sustainable, liveable and productive Greater Sydney.

The Strategy recognises that wastewater management plays a crucial role in achieving a variety of outcomes for the region. Not only does it protect public and environmental health, and help keep our waterways healthy, but it also contains valuable resources that have previously gone unused. Only about 7% of wastewater in Greater Sydney is recycled. Most wastewater is directed to treatment plants and then discharged to the ocean. As Greater Sydney continues to become denser and extend into new areas of growth, the reuse and recycling of wastewater will be essential to support a more productive and sustainable region.

Sydney Water's AWRC will contribute to improving wastewater management and resource recovery from wastewater in Greater Sydney. The AWRC will recover high-quality treated water for environmental flows to waterways, organic material known as biosolids for use as an alternative to chemical fertilisers in farming and gardening, use industry-leading technology to harness renewable energy from co-generation processes, and enable other sustainable practices.

The proposal will enable the wastewater collected in the surrounding area to be directed to the AWRC where treatment and resource recovery can take place through an integrated water cycle process.

5.1.4 Local Strategic Planning Statements

The proposal is located within the local government areas of Liverpool City Council and Penrith City Council. Both councils have prepared a Local Strategic Planning Statement (LSPS) in

accordance with section 3.9 of the EP&A Act. The LSPS guides land use planning in the LGA, taking into consideration economic, social, and environmental factors.

Each LSPS outlines a vision for the future of land use for their respective local government area, focusing on sustainability, liveability, and growth. The statements identify key directions, such as promoting sustainable development, enhancing community infrastructure, supporting economic development, and preserving the natural environment. The plans aim to provide a framework for future development and guide decision-making to ensure continued growth and prosperity while preserving the area's unique character and natural assets.

Penrith LSPS acknowledges the significant role Sydney Water has to ensure that the growth areas within the LGA can be adequately serviced. It also notes that some of the growth areas, such as the Western Sydney Aerotropolis, currently either lack the water-related infrastructure to cater for growth or are limited in their ability to provide additional capacity. Sydney Water is planning water and wastewater infrastructure throughout the region and is delivering critical assets to support the wider network that will service areas of growth. This includes the AWRC and the proposal that will unlock the potential to service a substantially greater population in Western Sydney.

Liverpool LSPS contains a number of planning priorities that relate to infrastructure and aligning with growth while being sustainable and protecting the natural environment. In particular, planning priority 15 aims for Liverpool to be a green, resilient and water-sensitive city. The proposal will support this priority, by providing a means for wastewater from the surrounding area to be transferred to the AWRC. The wastewater will then be treated to a high-quality that will be suitable for reuse in a range of applications.

Additionally, given the majority of the proposal will be located below ground, it is unlikely to affect a council's ability to implement any potential future land use plans.

5.2 Environmental legislation

Sydney Water is the proponent and determining authority under the EP&A Act. The proposal does not require development consent and is not classified as State significant infrastructure. This proposal has been assessed under Division 5.1 of the EP&A Act. This REF has concluded that the proposal is unlikely to have a significant impact on the environment.

The following environmental planning instruments (Table 5-1) and legislation (Table 5-2) are relevant to the proposal. Table 5-2 also documents any licences and permits required, and timing and responsibility for obtaining them.

Table 5-1 Environmental planning instruments relevant to the proposal

Environmental Planning Instrument	Relevance to proposal
State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP)	Section 2.126(6) of the TISEPP permits development by or on behalf of a public authority for sewage reticulation systems without consent on any land in the *prescribed circumstances*.

Environmental Planning Instrument	Relevance to proposal
	As Sydney Water is a public authority, the proposal is permissible without consent.
State Environmental Planning Policy (Precincts—Western Parkland City) 2021 (Western Parkland City SEPP)	The proposal is located on land zoned Environment and Recreation (ENZ), Enterprise (ENT) and Infrastructure (SP2). The proposal is located within the LGAs of Liverpool City Council and Penrith City Council, however the land is zoned under SEPP (Precincts – Western Parkland City) 2021. **Sydney region growth centres (Chapter 3)** The Western Parkland City SEPP coordinates the release of land for residential, employment and other urban development, in the Western Parkland City area. Chapter 3 applies to growth centres, including the SWGA. The southern portion of the proposal (south of Elizabeth Drive) is located within the SWGA and is subject to the conditions of the Biodiversity Certification Order (BCO) of the former *State Environmental Planning Policy (Sydney Region Growth Centres) 2006.* The BCO establishes certified areas in which proponents of developments do not need to undertake assessment of impacts on threatened ecological communities, species and populations, or their habitats that would normally be required by the *Environmental Planning and Assessment Act 1979.* The BCO also identifies non-certified areas where impacts to existing native vegetation (ENV) (as defined in the BCO) must be assessed and offset in accordance with the BCO. The proposal will avoid impacts to ENV in non-certified land. **Western Sydney Aerotropolis (Chapter 4)** The proposal is located within land to which Chapter 4 of this SEPP applies. The proposal is located on land zoned as Environment and Recreation (ENZ), Infrastructure (SP2) and Enterprise (ENT). As per Subsection 4.5, the provisions of the TISEPP still apply as the proposal does not meet the exceptions noted in that clause. Therefore, the proposal can be undertaken without development consent.
State Environmental Planning Policy (Biodiversity and Conservation) 2021 (BCSEPP)	**Vegetation in non-rural areas (Chapter 2)** The proposal is in an area or zone listed in subsection 2.3(1). However, subsection 2.4(1) states: '*This Policy does not affect the provisions of any other SEPP….*', and as the

Environmental Planning Instrument	Relevance to proposal
	works are permissible under the TISEPP, a council permit to clear vegetation under this SEPP is not required. **Koala habitat protection 2021 (Chapter 4)** Chapter 4 of this SEPP applies to the local government area of Liverpool, however subsection 4.4(3) provides that the Chapter does not apply to land on which biodiversity certification is in force. As the proposal within the Liverpool local government area is on land to which a biodiversity certification is in force, this Chapter does not apply. **Water catchments (Chapter 6)** Chapter 6 of this SEPP applies as the proposal is within the Hawkesbury-Nepean Catchment, a regulated catchment area. Section 6 of this REF assessed potential environmental impacts on water quality and quantity, aquatic ecology, flooding, access, cultural heritage, flora and fauna, and scenic quality. The assessment confirmed that potential impacts are minimal and meet the requirements of part 6.2 of the SEPP. **Strategic conservation planning (Chapter 13)** The works are within the Cumberland Plain Conservation Plan (CPCP) area which includes land mapped as certified – urban capable, excluded and avoided land. Chapter 13 of this SEPP sets out planning controls to achieve the development and biodiversity outcomes of the CPCP released by the DPE in August 2022. The CPCP establishes several land categories to which certain planning controls are applied: • avoided land • certified-urban capable land • land in a strategic conservation area. Any parts of the proposal on avoided land must follow the notification and reporting requirements in section 201A of the Environmental Planning and Assessment Amendment (Avoided Land) Regulation 2022. This proposal includes works on avoided land however it will not impact any native vegetation within avoided land. Sydney Water notified DPHI on 22 November 2024 of the proposed works within avoided land. Sydney Water has taken into consideration

Environmental Planning Instrument	Relevance to proposal
	the requirements of this Chapter. Refer to Section 6.2.3 of this REF.
Cumberland Plain Conservation Plan Guidelines for Infrastructure Development 2022 (CPCP)	The proposal is located on land classified under the CPCP as: • certified – urban capable land • excluded land • certified – major transport corridor • avoided land. The proposal has been designed to avoid native vegetation impacts on avoided land and meets the objectives listed in Section 2.3 and Section 3.3 of the CPCP, so no restrictions apply to these activities.

Table 5-2 Consideration of key environmental legislation

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility
Protection of the Environment Operations Act 1997 (POEO Act)	Sewage treatment is a scheduled activity under the Act. The proposal involves construction of part of a new sewage treatment system which will convey wastewater to the AWRC and will be operated under a future sewage treatment system EPL. Until the system EPL is established, or an existing EPL is in place, a scheduled development work licence will be required for construction of the proposal.	Scheduled Development Work (s47 licence) System EPL (s48 licence)	Pre-construction, Contractor Pre-operation, Sydney Water
Biodiversity Conservation Act 2016 (BC Act)	The BC Act lists threatened species, populations and ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats. If any of these could be impacted by the proposal, an assessment of significance 'Test of Significance' (ToS) that addresses the requirements of section 7.3 of the BC Act must be completed to determine the significance of the impact. The certification of land is governed by Part 8 of this Act. Section 8.4(5) states that a determining authority under Part 5 of the EP&A Act is not required to consider the effect on biodiversity of an	REF (and consent from Minister if needed)	Pre-construction, Sydney Water

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility
	activity, to the extent that it is carried out on biodiversity certified land.		
National Parks and Wildlife Act 1974 (NPW Act)	This Act provides for the establishment, preservation, and management of areas such as national parks, state conservation areas, nature reserves, and Aboriginal areas. This Act also provides for the protection of Aboriginal heritage, including Aboriginal objects and places. The proposal in not within National Parks, State Conservation areas or nature reserves. An Aboriginal Heritage Impact Permit is required for the works as they will disturb known areas of Aboriginal heritage. Aboriginal heritage is described in Section 6.2.4.	AHIP	Post REF, pre-construction, Sydney Water (for AHIP)
Heritage Act 1977	The *Heritage Act 1977* provides protection for those items of environmental heritage (historic-period) that are of value to the state of New South Wales.	s.139(4) REF	Pre-construction, Sydney Water
Fisheries Management Act 1994 (FM Act)	The FM Act protects threatened species, populations and communities of fish and marine vegetation, commercial and recreational fishing areas, in NSW waters. A permit and/or notification is required under Part 7 of the FM Act for activities that involve dredging and reclamation work, temporarily or permanently obstructing fish passages and or harming marine vegetation. The proposal will require dredging of Key Fish Habitat. Under s.199 of the FM Act a public authority can carry out dredging or reclamation work without a permit provided that: • the Minister is given written notice of the proposed work • consider any matters concerning the proposed work that are raised by the Minister within 21 days after the giving of the notice (or such other period as is agreed between the Minister and the public authority) In accordance with s.199 of the FM Act, the proposal was referred to DPIRD Fisheries for	Notification	Pre-construction, Sydney Water

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility
	comment 6 September 2024. DPIRD Fisheries responded on 3 October 2024 with consultation advice, including mitigation measures that have been included in this REF.		
Water Act 1912/ Water Management Act 2000	Under section 91B of the WM Act, Sydney Water is required to obtain a Water Supply Work Approval (WSWA) for the temporary dewatering of groundwater. In addition, a Water Access Licence (WAL) (section 60A) would be required if more than three megalitres (ML) of groundwater is likely to be extracted, in accordance with Schedule 4 of the Water Management (General) Regulation 2018. If a WAL is required, water shares must be secured prior to works commencing. A groundwater assessment for the proposal was completed and confirmed dewatering of approximately 1.9 ML of groundwater will be required. A WSWA will be obtained prior to commencement of any groundwater dewatering.	WSWA (for <3ML)	Pre-construction, Sydney Water
Roads Act 1993	This Act regulates works in, on, or over a public road. Approval under Section 138 of this Act is required for carrying out works in, digging up, or disturbing a public road. Much of the alignment passing through open fields or proposes trenchless construction methods. A Road Occupancy Licence (ROL) would be required from the relevant road authority prior to work on public roads and any temporary road closures during construction of the proposal.	Road Occupancy Licence	Pre-construction, contractor
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act provides the framework for Commonwealth environmental approvals. This REF finds that the proposal is unlikely to have a significant impact on any matters of national environmental significance.	Not applicable	Not applicable

6 Environmental assessment

Section 0 describes the existing environment and assesses direct and indirect impacts of construction and operation. It also identifies mitigation measures to minimise impacts. These will be incorporated into contract documents and a Construction Environmental Management Plan prior to starting work.

6.1 Existing environment

The proposal is in the suburbs of Badgerys Creek and Kemps Creek, in the local government areas (LGA) of Liverpool City Council (south of Elizabeth Drive) and Penrith City Council (north of Elizabeth Drive). The Badgerys Creek Stage 2 catchment crosses several development precincts including, Badgerys Creek and Northern Gateway.

The proposed wastewater infrastructure generally runs through rural, vegetated and/or agricultural lots, avoiding environmentally sensitive areas and minimising impacts to private property. Existing land use is mostly rural/agricultural and extensive past clearing of native vegetation and intensive grazing by cattle is evident across the landscape. Environmentally sensitive areas include Badgerys Creek and associated riparian areas. Much of the remnant native vegetation tends to be along the waterway and mainly consists of threatened ecological communities.

Aboriginal heritage sites are found throughout south western Sydney, particularly around waterways and impacts will require an Aboriginal Heritage Impact Permit (AHIP). Non-Aboriginal heritage items are also listed in the vicinity of the proposal but will not be directly affected by the work as construction methods and asset designs which are sympathetic to heritage values (eg trenchless techniques, alignment adjustments) have been adopted.

The environmental features within and adjacent to the study area are detailed in Section 6.2.

6.2 Environmental aspects, impacts and mitigation measures

6.2.1 Topography, geology and soils

Existing environment and potential impacts

The proposal will require ground disturbance, removal of vegetation and stockpiling of soil which could result in potential offsite erosion and sedimentation to surrounding land and waterways.

Construction of batters to raise the structure of SP1230 above the current flood level may cause permanent but localised changes to the surface topography and drainage patterns of the area. The rest of the proposal area will be returned to its original topography and drainage pattern following construction.

Trench dimensions will be about 6.5 m deep and 2.0 m wide. The maximum trenchless depth is expected to be about 16 m. The dimensions of the launch and retrieval pits are typically around 6

m deep by 3 m wide and 3 m in length. Deep excavation is required to construct the pumping station. The wet well would be about 20 m deep and 8 m in diameter.

Construction activities would be staged to minimise the extent of soil disturbance at any given time and disturbed areas would be stabilised and reinstated as soon as practical. Stringent erosion and sediment controls would be implemented to prevent the migration of sedimentation downstream of the work site, especially where excavating in proximity to creek lines and their tributaries.

All excavation works associated with the proposal will occur in areas with moderate to high potential for salinity. Disturbance of saline soils has the potential to impact the local environment if not managed appropriately. The erosion and transfer of saline sediments offsite has the potential to alter the water quality of receiving environments which in turn has the potential to impact upon flora and fauna that are sensitive to elevated levels of salinity.

Implementation of the safeguards and mitigation measures outlined in the following section would ensure that impacts associated with improper management or re-use of excavated soils are avoided during construction and impacts from salinity are considered unlikely.

The works are not proposed to cause major permanent change the surface topography and drainage patterns of the area. With the exception of SP1230, the area will be returned to its original topography and drainage pattern following construction. No topography, geology or soil impacts are anticipated during operation.

Mitigation measures

With the implementation of the mitigation measures below, impacts to topography, geology and soils can be adequately managed, and residual impacts are expected to be minor.

Table 6-1 Environmental mitigation measures — topography, geology and soils

Mitigation measures
Prevent sediment moving offsite in accordance with Managing Urban Stormwater, Soils and Construction, Volume 1 and 2A (Landcom 2004 and DECC 2008), including: • develop a Soil and Water Management Plan (SWMP) as part of the CEMP • divert surface runoff away from disturbed soil and stockpiles • install sediment and erosion controls before construction starts • reuse topsoil where possible and stockpile separately • inspect controls at least weekly and immediately after rainfall • rectify damaged controls immediately • remove controls once surfaces have been stabilised, including removing trapped sediment in drainage lines. These are to be maintained in good working order for the duration of the works and subsequently until the site has been stabilized and the risk of erosion and sediment movement from the site is minimal.
Minimise ground disturbance and stabilise disturbed areas progressively.

Mitigation measures
Contractor to ensure imported material is certified for intended use and is free from contamination including asbestos.
Stop work in the immediate vicinity of suspected contamination. Indicators of contamination include discoloured soil, anthropogenic fill material, asbestos, strong chemical or petrol odours and leachate. Contain disturbed material on an impermeable surface and cordon areas off. Notify the Sydney Water Project Manager and the Environmental Representative. Sydney Water Project Manager to contact Contamination and Hazardous Materials Team for advice regarding management options.
Stop work during heavy rainfall or in waterlogged conditions when there is a risk of sediment loss off site.
Sweep up any sediment/soil transferred off site at least daily, or before rainfall.
Eliminate ponding and erosion by restoring natural landforms to the pre-works condition.
Adopt appropriate soil salinity mitigation measures in accordance with Western Sydney Salinity Code of Practice (Western Sydney Regional Organisation of Councils, 2003). This may include: • (if relevant) treat existing salinity with gypsum • (if relevant) establish salt tolerant species in existing or potential salinity problem areas after construction • stabilise existing areas of erosion • minimise water use on site • avoid rotation and vertical displacement of the original soil profile • backfill excavations deeper than one metre in the same order, or treat or use this material as fill at depths more than one metre from the finished level.
Contractor to ensure imported material is Virgin Excavated Natural Materials (VENM) or meets a relevant NSW EPA Resource Recovery Order and Resource Recovery Exemption, or is a commercially supplied material that is not waste. If using materials that are subject to a NSW EPA Resource Recovery Order/Exemption the Delivery Contractor must ensure the conditions in that Order/Exemption are strictly adhered to.

6.2.2 Water and drainage

Existing environment and potential impacts

Groundwater

Regional groundwater flow direction is expected to be consistent with the topography, moving towards Badgerys Creek or Wianamatta South Creek. Badgerys Creek is a designated high potential terrestrial groundwater dependent ecosystem (GDE) and Wianamatta South Creek is a designated high potential aquatic groundwater dependent ecosystem. Terrestrial GDEs (patches of

remnant vegetation) are present within the study area. There are no recognised subterranean ecosystems present within the study area.

Impacts associated with dewatering excavations, such as aquifer supply loss or issues associated with the management of silt-laden construction water, would be temporary and manageable with standard safeguards. During construction, groundwater is expected to be encountered between 1.7 – 6.6 m bgl along the gravity carrier, between 5.8 – 6.6 m bgl along the pressure main and between 6.3 – 6.6 m bgl at the pumping station based on the 2023 Badgerys Creek Catchment Wastewater Network Dewatering Assessment (Sydney Water, 2023).

A groundwater assessment for the proposal was completed and confirmed dewatering of approximately 1.9 ML of groundwater will be required. A Water Supply Work Approval is required for all activities that involve dewatering of groundwater. The volume of dewatered groundwater would be monitored across the proposal area.

The proposed work is in an area that contains terrestrial GDEs. As the proposed work only involves minor vegetation clearing and dewatering of groundwater will be minimised by using trenchless techniques, the viability of these ecosystems is not considered to be at risk such that the water-table of groundwater on which they depend will be altered.

Construction impacts

The project area runs adjacent to and beneath Badgerys Creek and Wianamatta South Creek, which are part of the Hawkesbury-Nepean catchment area and both are Key Fish Habitat. The pipeline alignment also runs adjacent to and intersects with several unnamed ponds.

Poor site management may lead to potential sedimentation impacts to local waterways. Creek crossings will be completed using trenchless methods to minimise impacts to water quality and avoid surface water impacts adjacent to and within waterways. Trenchless methods beneath waterways have potential to result in frac outs. Geotechnical investigations have been undertaken to understand the potential for frac outs and the proposal has been designed to avoid them.

The proposal requires disturbance of groundcover, excavation of soils, and the establishment of temporary soil stockpiles. These activities increase the risk of sediment-laden runoff which has the potential to enter waterways and cause turbidity and additional sedimentation. This can result in decreased light levels for submerged aquatic vegetation and smothering of benthic organisms.

Flood maps for Badgerys Creek and Wianamatta South Creek from publicly available flood studies from Liverpool City Council and Penrith City Council show that the proposal is mostly bordering with and partially within the extent of a 1:100 ARI (1% AEP) flood. The eastern side of SP1230 is located partially within the 1% AEP, as such earthworks and construction of batters are proposed to elevate SP1230. The proposal and is not likely to adversely affect flood behaviour as the only permanent changes to surface topography and drainage patterns will be the pump station and pump station access road. The pump station and access road have been designed to maintain existing drainage patterns.

During periods of high rainfall, there is the risk that higher water levels in the creeks and surrounding flooding may impact on construction. Flooding has the potential to increase soil erosion and siltation from the construction site. Pollutants such as sediment, soil nutrients,

construction waste, chemicals and gross pollutants have the potential to enter drainage lines and creek systems, particularly during high rain events, which potentially could result in a decline of water quality.

Spillage of fuel during refueling, leakage of hydraulic, lubricating oil from plant and equipment, rinse water from plant washing or concrete slurries would all have the potential to enter drainage lines. This could potentially result in a decline of water quality. Control of construction water run-off is therefore necessary to avoid these potential impacts to surrounding waterways.

Operational impacts

Potential impacts to the hydrology of the study area during operation of the proposal may arise from:

- discharge of wastewater during commissioning activities
- repairs to wastewater pipelines and pumping station, which may involve excavation to access the pipeline.

Repairs to wastewater infrastructure are anticipated to occur infrequently.

Regarding impacts to water quality and quantity, and to Badgerys Creek and Wianamatta South Creek, the network and pumping station is designed to store a quantity of wastewater during wet weather events, preventing wastewater discharges most of the time. During extreme weather events however, the wastewater storage capacity of the network and pumping station may be exceeded and untreated wastewater has the potential to flow to overflow points. Wastewater system design requires overflow points as a contingency, so wastewater does not back up into houses and businesses if pipeline capacity is exceeded. This is a standard global approach to wastewater system design and Sydney Water also aligns with relevant Water Services Association of Australia (WSAA) codes and standards. During these overflow events, wastewater would have the potential to impact Badgerys Creek, potentially contributing to an increase in background nutrient loads, pathogen levels and trace pollutant loads. The impact of these temporary and infrequent wastewater discharges would be minimised by the large catchment flows that occur during extreme wet weather events. The new infrastructure has been designed for a maximum of 10 spill events in 10 years with overflow infrastructure only provided at the pumping station and not along the pipeline network. The network has been designed to be leak tight which will minimise infiltration of flood waters into the wastewater system.

The proposal will be operated under the future USC system Environmental Protection Licence (EPL). Until the future USC system EPL is in place, a scheduled development work licence under s47 of the *Protection of the Environment Operations (POEO) Act 1997* will be required for construction of the proposal.

Mitigation measures

With the implementation of the mitigation measures below, impacts to water and drainage can be adequately managed, and residual impacts are expected to be minor.

Table 6-2 Environmental mitigation measures — water and drainage

Mitigation measures
Bund potential contaminants and store on robust waterproof membrane, away from drainage lines.
Keep a functioning aquatic spill kit on site for clean-up of accidental chemical/fuel spills in mapped key fish habitat. Keep the spill kits stocked and located for easy access.
Locate portable site amenities away from watercourses or drainage lines.
Keep stockpiles to a minimum and ensure adequate contingency measures are in place to prevent sedimentation of waterways in the event of a large flood event.
Sydney Water will obtain a groundwater Water Supply Approval. The Delivery Contractor is responsible for: • preparing a Dewatering Management Plan • complying with the approval conditions (such as protecting water quality; minimising aquifer extraction volumes, monitoring extraction with flow meters and recording volumes).
Discharge all water in accordance with Sydney Water's Discharge Protocols Standard Operating Procedure (WPIMS5021), including erosion controls, discharge rate, dechlorination, monitoring. Re-use potable / groundwater water where possible.
Dewater excavations in accordance with the Delivery Management Guidance Standard 9.1 *Excavation Dewatering*.
If discharge to the environment is not possible, seek approval and discharge criteria from the relevant Sydney Water Business Customer Accountsprior to discharge to the wastewater system. Otherwise, tanker by a licensed waste contractor and dispose off-site to an appropriately licensed facility.
Store all chemicals and fuels in accordance with relevant Australian Standards and Safety Data Sheets. Record stored chemicals on site register. Bunded areas to have 110% capacity of stored liquid volume. Chemicals and fuels in vehicles must be tightly secured. All chemicals to be clearly labelled.
Conduct refuelling, fuel decanting and vehicle maintenance in compounds where possible. If field refuelling is necessary, designate an area away from waterways and drainage lines with functioning spill kits close by.
Conduct any equipment wash down within a designated washout area.
Ensure equipment is leak free. Repair oil/fuel leaks immediately or remove from site and replace with a leak-free item.
Prepare Drilling Fluid Management plan to avoid impacts, including: • contain and monitor drilling fluids at entry/exit points • identify and manage frac-outs • re-use and/or disposal of drilling fluids (checking waste classification).

Mitigation measures
On completion of the works all disturbed soil is to be levelled, smoothed and sown with a mixture of sterile/native grass seeds to encourage rapid revegetation and planted out with native endemic riparian vegetation.
Prior to use at the site, machinery is to be appropriately cleaned, degreased and serviced.
DPIRD Fisheries (1800 043 536) and the Environment Protection Authority (EPA) (131 555) are to be notified immediately if any fish kills occur in the vicinity of the works. In this situation, all works other than emergency response procedures are to cease until the issue is rectified and approval is given by DPIRD Fisheries and/or the EPA for the works to proceed.

6.2.3 Flora and fauna

A search of aerial imagery and existing vegetation mapping published on the State Vegetation Type Map (SVTM) NSW extant PCT (OEH, 2024) identified areas of vegetation with potential to be impacted by the proposal. The proposal has been modified to minimise impacts to flora and fauna by underboring riparian vegetation and moving the proposal to previously cleared areas where possible. However, there is still potential for some impacts to vegetation and therefore Aurecon were engaged to complete a Biodiversity Assessment Report (BAR). The assessment included a literature review, database search, field assessment and impact assessment. The complete BAR is summarized below and provided as Appendix C. The BAR assesses the worst case scenario impacts to flora and fauna. Impacts are likely to be less than those described in the BAR due to proposed underboring and impacts to vegetation being avoided where possible during construction.

Existing environment and potential impacts

The area surrounding the proposal is highly disturbed, adjacent to roads, active construction sites and residential houses. Vegetation within the surrounding area primarily consists of weeds and planted vegetation. The proposal area however is manly comprised of riparian vegetation and agricultural land with several scattered native trees. The proposal is generally located adjacent to Badgerys Creek and Wianamatta South Creek, where remnant riparian vegetation remains. Some sections of the proposal contain native vegetation and are mapped as areas of ‘Avoided Land’, ‘Excluded Land’ under the CPCP and ‘Existing Native Vegetation’ under the Biodiversity Certification Order (BCO) associated with the of the Western Parkland City SEPP (refer to Figure 3-5).

The BAR identified the vegetation communities within the proposal area, assessed impacts, and identified appropriate mitigation measures. Biodiversity features were identified during a site visit (Figure 6-1). Plant Community Type (PCT) 4025 Cumberland Red Gum River-flat Forest is present within the proposal area, comprising *of Eucalyptus moluccana, Casuarina glauca, Melaleuca stypheliodes* and *Microlaena stipoides*. PCT 4025 is associated with TECs listed under the BC Act and EPBC Act. Native vegetation within PCT 4025 matched the criteria for the BC Act listed EEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney

Basin and Southeast Corner Bioregions. However, due to the presence of a significant number of non-native ground-cover species and weeds, no native vegetation in the Study Area matched the criteria for any of the above EPBC Act listed communities. Therefore, the BAR found no EPBC Act listed TEC's occurring within the impact area. Other vegetation within the proposal area was found to be planted native or exotic vegetation including invasive weeds.

Fauna habitats present within the proposal area include:

- endemic native trees and shrubs – providing habitat for common bird species
- hollow-bearing trees – providing habitat for bird species, microbats and small mammals
- planted trees – providing foraging resources for birds
- fallen branches and logs – providing habitat for ground-dwelling reptiles, gastropods, birds and small mammals
- stick nests – providing habitat for common bird species.

No threatened flora or fauna were sighted during the visit. Threatened fauna species Cumberland Plain Land Snail *Meridolum corneovirens* (Endangered, BC Act) and Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act) were considered to have a moderate or higher likelihood of occurrence within the proposal area. The majority of potential habitat for these two species occurs within the native vegetation recorded along Badgerys Creek and South Creek (PCT 4025). These areas of potential habitat are outside of the impact area and will not be impacted by the proposal.

These areas fall within existing biodiversity-certified zones. Under Section 8.4(5) of the BC Act, a determining authority under Part 5 of the EP&A Act is not required to assess the impact of activities on biodiversity in certified areas. Therefore, impacts to these species are not further considered.

For development activities on 'Avoided Land' and 'Certified – Urban Capable Land', the objectives set out in Sections 2.3 and 3.3 of the *Cumberland Plain Conservation Plan Guidelines for Infrastructure Development* (DPE, 2023) must be met. In addition, the proposal must adhere to the mitigation requirements outlined in Section 3.3, Table 1 of the Infrastructure Guidelines, which apply to ecological values protected under both the BC Act and the EPBC Act. Relevant mitigation measures from the *Cumberland Plain Conservation Plan Guidelines for Infrastructure Development* are included in Table 6-3. These must be addressed in a statement (as per regulation 201A of the EP&A Regulation 2021) to demonstrate consistency with Section 2.3 of the CPCP Infrastructure Guidelines. This statement is currently being prepared by Sydney Water and any mitigation measures suggested by DPE should be included in the CEMP.

No native vegetation that is part of a TEC will be impacted by the works (field validated). Up to six planted non-native trees and up to 18 native trees are proposed to be impacted within the section of the main pipeline alignment immediately north of Elizabeth Drive (Figure 4). The non-native species are Camphor Laurels (*Cinnamomum camphora*). The native trees include five Grey Box (*Eucalyptus moluccana*), 13 Eucalyptus sp. and a Cabbage Gum (*Eucalyptus amplifolia*). A hollow-bearing Grey Box was identified within the impact area. Minor branch trimming of this tree may be required to complete the proposal, however the tree and hollows will be retained.

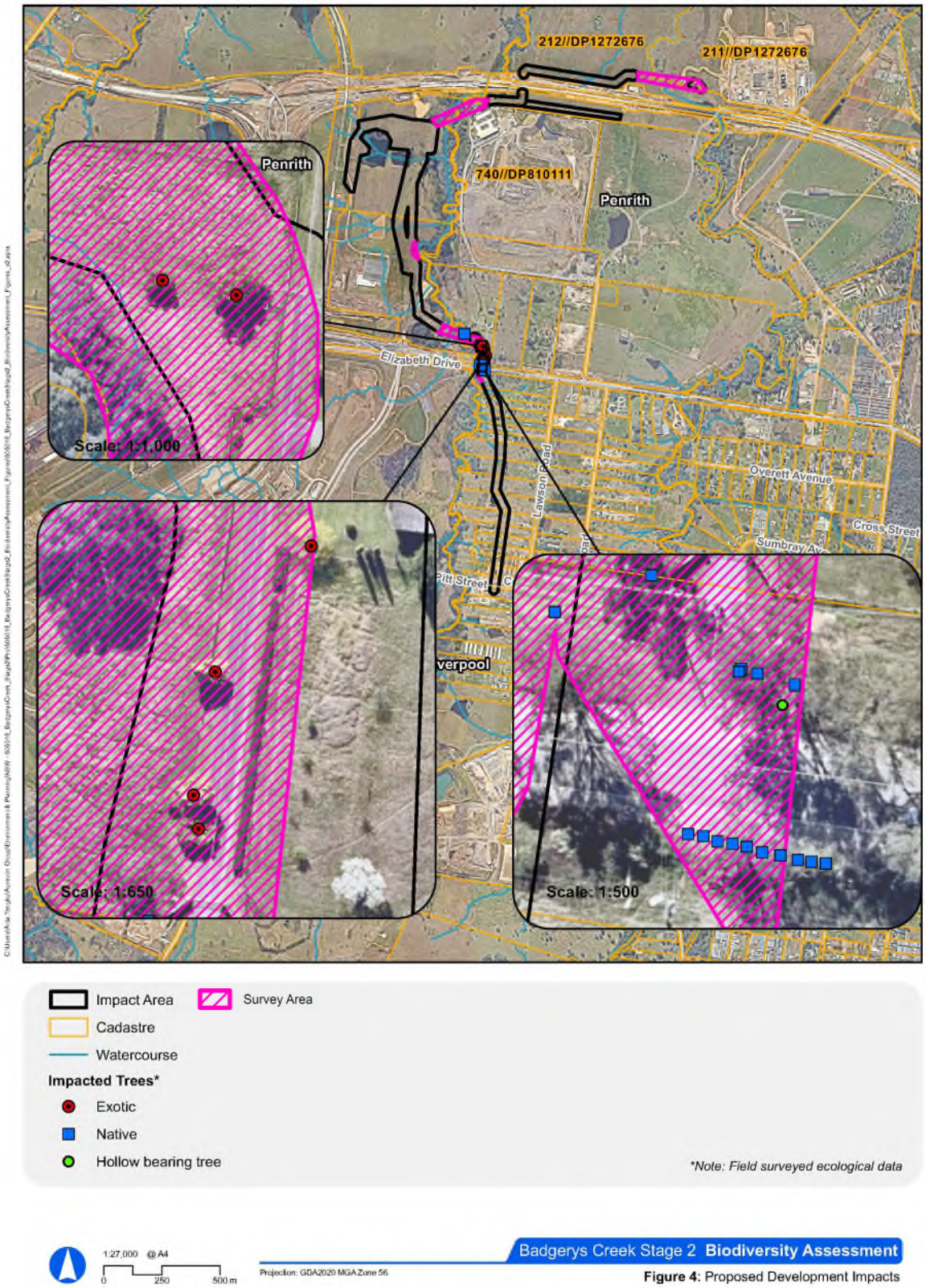
Although formal offsets are not required under the BC Act, Sydney Water has committed to deliver a 'maintained or enhanced' biodiversity outcome if proposals have biodiversity impacts. Offsets will be required in accordance with Sydney Water's Biodiversity Offset Guidelines and the tree offset multiplier is shown in Table 6-3. Offsets will be determined after vegetation removal as the number of trees to be removed has not yet been finalised. The number of trees to be removed is likely to be less than those identified in the BAR.

Table 6-3 Tree offset multiplier

Tree	Offset Multiplier
Locally native	3
Non-locally native	1
Exotic	1
Tree hollow	2 nest boxes or salvaged hollows (for each removed)

Several environmental weeds were recorded within the Study Area. Although these weeds are not declared priority weeds, they still pose a risk to the surrounding vegetation and biodiversity. The spread of environmental weeds will be limited with the implementation of mitigation measures listed in Table 6-4.

Figure 6-1 Proposed ecological impacts identified in BAR



Operational impacts

No direct operational impacts are anticipated to flora or fauna. Indirect operational impacts to biodiversity may result from noise disturbance and infrequent wastewater discharge during overflow events associated with flooding. Bushfire risk is considered low as the above ground infrastructure is clear of surrounding vegetation.

Mitigation measures

With the implementation of the mitigation measures below, impacts to flora and fauna can be adequately managed, and residual impacts are expected to be minor to moderate.

Table 6-4 Environmental mitigation measures — flora and fauna

Mitigation measures
Provided it is essential for delivering the project, Sydney Water's Project Manager can approve the following vegetation removal and tree trimming, without additional environmental assessment (but only after consultation with the Environmental and Community Representatives and affected landowners). Sydney Water considers vegetation removal in these circumstances has minimal environmental impact. • Any minor: - vegetation trimming or - removal of exotic vegetation or - removal of planted native vegetation where the vegetation is not a threatened species (including a characteristic species of a threatened community or population), heritage listed, in declared critical habitat, in a declared area of outstanding biodiversity value, in areas mapped as ENV or RBM 12 under the Sydney Growth Centre Biodiversity Certification Order or in land mapped as avoided land or strategic conservation area under the Cumberland Plain Conservation Plan. • Any removal of remnant vegetation where there is no net change to environmental impact (eg a different area of vegetation is removed but the total area is the same or less than assessed in the EIA). Written explanation of the application of this clause (including justification of the need for trimming or removal and any proposed revegetation) should be provided when seeking Project Manager approval.
Map and report native vegetation clearing to the Sydney Water Environmental Representative. Track vegetation clearing as per SWEMS0015.26 Contractor Native Vegetation Clearing and Rehabilitation template. Supporting documentation/evidence must be provided in the report including photos, marked up maps and GIS layers. If an ecologist is doing a preclearance survey they can provide GIS layers of the areas to be cleared.
Physically delineate vegetation to be cleared and/or protected on site and install appropriate signage prior to works commencing.
Adjust methodology (eg avoid area, hand excavate, implement exclusion fencing) to protect sensitive areas where possible (such as mature trees, known threatened species, populations or ecological communities).

Mitigation measures
If any damage occurs to vegetation outside of the disturbance corridor (as shown in the CEMP), notify the Sydney Water Project Manager and Environmental Representative so that appropriate remediation strategies can be developed.

Manage biosecurity in accordance with:

- Biosecurity Act 2015 (see NSW Weedwise), including reporting new weed infestations or invasive pests
- contemporary bush regeneration practices, including disposal of sealed bagged weeds to a licenced waste disposal facility.
- record pesticides and herbicides use in accordance with SWEMS00017

If replanting near Sydney Water pipelines refer to *'Which trees can damage wastewater pipes? '* link from Sydney Water website.

In TOBAN period:

1. Check specific TOBAN notice to confirm whether the work can be carried out under standard exemptions (Govt Gazette No18 Feb 2018)

If not, apply to RFS for specific exemption.

Where practical, open trenches will be covered at the end of each work day to avoid potential for native fauna to become trapped in open trenches.

Any native vegetation to be cleared within the Impact Area will be clearly identified and marked. Native vegetation to remain will be clearly delineated as No-Go-Zones to avoid risk of clearing. Clearing and No-Go-Zone maps to be prepared and approved by SWC prior to works commencing. Signage stating No-Go-Zone should be clearly displayed and all staff will be made aware of No-Go-Zones during induction.

Tree removal is to be confirmed by an arborist due to potential to retain these trees if impact to the Tree Protection Zone is minimal. Tree Protection Zone details are provided within the *Australian Standard 4970-2009 Protection of trees on development sites.*

A Weed management plan is to be developed and implemented by the Contractor and approved by Sydney Water prior to works commencing. The plan will be established and implemented to avoid spread and establishment of weeds during construction. Measures will include:

- A hygiene protocol must be prepared by the Contractor prior to works starting and implemented by the Contractor during works to avoid introduction of pathogens in machinery, tools, PPE or imported soils.
- All equipment and plant machinery to be appropriately cleaned before the start of works.
- All priority weeds within the Impact Area are to be cleared and disposed of at a registered waste management facility.

Mitigation measures

- If herbicide is to be used, this must be applied by a person trained to do so and that has a certificate of competency, or a statement of attainment issued by a registered training organisation. Herbicide will only be used in accordance with the label/permit.
- Conduct toolbox talks to identify high risk priority weeds and weeds of national significance to on-site staff
- Weed vegetation requiring clearing and removal should be disposed of at a registered waste management facility.

Offset residual impacts to native vegetation and trees in accordance with the Biodiversity Offset Guideline (SWEMS0019.13).

Where possible, limit clearing to trimming rather than the removal of whole plant.

Protect trees in accordance with the requirements of Australian *Standard 4970-2009 for the Protection of Trees on Development Sites*. Do not damage tree roots unless absolutely necessary and engage a qualified arborist where roots >50mm are impacted within the Tree Protection Zone.

Protect trees in accordance with the Program Delivery Guidance Standard 9.3 Biodiversity Management (EV-GS-003).

Inspect vegetation for potential fauna prior to clearing or trimming. If native fauna is encountered on site, stop work and allow the fauna to move away unharassed. If fauna is present and does not move away, or ecological assessment has determined high likelihood of native fauna presence (including hollow bearing trees), engage WIRES or a licenced ecologist to inspect and relocate fauna before works.

Retain dead tree trunks, bush rock or logs in-situ unless moving is unavoidable. Reposition material elsewhere on the site or approved adjacent sites.

If dewatering farm dams, engage a licensed ecologist to undertake fauna relocation (e.g., turtles, frogs, etc) into an appropriate nearby habitat.

If any threatened species (flora or fauna) is discovered during the works, stop work immediately and notify the Sydney Water Project Manager. Work will only recommence once the impact on the species has been assessed and appropriate control measures implemented.

If green waste is likely to contain herbicides or other chemical or physical contaminants (including man-made and other foreign materials), do not send for offsite recycling.

Consult Taronga Zoo's [redacted]) prior to the removal of vegetation to determine the usefulness of vegetation waste as koala feed.

Any mitigation measures received from DPE in response to statement to demonstrate consistency with Section 2.3 of the CPCP Infrastructure Guidelines should be included in the CEMP.

CPCP mitigation requirements for activities on 'Certified – Urban Capable Land'

Mitigation measures

Habitat features and connectivity:

1. Retain large trees that are greater than or equal to 50 cm diameter at breast height (including dead trees but excluding noxious weeds) where possible and apply tree-protection measures for all vegetation to be retained. This is to provide ongoing roosting and foraging opportunities for fauna

2. Retain areas of high density proteaceae shrubs where possible, particularly along riparian corridors, to retain foraging resources, habitat and movement corridors for the Eastern Pygmy-possum.

3. Before any disturbance, all structures potentially providing habitat for microbats (bridges, culverts, mine shafts, storm water tunnels, old or derelict buildings) must be inspected by a qualified ecologist at an appropriate time of year. Where microbats are found, the structure providing habitat must not be affected, or a bat management plan must be prepared by a microbat specialist which allows for:

- exclusion mechanisms to reduce the risk of direct physical harm to the microbats; and/or

- supplementary habitat to compensate for lost habitat: and/or

- regular inspections of structures and briefing of relevant construction staff.

Pests

4. Before construction works begin, a pest control strategy must be prepared. This strategy must be implemented during construction and operation of the development. This strategy must include pest

control methods that reduce the risk of secondary poisoning (for example, from Pindone or second generation rodenticides)

Disease

5. Incorporate best-practice site hygiene protocols to manage the potential spread of pathogens, such as

Phytophthora and myrtle rust adjacent to potential habitat for species targeted by the CPCP.

Weed invasion

1. Implement mitigation measures to manage weeds during construction and operation of the development, taking into account relevant guidance in the CPCP's Weed Control Implementation Strategy.

Disease

2. Incorporate best-practice site hygiene protocols to manage the potential spread of pathogens, such as Phytophthora and myrtle rust adjacent to potential habitat for TECs.

6.2.4 Heritage

Aboriginal Heritage

A search of the Aboriginal heritage information management system (AHIMS) undertaken by Sydney Water in November 2024 identified several Aboriginal heritage sites within the proposal area. Due to the proposal being within 200 m of waterways and AHIMS sites, the proposal was identified as having potential to impact Aboriginal heritage. Aboriginal heritage due diligence was

undertaken by Kelleher Nightingale Consulting (KNC) and an Aboriginal Cultural Heritage Assessment Report (ACHAR) was completed. The ACHAR is summarised below. The assessment included a database search for Aboriginal heritage sites, a desktop assessment, field surveys and archaeological test excavations. The complete assessment is provided as Appendix D.

Existing environment and potential impacts

A search of the AHIMS and review of prior Aboriginal heritage studies identified several Aboriginal heritage sites in the region. The identified sites were a combination of artefacts, potential archaeological deposits (PADs), an area of grinding groves and a culturally modified tree.

A field survey was carried out by KNC in May 2024 to expand on the findings of the desktop assessment. No surface stone artefacts were identified within the assessment area during the survey. The survey found that outside of the identified Aboriginal archaeological sites and PADs, much of the study area displayed low archaeological potential due to ground surface disturbance from land use practices and natural processes such as erosion and flooding. Additional information was required on the nature and extent of any subsurface archaeological deposits within the proposal area, therefore archaeological test excavations were undertaken by KNC in September and October 2024.

The test excavations confirmed the locations of six previously recorded Aboriginal sites (comprising 9 AHIMS registrations) within the proposal area and identified three previously unrecorded Aboriginal archaeological sites within the proposal area.

In general, results supported the existing understanding of the archaeological landscape within this part of the Cumberland Plain, namely that more intensive, focused and/or repeated Aboriginal occupation took place on landforms associated with the larger creek corridors. Much of the study area traverses the terraces, flats and floodplain rises adjacent to the Badgerys Creek and Wianamatta South Creek watercourses.

The ACHAR impact assessment found that all sites within the project study area were likely to be impacted by construction of the proposal, resulting in a partial impact to six sites (comprising eight AHIMS registrations) and a total impact at three sites (Table 6-5). If impact to these sites cannot be avoided through adjustments to the project scope (construction methodology/alignment), then a land based AHIP should be obtained under section 90 of the *National Parks and Wildlife Act 1974* for the project, for all areas not already covered under an existing approval/AHIP. At the time of assessment, the AHIP should include Aboriginal objects associated with sites identified in Table 6-5.

The consequence of harm includes total and partial loss, with the significance of harm ranging from low to moderate (Table 6-5). Depending on the existing archaeological value and proposed impact, salvage excavation and/or surface collection has been recommended as part of mitigation measures. The archaeological value of the sites is linked to the information that they contain. Recovery of this information through archaeological salvage excavation would help to mitigate the impact of the proposal. Offering an opportunity to better understand the activities which were undertaken at these sites and the effect of land use disturbance and natural processes on subsurface archaeological deposits in the vicinity of Badgerys Creek and Wianamatta South

Creek. As conservation is the primary goal of all Aboriginal heritage management all archaeological excavation undertaken will be restricted to the actual construction corridor and approved AHIP area. All other areas will be appropriately demarcated and protected as no-go zones that will be identified in the CEMP.

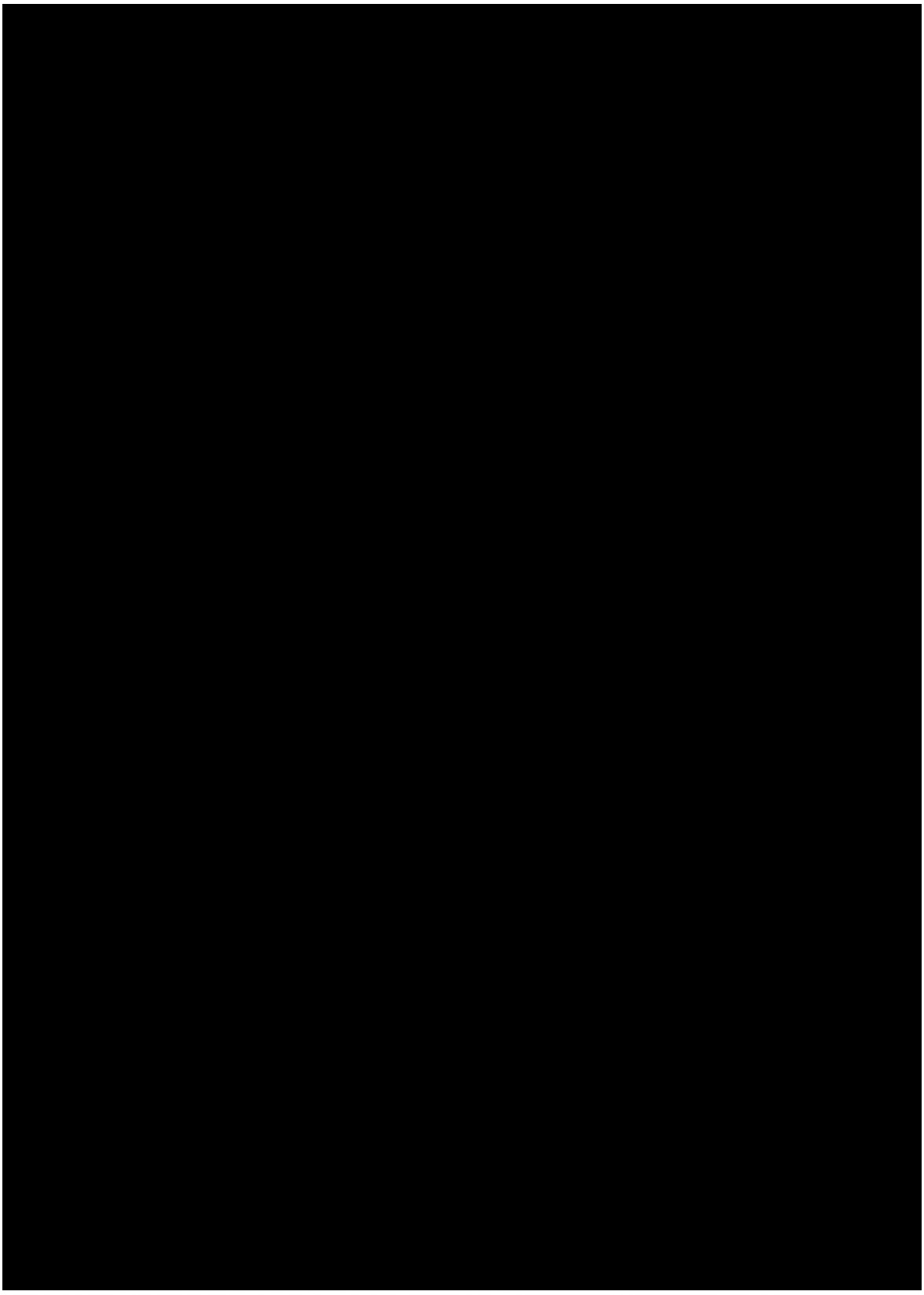
The proposal overlaps several areas that have been previously assessed for Aboriginal cultural heritage values under existing State Significant Infrastructure (SSI) approvals and AHIPs. Existing approvals/AHIPs are for major infrastructure projects, including: the M12 Motorway (SSI 9364), AWRC (SSI 8609189), Sydney Metro Western Sydney Airport (SSI 10051) and Western Sydney International (Nancy-Bird Walton) Airport. These approvals/AHIPs are active/current where they intersect the current proposed works, and include conditions related to Aboriginal heritage considerations within their boundaries. These areas are therefore excluded from impact assessment for the current project and Sydney Water must ensure that any works for the current project undertaken within these existing approvals/AHIPs comply with all relevant conditions.

Table 6-5 Summary of Aboriginal archaeological sites along the proposed construction corridor, including site significance, proposal impact, significance of harm, and proposed mitigation measures.

ID	AHIMS	Site feature	Archaeological significance and significance of harm	Consequence of harm	Mitigation
BWB	45-5-5298	Subsurface archaeological deposit	Low (within study area)	Partial loss of value	Surface collection
BCE (including Fleurs 2, M12 A2 and M12 A3)	45-5-5294 (including 45-5-0528/ 45-5-4748/ 45-5-4750)	Surface artefacts and subsurface archaeological deposit	Moderate	Partial loss of value	Salvage excavation
BC/ED1	45-5-2309	Surface artefacts and subsurface archaeological deposit	Moderate	Partial loss of value	Salvage excavation
EDU Badgerys Creek IF 1	45-5-5733	Subsurface archaeological deposit	Low	Total loss of value	Surface collection
Lawson Road Badgerys Creek AFT 1	To be confirmed	Subsurface archaeological deposit	Low	Total loss of value	Surface collection
McGarvie Smith Farm	To be confirmed	Subsurface archaeological deposit	Moderate	Total loss of value	Salvage excavation

ID	AHIMS	Site feature	Archaeological significance and significance of harm	Consequence of harm	Mitigation
Badgerys Creek AFT 1					Surface collection
McGarvie Smith Farm Badgerys Creek AFT 2	To be confirmed	Subsurface archaeological deposit	Moderate	Partial loss of value	Salvage excavation Surface collection
SCW T1	45-5-5307	Subsurface archaeological deposit	Low (within study area)	Partial loss of value	Surface collection
SCW T2	45-5-5308	Subsurface archaeological deposit	Moderate	Partial loss of value	Salvage excavation Surface collection

Figure 6-2 Proposed impact area and Aboriginal archaeological sites



Non-Aboriginal heritage

Listed non-Aboriginal heritage items in the vicinity of the proposal, are summarised below.

- The Fleurs Radio Telescope Site
  - State Environmental Planning Policy (Precincts – Western Parkland City) 2021, Schedule 2 – I5, Local significance
  - Penrith LEP 2010, Item 832, Local significance (*expired listing*)
- Fleurs Aerodrome, item of potential (Local) heritage significance

The Fleurs Radio Telescope Site (I5)

The Fleurs Radio Telescope Site is in Kemps Creek, in the Penrith local government area, approximately two (2) kilometres north from Elizabeth Drive. The area is bisected by South Creek which meanders through the landscape on a north-south axis, dividing the area into an eastern and western portion. Several large construction projects, including the Sydney Water Upper South Creek Advance Water Recycling Centre (USC AWRC) and M12 Motorway, wholly or partially fall within the heritage curtilage of the site. These projects have greatly changed the landscape within the heritage curtilage (Extent Heritage, 2021; Jacobs, 2019).

The current proposed works north of the M12 construction alignment fall within the curtilage of the Fleurs Radio Telescope Site. The works north of the M12 extend east towards the USC AWRC site, crossing beneath South Creek. Construction of the USC AWRC is currently underway and has caused significant changes to the site, including removal of many of the above ground features that added much value to the heritage listing of the Fleurs Radio Telescope Site (CRM, 2019; Extent Heritage, 2021).

Site significance

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 is highly fragmented with little integrity for the original site configuration across the site, but particularly east of South Creek due to recent construction of the USC AWRC (Extent Heritage, 2021; CRM, 2019).

In 2019, the University of Sydney (owners of the Fleurs Radio Telescope Site) commissioned Cultural Resources Management (CRM) to complete a heritage assessment to identify the cultural resources that remain within the site and determine the heritage significance of the site (CRM, 2019). This included completion of a site survey to identify and map areas of high archaeological potential, including physical remnants scattered throughout the site (refer Figure 3-3).

In a later heritage impact assessment, for the development of the USC AWRC, it was determined that the construction of the facility will '… *see the last remaining evidence of the sites' use removed*' (Extent Heritage, 2021, p. 170). In agreement with the 2019 report, the 2021 report identified two localised areas with high potential for archaeology (ie two collapsed timber bridges on South Creek, having potential state significance). Additional potential archaeology reported included subsurface cables, machinery foundations, service pits, remnants of staff

accommodation, and structural evidence of the former telescopic array. It was determined that the latter was *'… 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* ', and that *'…the archaeological resource associated with Fleurs Radio Telescope Site is unlikely to meet the threshold for local significance'* (Extent Heritage, 2021, section 5.4).

The extensive remnants identified on site were also found to have *"…limited potential to provide new insight into the operations of the telescope installations, particularly as they are highly truncated and fragmentary*…[and] *they would also be considered 'works', as defined by the Heritage Act, and not afforded protection under the 'relics provision' of the Heritage Act"* (Extent Heritage, 2021, p. 95).

Construction and operational impacts

The current proposal falls within the curtilage of heritage item I5 Fleurs Radio Telescope Site (local significance), and survey areas 7 and 9 as defined in the 2019 CRM study. The proposed construction activities within the Fleurs Radio Telescope Site will be at a localised scale and low intensity and would not adversely affect the significance of the heritage item. The proposed alignment has been designed to minimise ground disturbance, including impact to known heritage features identified by CRM (2019), through less destructive construction methods (trenchless technology), whilst positioning of the alignment and site access is designed to avoid known heritage features.

Construction activities closest to items with known or potential heritage value as identified by CRM (2019), include:

- horizontal directional drilling (HDD), including excavation for entry and exit pits
- setup and laydown of equipment compounds, with the exact location to be selected during detailed design and positioned away from known heritage features
- site traversal (vehicles and equipment, and personnel), to be confirmed and designed to avoid known heritage features.

The potential for proposed construction activities to impact the heritage significance and values of the Fleurs Radio Telescope Site, or unknown relics is expected to be minor when considering:

- recent impacts to the broader site from ongoing construction within the region (eg USC AWRC and M12 Motorway developments), which have removed many key heritage values/features of the site
- the preferred proposed construction method being HDD – minimising aboveground surface disturbance by reducing the area of excavation required
- the small footprint of the proposed construction, relative to the area of the site
- prior assessment that *'…the archaeological resource associated with Fleurs Radio Telescope Site is unlikely to meet the threshold for local significance'* (Extent Heritage, 2021, section 5.4)

- prior assessment that the remaining fragments and remnants of unknown structures above and beneath the ground "…*would also be considered 'works', as defined by the Heritage Act"* (Extent Heritage, 2021, p. 95)
- the implementation of the mitigation measures proposed below, including no-go zones where areas of known high potential heritage value are located and inclusion of an unexpected finds protocol.

The potential for the assets to impact the heritage significance and values of Fleurs Radio Telescope Site during operation is expected to be inconsequential as the proposal:

- will avoid items listed as part of the heritage listing
- the proposal area is to be returned to pre-existing conditions post construction work, including areas where ground disturbance is required for drill work. Therefore, the proposal's potential impact to the aesthetic values associated with the existing open rural landscape will be temporary.

The current proposal will avoid impacts to surveyed archaeological points of this potential heritage item using 5 m buffer no-go zones shown in Figure 3-4. The potential impact of the proposal on this item of potential heritage significance is therefore considered negligible.

There would be no impact to non-Aboriginal heritage during operation.

Mitigation measures

With the implementation of the mitigation measures below, impacts to heritage can be adequately managed, and residual impacts are expected to be moderate.

Table 6-6 Environmental mitigation measures — heritage

Mitigation measures
Do not make publicly available or publish, in any form, Aboriginal heritage information on sites / potential archaeological deposits, particularly regarding location.
Repeat the basic AHIMS search if it is older than 12 months. Conduct additional assessment if new sites are registered and could be impacted by the works.
Harm to any Aboriginal objects and declared Aboriginal places is only permitted once an Aboriginal Heritage Impact Permit (AHIP) has been granted. Include Aboriginal Heritage Management Plan (AHMP) in CEMP to address AHIP conditions.
The boundary of the AHIP area adjacent to the non-impacted parts of the Aboriginal sites must be demarcated with protective fencing and listed in the CEMP. These areas must be identified as "no-go zones" on the CEMP maps and workers inducted as to appropriate protection measures and requirements to comply with conditions in the adjacent AHIP.
Surface collection of Aboriginal objects is to be completed prior to commencing construction works within the impacted portion of the following Aboriginal archaeological sites; AHIMS 45-5-5298, AHIMS 45-5-5294 (including) 45-5-0528/ 45-5-4748/ 45-5-4750), AHIMS 45-5-2309, AHIMS 45-5-5733, Lawson Road

Mitigation measures
Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 2, AHIMS 45-5-5307 and AHIMS 45-5-5308.
Archaeological salvage excavation of Aboriginal objects is to be completed prior to commencing construction works within the impacted portion of the following Aboriginal archaeological sites; BCE, BC/ED1, McGarvie Smith Farm Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 2 and SCW T2.
If reburial is to be undertaken of objects, Requirement 26 “Stone artefact deposition and storage” in the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* must be complied with, unless the registered Aboriginal stakeholders agree to an alternative deposition method. If reburial is to take place, registered Aboriginal stakeholders would be notified and given the opportunity to attend, and the reburial recorded on AHIMS.
If any Aboriginal object or non-Aboriginal relic is found, cease all excavation or disturbance in the area and notify SW Project Manager in accordance with SWEMS0009.
All site personnel must be inducted by a heritage specialist (or delegate) before starting work on site. The induction should include clear explanation of heritage constraints, go and no-go areas, processes and measures to avoid impacts, stop work procedures, and contact details to obtain further heritage guidance if needed.
At Fleurs Radio Telescope Site access to, and equipment laydown/compound areas to remain outside areas where known sites are located as per Figure 3-3 and 3-4. This includes remnants of buildings, rubbish piles, brambles, timber bridge footings, power poles, parabolic antennae, and other structures on site.
No-go areas, including location of known heritage features, are to be delineated prior to works beginning on site.
Chance discovery of relics must be notified to the Heritage Council of NSW by means of an s146 notification.

6.2.5 Noise and vibration

Existing environment and potential impacts

The proposal is in a predominantly rural residential/agricultural setting. Existing noise levels in the study area are primarily influenced by traffic on surrounding local roads, noise from nearby development sites, the mixed rural residential environment and construction activities within the growth area. With future planned development and growth throughout the region, the surrounding area will provide land for a range of uses predominantly related to residential, employment, industry and environmental uses.

Proposed activities/ equipment and timing of works

The scope of work assessed in this noise memo is briefly summarised below (Table 6-7). The construction program is about 24 months total. At its closest, the proposal is approximately 20 m from sensitive receivers while most of the proposal is located at least 610 m from sensitive receivers and would not be intrusive. To minimise disruption to traffic and potential safety risks to construction personnel and road users, some of the work along Elizabeth Drive may be carried out outside of standard hours if required by the Road Occupancy Licence (ROL). Night works are anticipated to occur for a cumulative 25 nights total during the construction phase.

The proposal will generate noise and vibration during construction from plant and associated construction activities. Equipment, vehicles and machinery that would typically be used during construction of the proposal and that have potential to generate the most noise include:

- excavators (maximum 36 tonne excavator with hammer)
- rock breakers / jackhammers
- drill/piling rig
- backhoes
- concrete/demo saws
- compactor
- concrete pumps
- air compressors
- generators
- HDD equipment
- light and heavy vehicles movements.

Proposed use of noisy equipment during construction is summarised in Table 6-7 below. Use of a 36 t excavator with hammer may be required during excavation activities.

Table 6-7 Proposed scope of work and approximate duration of activities

Scope	Activities	Duration
Site mobilisation	Install compounds and access road, delineate construction corridor, install environmental controls, strip stockpiles, remove vegetation	1-2 months
Compound use	Ongoing use of amenities, storage, laydown, parking areas	24 months
Site demobilisation	Remove compounds and restore disturbed areas	1-2 months
BCGC01	Open trench and underbore	11-12 months
BCPM01	Open trench and underbore	11-12 months

Scope	Activities	Duration
SP1230 and overflow	Construction including: • overflow pipe • emergency storage structure • electrical switchroom • odour control unit • access road • wet well • inlet maintenance hole • valve chamber • surge tank slab and platform • intermediate maintenance hole • access road and fending around site.	22-24 Months

Table 6-8 Proposed use of noisy equipment during construction

Activity	Noisier equipment required	Tasks requiring this equipment	Frequency of use of noisy equipment
Site mobilisation/ demobilisation	Grinders, compactors, excavators	Install fence/ footpath	Less than an hour, intermittently, about 20 times during mobilisation
Compound use	Grinders, delivery trucks	Cut pipe	Daily
Open trench	Grinders, 36 t excavators with hammer	Cut pipe/ reinforcement, excavation	Daily
HDD (trenchless)	36 t excavators with hammer	Cut pipe and reinforcement	Daily
Microtunnelling (trenchless)	36 t excavators with hammer	Cut pipe/ reinforcement Excavation of launch/ receival pits	Daily
Pump station construction	Piling rig, grinders, 36 tonne excavators with hammer	Piling, excavation works	Daily

Based on the above details, the noisiest activity for both day and night works would be use of 36 t excavator with hammer with direct line of sight. The likelihood of noise impact from the proposal

was reviewed against risk factors (following Table 2 of the EPA's 2020 Draft Construction Noise Guideline). The review indicated that the likelihood of noise impact from construction will be low-medium risk and therefore a quantitative noise impact assessment was undertaken.

The quantitative noise assessment was completed based on the following worst case (noisiest) activities. It is noted that the worst case activities are short-lived and 'rare' in the context of the total duration of the construction period as they will occur for short periods of time.

- Activity 1: Use of 36 t excavator with hammer at night with line of sight to receptors. This activity may occur at the underbore crossing of Elizabeth Drive.
- Activity 2: Use 36 t excavator with hammer during standard daytime construction hours with line of sight to receptors. This activity may occur at all above ground construction locations of the proposal, excluding access tracks.

Most work and deliveries would be scheduled to occur during standard daytime hours during the working week:

- 7am to 6pm, Monday to Friday
- 8am to 1pm on Saturday
- No work on Sundays or public holidays.

The proposal is expected to take up to 2 years to construct, with much of the work set back from potential residential receivers or businesses or in low density rural settings, and therefore, only a limited number would be affected for extended periods of time.

For construction of the pipelines, much of the work would be completed using trenchless methods which require less ground disturbance, with noise impacts buffered by depth below ground. Where open trenching methods are applied, the works at any one location are of short duration and will progress along the alignment. Although they still have the the potential to temporarily impact on sensitive receivers, a receiver would not be exposed to noise impact for every shift over the project duration. The closest sensitive receiver to trenched sections of the proposal is located about 50 m from the proposal area. The closest sensitive receiver to a trenchless entry/exit pit is approximately 20 m from the proposal area.

For the construction of the pumping station, the noisiest activities would be associated with earth works, including excavation and potential rock breaking or grinding. Sensitive receivers around the proposal are likely to be noise impacted to some extent over most shifts during the two-year construction period. These works are static and include a mix of noisier activities (grinders, excavator with hammer) and less noisy (light vehicle movement, excavator without hammer) activities. The closest sensitive receiver to SP1230 is located about 800 m from the construction footprint and potential noise impacts are considered minor for this site.

Due to the potential for noise impacts, a noise impact assessment was completed and are presented below. The noise impact assessment considered impacts from stationary activities at the pumping station and transient activities that will move along the proposed pipeline alignment.

Noise impact assessment

A noise impact assessment was completed using the Transport for NSW (TfNSW) Construction and Maintenance noise estimator tool (TfNSW, 2022).

The likelihood of noise impact during transient and stationary construction activities was assessed using Table 2 of the Draft Construction Noise Guideline (EPA 2020). The review indicated that the likelihood of noise impact will be low-medium risk and a quantitative noise impact assessment was undertaken. This risk level was selected as construction outside of standard construction hours is unlikely to be regular or often, being a semi-rural setting there are few sensitive receivers in proximity, and noisy works will occur only intermittently throughout the construction program.

Noise area category

The TfNSW Construction and Maintenance noise estimator tool can be used to perform a basic noise assessment to capture predicted noise impacts at different distances for different types of receivers. The noise area category is chosen from the noise estimator tool to define an approximate background noise level for the environment surrounding the proposal (Table 6-8). The noise area category is chosen based on several factors, including:

- surrounding land use and receiver types
- traffic volumes on nearby roads
- other transport infrastructure eg trains, airports/flight paths.

The noise area category R1 was chosen for both day and night work, because:

- background noise is influenced by road traffic noise and low volumes of traffic from local roads and,
- the surrounding area is predominantly a rural residential/agricultural setting.

Table 6-9 Background noise levels and noise management levels applied for assessment of stationary and transient construction activities

	Noise area category	R1
RBL or L_{A901} Background level (dB(A))	Day	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Management Level[2] (dB(A))	Day	50
	Day (OOHW)	45
	Evening	40
	Night	35

Notes: [1]LA_{90} = Background noise level
[2]*Noise Management Level for works during standard hours = Background level plus 10dB(A)*
Noise Management Level (NML) for out of hours works = Background level plus 5dB(A).

Worst-case noise impact scenarios

The purpose of the noise assessment is to assess the predicted worst-case noise impacts. This will identify recommended additional mitigation measures for impacted receivers at different distances from the works, which will guide the community engagement for the sites.

For construction activities, the noisiest plant was chosen, the 36 t excavator with hammer (the largest size able to be selected in the tool). As a conservative, worst-case approach, the noisiest

plant for day work (excavator with hammer/ bulk earthworks) was also assessed as part of night work, even though the use of this equipment outside of standard construction hours is unlikely to be regular or often.

These assessments are sufficient to predict and assess worst-case noise impacts as:

- the noisiest equipment would not be used all shift, every shift, during both day and night work, and is therefore a conservative estimate
- multiple pieces of equipment may be used at any one time for different activities at different locations. Assessing use of the noisiest plant across the full construction corridor, is a representation of the cumulative noise impacts that may be experienced
- for transient construction activities, no individual receiver would be impacted by noise every shift from these activities over the proposed two-year construction period.

A receiver may have line of sight, or no line of sight, to the proposal. Line of sight is the straight line between the noise source and the receiver. Receivers with line of sight would typically include those in front of the work, who do not have their view blocked by barriers such as terrain, permanent noise walls or other buildings. Receivers with no line of sight (all other factors being equal, such as distance to the work and type of equipment) will experience less noise than receivers with line of sight. Typically, these include the receivers who have their view blocked from the works by barriers including those listed above.

Noise impact summary

In summary, two scenarios were considered:

- Activity 1: OOHW night – line of sight – 36 t excavator with hammer distance based (noisiest plant)
- Activity 2: standard construction hours (day work) – line of sight – 36 t excavator with hammer distance based (noisiest plant).

Based on the above scenarios, the predicted worst case noise impacts for residential receivers associated with transient and stationary activities during day and night work are shown in Table6-10 and Figures 6-3 and 6-4. These outputs include recommended mitigation measures at different distances from sensitive receivers, as identified by the noise estimator tool. These are to be considered by the community team and offered where appropriate.

Table 6-10 Affected distance (metres) for residential receivers during Activity 1 and Activity 2

Activities	$L_{Aeq(15minute)}$ noise level above background (L_{A90})		
	20 to 30 dB(A)	> 30 dB(A)	$L_{Aeq(15minute)}$ 75dB or greater
	Moderately intrusive	Highly intrusive	Highly affected
Activity 1 – 36 t excavator at night with line of sight	610 m Recommended mitigation measures:	290 m	95 m

Activities	$L_{Aeq(15minute)}$ noise level above background (L_{A90})		
	20 to 30 dB(A)	> 30 dB(A)	$L_{Aeq(15minute)}$ 75dB or greater
	Moderately intrusive	**Highly intrusive**	**Highly affected**
	Notification (N), phone call (PC), standard notification (SN), respite period 2 (R2), duration respire (DR)	Recommended mitigation measures: Alternate accommodation (AA), N, PC, SN, R2, DR	Recommended mitigation measures: N, PC, respite offer (RO)
Activity 2 – 36 t excavator during daytime hours with line of sight	290 m Recommended mitigation measures: N, PC, SN, R2, DR	140 m Recommended mitigation measures: AA, N, PC, SN, R2, DR	95 m Recommended mitigation measures: N, PC, RO

Figure 6-3 Noise impact distances of Activity 1

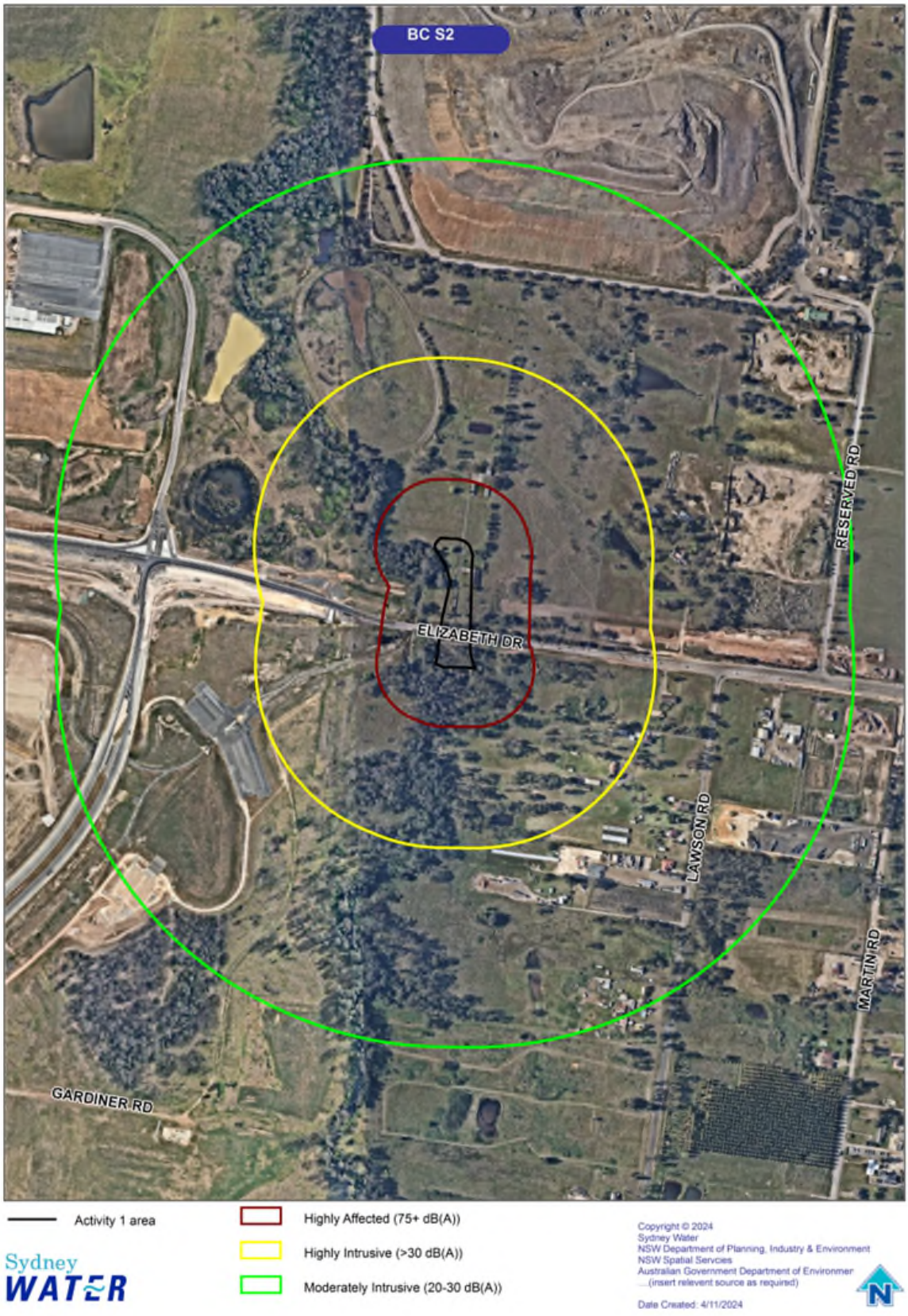
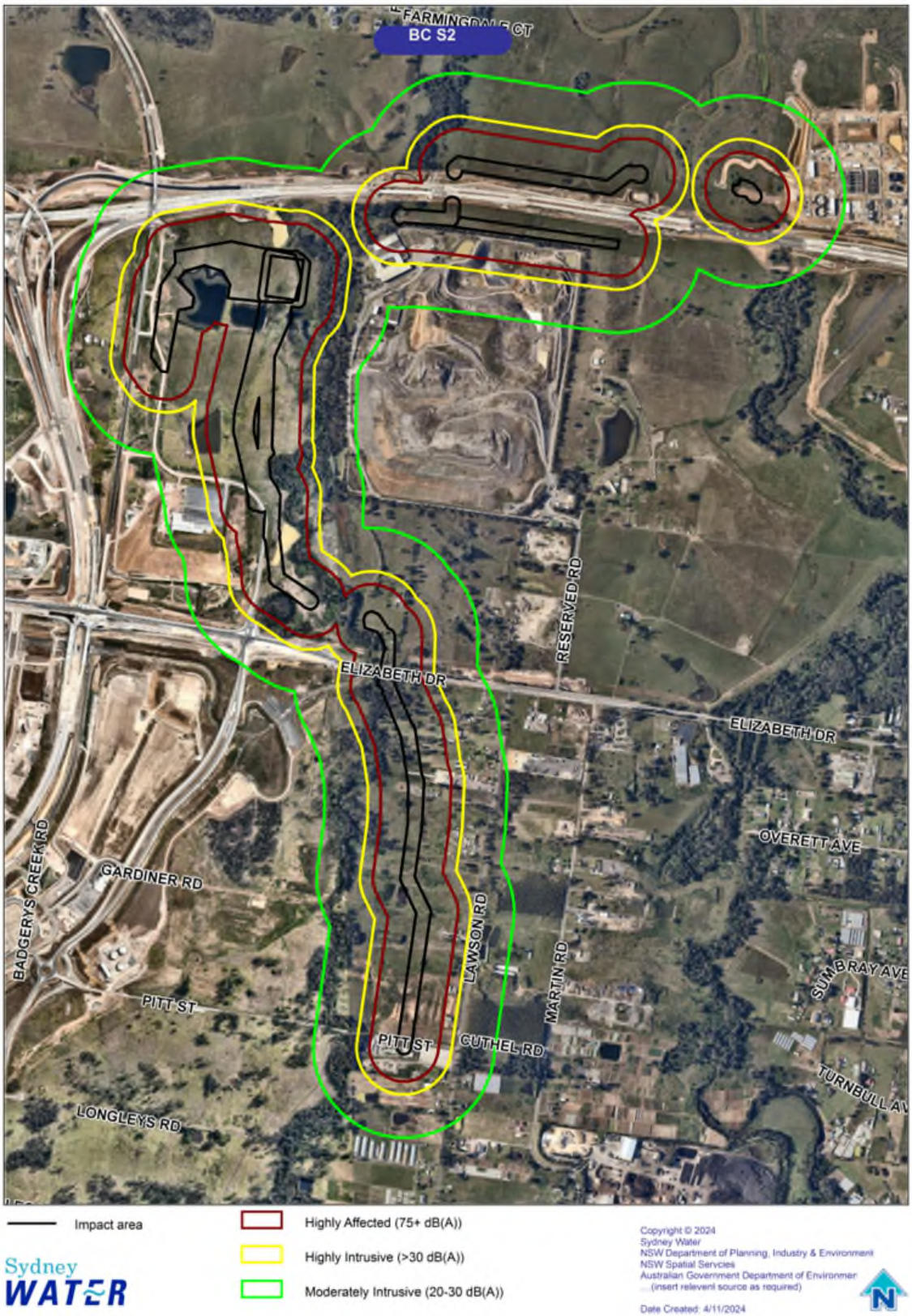


Figure 6-4 Noise impact distances of Activity 2



All reasonable and feasible measures will be implemented to reduce noise impacts during construction, therefore potential noise impacts in the surrounding area are considered minor.

Operational impacts

During operation, the alignment will be beneath the ground and no noise impacts are anticipated. Operational noise from the pumping station is likely to be minimal and would not result in a detectable noise increase perceptible to existing nearby residents. The pumping station is not expected to be intrusive to potential future receivers that would be in closer proximity as it consists of underground, submersible pumps and will be designed to comply with the EPA Noise Policy for Industry (2017). Operational noise levels will be assessed during detailed design and any noise attenuation measures identified and implemented to ensure compliance with the Noise Policy for Industry (EPA, 2017).

Noise may be generated during operational maintenance activities; however, these would generally be of short duration and mitigated.

Vibration

The noise estimator includes some indicative minimum working distances for different vibratory plant and equipment. These distances will vary depending on the item of plant, local geotechnical conditions, and the frequency of vibration. However, where works are performed within the minimum working distances of a structure, structural damage may occur, and additional mitigation measures are recommended.

Based on the plant and equipment list anticipated for this proposal, the following vibratory plant and equipment may be used:

- small (5 to 12 tonne) hydraulic hammer – minimum working distance of 2 m
- medium (12 to 18 tonne) hydraulic hammer – minimum working distance of 7 m
- large (18 to 34 tonne) hydraulic hammer – minimum working distance of 22 m
- Mechanised bored tunnelling works (Horizontal Directions Drilling, Mircro-tunnelling) – minimum working distance of 5 m to 21 m.

There is potential that some nearby residential buildings may be impacted by vibration when using the excavator with hammer; however, no substantial vibration-generating construction work would be occurring directly adjacent to physical structures. The entry/exit pit and MH location approximately 100 m north of Elizabeth Drive is within 22 m of a residential structure and could therefore potentially be impacted by use of a 36 t excavator with hammer. To avoid impacts to this structure use of smaller and less vibratory plant will be adopted within 22 m of the structure. A dilapidation survey will also be completed before and after construction.

In relation to human comfort, the minimum working distance of 73 m for 36 t excavator with hammer relates to continuous vibration. Vibration emissions will be intermittent in nature and for this reason higher vibration levels, occurring over shorter periods are consistent with *Assessing vibration – a technical guideline* (DEC 2006). Significant vibration impacts are therefore considered to be unlikely.

Mitigation measures

With the implementation of the mitigation measures below, impacts to noise and vibration can be adequately managed, and residual impacts are expected to be minor.

Table 6-11 Environmental mitigation measures — noise and vibration

Mitigation measures
Works must comply with the Interim Construction Noise Guideline (DECC 2009), including schedule work and deliveries during standard daytime working hours of 7am to 6pm Monday to Friday and 8am to 1pm Saturday. No work to be scheduled on Sundays or public holidays. The Proposal will also be carried out in accordance with: • Sydney Water's Noise Management Procedure SWEMS0056 • Noise Policy for Industry (EPA, 2017). All reasonable and feasible noise mitigation measures should be justified, documented and implemented on-site to mitigate noise impacts. All community notification will begin prior to work commencing on site.

Incorporate standard daytime hours noise management safeguards into the CEMP:
• identify and consult with the potentially affected residents prior to the commencement:
  ○ describe the nature of works; the expected noise impacts; approved hours of work; duration, complaints handling and contact details.
  ○ determine need for, and appropriate timing of respite periods (eg times identified by the community that are less sensitive to noise such as mid-morning or mid-afternoon for works near residences)
  ○ acceptance by the community of longer construction periods in exchange for restriction to construction times.
• implement a complaints handling procedure for dealing with noise complaints
• plant or machinery will not be permitted to warm-up near residential dwellings before the nominated working hours
• appropriate plant will be selected for each task, to minimise the noise impact (eg all stationary and mobile plant will be fitted with residential type silencers)
• engine brakes will not be used when entering or leaving the work site(s) or within work areas.
• regularly inspect and maintain equipment in good working order
• arrange work sites where possible to minimise noise (eg generators away from sensitive receivers, minimise use of vehicle reversing alarms)
• schedule noisy activities around times of surrounding high background noise (local road traffic or when other noise sources are active).

If night works are needed, the Contractor would: • justify the need for night works

Mitigation measures
• consider potential noise impacts and implement the relevant standard daytime and out of hours safeguards and other reasonable and feasible management measures • identify community notification requirements (ie for scheduled night work (not emergency works)), • notify all potentially impacted residents and sensitive noise receivers not less than one week prior to commencing night work • seek approval from the Sydney Water Project Manager in consultation with Sydney Water's Environment and communications representatives.
If works on Sundays or public holidays are required, the Contractor would: • justify why all other times are not feasible • consider potential noise impacts and, implement relevant standard daytime, out of hours and night-time safeguards and other reasonable and feasible management measures • identify community notification requirements • seek approval from the Sydney Water Project Manager in consultation with Sydney Water's Environment and communications representatives.
Consider less vibration intensive methodologies where practicable and use only the necessary sized and powered equipment.
Conduct a dilapidation survey / asset condition assessment prior to works which have potential to damage existing structures.
For works within 22 m of a residential structure, use of smaller and less vibratory plant rather than the 36t excavator should be adopted.

6.2.6 Air and energy

Existing environment and potential impacts

The proposal is in a rural-residential area that will be transformed from lower density and less intensive land use to employment, industry, and residential use. The main existing sources of air pollutants within the study area include emissions from motor vehicles and dust from nearby development. A search of the National Pollutant Inventory, maintained by the Department of Environment and Energy, was conducted for the study area on 20 August 2024. The search identified Elizabeth Drive Landfill Facility as the only pollutant emitting facility within 1 kilometre of the study area.

Potential sensitive receivers include:

- residents, pedestrians and road users
- industrial warehouse and development sites

- primary production properties.

Construction impacts

During construction, the following activities would potentially generate air emissions and dust which could impact air quality:

- emissions from machinery, equipment and vehicles used during construction
- dust generated by construction vehicles travelling on disturbed/unsealed access routes, prior to installation of the sealed access road
- during excavation and stockpiling.

During construction, dust and exhaust gases (air emissions) could impact the air quality and amenity of nearby sensitive receivers, and would be influenced by atmospheric conditions. Construction work and restoration of disturbed areas will be undertaken progressively. This will minimise potential air quality impacts and reduce the exposure of any one sensitive receiver to air emissions. These potential air quality impacts will be localised and short-term in nature, and unlikely to have a significant impact with the application of the environmental mitigation measures.

Operational impacts

The proposal has been designed with appropriate ventilation and odour management systems to avoid any operational odour impacts being experienced by sensitive receivers. Odour and corrosion modelling will be completed during detailed design of the project. The locations of vent shafts along the alignment will be determined during detailed design. In addition space has been allocated within the pumping station footprint for an odour control unit (OCU).

Ventilation of the sewer is essential, and maintenance holes will be equipped with educt and induct vents at maximum spacings of 400 m along the alignment. Vent shafts are designed to be close to existing or future open spaces where possible to reduce visual and odour impacts. Vent shafts are nominally sized with a DN300 shaft and height of 18 m, subject to confirmation by Sydney Water during detailed design.

During operation, wastewater maintenance holes and the pumping station may be opened when maintenance or repair works are required. This may result in odour impacts to nearby receivers which would largely be dependent on wind direction and strength. These impacts would be temporary in nature and appropriate safeguards would be implemented to minimise the potential for adverse impacts wherever possible.

During operation, the pumping station would require energy usage, and marginally increase Sydney Water's total energy use. The proposal would be operated in accordance with energy use procedures that apply to Sydney Water's existing network.

Mitigation measures

With the implementation of the mitigation measures below, impacts relating to air and energy can be adequately managed, and residual impacts are expected to be minor.

Table 6-12 Environmental mitigation measures — air and energy

Mitigation measures
Use alternatives to fossil fuels where practical and cost-effective.
Track energy use as per SWEMS0015.28 Contractor NGER template.
Maintain equipment in good working order, comply with the clean air regulations of the *Protection of the Environment Operations Act 1997*, have appropriate exhaust pollution controls, and meet Australian Standards for exhaust emissions.
Switch off vehicles/machinery when not in use.
Implement measures to prevent offsite dust impacts, for example: • water exposed areas (using non-potable water source where possible such as water from excavation pits) • cover exposed areas with tarpaulins or geotextile fabric • modify or cease work in windy conditions • modify site layout (place stockpiles away from sensitive receivers) vegetate exposed areas using appropriate seeding.
Cover all transported waste.
Minimise the potential for odours through the following where possible: • select appropriate heights for vent stacks • install carbon canisters on existing air valves • minimise the number of open access chambers.

6.2.7 Waste and hazardous materials

Existing environment and potential environmental impacts

One of Sydney Water's corporate objectives is to increase resource recovery with an increasing portfolio of circular economy products and services. This includes reducing waste through recycling and re-use and encouraging our suppliers to minimise waste.

The proposal has the potential to generate the following waste streams:

- general construction waste such as excess concrete, redundant pieces of pipe/fittings
- broken bricks, timber, paper, plastic and metal
- green waste from clearing vegetation including weeds
- domestic waste including food scraps, aluminium cans, glass bottles, plastic and paper containers, and putrescible waste generated by site construction personnel
- wastewater and grey water from temporary amenities
- spoil that is not suitable for backfilling, from trenching and other excavations

- groundwater dewatered from excavations
- wastewater and drilling fluid generated from trenchless construction and the compound sites
- interim operating plan (IOP) tank and associated pipework and fittings.

The largest volume of waste generated by construction would be excess spoil from excavations. Wherever possible, suitable excavated spoil would be re-used on site for backfilling, landscaping and other uses. Should any material be found to be unsuitable, it would be disposed of as detailed in the mitigation measures below. If spoil is unable to be re-used on-site, opportunities for off-site re-use would be investigated.

If re-use opportunities are unable to be identified, or the spoil is unsuitable for re-use due to its geotechnical or contamination characteristics (including asbestos), spoil would be tested and classified according to the Waste Classification Guidelines (NSW EPA, 2014) and disposed of at an appropriately licensed facility.

Construction by trenchless methods will involve the use of drilling fluids. The drilling fluids that will be used will be an environmentally benign substance such as bentonite. The drilling fluids will be circulated through the trenchless section and then screened to remove drill cuttings. Any waste drill cuttings and drilling fluid will be tested, classified, treated and disposed of appropriately.

General waste including food packaging will be generated in minor quantities and will be classified as putrescible or non-putrescible general solid waste.

No hazardous wastes are expected to be generated. It is not expected that the proposal will involve managing hazardous waste or hazardous building materials (HBM). Should the works uncover asbestos or any other hazardous or contaminated material, it will be managed through the unexpected finds procedures in table 6.17 and the incident management plan.

Opportunities to reduce, recycle and reuse on this project would be sought with the Contractor and documented in the CEMP.

Operational impacts

Operation of the proposal may generate minor volumes of waste during maintenance activities. Any wastewater overflow discharged would be in accordance with Sydney Water's EPL. Any operational wastes generated during maintenance would be managed and disposed of in accordance with Sydney Water's standard operating procedures and disposed of at an appropriately licensed waste disposal or recycling facility.

Mitigation measures

With the implementation of the mitigation measures below, impacts from waste and hazardous materials can be adequately managed, and residual impacts are expected to be minor.

Table 6-13 Environmental mitigation measures — waste and hazardous materials

Mitigation measures
Manage waste in accordance with relevant legislation and maintain records to show compliance eg waste register, transport and disposal records. Record and submit SWEMS0015.27 Contractor Waste Report.
Provide adequate bins for general waste, hazardous waste and recyclable materials.
Minimise the generation of waste, sort waste streams to maximise reuse/recycling in accordance with the *Waste Avoidance and Resource Recovery Act 2001*.
Manage waste and excess spoil in accordance with the NSW EPA Waste Classification Guidelines. Where materials are not suitable or cannot be reused onsite or offsite, recycle soils at a licensed soil recycling facility or dispose at an appropriately licenced landfill facility.
Prevent pollutants from escaping including covering skip bins.
Dispose excess vegetation (non-weed) that cannot be used for site stabilisation at an appropriate green waste disposal facility.
Minimise stockpile size and ensure delineation between different stockpiled materials.
If fibro or other asbestos containing material is identified, restrict access and follow Sydney Water's Asbestos Management – Minor Works procedure, Document Number 746607. Contact Sydney Water Project Manager (who will consult with Contamination and Hazardous Materials Team propertyenvironmental@sydneywater.com.au).
The Contractor should use the Sydney Water Material Stockpile and Material Receiver Dashboard and Register to identify potential opportunities for spoil reuse between projects. The Material Receiver Dashboard can also be used to identify suitable waste facilities for material that cannot be reused. It can be accessed via the SWDelivery Portal.

6.2.8 Traffic and access

Existing environment and potential impacts

The majority of the proposal is on private property, with some crossings beneath or running adjacent to several local and classified roadways, including the M12 Motorway (currently under construction) and Elizabeth Drive (State road). Partial and temporary road closures may be required during the construction where open trenching and/or excavation for pits is required within the road reserve. Sydney Water or the Contractor will consult with Council and TfNSW as required by the TISEPP to obtain any road occupancy licences required.

The proposal will require a construction workforce of up to 50 people with up to 27 light vehicles and 22 heavy vehicles on site at a given time. There will be very few vehicle movements during operation. The proposal will be accessed via existing local roads, a proposed permanent access road, temporary access tracks and informal access tracks through paddocks. The availability of street parking is not anticipated to be impacted during the works.

New access tracks will be required for SP1230. The proposed main access for SP1230 will be from Elizabeth Drive. Permanent access to the pumping station will include a dual lane all-weather sealed access road (min 8 m wide), with kerb and gutter plus surface and subsurface drainage systems (as required) to the nearest public road. A vehicle turning area designed to fit a 19 m semi-trailer will be provided at the pumping station. A minimum of four spaces for vehicle parking will be allowed for. Bollards shall be placed, where required, to protect the wet well, valve chamber, and above ground structures from vehicles.

Access to private property may be temporarily affected during construction of the pipelines. Properties will only be affected for a relatively short period of time. Some fence lines may need to be temporarily removed for access. Property owners will be informed of any potential loss of access and appropriate measures will be negotiated to either provide an alternative access or reinstate access at the end of the day. Any access ways or fences affected by construction will be reinstated to their original condition.

Mitigation measures

With the implementation of the mitigation measures below, impacts to traffic and access can be adequately managed, and residual impacts are expected to be low.

Table 6-14 Environmental mitigation measures — traffic and access

Mitigation measures
Prepare a Traffic Management Plan (TMP) in consultation with the relevant traffic authority.
Meet NSW Roads and Maritime Service's Traffic Control at Worksites Manual v5 requirements for TfNSW roads. The Contractor will obtain a Road Occupancy Licence (ROL) from TfNSW, including if works are within 100m of traffic signals when construction commences.
Minimise traffic impacts near residential properties, schools and businesses by consulting with them (eg no major materials deliveries at school drop off or pick up times etc.).
Manage sites to allow people to move safely past the works, including alternative pedestrian, bicycles, pram and wheelchair access.
Consult with the relevant traffic authority about managing impacts to pedestrian traffic, signposting, meters, parking, line-marking or if traffic control or pavement restoration is required.
Erect signs to inform road users of the proposed works and any temporary road closures.
Ensure work vehicles do not obstruct vehicular or pedestrian traffic, or private driveway, public facility or business access unless necessary and only if appropriate notification has been provided.
The Contractor must consult with the M12 constructor about traffic management in and around the M12 construction corridor.

6.2.9 Social and visual

Existing environment and potential impacts

The existing visual environment is representative of a rural-residential area interspersed with areas of new development including residential estates, road construction and upgrades, and Western Sydney Airport (WSA) west of the proposal. Residential properties are predominantly single or double story detached dwellings on acreage lots. The proposal is currently within a rural-residential area, however future changes anticipated for the area include employment, industry, and higher density residential growth.

The proposed wastewater infrastructure is located within 200 m of several light industrial or agricultural businesses including Cleanaway Kemps Creek Resource Recovery Park, Gill Roadways Logistics Company Sydney and Joe Ducks & Chickens. The study area is also surrounded by rural, rural living and/or agricultural lots, and lots undergoing earthworks for future growth, including the development of the USC AWRC.

The proposal could potentially impact on social amenity in a variety of ways, some of which have been assessed in other sections of this REF:

- Noise and vibration (Section 6.2.5)
- Air and energy (Section 6.2.6)
- Traffic and access (Section 6.2.8).

The proposal will have an overall positive impact on the community by providing a wastewater network that supports the growth of the precincts and establishment of new jobs in Western Sydney.

Construction impacts

During construction, there would be temporary impacts on visual amenity from equipment, generation of waste and construction activities such as earthworks within the study area. There will also be some temporary visual impacts associated with the establishment of site compounds and worksites during construction. These temporary visual impacts would be mitigated in consultation with stakeholders, such as council and residents, and the mitigation measures listed below.

Following the completion of the works, all items associated with construction would be removed and the site would be remediated. Disturbed areas would be rehabilitated to pre-existing condition or better, as far as practicable; however, restoration, such as revegetation, may take a longer period to become established. Restoration of work areas would ensure that the potential for long term adverse visual impacts is minimised. Overall, potential impacts on social and visual amenity are considered minor as the works would be temporary and short-term.

Operational impacts

The works will involve the construction of new, permanent above ground structures, including the pumping station building and vent stacks. Considering the future use and growth of the precincts, these new above ground structures are not expected to significantly impact the visual character of the environment. Rather, once operational, the proposal would have significant social benefits,

enabling the development of the region by providing a wastewater network that supports planned growth in Western Sydney.

The pumping station will be landscaped to minimise any permanent visual impacts. The pipelines will be entirely underground and will not be visible. There will be a positive social impact during operation by capturing and transferring wastewater for treatment.

Mitigation measures

With the implementation of the mitigation measures below, social and visual impacts can be adequately managed, and residual impacts are expected to be minor.

Table 6-15 Environmental mitigation measures — social and visual

Mitigation measures
Undertake works in accordance with Sydney Water Communications policies and requirements including: • notify impacted residents and businesses • erect signs to inform the public on nature of work • personnel treat community enquiries appropriately.
Work sites will be restored to pre-existing condition or better.
Minimise visual impacts (eg retain existing vegetation where possible).
Direct artificial light away from sensitive receivers where possible (ie residents, fauna or roadways).
Maintain work areas in a clean and tidy condition.
Site restoration including roads, verges and vegetation is to be performed in consultation with private property owners and council.
Continue to consult with key stakeholders that are constructing infrastructure in the area with a view to coordinate works where practicable.
Regular engagement with the local community and relevant stakeholders will be performed in accordance with the project Community and Stakeholder Engagement Plan to manage any impacts and ensure the scope of works performed by Sydney Water is communicated accurately.

6.2.10 Cumulative and future trends

Potential environmental impacts

The proposal is located in an area that is subject to ongoing development associated with the precinct and growth planning in Western Sydney. Cumulative impacts are minimal given the small scale of the proposal relative to the overall works planned within the growth centre.

A search of the Department of Planning, Housing and Infrastructure Major Projects Planning Portal was undertaken and identified several urban release projects planned for the area.

Cumulative impacts with other local development occurring in the area may include:

- cumulative noise and air quality impacts from works being undertaken concurrently
- potential traffic management issues during construction
- increased waste production
- community construction fatigue resulting from works being undertaken simultaneously or concurrently.

The proposal is required to support the future population growth in the south west and as such facilitates the progression of residential developments in the locality. Implementing mitigation measures will reduce the scale and extent of any potential cumulative impacts.

During operation, minor increases in noise and traffic are anticipated due to maintenance activities of proposed infrastructure. However, with the rapid development of the broader region, these additions to the greater environment are considered negligible.

Future trends such as climate change were considered including factors such as bushfires, flooding, extreme heat, and extreme storm events that could impact the proposal. The proposal is unlikely to be impacted by future trends because most infrastructure is proposed to be located below ground or will be situated predominantly outside the 1% AEP flood level.

Mitigation measures

With the implementation of the mitigation measures below, cumulative impacts and impacts to future trends can be adequately managed, and residual impacts are expected to be minor.

Table 6-16 Environmental mitigation measures — cumulative and future trends

Mitigation measures
Coordination of works with other ongoing or proposed developments would be required to minimise negative impacts or conflicts with construction scheduling.

6.2.11 General environmental management

Table 6-17 Environmental mitigation measures — general environmental management

Mitigation measures
Sydney Water's Project Manager (after consultation with Sydney Water's environmental and community representatives and affected landowners) can approve temporary ancillary construction facilities (such as compounds and access tracks), without additional environmental assessment or approval if the facilities meet the following principles: • limit proximity to sensitive receivers • no disruption to property access • no impact to known items of non-Aboriginal and Aboriginal heritage • outside high risk areas for Aboriginal heritage • use existing cleared areas and existing access tracks

Mitigation measures

- no impacts to remnant native vegetation or key habitat features
- no disturbance to waterways
- potential environmental impacts can be managed using the safeguards in the EIA
- no disturbance of contaminated land or acid sulfate soils
- will be rehabilitated at the end of construction.

The Contractor must demonstrate in writing how the proposed ancillary facilities meet these principles. Any facilities that do not meet these principles will require additional environmental impact assessment.

The agreed location of these facilities must be shown on the CEMP site plan and appropriate environmental controls installed.

Prepare a Construction Environmental Management Plan (CEMP) addressing the requirements of this environmental assessment. The CEMP should identify licence, approval and notification requirements. Prior to the start of work, all project staff and contractors will be inducted in the CEMP.

The CEMP must be readily available on site and include a site plan which shows:

- go/ no go areas and boundaries of the work area
- location of environmental controls (including erosion and sediment controls, any fences or other measures to protect vegetation or fauna, spill kits, stockpile areas)
- location and full extent of any vegetation disturbance.

Prepare an Incident Management Plan (IMP) outlining actions and responsibilities during:

- predicted/onset of heavy rain during works
- spills
- unexpected finds (eg heritage and contamination)
- other potential incidents relevant to the scope of works.

All site personnel must be inducted into the IMP.

The Contractor must obtain a Scheduled Development Work Licence prior to construction of the proposal from the EPA. This REF must be submitted to the EPA as part of the application.

Works within the M12 construction boundary and/or within the area subject to the M12 – Central Environment Protection Licence (EPL no. 21596) must not affect the ability of Transport for NSW and its contractors to comply with conditions of the EPL.

Where there is doubt, the Contractor is to contact the Sydney Water Project Manager and Environment Representative for further advice. If an impact occurs to any control or monitoring instrument associated with EPL no. 21596, Transport for NSW and its principal construction contractor (or relevant site contact) must be notified. The EPA must be notified immediately (or as soon as it is safe to do so) on 131 555 if any such impact has or will cause material harm to the environment.

Mitigation measures

Complaints to be managed in accordance with Sydney Water's Complaints Procedure and relevant Community Engagement Plan.

Should the methodology or alignment change from the EIA, no further environmental assessment is required provided the change:

- remains within the study area for the EIA and has no net additional environmental impact
- is outside the study area for the EIA but:
  - reduces impacts to biodiversity, heritage or human amenity after consultation with any potentially affected landowners and relevant agencies
  - avoids engineering (for example, geological, topographical) constraints after consultation with any potentially affected landowners and relevant agencies.

The Contractor must demonstrate in writing how the changes meet these requirements, for approval by Sydney Water's Project Manager in consultation with the environmental and community representatives.

7 Conclusion

Sydney Water has prepared this REF to assess the potential environmental impacts of Badgerys Creek Wastewater Stage 2. The proposal is required to ensure Sydney Water is acting in accordance with the Sydney Water Act and providing the community with access to wastewater service options in compliance with its Operating Licence.

The main potential environmental impacts of the proposal are construction impacts such as erosion and sedimentation, Aboriginal heritage impacts, vegetation removal, noise and dustemissions, and traffic impacts. During operation, the main potential impacts are associated with air quality and visual amenity. Given the nature, scale and extent of impacts and implementation of the mitigation measures outlined in this REF, the proposal is unlikely to have a significant impact on the environment. Therefore, an environmental impact statement is not required under Division 5.1 of the EP&A Act.

The REF considers how the proposal aligns with the principles of ESD. The proposal will result in positive long-term environmental improvements. The proposal will not result in the degradation of the quality of the environment and will not pose a risk to the safety of the environment.

Appendices

Appendix A – Section 171 checklist

Section 171 checklist	REF finding
Any environmental impact on a community	There may be short-term impacts on the community from construction impacts associated with noise, dust, odour and traffic. There will be environmental improvements by providing a reliable wastewater service to the local community.
Any transformation of a locality	The proposal will not result in the transformation of a locality.
Any environmental impact on the ecosystems of the locality	The proposal may result in minor environmental impacts to ecosystems of the locality due to the potential for impacts to vegetation. The proposal will lead to environmental improvements by ensuring a reliable wastewater service to collect and treat wastewater, minimising any impacts on the ecosystem.
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	The proposal will not reduce the aesthetic, recreational or other environmental quality or value of the locality. The potential impacts to Aboriginal heritage may reduce the scientific value of the locality. However, consultation with relevant stakeholders has taken place and no impact to Aboriginal heritage will take place without an AHIP.
Any effect upon a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or any other special value for present or future generations	The proposal will not have any effect upon a locality, place or building having aesthetic, archaeological, architectural, cultural, historical, scientific or social significance or any other special value for present or future generations. The potential impacts to Aboriginal heritage may result in impacts to cultural, historical, scientific or anthropological value for present or future generations. However, consultation with relevant stakeholders has taken place and no impact to Aboriginal heritage will take place without an AHIP.
Any impact on the habitat of any protected animals (within the meaning of the *Biodiversity Conservation Act 2016*)	The proposal has potential for minor impacts on the habitat of protected animals. Only one protected species was considered to have a likelihood of occurrence within the proposal area above low.
Any endangering of any species of animal or plant or other form of life, whether living on land, in water or in the air	The proposal will not be endangering any species of animal, plant or other form of life, whether living on land, in water or in the air.
Any long-term effects on the environment	Construction of the proposal has potential to have a long term impact on native vegetation and Aboriginal heritage, but will have a long-term benefit by providing a reliable and modern wastewater service for the area.

Section 171 checklist	REF finding
Any degradation of the quality of the environment	The proposal has potential to cause minor degradation of the quality of the environment due to the proposed impacts to vegetation. However, impacts to vegetation will be offset in accordance with Sydney Water's Biodiversity Offset Guidelines.
Any risk to the safety of the environment	The proposal will not increase risk to the safety of the environment.
Any reduction in the range of beneficial uses of the environment	The proposal will not reduce the range of beneficial uses of the environment.
Any pollution of the environment	During construction, the proposal has the potential to cause minor localised, noise, air and water pollution. These impacts would be of short duration, and would be mitigated through the implementation of the safeguards outlined in this REF. During operation, wastewater discharges to the environment would be in accordance with the conditions of the Upper South Creek System EPL.
Any environmental problems associated with the disposal of waste	Waste disposal will be in accordance with the environmental mitigation measures, and no environmental problems associated with the disposal of waste are expected.
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply	The proposal will not increase demand on resources, that are, or are likely to become, in short supply.
Any cumulative environmental effect with other existing or likely future activities	The proposal will not have any cumulative environmental effect with other existing or likely future activities.
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions	The proposal will not have any impact on coastal processes or hazards, and coastal processes and coastal hazards will not have any impact on the proposal.
Any applicable local strategic planning statements, regional strategic plans or district strategic plans made under the EP&A Act, Division 3.1	The proposed works are to service growth and the applicable strategic planning statements or plans have been considered in the system planning and options selection process.
Any other relevant environmental factors.	The proposal has been assessed against the factors listed above, and there are no other relevant environmental factors to consider.

Appendix B – Consideration of TISEPP consultation

TISEPP section	Yes	No
Section 2.10, council related infrastructure or services – consultation with council		
Will the work:		
Potentially have a substantial impact on stormwater management services provided by council?		X
Be likely to generate traffic that will strain the capacity of the road system in the LGA?		X
Connect to, and have a substantial impact on, the capacity of a council owned sewerage system?		X
Connect to, and use a substantial volume of water from a council owned water supply system?		X
Require temporary structures on, or enclose, a public space under council's control that will disrupt pedestrian or vehicular traffic that is not minor or inconsequential?		X
Excavate a road, or a footpath adjacent to a road, for which the council is the roads authority, that is not minor or inconsequential?		X
Section 2.11, local heritage – consultation with council		
Is the work likely to affect the heritage significance of a local heritage item, or of a heritage conservation area (not also a State heritage item) more than a minor or inconsequential amount?		X
Section 2.12, flood liable land – consultation with council		
Will the work be on flood liable land (land that is susceptible to flooding by the probable maximum flood event) and will works alter flood patterns other than to a minor extent?		X
Section 2.13, flood liable land – consultation with State Emergency Services		
Will the work be on flood liable land (land that is susceptible to flooding by the probable maximum flood event) and undertaken under a relevant provision*, but not the carrying out of minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance? * (e) Div.14 (Public admin buildings), (g) Div.16 (Research/ monitoring stations), (i) Div.20 (Stormwater systems)?	X	
Section 2.14, development with impacts on certain land within the coastal zone– council consultation		
Is the work on land mapped as coastal vulnerability area and inconsistent with a certified coastal management program?		X
Section 2.15, consultation with public authorities other than councils		
Will the proposal be on land adjacent to land reserved under the *National Parks and Wildlife Act 1974* or land acquired under Part 11 of that Act*? If so, consult with DPE (NPWS).*		X
Will the proposal be on land in Zone C1 National Parks and Nature Reserves or on a land use zone that is equivalent to that zone? *If so, consult with DPE (NPWS).*		X
Will the proposal include a fixed or floating structure in or over navigable waters? *If so, consult TfNSW.*		X
Will the proposal be on land in a mine subsidence district within the meaning of the *Coal Mine Subsidence Compensation Act 2017*? *If so, consult with Subsidence Advisory NSW.*		X
Will the proposal be on land in a Western City operational area specified in *the Western Parkland City Authority Act 2018,* Schedule 2 and have a capital investment value of $30 million or more? *If so, consult the Western Parkland City Authority*.	X	
Will the proposal clear native vegetation on land that is not subject land (ie non-certified land)? *If so, notify DPE at least 21 days prior to work commencing. (Requirement under s3.24 Chapter 3 Sydney Region Growth Centres - of the SEPP (Precincts – Central River City) 2021).*		X

Appendix C – Biodiversity Assessment Report

Badgerys Creek Stage 2

Biodiversity Assessment Report

Sydney Water

Reference: IN.P0000366.03.01.007

Revision: 2

2024-10-23

aurecon

Bringing ideas to life

Document control record

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Document control		aurecon				
Report title		Biodiversity Assessment Report				
Document code			**Project number**		IN.P0000366.03.01.007	
File path		Document1				
Client		Sydney Water				
Client contact			**Client reference**			
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
1	2024-10-14	First draft	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
Current revision		**2**				

Approval			
Author signature	[redacted]	Approver signature	[redacted]
Name		Name	
Title	Consultant (Ecologist)	Title	Associate (Ecologist)

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1 Introduction

1.1 Background

The Sydney Water Planning Partner (SWPP) was commissioned by the Sydney Water Corporation (SWC) to undertake an ecological assessment and prepare a Biodiversity Assessment Report (BAR) to inform the development of a new wastewater pipeline in the suburb of Badgerys Creek, NSW (the Project). It is understood that the works include construction of:

- The wastewater main alignment
- Pump station
- Staging area
- Access track south of the M12
- Original north-south access track to the pump station
- Access track west of the pump station.

The Project is subject to environmental assessment under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which requires SWC to prepare of a review of environmental factors (REF) for the Project. This BAR has been prepared to support the REF.

1.2 Project location and details

The Project is located in the suburb of Badgerys Creek, in western Sydney, NSW (Figure 1). Table 1 below provides further details on the location of the Project, and Table 2 provides the property details including address and lot number.

Table 1 Project location and details

Definitions	Details
Address	The proposed alignment and associated infrastructure crosses a total of 33 lots (see Table 1)
Study Area	Approximately 6.02 ha Includes all elements listed in Section 1.1 above that only occur within 'Excluded Land', 'Avoided Land' or 'High Biodiversity Value Areas (Existing Native Vegetation)' (Figure 1). The remaining areas within Certified Land (including 'Certified – Urban Capable', 'Existing Certified' and 'Certified Major Transport Corridor') were not assessed as biodiversity approvals for these areas are covered under either the Cumberland Plain Conservation Plan (CPCP) or existing biodiversity certification under the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (see Table 3 for further information).
Impact Area	Approximately 34.67 ha Includes all areas listed in Section 1.1 excluding areas that occur within land classified as 'Excluded Land', 'Avoided Land' or 'High Biodiversity Value Areas (Existing Native Vegetation)' (see Table 3 for further information). The only exception to this is a small section of the Impact Area just north of Elizabeth Drive occurs within these land classification. However, all native vegetation impacts within this area will be avoided.
Project Area	Approximately 40 ha Combines both the Study Area and Impact Area to make up the entire extent of the Project.
Locality	Includes a 10 km radius around the Project Area boundaries used for review of existing threatened species records.

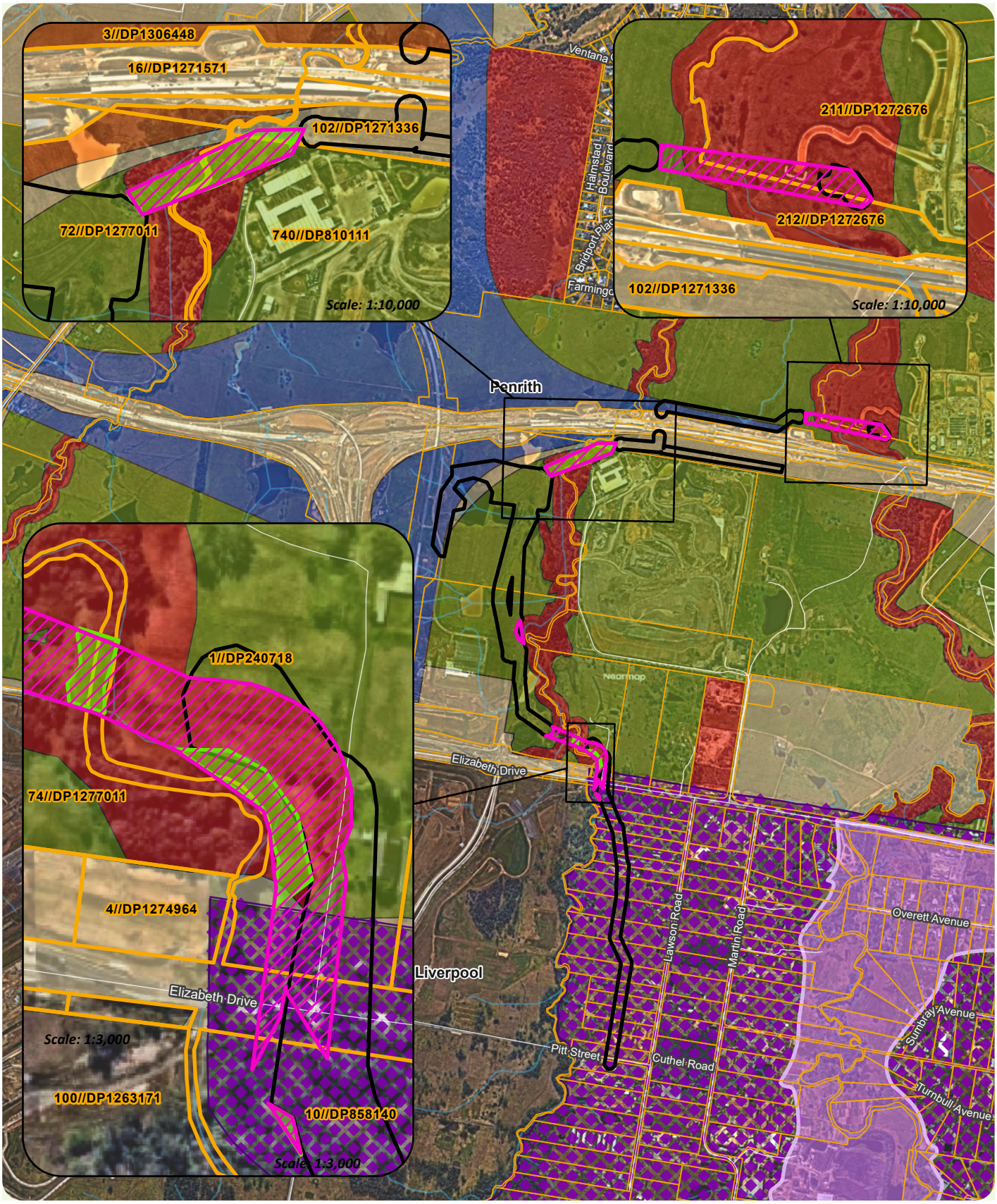
Definitions	Details
Local Government Area (LGA)	Liverpool
Other	**Cumberland Plain Conservation Plan (CPCP)** The northern section of the Study Area (north of Elizabeth Drive) occurs within the CPCP boundary. The Project alignment has portions located within “Certified Lands” (Certified - Urban Capable Land and Certified - Major Transport Corridor) and “Non-Certified Lands” (Avoided Land, Excluded Land, Major Transport Corridors (strategic assessment only), Strategic Conservation Areas, etc). See Table 3 for further information. **State Environmental Planning Policy (SEPP) (Precincts – Western Parkland City) 2021** The southern section of the Study Area (south of Elizabeth Drive) occurs within the South West Growth Area (SWGA) and occurs only within “Existing Certified” lands. Additionally, the Study Area occurs within areas classified as ‘High Biodiversity Value Areas (Existing Native Vegetation)’. See Table 3 for further information.

Table 2 List of properties within the Project Area

Lot and DP	Address	Project component	CPCP or SWGA	Land classification/s
1/DP566109	185 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
6//DP226912	175 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
4//DP226912	155 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
3//DP226912	145 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
2//DP226912	135 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
1//DP226912	125 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
104//DP1271336	Badgerys Creek 2555	Main alignment	CPCP	Certified-Urban Capable
107//DP1271336	Badgerys Creek 2555	Main alignment	CPCP	Certified-Urban Capable
102//DP1271336	1793 Elizabeth Drive Badgerys Creek	Main alignment	CPCP	Certified-Urban Capable
5//DP226912	165 Lawsons Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
9//DP3050	115 Lawsons Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
5//DP3050	75 Lawsons Rd Badgerys Creek	Main alignment	SWGA	Existing Certified

Lot and DP	Address	Project component	CPCP or SWGA	Land classification/s
6//DP3050	83-87 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
1//DP104049	65 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
1//DP566109	185 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
14//DP531743	45 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
13//DP531743	35 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
23//DP552531	25 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
22//DP552531	15 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
1//DP1084967	55 Lawson Rd Badgerys Creek	Main alignment	SWGA	Existing Certified
101//DP1263171	Elizabeth Drive Badgerys Creek 2555	Main alignment	SWGA	Existing Certified
102//DP1263171	Elizabeth Drive Badgerys Creek 2555	Main alignment	SWGA	Existing Certified
71//DP1277011	1793 Elizabeth Drive Badgerys Creek	Main alignment	SWGA	Existing Certified
72//DP1277011	1793 Elizabeth Drive Badgerys Creek	Main alignment	SWGA	Existing Certified
10/DP858140	5 Lawson Road Badgerys Creek	Main alignment	SWGA	Existing Certified Land
1/DP240718	1783-1789 Elizabeth Drive, Badgerys Creek	Main alignment	CPCP	Avoided Land, Certified Urban Capable Land
74/-/DP1277011	1793 Elizabeth Drive, Badgerys Creek	Main alignment, access tracks	CPCP	Avoided Land, Certified Urban Capable Land, Excluded Land, Certified Major Transport Corridor
72//DP1277011	1793 Elizabeth Drive, Badgerys Creek	Main alignment, access tracks, staging area, pump station	CPCP	Avoided Land, Certified Urban Capable Land, Excluded Land, Certified Major Transport Corridor
740/DP810111	1725A Elizabeth Drive, Badgerys Creek	Main alignment, access tracks, staging area, pump station	CPCP	Avoided Land, Certified Urban Capable Land

Lot and DP	Address	Project component	CPCP or SWGA	Land classification/s
102/DP1271336	1793 Elizabeth Drive, Badgerys Creek	Main alignment, access tracks	CPCP	Excluded Land
107/-/DP1271336	No specified address	Main alignment	CPCP	Excluded Land
104//DP1271336				
212/-/DP1272676	1793 Elizabeth Drive, Badgerys Creek	Main alignment	CPCP	Certified Urban Capable
211/-/DP1272676	No specified address	Main alignment	CPCP	Avoided Land, Certified Urban Capable Land



C:\Users\Aida.Tengku\Aurecon Group\Environment & Planning NSW - 505018_BadgerysCreek_Stage2\Pro\505018_BadgerysCreekStage2_BiodiversityAssessment_Figures\505018_BadgerysCreekStage2_BiodiversityAssessment_Figures_v2.aprx

Project No: P522314 Map Author: Aida.Tengku Date: 22/10/2024 Revision: 0

- Impact Area
- Cadastre
- Survey Area
- PCT 4025 – Cumberland Red Gum Riverflat Forest
- Watercourse

South West Growth Area

- Existing Certified
- Existing Non Certified

Land Categories (CPCP)

- Avoided land
- Certified - major transport corridor
- Certified - urban capable land
- Excluded land



Source: Aurecon, TfNSW, NSW Spatial Services (DCS), ESRI

1:30,000 @ A4

0 250 500 m

Projection: WGS 1984 Web Mercator Auxiliary Sphere

Badgerys Creek Stage 2 **Biodiversity Assessment**

Figure 1: Project area

1.3 Scope and purpose of the assessment

The purpose of the biodiversity assessment was to provide an assessment of the ecological values within the Study Area, including the potential presence of native vegetation and/or significant flora, fauna, and ecological communities. This assessment identifies the environmental approvals that may be triggered under Commonwealth and state legislation. This assessment also provides identification of any key risk areas and recommendations for locating project infrastructure to avoid impacts.

The scope of the assessment was to:

- Undertake a review of existing ecological information for the Project Area, including preparation of database searches for native vegetation, flora and fauna
- Undertake an ecological field survey to determine the type, extent and quality of native vegetation and fauna habitat present in the Study Area
- Identify any significant ecological values (including threatened species or communities) that have potential to occur in the Study Area
- Provide mapping of native vegetation and any records of habitat for threatened flora, fauna and ecological communities recorded during the ecological field survey
- Provide assessment of the likelihood of occurrence for threatened flora and fauna listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Biodiversity Conservation Act 2016* (BC Act), including determination of whether any targeted surveys are required
- Identify the potential constraints and opportunities for the project based on relevant biodiversity legislation and policy, including non-statutory and statutory impacts
- Provide recommendations to avoid and minimise impacts, including providing mitigation and management measures.

1.4 Legislative context

Biodiversity legislation and policy applicable to the Project is listed in Table 3 below.

Table 3 Relevant biodiversity legislation and policies

Relevant legislation or policy	Details	Relevance to the Project
State		
Environmental Planning and Assessment Act 1979 (EP&A Act)	The EP&A Act establishes the system of environmental planning and assessment in NSW. This Project is subject to the environmental impact assessment and planning approval requirements of Division 5.1 of the EP&A Act. Division 5.1 specifies the environmental impact assessment requirements for activities undertaken by public authorities, such as SWC, which do not require development consent under Part 4 of the Act. In accordance with Section 5.5 of the EP&A Act, SWC, as the proponent and determining authority, must examine and consider to the fullest extent possible all matters affecting or likely to affect the environment by the Project (via a REF). Under Part 5 of the EP&A Act, an activity will likely result in a significant impact if: • It is likely to significantly affect threatened species or ecological communities, or their habitats, according to the ToS (Section 7.3 of the BC Act) • It is carried out in a declared Area of Outstanding Biodiversity Value (AOBV). If it is determined that an activity is likely to significantly affect threatened species or ecological communities the preparation of a Species Impact Statement (SIS) or a Biodiversity Development Assessment Report (BDAR) would be required (if the proponent elects to participate in the Biodiversity Offset Scheme (BOS)).	This BAR forms part of the REF being prepared for the Project and assesses the biodiversity impacts of the Project to meet the requirements of the EP&A Act.

Relevant legislation or policy	Details	Relevance to the Project
Biodiversity Conservation Act 2016 (BC Act)	The BC Act establishes a framework for assessing and offsetting biodiversity impacts from proposed development. It provides for: • Threatened species and ecological communities • Areas of Outstanding Biodiversity Value (AOBV) (previously critical habitat under the *Threatened Species Conservation Act 1995*) • Key Threatening Processes (KTPs) • Private land conservation agreements • The Biodiversity Offsets Scheme (BOS) • Biodiversity assessment requirements • Biodiversity certification of land. Section 7.3 of the BC Act states that a test should be used to determine whether a proposed development or activity is 'likely to significantly affect threatened species'. Section 7.8 specifies that if an activity under Division 5.1 of the EP&A Act is likely to significantly affect threatened species, then a Species Impact Statement (SIS) or a BDAR is required to be prepared.	This BAR has been prepared to determine whether threatened species and/or ecological communities listed under the BC Act are considered likely to occur within the Project Area, and if so, whether the Project is likely to result in a significant impact to these values. Consequently, the BAR will outline whether a SIS or BDAR is required. **Note:** the BC Act only needs to be considered within 'Non-certified Land', as outlined below.
Fisheries Management Act 1994 (FM Act)	The FM Act aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. Part 7A Division 4 of the FM Act prohibits, without a licence or permit, activities that damage habitats or harm threatened species, populations or ecological communities.	This BAR will determine whether the Project will result in activities that damage habitats or harm threatened species, populations or ecological communities listed under the FM Act. Consequently, the BAR will outline whether a licence or permit is required for the works.
Biosecurity Act 2015	The *Biosecurity Act 2015* covers all biosecurity risks, including pest animals, plant diseases and weeds and introduces the legally enforceable concept of a general biosecurity duty. The Biosecurity Act divides NSW into regions based on combined LGAs and priority weeds for a region. Some weeds are managed at a State level as they form part of a broader containment strategy. The legislation also compliments listed as Weeds of National Significance (WoNS). Under Clause 22 of the Act, SWC has a duty to ensure that, so far as is reasonably practicable, potential biosecurity risks from the Project are prevented, eliminated or minimised.	This BAR will determine whether any priority weeds are located within the Project Area which need to be managed by SWC.
State Environmental Planning Policy (Hazards and Resilience) 2021 (SEPP Resilience and Hazards)	This SEPP includes coastal planning provisions that were previously enacted by the State Environmental Planning Policy (Coastal Management) 2018.	This BAR will determine whether coastal management areas identified under the SEPP are present within the Project Area.

Relevant legislation or policy	Details	Relevance to the Project
State Environmental Planning Policy (Precincts - Western Parkland City) 2021	This SEPP contains planning provisions for precincts which are located within the Western Parkland City, which includes the majority of land within the Project Area. The SEPP came into effect in March 2022 and consolidated several existing SEPPs for precincts within the Western Parkland City. Chapter 4 (Western Sydney Aerotropolis) of the SEPP Precincts – Western Parkland City sets out planning controls to facilitate development in the Western Sydney Aerotropolis in accordance with the Western Sydney Aerotropolis Plan. As part of this SEPP, the SWGA has been established and designated by the NSW Government as land for future urban development. Under the SEPP, all certified land within the SWGA has been subject to biodiversity certification, meaning that activities undertaken within certified areas do no need to undertake assessment of impacts on threatened species, populations or ecological communities, or their habitats, that would normally be required by Part 5 of the EP&A Act. This covers approvals under both the BC Act and EPBC Act, similar to the CPCP (see below).	The southern section of the Project Area (south of Elizabeth Drive) occurs within the SWGA. Therefore, sections of the Project Area that are classified as 'Existing Certified' do not require further assessment under the BC Act or EPBC Act.
Cumberland Plain Conservation Plan 2022	The CPCP identifies strategically important biodiversity areas within the Cumberland subregion to offset the biodiversity impacts of future urban development in the Western Parkland City. The CPCP has been developed to meet requirements for strategic biodiversity certification under the BC Act and strategic assessment under the EPBC Act (biodiversity approvals). The CPCP provides the biodiversity approvals required for new development in four nominated areas in Western Sydney. The Study Area resides within the nominated area of the Western Sydney Aerotropolis. The CPCP has identified the following land categories: • Avoided Land (not certified for development) • Strategic Conservation Area (not certified for development) • Certified - Urban Capable Land (certified for development) Under the CPCP, only development classified as 'Essential Infrastructure' can occur within 'Avoided Land'. The Project is classed as 'Essential Infrastructure' under the CPCP, as it is identified in Division 24: water supply systems and meets the criteria identified below: • Designed to service and support urban and industrial development within nominated areas of the Western Parkland City wholly or mostly within nominated areas. • Is a Part 5 activity (Division 5.1) under the EP&A Act • Does not include state-significant development, state-significant infrastructure and is not classified as roads under the EP&A Act.	The northern section of the Project Area (north of Elizabeth Drive) occurs within the CPCP. Therefore, sections of the Project Area that are classified as 'Certified – Urban Capable Land' do not require further assessment under the BC Act or EPBC Act.
Commonwealth		

Relevant legislation or policy	Details	Relevance to the Project
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act is Commonwealth legislation that provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, termed Matters of National Environmental Significance (MNES). Under the EPBC Act, an action that has, will have, or is likely to have, a significant impact on a MNES must be referred to the Commonwealth Minister for Environment. The Minister will then determine whether the proposed action requires formal assessment and approval under the EPBC Act.	This BAR has been prepared to determine whether threatened species and/or ecological communities listed under the EPBC Act are considered likely to occur within the Project Area, and if so, whether the Project is likely to result in a significant impact to these values. Consequently, the BAR will outline whether an EPBC Act referral is required. **Note:** the EPBC Act only needs to be considered within 'Non-certified Land', as outlined above.

1.5 Limitations

The outcomes of this report are limited to the ecological assessment undertaken for the Study Area and immediate surrounds. This report is limited to the scope defined in Section 1.3. Should further information become available regarding the conditions at the Study Area, the Planning Partnership reserves the right to review the report in the context of the additional information.

Ecological assessments can be undertaken at any time of year; however, seasonal variations can result in some flora and fauna not being detectable at certain times. Particularly, many flowering plant species are only detectable when producing flowers or fruits. In general, spring is considered the optimal period to undertake ecological field assessments in NSW. Consequently, the spring timing of the ecological field survey that informed this assessment was considered appropriate to ascertain the extent and condition of native vegetation and habitat in the Study Area.

2 Methodology

The methodology included a desktop assessment, field investigation and impact assessment, as described in the sections below.

2.1 Desktop assessment

The desktop assessment comprised a review of current databases for information on native vegetation and threatened flora, fauna and ecological communities listed under the EPBC Act and BC Act.

The methods adopted for the database search, likelihood of occurrence and impact assessment are outlined in the following sections.

2.1.1 Literature review

As part of the desktop assessment, the following policy documents were reviewed:

- State Environmental Planning Policy (Resilience and Hazards) 2021 (SEPP) – Coastal Wetland Mapping (NSW Government, 2023)
- State Environmental Planning Policy (SEPP) (Precincts – Western Parkland City) 2021 (NSW Government, 2021)
- Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, Department of Planning and Environment, August 2023 (DPE, 2022).

2.1.2 Database search

The database searches undertaken provided a shortlist of the potential flora, fauna and ecological communities that may occur within the Locality. The following databases were reviewed to inform the assessment:

- NSW BioNet Atlas database and BioNet Vegetation Classification (NSW Government, 2024)
- Commonwealth Protected Matters Search Tool (DCCEEW, 2024)
- Existing vegetation mapping, published on the State Vegetation Type Map (SVTM) NSW extant PCT (OEH, 2024)
- National Atlas of Groundwater Dependent Ecosystems (GDE) (BoM, 2024)
- DPI Fisheries NSW Spatial Data Portal for Key Fish Habitat (DPI, 2024a)
- DPI WeedWise – Priority Weeds within the Greater Sydney Local Land Service Region (DPI, 2024b)
- Cumberland Plain Conservation Plan (CPCP) boundary and land categorisation mapping (DPE, 2022).

Note: BioNet records greater than 20 years old were considered no longer current and were excluded from consideration. This ensured only the most up-to-date and relevant records were reviewed.

2.1.3 Likelihood of occurrence analysis for threatened flora and fauna

The likelihood of occurrence of all the threatened flora and fauna species collated in the database search was considered for the Project Area. The following threatened species were considered:

- Flora listed as threatened under the EPBC Act
- Fauna listed as threatened and/or migratory under the EPBC Act
- Flora and fauna listed as threatened under the BC Act.

Each of these species were considered against the suitability of habitat, to determine their likelihood of occurrence in the Project Area. The likelihood of a species occurring within the Project Area was classified as 'Negligible', 'Low', 'Moderate' or 'High' based on the consideration of:

- The presence/absence of previous records in the search region (as returned from the database search)
- The known habitat requirements and distribution of the species
- The suitability of habitat in the Project Area (based on the findings of the overview field assessment, and previous reports for the site).

The likelihood of occurrence of ecological communities are also considered in this report (see Section 3.2.3).

Details of the ranking criteria used to determine likelihood of occurrence of threatened flora and fauna in the Project Area is provided in Table 4 and Table 5. Those determined to have moderate or higher likelihood of occurrence in the Project Area are considered further and discussed in Section 3.2.4 and Section 3.2.5.

Table 4 Likelihood of occurrence criteria for threatened flora species

Likelihood of Occurrence	Criteria
High	Recent records of the species in the local vicinity (i.e., within the last 10 years).
	Known resident in the area based on site observations, database records or expert advice and/or the project area contains high quality habitat.
Moderate	Previous reputable records of the species in the local vicinity and/or the Project Area contains moderate quality habitat.
Low	Limited previous records of the species in the local vicinity, and/or the Project Area contains poor or limited habitat. May also be considered low if other environmental factors are present such as fragmented or isolated habitat.
Negligible	No suitable habitat and/or the project area falls outside the known species range.

Table 5 Likelihood of occurrence criteria for threatened and migratory fauna species

Likelihood of Occurrence	Criteria
High	Known resident in the area based on site observations, database records or expert advice.
	Recent reputable records (within 5 years) of the species in the local area.
	The Project Area contains the species' preferred habitat.
Moderate	The species is likely to visit the project area regularly (i.e. at least seasonally).
	Previous reputable records of the species in the local area.
	The Project Area contains some characteristics of the species' preferred habitat.
Low	The species is likely to visit the Project Area occasionally or opportunistically whilst en-route to more suitable sites.
	There are only limited or historical records of the species in the local area (>20 years old).
	The Project Area contains few or no characteristics of the species' preferred habitat.
Negligible	No previous records of the species in the local area
	Previous records of the species exist in the local area but >30 years old
	The species may fly over the area when moving between areas of more suitable habitat
	Out of the known species' range
	No suitable habitat present within the Project Area
	Species is known to be regionally extinct

2.2 Field assessment

The ecological field assessment was undertaken on the 16 September and 1 October 2024. The assessment included:

- Plant Community Type (PCT) identification and mapping
- Threatened Ecological Community (TEC) identification and condition mapping
- Biodiversity constraints assessment and mapping
- Identification of trees containing habitat values (hollows, nests and dreys etc.)
- Priority weed identification
- Opportunistic targeted surveys for non-cryptic threatened flora with suitable survey period at the time of surveys
- Incidental fauna records
- Threatened species habitat suitability assessments.

2.3 Impact assessment and mitigation requirements

As outlined in Table 3, under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), SWC must assess the environmental impact of all its activities. SWC must seek to avoid, minimise, and mitigate these impacts. Residual impacts resulting from SWC activities, must be offset as follows:

- **Non-statutory impacts** are non-significant impacts on native vegetation, trees, threatened biodiversity (i.e., TECs, threatened species, habitat of threatened species) or Matters of National Environmental Significance (MNES). Non-statutory impacts can be offset based on SWC's Biodiversity Offset Policy (Sydney Water, 2024).
- **Statutory impacts** are likely, predicted or known significant impacts on threatened biodiversity and MNES. Those impacts need to be offset in accordance with the BC Act and EPBC Act.

2.3.1 Non-statutory impacts

Non-significant residual impacts must be offset based on SWC Biodiversity Offset Guide (the Guide). Non-significant impacts apply to:

- **Minor Impact**: localised impacts, such as removal of an individual isolated tree (e.g. street tree or garden planting), or a small amount (< 100 m^2) of native vegetation removal (e.g. around a maintenance hole).
- **Moderate Impact**: larger scale impacts (> 100 m^2), that are not considered significant (e.g. removal of native vegetation associated with new infrastructure projects).

Where minor and moderate residual impacts are identified, residual impacts must be offset in accordance with the offset multipliers provided in the Guide (refer to Section 4.4 for assessment of non-statutory impacts).

2.3.2 Statutory impacts

Where impacts on threatened biodiversity (i.e., TECs, threatened species or their habitat) are likely to occur, an Assessment of Significance (AoS) is undertaken to evaluate if the impacts resulting from the Project would be significant. Assessment of significance is undertaken based on:

- **Test of Significance** for threatened biodiversity listed under the BC Act and based on the criteria listed in Office of Environment and Heritage Threatened Species Test of Significance Guidelines (OEH, 2018). If a project is predicted to result in significant impacts on threatened biodiversity, a

Biodiversity Development Assessment Report (BDAR) in accordance with the Biodiversity Assessment Method (BAM) is required and offsets as per Biodiversity Offsets Scheme (BOS) apply.

- **Significant Impact Assessment** for MNES listed under the EPBC Act based on the significant impact criteria for each MNES as per the *Significant impact guidelines 1.1: MNES* (DEWHA, 2013). If a project is predicted to result in significant impacts on MNES, a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) is required for approval. Where required, offsets on MNES must meet the EPBC Act Environmental Offsets Policy. There are nine MNES consisting of:
    - World Heritage Properties
    - National Heritage Places
    - Wetlands of International Importance
    - TECs and threatened species
    - Migratory Birds
    - Marine areas
    - The Great Barrier Reef Marine Park
    - Nuclear Actions
    - A water resource, in relation to coal seam gas development and large coal mining development.

Refer to Section 4.4 for assessment of statutory impacts.

3 Results

3.1 Desktop assessment

A review of publicly available ecological information was undertaken to provide context and understanding of ecological values occurring on the site. Information reviewed is summarised in the following subsections.

3.1.1 BioNet Atlas

A total of 71 threatened species protected under the BC Act and EPBC Act were predicted to occur within the Locality, including 21 birds, 9 mammals, 2 fish, 1 insect, 1 gastropod, 2 reptiles, 3 amphibians and 32 flora species. Following review of these search results, the threatened species considered most likely to occur on site based on habitat and historical records are listed in Section 3.2.4.

A full list of potentially occurring threatened flora, fauna and migratory species listed under both the BC and EPBC Act can be found in Appendix D – Likelihood of occurrence analysis for threatened flora and Appendix E – Likelihood of occurrence analysis for threatened fauna, respectively.

3.1.2 Matters of National Environmental Significance

Table 6 shows the summary of the Matters of National Environmental Significance (MNES) predicted to occur as per the PMST report for the Locality (Appendix B – PMST).

Table 6 Summary of predicted MNES

MNES	Predicted within the Locality	Further assessment
World Heritage Properties	One – Greater Blue Mountains Area	Greater Blue Mountains Area is present within the buffer area
National Heritage Places	One – Greater Blue Mountains Area	Greater Blue Mountains Area is present within the buffer area
Wetlands of International Importance (Ramsar Wetlands)	None	N/A
Great Barrier Reef Marine Park	None	N/A
Commonwealth Marine Area	None	N/A

<table>
<tr><th>MNES</th><th>Predicted within the Locality</th><th>Further assessment</th></tr>
<tr><td>Threatened Ecological Communities (TECs)</td><td>A total of 12 TECs were predicted to occur in the Locality:
Castlereagh Scribbly Gum and Agnes Banks Woodland of the Sydney Basin Bioregion (E)
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and Southeast Queensland ecological community (EEC)
Coastal Swamp Sclerophyll Forest of New South Wales and Southeast Queensland (E)
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (CEEC)
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CEEC)
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion (CEEC)
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (CEEC).
Shale Sandstone Transition Forest of the Sydney Basin Bioregion (CEEC)
Temperate Highland Peat Swamps on Sandstone (EEC)
Turpentine-Ironbark Forest of the Sydney Basin Bioregion (CEEC)
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion (EEC)
Western Sydney Dry Rainforest and Moist Woodland on Shale (CEEC).</td><td>Further assessment of vegetation zones and TECs was undertaken (refer to Section 3.2.3)</td></tr>
<tr><td>Threatened Species</td><td>A total of 71 threatened species were predicted as follows:<table><tr><th>Group</th><th>V</th><th>E</th><th>CE</th></tr><tr><td>Birds</td><td>11</td><td>6</td><td>4</td></tr><tr><td>Fish</td><td>1</td><td>1</td><td></td></tr><tr><td>Frog</td><td>3</td><td></td><td></td></tr><tr><td>Insect</td><td></td><td>1</td><td></td></tr><tr><td>Mammal</td><td>5</td><td>4</td><td></td></tr><tr><td>Plant</td><td>17</td><td>11</td><td>4</td></tr><tr><td>Reptile</td><td>1</td><td>1</td><td></td></tr><tr><td>Snail</td><td></td><td>1</td><td></td></tr></table></td><td>Assessment of likelihood of occurrence of threatened species was undertaken (refer to Section 3.2.4, 3.2.5 and Appendix D – Likelihood of occurrence analysis for threatened flora and Appendix E – Likelihood of occurrence analysis for threatened fauna).</td></tr>
<tr><td>Migratory Species</td><td>A total of 16 migratory species were predicted to occur in the locality, including:
One migratory marine bird
Seven migratory terrestrial birds
Eight migratory wetland birds.</td><td>Assessment of likelihood of occurrence of threatened species was undertaken (refer to Section 3.2.4, 3.2.5 and Appendix E – Likelihood of occurrence analysis for threatened fauna).</td></tr>
</table>

Legend: *EEC = Endangered Ecological Community, CEEC = Critically Endangered Ecological Community. Status: V = vulnerable; E = Endangered; CE = Critically Endangered*

3.1.3 Existing mapped native vegetation

The State Vegetation Type Map (SVTM) for NSW extant PCTs (DPE, 2024) indicates that three Plant Community types (PCTs) are mapped in the Project Area. In accordance with the Threatened Biodiversity Data Collection (TBDC), all PCTs have known associated TECs. Table 7 provides a summary of the mapped PCTs and their known associated TECs.

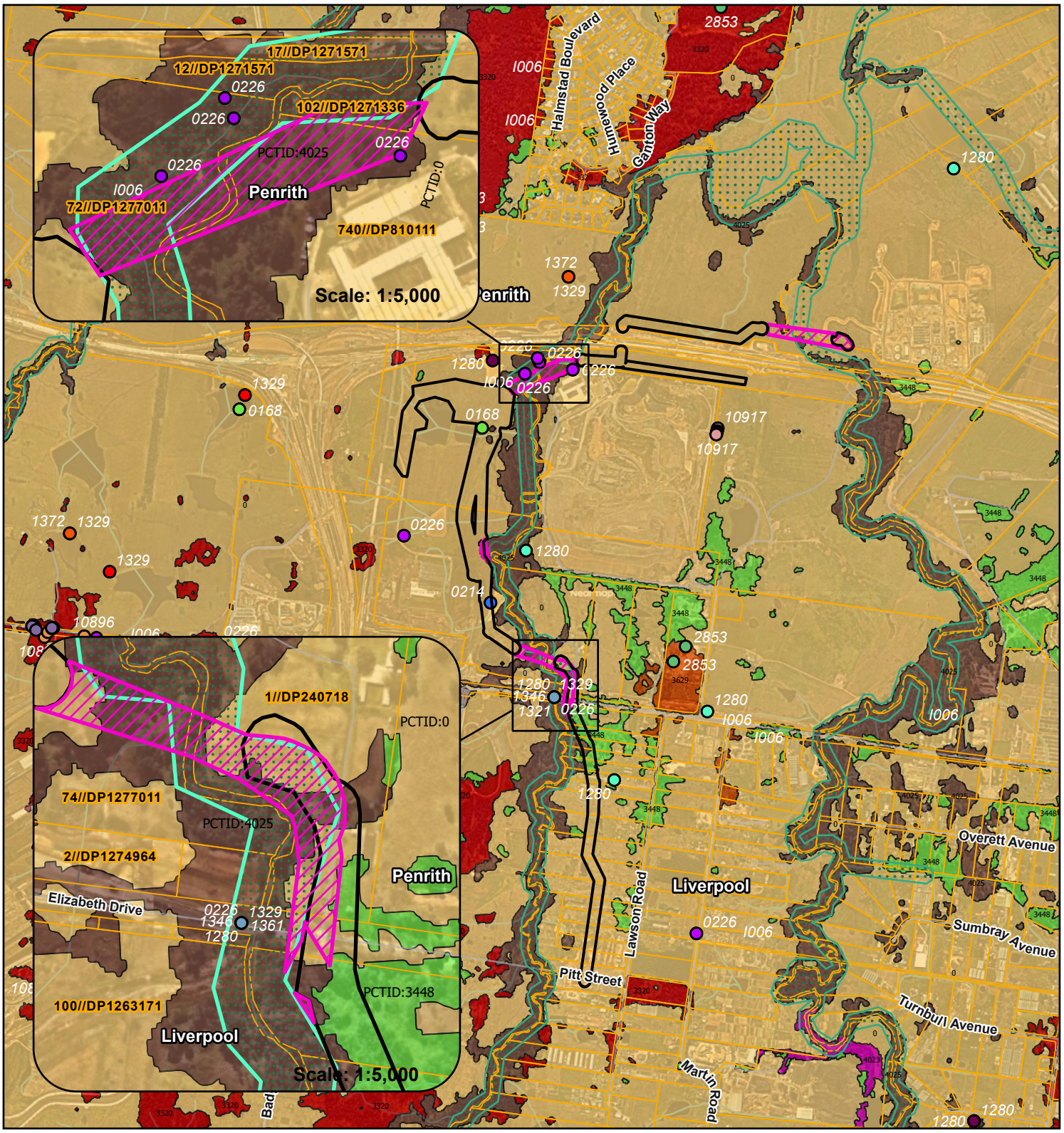
Table 7 Summary of mapped PCTs in the Project Area

PCT ID	PCT Name	TEC known to be associated with the PCT		
		Act	TEC Name	TEC Status
PCT 4025	Cumberland Red Gum Riverflat Forest	BC Act	Elderslie Banksia Scrub Forest	CEEC
			River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions	EEC
		EPBC Act	Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	CEEC
			River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	CEEC
PCT 3448	Castlereagh Ironbark Forest	BC Act	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	EEC
			Shale Gravel Transition Forest in the Sydney Basin Bioregion	EEC
		EPBC Act	Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CEEC
			Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CEEC
PCT 3629	Castlereagh Scribbly Gum Woodland	BC Act	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	VEC
		EPBC Act	Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	EEC

Legend

Act: BC Act = NSW *Biodiversity Conservation Act 2016*; EPBC Act = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

TEC status: VEC = Vulnerable Ecological Community; EEC = Endangered Ecological Community; CEEC = Critically Endangered Ecological Community



- Impact Area
- Cadastre
- Watercourse
- Key Fish Habitat

Survey Area

- Survey Area

Threatened Species (BioNet records)

Scientific Name ID, Scientific Name

- 3330,Juncus flavidus
- 0163,Calidris acuminata
- 0168,Gallinago hardwickii
- 0214,Stictonetta naevosa
- 0218,Circus assimilis
- 0225,Hieraaetus morphnoides
- 0226,Haliaeetus leucogaster
- 0230,Lophoictinia isura
- 0260,Glossopsitta pusilla
- 0504,Chthonicola sagittata
- 0549,Daphoenositta chrysoptera
- 0879,Hirundo rustica
- 10896,Marsdenia viridiflora subsp. viridiflora
- 10917,Grevillea juniperina subsp. juniperina
- 1162,Phascolarctos cinereus
- 1162,Xanthosia pilosa
- 1280,Aster subulatus
- 1280,Pteropus poliocephalus
- 1321,Saccolaimus flaviventris
- 1329,Micronomus norfolkensis
- 1346,Miniopterus australis
- 1357,Myotis macropus
- 1361,Scoteanax rueppellii
- 1372,Falsistrellus tasmaniensis
- 2853,Dillwynia tenuifolia
- 3007,Pultenaea parviflora

Plant Community Type (SVTM)

PCTID, PCTName

- 0,Not classified
- 3318,Cumberland Moist Shale Woodland
- 3319,Cumberland Shale Hills Woodland
- 3320,Cumberland Shale Plains Woodland
- 3448,Castlereagh Ironbark Forest
- 3629,Castlereagh Scribbly Gum Woodland
- 3972,Sydney Creekflat Wetland
- 4023,Coastal Valleys Swamp Oak Riparian Forest
- 4024,Cumberland Blue Box Riverflat Forest
- 4025,Cumberland Red Gum Riverflat Forest

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Projection: GDA2020 MGA Zone 56

Figure 2: Desktop Assessment of the Study area

3.1.4 Key Fish Habitat

The NSW Department of Primary Industries' Fisheries spatial data portal (DPI, 2024) indicated that Key Fish Habitat – Hawkesbury-Nepean occurs within the Project Area, within Badgerys Creek and South Creek (Figure 2). The Project Area crosses South Creek at one point and Badgerys Creek at three points.

3.1.5 Area of Outstanding Biodiversity Value

There are no Areas of Outstanding Biodiversity Value (AOBV) declared under the BC Act within or adjacent to the Project Area.

3.1.6 Groundwater-dependent Ecosystems

The Bureau of Meteorology (BoM) Groundwater-dependent Ecosystems (GDEs) Atlas indicated that:

- South Creek is mapped as an aquatic GDE. The proposed alignment crosses South Creek at one point
- Terrestrial GDE is mapped along both Badgerys Creek and South Creek's riparian corridor. The mapped terrestrial GDE's are Cumberland Shale Plains Woodland, Cumberland River Flat Forest, and Cumberland Shale Hills Woodland
- The Subterranean GDE map shows that no subterranean GDEs occur in the Project Area. The Project Area is part of the Greater Metropolitan Region, a groundwater management area, which has a water sharing plan under the *Water Management Act 2000*. The Greater Metropolitan Region Groundwater Sources map indicates that the subterranean groundwater at the Project Area is sourced from the Sydney Basin Central Groundwater.

3.1.7 State Environmental Planning Policy (Resilience and Hazards) 2021 – Coastal Wetland mapping

The State Environmental Planning Policy (Resilience and Hazards) 2021 Coastal Wetland Mapping (NSW Government, 2023) indicates that the Project Area is outside of land application for coastal wetlands. The nearest coastal wetland is in the suburb of Abbotsbury located approximately 10 km south-east of the Project Area.

3.1.8 State Environmental Planning Policy (Precincts – Western Parkland City) 2021

The southern section of the Project Area (south of Elizabeth Drive) is located within the SWGA, which was established and designated by the Government as land for future urban development. All sections of the Project Area that occur within the SWGA are within 'Existing Certified' Land. Therefore, no further biodiversity assessment is required for this section of the Project Area, as biodiversity approvals for the BC Act and EPBC Act are covered under the existing biodiversity certification as part of the SEPP.

The Impact Area does intersect areas declared as a 'High Biodiversity Value Area (Existing Native Vegetation)' under the SEPP. These coincide with areas classified as 'Avoided Land' and 'Excluded Land' under the CPCP, which occur along Badgerys Creek and South Creek.

3.1.9 Cumberland Plain Conservation Plan

The northern section of the Project Area (north of Elizabeth Drive) is located within the Cumberland Plain Conservation Plan (CPCP) (DPE, 2022), within the Northern Gateway precinct of the Western Sydney Aerotropolis within the CPCP application area. Five land categories of the CPCP occurs within the Project Area (Table 8 and Figure 1).

Table 8 Summary of land categories of the CPCP in the Project Area

CPCP Land Category	Description[1]	Implications for Biodiversity Assessment	Amount within the Project Area (ha)
Certified – Urban Capable Land	Land identified as suitable for development. Development in certified land will not require further biodiversity approvals under the BC Act and/or EPBC Act if development is in accordance with the CPCP.	No further biodiversity assessment under the BC or EPBC Act as long as the works are in accordance with the CPCP.	16.05 ha
Certified – Major Transport Corridors			5.67 ha
Excluded Land	Land that has been excluded from the CPCP and for which NSW strategic biodiversity certification and approval through the federal strategic assessment was not sought.	Requires biodiversity assessment as per BC Act and/or EPBC Act requirements.	4.62 ha
Avoided Land	Land with high biodiversity values and that was identified for protection. Avoided land is subject to development controls as required under the BC Act and EPBC Act to avoid and minimise impacts on nationally and state-listed threatened species and ecological communities.		0.50 ha

3.2 Field assessment

3.2.1 Site description

The Study Area is within a highly disturbed setting, as it was bounded by roads, active construction sites and residential houses. Vegetation primarily consisted of weeds and planted vegetation (Photo 4). Vegetation along the roadside also included Weeds of National Significance (WoNS), consisting of Blackberry (*Rubus fruticosus*) and Fireweed (*Senecio madagascariensis*).

Sections of the Study Area, particularly those confined to areas of 'Avoided Land', 'Excluded Land' and 'High Biodiversity Value Area (Existing Native Vegetation)', comprised of native vegetation. This vegetation was typically located along Badgerys Creek and South Creek, where remnant riparian vegetation remains (Photo 1 and Photo 2).



Photo 1 Native vegetation in Avoided Land North of Elizabeth Drive



Photo 2 Native vegetation along the Badgerys Creek riparian zone in Avoided Land within the Cleanaway property



Photo 3 Patch of *Eucalyptus amplifolia* and *Angophora floribunda* trees within the Cleanaway property



Photo 4 Non-native vegetation within Avoided Land, on Elizabeth Drive

Contrastingly, the Impact Area mainly comprised of agricultural land with several scattered native trees, one of which contained two small-sized hollows (Photo 5).



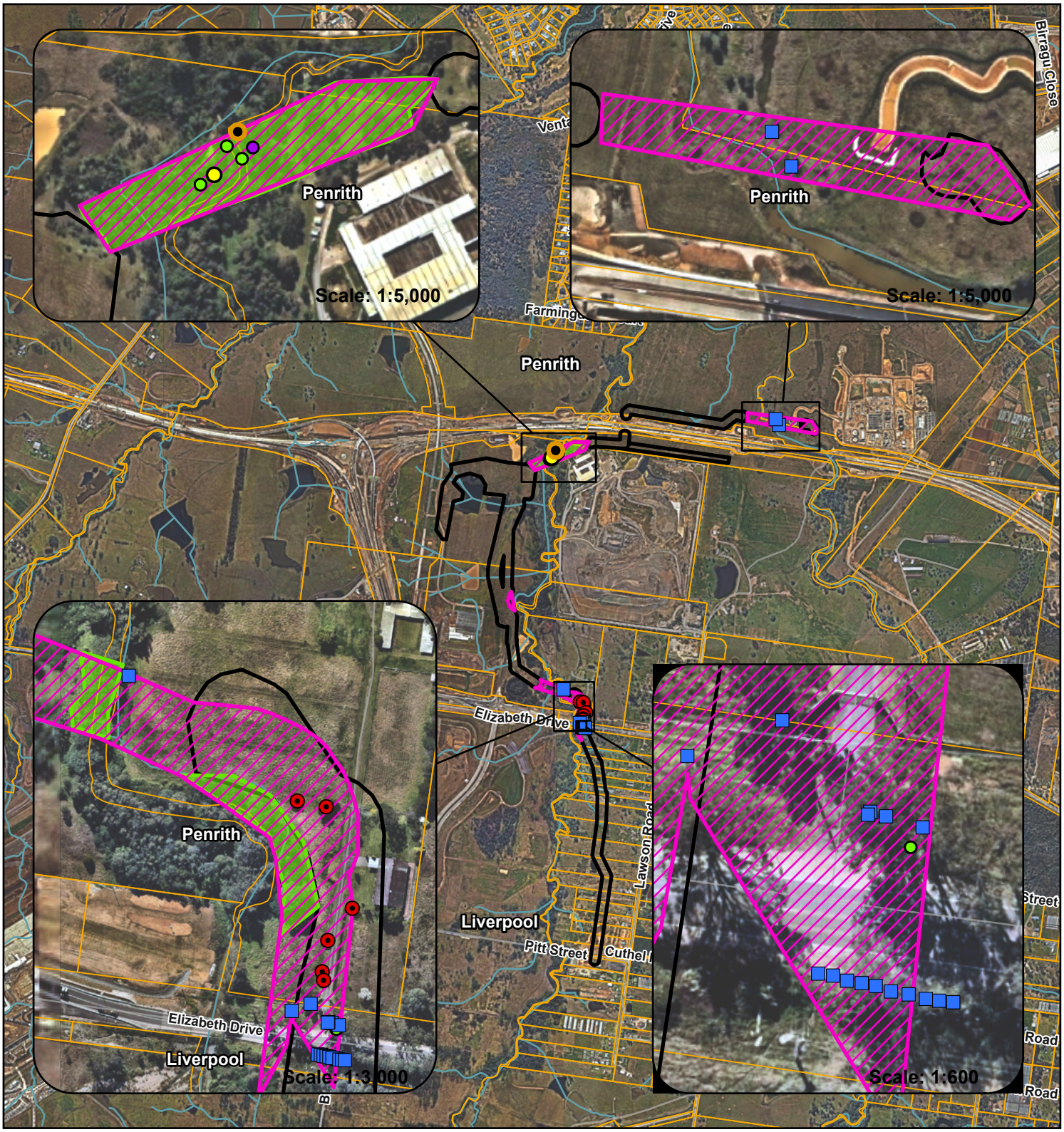
Photo 5 Native Grey box, Eucalyptus moluccana tree with small-sized hollows

3.2.2 Native vegetation

Two vegetation zones were recorded in the Study Area surveyed, including one zone of native PCTs and one zone of planted native/exotic vegetation. Native and exotic vegetation zones identified within the Study Area are outlined in Table 9.

Table 9 Vegetation zones identified within the Study Area

Vegetation zone	Description within the Study Area	Associated TEC
Within the Impact Area		
PCT 4025	**Classification:** Non-threatened native vegetation **PCT Scientific name**: Cumberland Red Gum River-flat Forest **Vegetation Formation:** Forested Woodlands **Vegetation Class:** Coastal Floodplain Wetlands **Canopy:** Grey Box (*Eucalyptus moluccana), Swamp she-oak (Casuarina glauca),* Prickly-leaved paperbark *(Melaleuca stypheliodes),* Weeping grass (*Microlaena stipoides)* **Mid layer/ground layer:** Blackthorne (*Bursaria spinosa*)	**EPBC Act** River-flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria (Critically Endangered under EPBC Act) **BC Act** River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions (Endangered under BC Act)
Planted Native/Exotic vegetation	**Classification:** Planted Native/Exotic **Canopy layer:** *Camphora officinaum* (Camphor laurel) **Mid layer/ ground layer:** Green Cestrum (Cestrum parqui), Trad Weed (Tradescantia fluminensis), Chinese Privet (*Ligustrum sinense),* Scotch Thistle (*Onopordum acanthium),* Purpletop *(Verbena bonariensis),*	**EPBC Act** No associated TECs **BC Act** No associated TECs



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- Impact Area
- Cadastre
- Watercourse
- Survey Area

Ground Truth Native Vegetation*

- PCT 4025 – Cumberland Red Gum Riverflat Forest

Trees*

- Exotic
- Native

Fauna Habitat*

- Hollow bearing trees
- Log
- Stag
- Stick nest

*Note: Field surveyed ecological data

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0 250 500 m

Projection: GDA2020 MGA Zone 56

Badgerys Creek Stage 2 **Biodiversity Assessment**

Figure 3: Ecological Values

3.2.3 Threatened Ecological Communities

Native vegetation within PCT 4025 matched the criteria for the BC Act listed EEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions.

However, due to the presence of a significant number of non-native ground-cover species and weeds, no native vegetation in the Study Area matched the criteria for any of the above EPBC Act listed communities. Therefore, no EPBC Act listed TEC's occur within the Impact Area.

3.2.4 Flora

During the field assessment 33 flora species were recorded. The majority of flora species were exotic (66%). A full list of the flora species recorded in the Study Area is provided in Appendix C – List of Flora species recorded in the Impact Area. No threatened flora species were recorded within the Study Area. The likelihood of occurrence of threatened flora species within 10 km of the study area was considered in Appendix D – Likelihood of occurrence analysis for threatened flora.

Based on the analysis presented in Appendix D – Likelihood of occurrence analysis for threatened flora, no threatened flora species are considered likely to occur within the Study Area due to the historic disturbance and modification to the vegetation and ground layer.

3.2.5 Fauna

Several common fauna species were opportunistically recorded in the Study Area. This includes Sulphur-Crested Cockatoo *(Cacatua galerita*), Laughing Kookaburra (*Dacelo novaguineae*), Grey Butcherbird (*Cracticus torquatus,* Common myna (*Acridotheres tristis)* and Australian Magpie *(Gymnorhina tibicen*), most of which were either flying overhead, heard calling or foraging. The presence of mature native trees, shrubs and grasses, alongside key habitat values such as hollows and logs within the Study Area may provide suitable habitat for these species.

Fauna habitats present within the Study Area include:

- Endemic native trees and shrubs – provides habitat for common bird species
- Hollow-bearing trees – provide habitat for bird species, microbats and small mammals
- Planted trees – provide foraging resources for birds
- Fallen branches and logs – provide habitat for ground-dwelling reptiles, gastropods, birds and small mammals
- Stick nests – provides habitat for common bird species.

No threatened fauna species were opportunistically recorded. The likelihood of occurrence of threatened fauna species within 10 km of the Study Area was considered in Appendix E – Likelihood of occurrence analysis for threatened fauna. Based on the analysis presented in Appendix E – Likelihood of occurrence analysis for threatened fauna, two threatened fauna species were considered to have a moderate or higher likelihood of occurrence within the Study Area:

- Cumberland Plain Land Snail *Meridolum corneovirens* (Endangered, BC Act)
- Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act).

The majority of potential habitat for these two species occurs within the native vegetation recorded along Badgerys Creek and South Creek (PCT 4025). These areas are within Avoided Land/Excluded Land/High Biodiversity Value Area (Existing Native Vegetation) areas, which are outside of the Impact Area, and will not be impacted by the Project.

Limited potential habitat (in the form of one Hollow-bearing tree with two hollows, logs, a large stick nest and exotic or planted vegetation) occurs within the Impact Area. However, these areas occur within existing certified areas, and therefore, according to Section 8.4 (5) of the BC Act, ‘’a determining authority under Part

5 of the EP&A Act is not required to consider the effect on biodiversity, of an activity to be carried out on biodiversity certified land''.

Consequently, no Test of Significance (ToS) under the BC Act or Significant Impact Assessment (SIA) under the EPBC Act has been undertaken.

4 Impact assessment

4.1 Details of the proposed development

SWC are proposing to construct a new wastewater pipeline which includes:

- The wastewater main alignment
- Pump station
- Staging area
- Access track south of the M12
- Original north-south access track to the pump station
- Access track west of the pump station.

The proposed methodology includes a mix of trenched and trenchless construction for the pipeline and access shafts. All sensitive areas, including areas classified as 'Avoided Land', 'Excluded Land' and 'High Biodiversity Value Area (Existing Native Vegetation) will be avoided through the trenchless construction. Vegetation clearing is only proposed to occur within 'Certified Lands'.

4.2 Impacts on ecological values

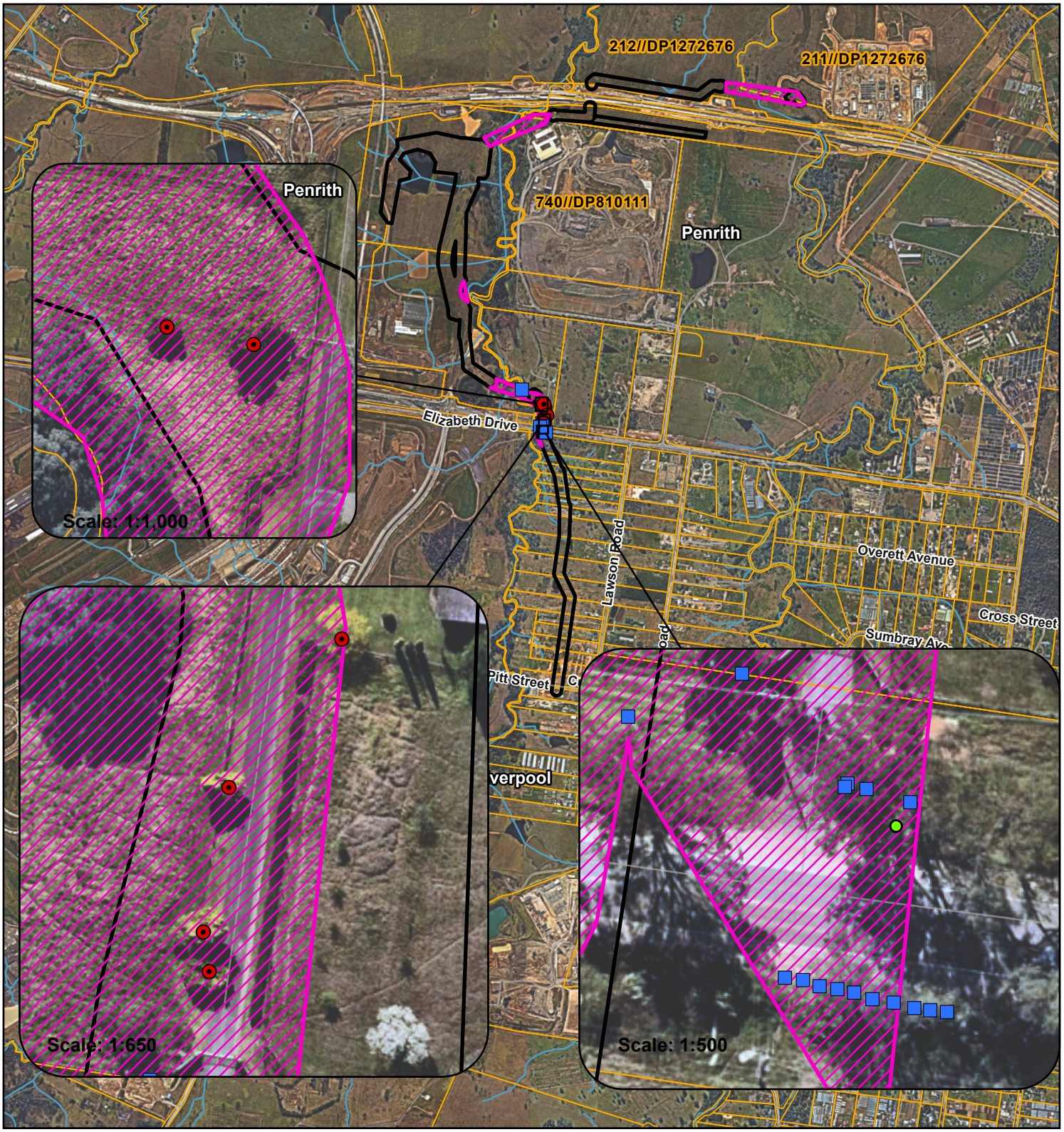
4.2.1 Native Vegetation

No native vegetation comprising a PCT will be impacted by the works. Six planted non-native trees and 19 native trees including one hollow-bearing tree are proposed to be impacted within the section of the main pipeline alignment immediately north of Elizabeth Drive (Figure 4). The non-native species comprised of Camphor Laurel (*Cinnamomum camphora*). The native trees proposed to be impacted include:

- Six (6) Grey Box (*Eucalyptus moluccana*)
- 13 *Eucalyptus sp.* and Cabbage Gum (*Eucalyptus amplifolia*) with approximately 10 being along the roadside along Elizabeth Drive.

It is recommended that an arborist is engaged to assess the impacts under the *Australian Standard AS4970-2009 Protection of trees on development sites*. The Standards state that if the TPZ is encroached by >10%, the arborist must demonstrate that the tree would remain viable. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ. It's likely if the Structural Root Zone (SRZ) is not encroached, then with arborist supervision during works, some of these trees could be retained.

It is worth noting that the site survey focused on identifying vegetation within the Study Area only, to assess impacts outside of 'Certified Land'. However, these trees were identified incidentally within the Impact Area. There are likely to be other trees, especially those along the roadside south of Elizabeth Drive, within the broader Impact Area that may be impacted by the proposed works but were not identified during the site survey. Impacts to trees within 'Certified Land' are considered to be non-statutory impacts which can be offset based on SWC's Biodiversity Offset Policy (Sydney Water, 2024).



Impact Area

Cadastre

Watercourse

Impacted Trees*

Exotic

Native

Hollow bearing tree

*Note: Field surveyed ecological data

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Projection: GDA2020 MGA Zone 56

Badgerys Creek Stage 2 **Biodiversity Assessment**

Figure 4: Proposed Development Impacts

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4.2.2 Threatened Ecological Communities

The Project will not impact the BC Act listed EEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions as it only occurs in areas outside of the Impact Area. Indirect impacts will be avoided through the use of management and mitigation measures outlined in Table 11 (e.g. No-Go Zones around adjacent TECs with clear signage).

4.2.3 Threatened flora

No threatened flora was observed during site survey within the Study Area. Additionally, based on the analysis presented in Appendix D – Likelihood of occurrence analysis for threatened flora, no threatened flora species are considered likely to occur within the Study Area due to the historic disturbance and modification to the vegetation and ground layer.

4.2.4 Threatened fauna

No threatened fauna species were sighted during the investigation. Two threatened species were considered to have a moderate or higher likelihood of occurrence within the Project Area:

- Cumberland Plain Land Snail (*Meridolum corneovirens*) (Endangered, BC Act)
- Little Bent-winged Bat (*Miniopterus australis*) (Vulnerable, BC Act).

However, as noted in Section 3.2.5, the majority of habitat for these species occurs within native vegetation outside of the Impact Area. Limited potential habitat occurs within the Impact Area, however, these areas occur within existing certified areas, and therefore, according to Section 8.4 (5) of the BC Act, a determining authority under Part 5 of the EP&A Act is not required to consider the effect on biodiversity, of an activity to be carried out on biodiversity certified land. Therefore, impacts to these species are not considered further.

4.3 Potential implications under relevant environmental legislation and policy

Relevant legislation or policy	Summary and actions required
State	
Environmental Planning and Assessment Act 1979 (EP&A Act)	No action required The Project is not likely to result in a significant impact to threatened species or ecological communities or their habitat. Additionally, it doesn't occur within an AOBV.
Biodiversity Conservation Act 2016 (BC Act)	No action required No BC Act listed threatened ecological communities or threatened flora species were identified or are considered likely to occur within the Project Area. Two threatened fauna species, Cumberland Plain Land Snail (*Meridolum corneovirens*) and Little Bent-winged Bat (*Miniopterus australis*), were considered to have a moderate likelihood of occurrence within the Project Area. However, the majority of habitat occurs outside of the Impact Areas, and where potential habitat occurs within the Impact Area, it occurs within 'Certified Lands'. Consequently, impacts to BC Act listed species within these areas have already been accounted for in the existing biodiversity approvals.
Fisheries Management Act 1994 (FM Act)	**Action already complete** Notification is required under Section 199 of the FM Act, as the works involve dredging (as defined under the Act) within Key 'Fish Habitat'.

Relevant legislation or policy	Summary and actions required
Biosecurity Act 2015	**Action required** Several environmental weeds were recorded within the Study Area. Although these weeds are not declared priority weeds, they still pose a risk to the surrounding vegetation and biodiversity. The use of plant machinery and equipment can act as a vector to introduce and spread existing and new weeds in the form of soil-stored seeds or reproductive vegetative materials including *Lantana camara* seeds. Spread of weeds off-site is possible if green waste is contaminated and not disposed of appropriately and used elsewhere. Appropriate weed management controls and safeguards should be created before to works start and adhered to throughout the works phase (see Table 11).
State Environmental Planning Policy (Hazards and Resilience) 2021 (SEPP Resilience and Hazards)	No action required No coastal management areas identified under the SEPP are present within the Project Area, therefore, the Project does not need to consider SEPP (Resilience and Hazards) 2021.
State Environmental Planning Policy (Precincts—Western Parkland City) 2021	No action required There are several areas classified as 'High Biodiversity Value Area (Existing Native Vegetation)' which intersect the Project Area. However, none of these areas are proposed to be impacted.
Cumberland Plain Conservation Plan 2022	**Action required** Development activities on 'Avoided Land' and 'Certified – Urban Capable Land' must meet the objectives listed in Section 2.3 and Section 3.3 of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development (Infrastructure Guidelines) (DPE, 2023), respectively. Additionally, the Project must meet the mitigation requirements outlined in Section 3.3 (Table 1) of the Infrastructure Guidelines for activities on 'Certified – Urban Capable Land', which apply to ecological values listed under both the BC Act and EPBC Act (these have been incorporated into mitigation measures within Table 11 in Section 5). These must be addressed in a statement (as per regulation 201A of the EP&A Regulation 2021) to demonstrate consistency with Section 2.3 of the CPCP Infrastructure Guidelines.
Commonwealth	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	No action required No EPBC Act listed threatened ecological communities, threatened flora species or threatened fauna species were identified or are considered likely to occur within the Project Area.

4.4 Offset multiplier requirements

No native vegetation comprising a PCT will be impacted by the works. Six planted non-native trees and 19 native trees (including one hollow-bearing tree) are proposed to be impacted within the section of the main pipeline alignment immediately north of Elizabeth Drive (Figure 4). According to the Guide, this is considered a minor-moderate impact.

As outlined in Section 4.2.1, it is recommended that an arborist is engaged to assess the impacts under the *Australian Standard AS4970-2009 Protection of trees on development sites*, as impacts to some of these trees may be able to be avoided depending on the extent of TPZ encroachment.

It is worth noting that the site survey focused on identifying vegetation within the Study Area only, to assess impacts outside of 'Certified Land'. However, these trees were identified incidentally within the Impact Area. There are likely to be other trees, especially those along the roadside south of Elizabeth Drive, within the broader Impact Area that may be impacted by the proposed works but were not identified during the site

survey. Impacts to trees within ‘Certified Land’ are considered to be non-statutory impacts which can be offset based on SWC’s Biodiversity Offset Policy (Sydney Water, 2024).

According to the Guide, this is considered a minor – moderate impact.

Removal of ‘Habitat Area of threatened flora and/or fauna’ with a moderate impact requires a 3:1 offset strategy. Removal of locally native tree species requires a 3:1 offset strategy, and removal of non-locally native or exotic tree or street tree requires a 1:1 offset strategy (Table 10).

Table 10 Non-statutory biodiversity impacts and offsets.

Impact	Project Level of Impact	Offset requirements			
		Biodiversity Value Impacted	Total Impact	Residual loss of biodiversity values resulting from works	Offset Multiplier Required
Non-statutory Impacts					
Minor impact	Yes	6 exotic trees with no hollows	6 trees	Non-locally native and exotic trees within an exotic vegetation zone	1
Moderate Impact	Yes	Eighteen mature native trees with no hollows	18 trees	Locally native trees within an exotic vegetation zone	3
Minor impact	Yes	One mature native tree with two hollows	1 tree	Locally native tree within an exotic vegetation zone with hollows	4 (2 per hollow)

5 Conclusion and recommendations

No native vegetation comprising a PCT will be impacted by the works. Six planted non-native trees and 19 native trees (including one hollow-bearing tree) are proposed to be impacted within the section of the main pipeline alignment immediately north of Elizabeth Drive. It is recommended that tree removal is to be confirmed by an arborist, to assess the impacts under the *Australian Standard AS4970-2009 Protection of trees on development sites*.

Considering the high weed incursion and non-native vegetation zones within the Study Area, the Project works are unlikely to have a significantly adverse impact on ecological communities or species such that local occurrence is likely to be placed at risk of extinction, on any habitat of a threatened species or ecological community, or on any areas of outstanding biodiversity value.

In the case that there are potential impacts to threatened species and ecological communities listed under the BC Act and the EPBC Act within Certified Lands, these impacts are covered under existing biodiversity approvals within the CPCP and SWGA.

5.1 Safeguards and mitigation measures

Despite the above proposed moderate impact to biodiversity values, mitigation measures will be implemented to minimise residual risks to threatened biodiversity. These measures are outlined in Table 11 below.

Table 11 Safeguards and mitigation measures

Category/Impact	Mitigation requirements/Safeguard	Responsibility	Timing
CPCP mitigation requirements for activities on 'Certified – Urban Capable Land'			
Threatened fauna	• **Habitat features and connectivity:** 1. Retain large trees that are greater than or equal to 50 cm diameter at breast height (including dead trees but excluding noxious weeds) where possible and apply tree-protection measures for all vegetation to be retained. This is to provide ongoing roosting and foraging opportunities for fauna 2. Retain areas of high density proteaceae shrubs where possible, particularly along riparian corridors, to retain foraging resources, habitat and movement corridors for the Eastern Pygmy-possum. 3. Before any disturbance, all structures potentially providing habitat for microbats (bridges, culverts, mine shafts, storm water tunnels, old or derelict buildings) must be inspected by a qualified ecologist at an appropriate time of year. Where microbats are found, the structure providing habitat must not be affected, or a bat management plan must be prepared by a microbat specialist which allows for: - exclusion mechanisms to reduce the risk of direct physical harm to the microbats; and/or - supplementary habitat to compensate for lost habitat: and/or - regular inspections of structures and briefing of relevant construction staff. • **Pests** 4. Before construction works begin, a pest control strategy must be prepared. This strategy must be implemented during construction and operation of the development. This strategy must include pest control methods that reduce the risk of secondary poisoning (for example, from Pindone or second-generation rodenticides) • **Disease** 5. Incorporate best-practice site hygiene protocols to manage the potential spread of pathogens, such as Phytophthora and myrtle rust adjacent to potential habitat for species targeted by the CPCP.	SWC/Contractor	Prior and during works
Threatened flora	• **Weed invasion** 1. Implement mitigation measures to manage weeds during construction and operation of the development, taking into account relevant guidance in the CPCP's Weed Control Implementation Strategy.	SWC/Contractor	Prior and during works
Threatened Ecological Communities	• **Habitat features and connectivity** 1. When works are likely to have indirect impacts on Cooks River/Castlereagh Ironbark Forest, undertake mitigation in accordance with best-practice guidelines (for example, Cooks River/Castlereagh Ironbark Forest – NSW DECC, 2008) within and adjacent to the TEC. • **Disease** 2. Incorporate best-practice site hygiene protocols to manage the potential spread of pathogens, such as *Phytophthora* and myrtle rust adjacent to potential habitat for TECs.	SWC/Contractor	Prior and during works
Other protected matters	• **Habitat features and connectivity** 1. Development adjacent to the southern and western boundaries of Commonwealth land comprising the Orchid Hills Defence Establishment must mitigate impacts on surface water flows and the water quality of Blaxland Creek.	SWC/Contractor	Prior and during works

Category/Impact	Mitigation requirements/Safeguard	Responsibility	Timing
*Only relevant mitigation requirements from Table 1 of the CPCP Guidelines have been included. E.g. pre-clearance surveys for koalas have been excluded, as no koala habitat was identified within the Impact Area.			
Project-specific safeguards and mitigation measures			
Loss of native vegetation extent or trees	All direct impacts are to be offset as per SWC Biodiversity Offset Guide (Sydney Water, 2024). Revegetated areas and trees planted must be monitored so that their survival until establishment is achieved. This will secure long-term offset.	SWC/Contractor	Prior and during works
	If clearing of native vegetation is required outside the Impact Area, these areas will require additional assessment by an ecologist for potential impacts to TECs, threatened species and their habitats.	SWC/Contractor	Prior to and during works
Minimise risk of over clearing	Any native vegetation to be cleared within the Impact Area will be clearly identified and marked. Native vegetation to remain will be clearly delineated as No-Go-Zones to avoid risk of clearing. Clearing and No-Go-Zone maps to be prepared and approved by SWC prior to works commencing. Signing stating No-Go-Zone to be placed in fences. All staff will be made aware of No-Go-Zones during induction and be provided with a map of No-Go-Zones.	SWC / Contractor	Prior to and during works
	Tree removal is to be confirmed by an arborist due to potential to retain these trees if impact to the Tree Protection Zone is minimal. Tree Protection Zone details are provided within the *Australian Standard 4970-2009 Protection of trees on development sites.*	SWC/Contractor	Prior to and during works
Introduction, establishment and/or spread of weeds	Weed management plan is to be developed and implemented by the contractor and approved by SWC prior to works commencing. The plan will be established and implemented to avoid spread and establishment of weeds during construction. Measures will include: • All equipment and plant machinery to be appropriately cleaned before the start of works. • All priority weeds within the Impact Area are to be cleared and disposed of at a registered waste management facility. • If herbicide is to be used, this must be applied by a person trained to do so and that has a certificate of competency, or a statement of attainment issued by a registered training organisation. Herbicide will only be used in accordance with the label/permit. • Conduct toolbox talks to identify high risk priority weeds and weeds of national significance to on-site staff • Weed vegetation requiring clearing and removal should be disposed of at a registered waste management facility.	SWC/Contractor	Prior and during works
Unexpected finds: Threatened flora, or injury or risk to native fauna, including threatened species	An unexpected finds protocol to be prepared by SWC and implemented by the contractor if unexpected threatened flora, or native fauna are found or discovered during works. Works must stop immediately upon an unexpected find occurrence, and the environment/site manager informed. An ecologist should be engaged to determine management action(s).	SWC/Contractor	Prior to and during works
Indirect impacts to adjacent vegetation and waterways	A sedimentation and controls plan is to be prepared by the contractor and approved by SWC prior to works starting to avoid indirect impacts due to runoff of building materials and/or water into adjacent vegetation and waterways.	SWC/Contractor	Prior, during and post works

Category/Impact	Mitigation requirements/Safeguard	Responsibility	Timing
Introduction of pathogens into riparian areas and/or native vegetation	Introduction of pathogens in native vegetation can cause diseases. A hygiene protocol must be prepared by SWC prior to works starting and implemented by the contractor during works to avoid introduction of pathogens in machinery, tools, PPE or imported soils.	SWC/Contractor	Prior, and during works
SWC standard mitigation measures for flora and fauna			
4.1	Provided it is essential for delivering the project, Sydney Water's Project Manager can approve the following vegetation removal and tree trimming, without additional environmental assessment (but only after consultation with the Environmental and Community Representatives and affected landowners). Sydney Water considers vegetation removal in these circumstances has minimal environmental impact. • Any minor: - vegetation trimming or - removal of exotic vegetation or - removal of planted native vegetation where the vegetation is not a threatened species (including a characteristic species of a threatened community or population), heritage listed, in declared critical habitat or in a declared area of outstanding biodiversity value. • Any removal of remnant vegetation where there is no net change to environmental impact (e.g., a different area of vegetation is removed but the total area is the same or less than assessed in the EIA). Written explanation of the application of this clause (including justification of the need for trimming or removal and any proposed revegetation) should be provided when seeking Project Manager approval. Any impacts to native vegetation and trees must be offset in accordance with the Biodiversity Offset Guideline (SWEMS0019.13).	SWC	During works
4.2	Offset residual impacts to native vegetation and trees in accordance with the Biodiversity Offset Guideline (SWEMS0019.13). The EIA author will calculate the required offsets during preparation of the EIA. This will also include identifying offsetting option and location.	SWC/Contractor	Prior and during works
4.3	If vegetation is highly sensitive (e.g. comprises a TEC or provides habitat for threatened species), trimming or clearance cannot proceed without written authorisation from the Sydney Water Project Manager (in consultation with Environmental Representative). In sensitive areas where further assessment is required for any further trimming or removal of vegetation.	SWC/Contractor	Prior and during works
4.4	Map and report native vegetation clearing greater than 0.01 ha in extent (and any associated rehabilitation) to the Sydney Water Environmental Representative. Track vegetation clearing as per SWEMS0015.26 Contractor Native Vegetation Clearing and Rehabilitation template. Refer to Native Vegetation Clearing and Rehabilitation Report template (SWEMS0015.26). Supporting documentation/evidence must be provided in the report including photos, marked up maps and GIS layers. If an ecologist is doing a preclearance survey they can provide GIS layers of the areas to be cleared.	SWC/Contractor	Prior and during works

Category/Impact	Mitigation requirements/Safeguard	Responsibility	Timing
4.5	Minimise vegetation clearance and disturbance, including impacts to standing dead trees and riparian zones. Where possible, limit clearing to trimming rather than the removal of whole plants e.g., can be used to give the DC option to under bore, tie-back and trim rather than removal	SWC/Contractor	Prior and during works
4.6	Adjust methodology (e.g., avoid area, hand excavate, implement exclusion fencing) to protect sensitive areas where possible (such as mature trees, known threatened species, populations or ecological communities).	SWC/Contractor	Prior and during works
4.7	Protect trees in accordance with the requirements of *Australian Standard 4970-2009 for the Protection of Trees on Development Sites*. Do not damage tree roots unless absolutely necessary and engage a qualified arborist where roots >50mm are impacted within the Tree Protection Zone. Protect trees in accordance with the Program Delivery Guidance Standard 9.3 Biodiversity Management (EV-GS-003). Standard available in SWIM. The TPZ = trunk diameter (measured 1.4m above ground) x 12. PD Guidance standards on PMSP *drive Env\01 Program Management\02 Plans & Procedures\DM Guidance Standards*	SWC/Contractor	Prior and during works
4.8	Notify potentially affected residents of any tree removal. Need to negotiate with Project Manager at early planning stages of project. Liaise with Council and comms as needed to determine who is 'affected'.	SWC/Contractor	N/A
4.19	Retain dead tree trunks, bush rock or logs in-situ unless moving is unavoidable. Reposition material elsewhere on the site or approved adjacent sites. If native fauna is likely to be present, a licenced ecologist should conduct a pre-clearance inspection and undertake fauna relocation. See Fauna Encounters on Construction Sites Factsheet if you need further guidance. CEMP to include contact details of appropriately licenced handler.	SWC/Contractor	Prior and during works
4.10	Inspect vegetation for potential fauna prior to clearing or trimming. If fauna is present, or ecological assessment has determined high likelihood of native fauna presence (including hollow bearing trees), engage WIRES or a licenced ecologist to inspect and relocate fauna before works. See Fauna Encounters on Construction Sites Factsheet if you need further guidance.	SWC/Contractor	Prior and during works
4.11	If native fauna is encountered on site, stop work and allow the fauna to move away unharassed. Engage WIRES or a licenced ecologist if assistance is required to move fauna. See Fauna Encounters on Construction Sites Factsheet if you need further guidance.	SWC/Contractor	Prior and during works
4.12	Avoid impeding/blocking fish passage. Retain snags and natural obstructions in waterways where possible.	SWC/Contractor	N/A
4.13	If dewatering farm dams, engage a licensed ecologist to undertake fauna relocation (e.g., turtles, frogs, etc) into an appropriate nearby habitat.	SWC/Contractor	N/A
4.14	If any threatened species (flora or fauna) is discovered during the works, stop work immediately and notify the Sydney Water Project Manager. Work will only recommence once the impact on the species has been assessed and appropriate control measures implemented.	SWC/Contractor	During works

Category/Impact	Mitigation requirements/Safeguard	Responsibility	Timing
4.15	If any damage occurs to vegetation outside of the disturbance corridor (as shown in the CEMP), notify the Sydney Water Project Manager and Environmental Representative so that appropriate remediation strategies can be developed.	SWC/Contractor	During works
4.16	Manage biosecurity in accordance with: • *Biosecurity Act 2015* (see NSW WeedWise), including reporting new weed infestations or invasive pests • contemporary bush regeneration practices, including disposal of sealed bagged weeds to a licenced waste disposal facility. Record Pesticides and Herbicides use in accordance with **SWEMS0017**. If green waste is likely to contain herbicides or other chemical or physical contaminants (including man-made and other foreign materials), do not send for offsite recycling.	SWC/Contractor	During works
4.17	For works in council owned bushland and National Parks the Delivery Contractor will consult with Councils/NPWS to identify known plant pathogens or pests and management requirements. Prepare a Hygiene Management Plan if there is a risk of infestation and spread. Phytophthora and Myrtle Rust factsheets contain hygiene management measures.	SWC/Contractor	N/A
4.18	Bag all plant parts and excavated topsoil that may be infested with weed propagules and dispose at a licensed waste disposal facility. Weed species that need to be bagged should be identified specifically. This would be through ecologist specialist study, or consultation with Council/ NPWS.	SWC/Contractor	During works
4.19	If replanting near Sydney Water pipelines refer to '*Which trees can damage wastewater pipes?'* link from Sydney Water website to help identify suitable species.	SWC/Contractor	During works
4.20	In TOBAN period: • check specific TOBAN notice to confirm whether the work can be carried out under standard exemptions (Govt Gazette No18 Feb 2018) if the work is not covered by a standard exemption, apply to RFS for specific exemption. Note: Exemptions may be updated periodically. Search to check to confirm if Gazette 18 2018 is current. Standard exemptions only apply if specifically referred to in the gazetted TOBAN order.	SWC/Contractor	During works
4.21	Consult Taronga Zoo's Ben Zerbes (Mobile: 0417 201 180, Email: **bzerbes@zoo.nsw.gov.au**) prior to the removal of vegetation to determine the usefulness of vegetation waste as koala feed. Use when clearing/trimming koala feed trees.	SWC/Contractor	Prior to and during works

5.2 References

DAWE (2020) Conservation advice for the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria. Canberra, Department of Agriculture, Water and the Environment.

DCCEEW (2024) Protected Matters Search Tool On-line resource accessed via: https://pmst.awe.gov.au/#/map?lng=131.52832031250003&lat=-28.671310915880834&zoom=5&baseLayers=Imagery,ImageryLabels

DPI (2024) Key Fish Habitat Maps. NSW Department of Primary Industries. Key Fish Habitat Maps. On-line resource accessed via: https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps

DPI (2024b) WeedWise – Priority Weeds within the Greater Sydney Local Land Service Region. Available from: **https://weeds.dpi.nsw.gov.au/**

NSW Government (2022) Cumberland Plain Conservation Plan. NSW Department of Planning and Environment. On-line resource accessed via **The Cumberland Plain Conservation Plan - A conservation plan for Western Sydney to 2056 (shared-drupal-s3fs.s3.ap-southeast-2.amazonaws.com)**

NSW Government (2024) NSW BioNet Atlas database. Available from: **https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet**

NSW Government (2024) BioNet Vegetation Classification. Available from: **https://vegetation.bionet.nsw.gov.au/LoginPR.aspx?ReturnUrl=%2f**

NSW Scientific Committee (2011b) Final Determination River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions – Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act. Accessed on-line via: **https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2011-2012/river-flat-eucalypt-forest-on-coastal-floodplains-minor-amendment-determination**

OEH (2024) State Vegetation Type Map. Available from: https://datasets.seed.nsw.gov.au/dataset/nsw-state-vegetation-type-map

Sydney Water (2024). Biodiversity Offset Guide.

Appendix A – BioNet Search Results

The table below provides known records of threatened and migratory species as per BioNet Atlas and within 10km radius surrounding the Study Area. Records include threatened species listed under the BC Act, along with threatened species and migratory species listed under the EPBC Act.

Table A1 BioNet Atlas records

Family	Scientific name	Common name	NSW Status	Comm Status	Records
Anatidae	*Stictonetta naevosa*	Freckled Duck	V,P		1
Accipitridae	*Circus assimilis*	Spotted Harrier	V,P		1
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V,P		12
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V,P		4
Accipitridae	^^*Lophoictinia isura*	Square-tailed Kite	V,P,3		2
Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper	P	C,J,K	1
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	V,P	V,J,K	6
Cacatuidae	^^*Callocephalon fimbriatum*	Gang-gang Cockatoo	E1,P,3	E	1
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V,P		1
Acanthizidae	*Chthonicola sagittata*	Speckled Warbler	V,P		3
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V,P		1
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V,P		2
Artamidae	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V,P		7
Petroicidae	*Melanodryas cucullata cucullata*	South-eastern Hooded Robin	E1,P	E	1
Hirundinidae	*Hirundo rustica*	Barn Swallow	P	C,J,K	1
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V,P	V	1
Phascolarctidae	*Phascolarctos cinereus*	Koala	E1,P	E	1
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V,P	V	11

Family	Scientific name	Common name	NSW Status	Comm Status	Records
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V,P		1
Molossidae	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	V,P		9
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V,P		2
Vespertilionidae	*Myotis macropus*	Southern Myotis	V,P		18
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V,P		4
Miniopteridae	*Miniopterus australis*	Little Bent-winged Bat	V,P		1
Miniopteridae	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V,P		4
Camaenidae	*Meridolum corneovirens*	Cumberland Plain Land Snail	E1		60
Apocynaceae	*Marsdenia viridiflora subsp. viridiflora*	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		59
Fabaceae (Faboideae)	*Dillwynia tenuifolia*		V		7
Fabaceae (Faboideae)	*Pultenaea parviflora*		E1	V	76
Proteaceae	*Grevillea juniperina subsp. juniperina*	Juniper-leaved Grevillea	V		1
Proteaceae	*Macadamia integrifolia*	Macadamia Nut		V	1
Thymelaeaceae	*Pimelea spicata*	Spiked Rice-flower	E1	E	1

Legend

Act: BC Act = *Biodiversity Conservation Act 2016*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

Status: CE= Critically Endangered, E=Endangered, V=Vulnerable, P=Protected

Migratory agreements: J=Listed on Japan Australia Migratory Bird Agreement, K= Listed on Republic of Korea Australia Migratory Bird Agreement

Appendix B – PMST

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 12-Sep-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	12
Listed Threatened Species:	71
Listed Migratory Species:	16

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	219
Commonwealth Heritage Places:	1
Listed Marine Species:	24
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	7
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	86
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Legal Status	Buffer Status
Greater Blue Mountains Area	NSW	Declared property	In buffer area only

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Natural			
The Greater Blue Mountains Area	NSW	Listed place	In buffer area only

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community likely to occur within area	In feature area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area	In feature area
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community may occur within area	In buffer area only
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area	In feature area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area	In feature area
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	Critically Endangered	Community may occur within area	In feature area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area	In feature area
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area	In feature area
Temperate Highland Peat Swamps on Sandstone	Endangered	Community known to occur within area	In buffer area only

Community Name	Threatened Category	Presence Text	Buffer Status
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area	In buffer area only
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community likely to occur within area	In buffer area only
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat may occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In feature area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat known to occur within area	In feature area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat known to occur within area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Pycnoptilus floccosus Pilotbird [525]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Stagonopleura guttata](#) Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area
FISH			
[Macquaria australasica](#) Macquarie Perch [66632]	Endangered	Species or species habitat known to occur within area	In feature area
[Prototroctes maraena](#) Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area	In feature area
FROG			
[Heleioporus australiacus](#) Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Litoria aurea](#) Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Mixophyes balbus](#) Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat may occur within area	In buffer area only
INSECT			
[Austrocordulia leonardi](#) Sydney Hawk Dragonfly [84741]	Endangered	Species or species habitat may occur within area	In buffer area only
MAMMAL			
[Chalinolobus dwyeri](#) Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat known to occur within area	In feature area
[Dasyurus maculatus maculatus (SE mainland population)](#) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Notamacropus parma			
Parma Wallaby [89289]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Petauroides volans			
Greater Glider (southern and central) [254]	Endangered	Species or species habitat known to occur within area	In feature area
Petaurus australis australis			
Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In feature area
Petrogale penicillata			
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)			
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
Pseudomys novaehollandiae			
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pteropus poliocephalus			
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In feature area
PLANT			
Acacia bynoeana			
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Acacia pubescens			
Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat known to occur within area	In feature area
Allocasuarina glareicola			
[21932]	Endangered	Species or species habitat likely to occur within area	In feature area
Cryptostylis hunteriana			
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area	In feature area
Eucalyptus aggregata Black Gum [20890]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Eucalyptus benthamii Camden White Gum, Nepean River Gum [2821]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Genoplesium baueri Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat may occur within area	In feature area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area	In feature area
Hakea dohertyi Kowmung Hakea [66701]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area	In feature area
Leucopogon exolasius Woronora Beard-heath [14251]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat known to occur within area	In feature area
Micromyrtus blakelyi [6870]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Micromyrtus minutiflora [11485]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area	In feature area
Persoonia acerosa Needle Geebung [7232]	Endangered	Species or species habitat may occur within area	In buffer area only
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat known to occur within area	In buffer area only
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat known to occur within area	In feature area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat may occur within area	In feature area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area	In feature area
Pomaderris brunnea Rufous Pomaderris, Brown Pomaderris [16845]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area	In buffer area only
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat likely to occur within area	In feature area
Pultenaea glabra Smooth Bush-pea, Swamp Bush-pea [11887]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pultenaea parviflora [19380]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area	In feature area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area	In feature area
Thelymitra kangaloonica Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Veronica lithophila [87479]	Endangered	Species or species habitat likely to occur within area	In buffer area only
REPTILE			
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area	In feature area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Endangered	Species or species habitat known to occur within area	In buffer area only
SNAIL			
Pommerhelix duralensis Dural Land Snail [85268]	Endangered	Species or species habitat known to occur within area	In buffer area only

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat known to occur within area	In buffer area only
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In feature area
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Pandion haliaetus			
Osprey [952]		Species or species habitat known to occur within area	In feature area
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Commonwealth Trading Bank of Australia		
Commonwealth Land - Commonwealth Trading Bank of Australia [12113]	NSW	In buffer area only
Commonwealth Land - Commonwealth Trading Bank of Australia [16450]	NSW	In buffer area only
Communications, Information Technology and the Arts - Australian Postal Corporation		
Commonwealth Land - Australian Postal Commission [12815]	NSW	In buffer area only
Commonwealth Land - Australian Postal Corporation [12819]	NSW	In buffer area only
Communications, Information Technology and the Arts - Telstra Corporation Limited		
Commonwealth Land - Australian Telecommunications Commission [14555]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12776]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12120]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12486]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12487]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian Telecommunications Commission [12827]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12818]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12810]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [13342]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [13341]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [13340]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [14628]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [14629]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [16125]	NSW	In buffer area only
Commonwealth Land - Overseas Telecommunications Commission (Australia) [13339]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [16429]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [15966]	NSW	In buffer area only
Defence		
Commonwealth Land - Defence Service Homes Corporation [14561]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [14562]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [12816]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [12817]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [12824]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [12820]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [14546]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10149]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10170]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10171]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10173]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10175]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10174]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10162]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10163]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10167]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10164]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10165]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10168]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10169]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10166]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10161]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10172]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10160]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10150]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10151]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10152]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10155]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10153]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10154]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10156]	NSW	In feature area
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10157]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10158]	NSW	In buffer area only
Defence - 1CAD ORCHARD HILLS KINGSWOOD [10159]	NSW	In buffer area only
Defence - AIR HEADQUARTERS AUSTRALIA - GLENBROOK [10238]	NSW	In buffer area only
Defence - AIR HEADQUARTERS AUSTRALIA - GLENBROOK [10239]	NSW	In buffer area only
Defence - AIR HEADQUARTERS AUSTRALIA - GLENBROOK [10235]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Defence - AIR HEADQUARTERS AUSTRALIA - GLENBROOK [10240]	NSW	In buffer area only
Defence - AIRTC CAMDEN [10146]	NSW	In buffer area only
Defence - AIRTC ST MARYS [10007]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10188]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10189]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10179]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10180]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10182]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10181]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10184]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10183]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10186]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10185]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10187]	NSW	In buffer area only
Defence - BRINGELLY RADIO RECEIVING STATION [10190]	NSW	In buffer area only
Defence - PENRITH DEPOT (Army Stores) [10206]	NSW	In buffer area only
Defence - PENRITH DEPOT (Army Stores) [10208]	NSW	In buffer area only
Defence - PENRITH DEPOT (Army Stores) [10207]	NSW	In buffer area only
Defence - RANMME (DEOH) [10177]	NSW	In buffer area only
Defence - RANMME (DEOH) [10176]	NSW	In feature area
Defence - SIGNAL STRS DEPOT-KINGSWOOD [10210]	NSW	In buffer area only
Defence - SIGNAL STRS DEPOT-KINGSWOOD [10209]	NSW	In buffer area only
Defence - Defence Housing Authority		
Commonwealth Land - Defence Housing Authority [12777]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12774]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12775]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12835]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Defence Housing Authority [12773]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12770]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12778]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15424]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [16496]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [16497]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12790]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12791]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12792]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12793]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12795]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12772]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12797]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12796]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12799]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12798]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12766]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12805]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12804]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12806]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12801]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12800]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12764]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12768]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12769]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12814]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12784]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Defence Housing Authority [12763]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12758]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12759]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12785]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12762]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12782]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12783]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12780]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12781]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12788]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12789]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12787]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12786]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12779]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12823]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15675]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15087]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [16300]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12811]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12802]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12803]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12808]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12809]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15423]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15646]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15645]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15648]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Defence Housing Authority [15647]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15644]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15643]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [15649]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12812]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12813]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12794]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12765]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12761]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12760]	NSW	In buffer area only
Commonwealth Land - Defence Housing Authority [12767]	NSW	In buffer area only
Commonwealth Land - Deputy Director of War Service Homes [14566]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14552]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14564]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14553]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14565]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14550]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14551]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14557]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14554]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14543]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14559]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14558]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14541]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14545]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [12807]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Director of War Service Homes [14547]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14549]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14563]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14548]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14560]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [12825]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [12821]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [12826]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [12822]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14556]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14567]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14540]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14542]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [12847]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [14544]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [12848]	NSW	In buffer area only
Unknown		
Commonwealth Land - [15661]	NSW	In feature area
Commonwealth Land - [15662]	NSW	In feature area
Commonwealth Land - [15422]	NSW	In buffer area only
Commonwealth Land - [14625]	NSW	In buffer area only
Commonwealth Land - [13335]	NSW	In buffer area only
Commonwealth Land - [14627]	NSW	In buffer area only
Commonwealth Land - [14626]	NSW	In buffer area only
Commonwealth Land - [12771]	NSW	In buffer area only
Commonwealth Land - [12485]	NSW	In buffer area only
Commonwealth Land - [12482]	NSW	In feature area

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [12484]	NSW	In feature area
Commonwealth Land - [12483]	NSW	In feature area
Commonwealth Land - [12481]	NSW	In feature area
Commonwealth Land - [12480]	NSW	In feature area
Commonwealth Land - [15425]	NSW	In buffer area only
Commonwealth Land - [12478]	NSW	In feature area
Commonwealth Land - [12479]	NSW	In feature area
Commonwealth Land - [15909]	NSW	In feature area
Commonwealth Land - [13102]	NSW	In feature area
Commonwealth Land - [13103]	NSW	In buffer area only
Commonwealth Land - [16486]	NSW	In buffer area only
Commonwealth Land - [15653]	NSW	In feature area
Commonwealth Land - [16481]	NSW	In buffer area only
Commonwealth Land - [14104]	NSW	In buffer area only
Commonwealth Land - [16484]	NSW	In buffer area only
Commonwealth Land - [16485]	NSW	In buffer area only
Commonwealth Land - [14102]	NSW	In buffer area only
Commonwealth Land - [14101]	NSW	In buffer area only
Commonwealth Land - [14100]	NSW	In buffer area only
Commonwealth Land - [14105]	NSW	In buffer area only
Commonwealth Land - [16482]	NSW	In buffer area only
Commonwealth Land - [16483]	NSW	In buffer area only
Commonwealth Land - [13338]	NSW	In buffer area only
Commonwealth Land - [15419]	NSW	In feature area
Commonwealth Land - [15212]	NSW	In buffer area only
Commonwealth Land - [14103]	NSW	In buffer area only
Commonwealth Land - [13337]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [13336]	NSW	In buffer area only
Commonwealth Land - [13334]	NSW	In buffer area only

Commonwealth Heritage Places [Resource Information]

Name	State	Status	Buffer Status
Natural			
Orchard Hills Cumberland Plain Woodland	NSW	Listed place	In feature area

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat likely to occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans			
Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In feature area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Sterna striata White-fronted Tern [799]		Migration route may occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Bents Basin	State Conservation Area	NSW	In buffer area only
Blue Mountains	National Park	NSW	In buffer area only
Burragorang	State Conservation Area	NSW	In buffer area only
Gulguer	Nature Reserve	NSW	In buffer area only
Kemps Creek	Nature Reserve	NSW	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Mulgoa	Nature Reserve	NSW	In buffer area only
Wianamatta	Regional Park	NSW	In buffer area only

EPBC Act Referrals

[Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
1-51 Aldington Road Estate Industrial Warehouse and Distribution Facility	2023/09574		Assessment	In buffer area only
Eastern Creek Business Hub Stage 3	2020/8715		Post-Approval	In buffer area only
Multipurpose development	2002/751		Completed	In feature area
Warragamba Dam Raising Project	2017/7940		Completed	In feature area
Controlled action				
Chapman Street Residential Development	2019/8552	Controlled Action	Post-Approval	In buffer area only
Construction and Operation of Western Sydney Airport, Badgerys Creek, NSW	2014/7391	Controlled Action	Post-Approval	In feature area
construction of a regional scale stormwater detention basin, spillway and outlet	2011/5819	Controlled Action	Post-Approval	In buffer area only
Eastern Creek Business Hub, NSW	2012/6617	Controlled Action	Post-Approval	In buffer area only
Emerald Hills residential & commercial estate development, Camden Valley Way, Leppington, NSW	2013/6999	Controlled Action	Post-Approval	In buffer area only
Glenmore Park Stage 2 - 120 Lot Residential Development At Lot 1 DP222144	2004/1867	Controlled Action	Completed	In buffer area only
Harrington Grove 900-Lot Residential Development	2009/4862	Controlled Action	Post-Approval	In buffer area only
Industrial development on Lot 141 DP843899 and Lot 5 DP1094504, Erskine Park Emp	2006/3156	Controlled Action	Post-Approval	In buffer area only
Kemps Creek Warehouse, Logistics and Industrial Facilities Hub	2021/8926	Controlled Action	Post-Approval	In feature area
Light Horse Interchange Business Hub, Eastern Creek, NSW	2019/8395	Controlled Action	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Lyn Parade Extension	2004/1392	Controlled Action	Post-Approval	In buffer area only
M12 Motorway Project, Luddenham, NSW	2018/8286	Controlled Action	Post-Approval	In feature area
Multipurpose Development-rural residential, a motel and a golf course	2002/585	Controlled Action	Completed	In feature area
Oakdale West Estate commercial development, NSW	2017/7952	Controlled Action	Post-Approval	In buffer area only
Residential development	2015/7578	Controlled Action	Post-Approval	In buffer area only
Residential subdivision Lot 1 DP 588912 1-41 Marsh Road, Silverdale, NSW	2016/7684	Controlled Action	Post-Approval	In buffer area only
Subdivision of Lot 1 DP106143, 327-335 Burley Road, Horsley Park, NSW	2016/7744	Controlled Action	Post-Approval	In buffer area only
Sydney Metro, Western Sydney Airport - St Marys to Elizabeth Drive	2020/8687	Controlled Action	Post-Approval	In feature area
The Northern Road upgrade - Mersey Rd, Bringelly to Glenmore Parkway, Glenmore Park, NSW	2016/7696	Controlled Action	Post-Approval	In feature area
Twin Creeks Estate - stage 4 - 26 rural residentia	2004/1495	Controlled Action	Post-Approval	In feature area
Urban & recreational Development (El Caballo Blanco, Gledswood & Lakeside), Gledswood, NSW	2013/6979	Controlled Action	Post-Approval	In buffer area only
Western Sydney International Dragway	2002/720	Controlled Action	Completed	In buffer area only
Not controlled action				
132kV electricity transmission lines	2002/865	Not Controlled Action	Completed	In buffer area only
18-hole, golf course development, west of Eastern Creek	2004/1757	Not Controlled Action	Completed	In buffer area only
Aldington Road Estate Industrial Development	2021/8982	Not Controlled Action	Completed	In buffer area only
Christ Catholic College - Loyola Campus - Building Construction and Redevelopment	2002/642	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Clearance of 6.3ha of Cumberland Plain Woodland for industrial subdivision cnr of Old Walgrove and W	2004/1445	Not Controlled Action	Completed	In feature area
Clearance of 6ha Shale Plains Woodland	2004/1346	Not Controlled Action	Completed	In buffer area only
Clearance of vegetation for Warehouse Units	2003/994	Not Controlled Action	Completed	In buffer area only
Concrete Batching Plant and Associated Facilities	2005/2067	Not Controlled Action	Completed	In buffer area only
Conrad Road Residential Subdivision	2001/320	Not Controlled Action	Completed	In buffer area only
Construction & operation of lead-in infrastructure for drinking water & wastewat	2009/4909	Not Controlled Action	Completed	In buffer area only
construction of a crematorium and associated facilities	2011/5822	Not Controlled Action	Completed	In buffer area only
Construction of Dwelling - Lot 12 DP 18351	2002/767	Not Controlled Action	Completed	In buffer area only
Development of a residential subdivision	2010/5731	Not Controlled Action	Completed	In buffer area only
Development within Caddens Release Area	2010/5429	Not Controlled Action	Completed	In buffer area only
Electricty Substation at Old Wallgrove Road	2005/2220	Not Controlled Action	Completed	In feature area
Erection of a dwelling and associated access and infrastructure, 19 Tidswell Str	2003/1078	Not Controlled Action	Completed	In feature area
gas main installation from Eastern Creek to Erskine Park	2005/2235	Not Controlled Action	Completed	In feature area
Green Valley NSW residential developmemt	2003/1236	Not Controlled Action	Completed	In buffer area only
Greenway Park Stage 3 residential subdivision	2004/1622	Not Controlled Action	Completed	In buffer area only
hazard reduction burn	2003/1181	Not Controlled Action	Completed	In buffer area only
Hoxton Park Residential development	2011/6103	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Industrial development of 24.8ha, including access road from Lenore Lane	2005/2326	Not Controlled Action	Completed	In buffer area only
Mountain View Classrooms Construction	2001/306	Not Controlled Action	Completed	In buffer area only
Multi User Depot	2002/562	Not Controlled Action	Completed	In buffer area only
Orchard Hills Water Filtration Plant	2001/373	Not Controlled Action	Completed	In buffer area only
Proposed Rezoning of land at 60 Wallgrove Rd, Minchinbury, NSW	2009/5012	Not Controlled Action	Completed	In buffer area only
Realignment of Link Road and residential development adjacent to Camden Bypass	2005/2181	Not Controlled Action	Completed	In buffer area only
Residential Development, Stages 1-3	2002/710	Not Controlled Action	Completed	In buffer area only
Residential development at Doonside Crescent Woodcroft, Blacktown LGA	2004/1378	Not Controlled Action	Completed	In buffer area only
Residential development within 2.08ha, Fyfe Road	2005/1966	Not Controlled Action	Completed	In buffer area only
Residential Subdivision	2001/304	Not Controlled Action	Completed	In buffer area only
Residential subdivision Lot 1005 Conrad Road	2003/1054	Not Controlled Action	Completed	In buffer area only
Rezoning & Disposal of Quakers Hill property	2001/281	Not Controlled Action	Completed	In buffer area only
Riverstone Integrated Water Services Proposal	2007/3216	Not Controlled Action	Completed	In buffer area only
Rooty Hill Residential Subdivision	2002/651	Not Controlled Action	Completed	In buffer area only
Rural residential subdivision	2002/594	Not Controlled Action	Completed	In buffer area only
Second Ponds Creek Urban Development of Precinct 1b	2005/1991	Not Controlled Action	Completed	In buffer area only
Sewerage Scheme for the three villages of Mulgoa, Wallacia and Silverdale	2003/1314	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Shale quarry and materials recovery facility	2008/4661	Not Controlled Action	Completed	In buffer area only
Subdivision of precincts C, D and E of Bradley Ridge	2010/5745	Not Controlled Action	Completed	In buffer area only
TransGrid Sydney West 330kV Substation Augmentation	2002/677	Not Controlled Action	Completed	In buffer area only
Upgrade of Exisitng DECCW Radio Communications Facility	2010/5374	Not Controlled Action	Completed	In buffer area only
Waste Management Centre	2002/607	Not Controlled Action	Completed	In buffer area only
Western Sydney Parklands Bungarribbee Precinct and Doonside residential developm	2007/3718	Not Controlled Action	Completed	In buffer area only
Wonderland Business Park Precinct, industrial development, Lot B1	2004/1627	Not Controlled Action	Completed	In buffer area only
Wonderland Business Park Precinct, Stage 1, Lot D1	2004/1626	Not Controlled Action	Completed	In feature area
Wonderland Business Park - Stage 3	2006/2817	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Cross Country and Downhill Tracks	2011/6171	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Replacement of flows with recycled water	2006/3050	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Residential development of 210 lots at Wivenhoe	2008/4352	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Senior Campus, Chifley Multi Campus College	2000/118	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
St Mary's Rugby League Club upgrade	2011/6042	Not Controlled Action (Particular	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Subdivision of rural residential and associated works	2003/1082	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
Keyhole Site Horsley Park	2021/9000	Referral Decision	Referral Publication	In buffer area only
Northern Expansion of the Camden Gas Project	2012/6638	Referral Decision	Completed	In buffer area only
St Marys Rugby League Club new training field	2011/5836	Referral Decision	Completed	In buffer area only
Sydney Science Park, Luddenham, NSW	2017/7971	Referral Decision	Completed	In feature area

Bioregional Assessments			[Resource Information]
SubRegion	BioRegion	Website	Buffer Status
Sydney	Sydney Basin	BA website	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Appendix C – List of Flora species recorded in the Impact Area

Table C1 List of flora species

Origin	Conservation Status		Family	Scientific name	Common name
	EPBC Act	BC Act			
N			Myrtaceae	*Angophora floribunda*	Rough-barked Apple
N	-	-	Pittosporaceae	*Bursaria spinosa*	Blackthorn
E	-	-	Lauraceace	*Cinnamomum camphora*	Camphor Laurel
N	-	-	Casuarinaceae	*Casuarina glauca*	Swamp Oak
N	-	-	Casuarinaceae	*Casuarina sp.*	She-oak
N	-	-	Cyperaceae	*Carex suppressa*	Tall Sedge
E	-	-	Poaceae	*Pennisetum clandestinum*	Kikuyu
E	-	-	Solanaceae	*Cestrum parqui*	Green Cestrum
E	-	-	Poaceae	*Chloris gayana*	Rhodes Grass
E			Poaceae	*Ehrhata erecta*	Panic veldtgrass
N	-	-	Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum
N	-	-	Myrtaceae	*Eucalyptus moluccana*	Grey Box
N	-	-	Myrtaceae	*Eucalyptus sp.*	-
N	-	-	Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
E			Rubiaceae	*Galium aparine*	Cleavers
E	-	-	Verbenaceae	*Lantana camara*	Lantana
E			Oleaceae	*Ligustrum sinense*	Chinese Privet
N	-	-	Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Paperbark
N	-	-	Poaceae	*Microlaena stipoides*	Weeping Grass
E	-	-	Asteraceae	*Onopordum acanthium*	Scotch Thistle
E			Plantaginaceae	*Plantago lanceolata*	Lamb's tongue
E	-	-	Rosaceae	*Rubus fruticosus*	Blackberry
E				*Rumex crispus*	Curly Doc
E	-	-	Asteraceae	*Senecio madagascariensis*	Fireweed
E	-	-	Poaceae	*Setaria parviflora*	-

E	-	-	Malvaceae	*Sida rhombifolia*	Paddy's Lucerne
E	-	-	Solanaceae	*Solanum pseudocapsicum*	Jerusalem Cherry
E	-	-	Solanaceae	*Solanum sp.*	-
E	-	-	Solanaceae	*Solanum sisymbriifolium*	Sticky Nightshade
E	-	-	Asteraceae	*Taraxacum officinale*	Dandelion
E	-	-	Commelinaceae	*Tradescantia fluminensis*	Trad
E	-	-	Fabaceae (Faboideae)	*Trifolium repens*	White Clover
E	-	-	Verbenaceae	*Verbena bonariensis*	Purpletop

Legend

N= Native, E=Exotic

Act: BC Act = *Biodiversity Conservation Act 2016*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

Status: CE= Critically Endangered, E=Endangered, V=Vulnerable, P=Protected

Appendix D – Likelihood of occurrence analysis for threatened flora

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Acacia byoneana	Bynoe's Wattle, Tiny Wattle	E	V	PMST	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches.	**Low**	Low likelihood of occurrence due to a lack of associated vegetation communities, with the study area being primarily fragmented eucalypt canopy and a non-native ground cover.
Acacia pubescens	Downy Wattle	V	V	PMST	It occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland.	**Low**	This species has a low likelihood of occurrence as the study area was primarily disturbed with non-native vegetation and only supported patches of woodlands or forests. The species was also not observed during field surveys.
Allocasuarina glareicola	-	E	E	PMST	Mostly restricted to the north-western portion of the Cumberland Plain. Found in open woodlands with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla and Melaleuca decora.*	**Negligible**	This species has a negligible likelihood of occurrence due to a lack of habitat and geographic suitability. The species was also not observed during field surveys.
Cryptostylis hunteriana	Leafless tongue Orchid	V	V	PMST	Occurs in a range of vegetation communities including swamp-heath and woodland. Mostly occur in woodland with *Eucalyptus sclerophylla, E. sieberi, Corymbia gummifera and Allocasuarina littoralis.*	**Low**	This species has a low likelihood of occurrence as the study area was primarily disturbed with non-native vegetation and only supported patches of woodlands or forests. The species was also not observed during field surveys.
Cynanchum elegans	White-flowered Wax Plant	E	E	PMST	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest*; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub*; *Forest Red Gum Eucalyptus tereticornis* aligned open forest and woodland;	**Low**	This species has a low likelihood of occurrence due to a lack of habitat and geographic suitability. The ground cover is highly disturbed from grazing, clearing and weed incursion, making it unsuitable for this species. The species was also not observed during field surveys.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Dillwynia tenuifolia	Dillwynia tenuifolia, Kemps Creek	E Population, V	-	7	This species has large populations in western Sydney, especially in the nature reserves on the Cumberland Plain. It extends up from Windsor, towards Wisemans Ferry, and as far south as Liverpool. It is typically found in dry sclerophyll woodland and forest, on clay to alluvial soils, especially the Cooks River Castlereagh Ironbark Forests and Shale-Gravel Transition Forests	**Low**	This species has a low likelihood of occurrence as whilst there are several historical records nearby in Luddenham rd and Kemps Creek, there are no records within the Project area. Likewise, majority of the project area is disturbed and within a non-native vegetation zone, so it is unlikely to provide suitable habitat for this species.
Eucalyptus aggregata	Black Gum	V	V	PMST	Grows in the lowest parts of the landscape, on alluvial soils and cold, poorly-drained flats adjacent to creeks and small rivers. Usually occurs in an open woodland.	**Low**	Low likelihood of occurrence due to the highly degraded nature of the vegetation along the Badgerys Creek riparian zone.
Eucalyptus benthamii	Camden White Gum	V	V	PMST	The Camden white gum occurs west of Sydney in the Cumberland Plains and Blue Mountains. The Camden white gum occurs on alluvial flats of the Nepean River and its tributaries at altitudes of 30 to 750 m above sea level	**Negligible**	This species has a negligible likelihood of occurrence as the study area is outside the geographic area for this species.
Genoplesium baueri	Bauer's Midge Orchid	E	E	PMST	Grows in dry sclerophyll forest and moss gardens over sandstone.	**Low**	Low likelihood of occurrence due to the very limited availability of quality forest habitat. The ground cover is also highly disturbed from grazing, clearing and weed incursion, making it unsuitable for this species.
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	V	1	This species grows primarily on the NSW Central Coast and is common on creeks and moist areas. It adapts easily to cultivation and grows on a wide range of soils.	**Negligible**	Negligible likelihood of occurrence as the study area is outside the geographic range for this species.
Grevillea parviflora subsp parviflora	Small-flower Grevillea	V	V	PMST	Occurs in a range of vegetation types from heath and shrubby woodland to open forest. In Sydney it has been recorded from Shale Sandstone Transition Forest and in the Hunter in Kurri Sand Swamp Woodland.	**Low**	Low likelihood of occurrence due to the lack of supporting heath and shrub woodland communities present. The ground cover is also highly disturbed from grazing, clearing and weed incursion, making it unsuitable for this species.
Hakea dohertyi	Kowmung Hakea	E	E	PMST	It is confined to a small area in the Kowmung Valley in Kanangra Boyd National Park of NSW. It grows in dry sclerophyll forest on ridges	**Negligible**	Negligible likelihood of occurrence as the study area is outside the geographic range for this species.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Haloragsis exalata subsp exalata	Wingless raspwort	V	V	PMST	Square Raspwort appears to require protected and shaded damp situations in riparian habitats.	**Low**	Low likelihood of occurrence due to the lack of supporting habitat.
Leucopogan exolasius	Woronora Beard-Heath	V	V	PMST	Woronora Beard-heath is found along the upper Georges River area and in Heathcote National Park. The plant occurs in woodland on sandstone. Flowering occurs in August and September	**Negligible**	Negligible likelihood of occurrence as the study area is outside the geographic range for this species.
Macadamia integrifolia	Macadamia Nut	V	V	1	It is not known to occur naturally in the wild in N.S.W. However, it was recorded from Camden but it is not known if the tree was cultivated or growing naturally. This species is frequently cultivated for its fruit. Flowering occurs in August and September.	**Low**	This species has a low likelihood of occurrence due to a low number of historical records and a lack of habitat suitability. The species was also not observed during field surveys.
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		59	Grows in vine thickets and open shale woodland. The flowering period occurs in November to December.	**Low**	This species has a low likelihood of occurrence, as there are no records within the project area, with the closest records being at least 5km away.
Pimelea spicata	Spiked-Rice flower	E	V	1	On the Cumberland Plain sites it is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark.	**Low**	Whilst Eucalypt species were present, these species were often fragmented, and supported by a highly disturbed understorey due to grazing, clearing and weed incursion. This species was not observed on site.
Melaleuca deanei	Deane's Melaleuca	V	V	PMST	The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. Flowers appear in summer, but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate.	**Low**	This species has a low likelihood of occurrence as the study area was primarily disturbed with non-native vegetation and rarely supported vegetation characteristic of heath and ridgetop woodland.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Micromyrtus minutiflora		E	V	PMST	Restricted to the general area between Richmond and Penrith, western Sydney.	**Negligible**	Negligible likelihood of occurrence as the study area is outside the geographic range for this species.
Persicaria elatior	Knotweed	V	V	PMST	Within 50m of swamps, wetlands or ephemeral wet areas	**Low**	This species has a low likelihood of occurrence due to the absence of wetland and swamp habitat within the alignment.
Persoonia hirsuta	Hairy Geebung	E	E	PMST	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone	**Low**	This species has a low likelihood of occurrence, as whilst there are patches of remnant dry, open forest and woodland, the ground cover is predominantly non-native and disturbed from grazing, clearing and weed incursion, making it unsuitable habitat for this species.
Persoonia nutans	Nodding Geebung	E,P	E	PMST	Nodding geebung grows in woodland and forest on the Cumberland Plain between Sydney and the Blue Mountains and between Richmond in the north and Macquarie Fields in the south.	**Low**	This species has a low likelihood of occurrence, as whilst there are patches of remnant dry, open forest and woodland, the ground cover is predominantly non-native and disturbed from grazing, clearing and weed incursion, making it unsuitable habitat for this species.
Pimelea curviflora var curviflora		V	V	PMST	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands	**Low**	This species has a low likelihood of occurrence due to the absence of Shale Sandstone woodland vegetation and habitat.
Pomaderris cotoneaster	Spiked-Rice flower	E	V	PMST	On the Cumberland Plain sites it is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark.	**Low**	This species has a low likelihood of occurrence due to the lack of records within or adjacent to the project area.
Pterostylis gibbosa	Cotoneaster Pomaderris	E	E	PMST	Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.	**Low**	The species has a low likelihood of occurrence due to the absence of dense forest habitat, rocky slopes and sandstone cliff habitat.
Pterostylis saxicola	Illawarra Greenhood	E	E	PMST	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. It is apparently extinct in western Sydney which is the area where it was first collected.	**Negligible**	Negligible likelihood of occurrence as the footprint is outside the geographic range for this species.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Pultenaea parviflora	Sydney Plains Greenhood	E	E	76	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	**Low**	This species has a low likelihood of occurrence due to the lack of supporting habitat and the highly disturbed understorey from grazing, clearing and weed incursion.
Rhizanthella slateri		E	V	PMST	Found only within the Cumberland Plain. Abundant within Shale Gravel Transition Forests on tertiary alluvium or laterised clays.	**Negligible**	This species has a negligible likelihood of occurrence as the study area is outside the geographic range for this species.
Rhodamnia rubescens	Eastern Underground Orchid	V	E	PMST	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest.	**Low**	This species has a low likelihood of occurrence due to the lack of wet sclerophyll and rainforest habitat, with the study area being predominantly dry, open woodland and forest, with it being 100km away from the coast.
Syzygium paniculatum	Scrub Turpentine	CE	CE	PMST	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forests, usually on volcanic and sedimentary soils.	**Low**	This species has a low likelihood of occurrence due to the lack of wet sclerophyll and rainforest habitat, with the study area being predominantly dry, open woodland and forest, with it being 100km away from the coast.
Thesium australe	Kangaloon Sun Orchid	CE	CE	PMST	Found in swamps in sedgelands over grey silty grey loam soils. Not known to occur on the Cumberland Plain.	**Low**	Low likelihood of occurrence due to a lack of intact native groundcover this is because the study area is primarily disturbed from grazing, clearing and weed incursion.

Legend

Act: BC Act = *Biodiversity Conservation Act 2016*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

Status: CE= Critically Endangered, E=Endangered, V=Vulnerable, P=Protected

Migratory agreements: J=Listed on Japan Australia Migratory Bird Agreement, K= Listed on Republic of Korea Australia Migratory Bird Agreement

Appendix E – Likelihood of occurrence analysis for threatened fauna

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Amphibian							
Heleioporus australiacus	Giant burrowing frog	V	V	PMST	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding frogs will call from open spaces, under vegetation or rocks from within burrows in the creek bank. Typically inhabit swamps, second order streams and even small pools of collected water.	**Low**	This species has a low likelihood of occurrence, as whilst there is a riparian corridor along Badgerys Creek, there was a lack of suitable habitat observed during field survey, due to the absence of aquatic vegetation such as aquatic sedges and rushes that are typically utilised by frogs. Overall, the species is more likely to use surrounding vegetation and adjacent creeks with more suitable habitat. The species was not observed or heard during field survey.
Littoria aurea	Green and Golden Bell Frog	E	V	PMST	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki)*, have a grassy area nearby and diurnal sheltering sites available.	**Low**	This species has a low likelihood of occurrence, as whilst there is a riparian corridor along Badgerys Creek, there was a lack of suitable habitat observed during field survey, due to the absence of aquatic vegetation such as aquatic sedges and rushes that are typically utilised by frogs. Overall, the species is more likely to use surrounding vegetation and adjacent creeks with more suitable habitat. The species was not observed or heard during field survey.
Aves							
Anthochaera phrygia	Regent Honeyeater	CE	CE	PMST	The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany.	**Low**	This species has a low likelihood of occurrence. Whilst the species may utilise surrounding areas for foraging, very few historical records exist and there are several habitat constraints as the study area is largely disturbed and urbanised.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Aphelocephala leucopsis	Southern Whiteface	-	V	PMST	Dry open forests and woodland and inland scrubs of mallee, mulga and saltbush are the preferred habitat of Southern Whiteface, especially areas with fallen timber or dead trees and stumps.	**Low**	Given the high mobility of the species, it may have an occasional presence flying over the study area, however due to the low number of records its consistent presence is unlikely. Likewise, there is no suitable habitat of scrubs of mallee, mulga and saltbush within the study area and only limited woodland habitat.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V,P	-	7	The Dusky Woodswallow primarily inhabits dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understory of eucalypt saplings, acacias and other shrubs, and groundcover of grasses or sedges and fallen woody debris.	**Low**	This species has a low likelihood of occurrence due to the lack of supporting habitat, as the study area is primarily in a disturbed area with only sporadic native vegetation available alongside a lack of mallee and mulga scrub. Likewise, all of the historical records are outside the study area. The nearest records include two records in Rossmore, one in September 2017 and other in February 2006. Another record in Kelvin Park Drive, Bringelly from June 2006. These records are approximately 10km away from the study area.
Botaurus pociloptilus	Australasian Bittern	E	E	PMST	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spike rushes (*Eleocharis spp*.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.	**Low**	This species has a low likelihood of occurrence, due to the lack of supporting aquatic vegetation such as sedges, rushes and *Typha.*
Calidris acuminata	Sharp-tailed Sandpiper	-	V	PMST	Sharp-tailed sandpipers occur within all states of Australia. They are found mostly in the south-east and are widespread in both inland and coastal locations. The species also occurs in both freshwater and saline habitats.	**Low**	This species has a low likelihood of occurrence as the study area is inland and consists of primarily scattered dry eucalypt and non-native vegetation. There is also very limited freshwater habitat with only one dam and creek within the alignment. No coastal vegetation or habitat is present.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Calidris ferruginea	Curlew Sandpiper	E	CE	PMST	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed	**Low**	This species has a low likelihood of occurrence as the study area is inland and consists of primarily scattered dry eucalypt and non-native vegetation. There is also very limited freshwater habitat with only one creek within the alignment. No coastal vegetation or habitat is present.
Callocephalon fimbriatum	Gang-gang Cockatoo	E	E	PMST	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.	**Low**	This species has a low likelihood of occurrence as whilst there are elevated areas within the study area the vegetation identified is not characteristic of tall mountain forests and woodlands.
Calyptorhynchus lathami	Southern-eastern Glossy Black-Cockatoo	V	V	PMST	This species inhabits forest and woodlands of coastal areas.	**Negligible**	This species has a negligible likelihood of occurrence as the study area is inland, with it being approximately 100km away from the coast and therefore is unsuitable habitat
Chthonicola sagittata	Speckled Warbler	V,P	-	3	The Speckled Warbler is found throughout eastern NSW. Its habitat includes a range of Eucalyptus dominated communities with a grassy understory, a shrub layer and an open canopy.	**Low**	This species has a low likelihood of occurrence. Whilst a few historical records are apparent, habitat constraints exist as the study area is largely disturbed with a non-native understory and with few in-tact Eucalypt habitat. The nearest known records of the species were made in 2013 in Greendale which is 15 km away from the study area.
Circus assimilis	Spotted Harrier	V,P	-	1	The spotted harrier occurs throughout most of the Australian mainland except in forested woodland	**Negligible**	This species has a negligible likelihood of occurrence. This is due to habitat constraints such as urbanisation, fragmentation and limited connectivity corridors, which makes the study area disturbed and unsuitable for nesting and breeding.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Climacteris picumnus victoriae	Brown treecreeper	V	V	PMST	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis).	**Low**	Although there were a few Eucalyptus trees located within the study area, especially along the Badgerys Creek riparian corridor, it is unlikely that the species would be utilising the highly fragmented surround vegetation. Similarly, as the study area is highly disturbed and urbanised this makes it unsuitable habitat.
Daphoenositta chrysoptera	Varied Sittella	V,P	-	2	The Varied Sittella is sedentary and has a continuous distribution in NSW from the coast to the far west. It inhabits eucalypt forest and woodlands specifically rough barked species and Acacia woodlands.	**Low**	This species has a low likelihood of occurrence due to the low number of records with the most recent record being over 10 years ago. Likewise, the nearest record is distant from the study area. The closest record was recorded at Elizabeth Drive, Kemps Creek in August 2002, which is approximately 13km from the study area.
Erythrotriorchis radius	Red Goshawk	E	E	PMST	They often occur at the boundary between two vegetation types, and often favour forests or woodlands dominated by eucalypts or paperbarks. Also favours wetlands.	**Negligible**	This species has a negligible likelihood of occurrence due to the absence of a suitable wetland habitat, and the absence of an intact and well-connected forest or woodland habitat.
Falco hypoleucos	Grey Falcon	V	V	PMST	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	**Negligible**	This species has a negligible likelihood of occurrence as the study area is inland, with it being approximately 100km away from the coast and therefore is unsuitable habitat
Gallinago hardwickii	Lathams Snipe	V	V	PMST	Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	**Negligible**	This species has a negligible likelihood of occurrence as the study area is inland, with it being approximately 100km away from the coast and therefore is unsuitable habitat

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Glossopsitta pusilla	Little Lorikeet	V, P	-	1	NSW provides a large portion of the Little Lorikeet's habitat. They forage primarily in the canopy of open Eucalyptus Forest and woodland. Riparian habitats are particularly used. They roost in treetops often far from feeding areas.	**Low**	This species has a low likelihood of occurrence as since it has a broad habitat range it is unlikely to regularly use the vegetation within the study area. The lack of records further supports this. Similarly, there is an abundance of better-quality habitat in nearby areas such as at Burragorang State Conservation Area.
Grantiella picta	Painted Honeyeater	V	V	PMST	Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias.	**Negligible**	This species has a negligible likelihood of occurrence due to the lack of characteristic vegetation habitat within the study area.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V,P	-	12	The White-bellied Sea Eagle is widespread along the east coast of NSW. Habitats characterised by large areas of open water. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts. It occurs at sites near the sea and terrestrially at coastal dunes, tidal flats, grassland, heathland, woodland and forest.	**Negligible**	This species has a negligible likelihood of occurrence due to the lack of characteristic vegetation habitat within the study area.
Hieraaetus morphnoides	Little Eagle	V,P	-	4	The Little Eagle is found throughout the Australian mainland. The main habitat is open eucalypt forest, woodland or open woodland.	**Low**	This species has a low likelihood of occurrence. Whilst a few historical records are apparent, habitat constraints exist as the study area is largely disturbed and urbanised. The species is more likely to utilise the surrounding areas for foraging. No known records of the species occurred within the study area.
Hirundapus caudacutus	White-throated Needletail	-	V	PMST	Most often seen in eastern Australia before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. These conditions are often used by insects to swarm (eg termites and ants) or tend to lift insects away from the surface which favours sighting of White-throated Needletails as they feed. More common in coastal areas, less so inland.	**Negligible**	This species has a negligible likelihood of occurrence as the study area is inland, with it being approximately 100km away from the coast and therefore is unsuitable habitat

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Lathamus discolor	Swift Parrot	E,P	CE	PMST	The Swift Parrot migrates to south-east mainland Australian between February and October. It occurs in areas where eucalypts flower profusely or were there are abundant lerp infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*.	**Low**	This species has a low likelihood of occurrence. This is due to the limited abundance of flowering gums within the study area. Likewise, there is a low number of records and only marginal areas of suitable roosting and foraging habitat.
Lophoictinia isura	Square-tailed Kite	V,P	-	2	The Square-Tailed Kite is found in various timbered habitats including dry woodlands and open forests. Prefers timbered watercourses. Appears to occupy large hunting ranges of more than 100 km^2. Nest sites are generally located along or near watercourses, in a fork or on large horizontal limbs.	**Low**	This species has a low likelihood of occurrence as its preferred habitat is coastal and sub-coastal areas and more inland this includes major river systems. The species is unlikely to inhabit small creeks but may occasionally fly past as the study area is within the geographic range for this species.
Melanodryas cucullata cucullata	South-eastern Hooded Robin		E	PMST	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas.	**Negligible**	This species has a negligible likelihood of occurrence due to the lack of characteristic vegetation habitat within the study area.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V,P	-	1	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts.	**Low**	This species has a low likelihood of occurrence. Whilst the species may utilise surrounding areas for foraging, very few historical records exist and there are several habitat constraints as the site is largely disturbed and urbanised. The only known record was recorded in August 2013 at Greendale which is more than 15km from the study area.
Neophema chrysostoma	Blue-winged Parrot	-	V	PMST	The Blue-winged Parrot inhabits a range of habitats from coastal, sub-coastal and inland areas, right through to semi-arid zones. Throughout their range, they favour grasslands and grassy woodlands.	**Negligible**	This species has a negligible likelihood of occurrence due to the lack of in-tact grassy woodland habitat, with the study area being predominantly cleared areas, mown lawns or areas with a non-native ground cover.
Numenius madagascariensis	Eastern Curlew	-	CE	PMST	The Far Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.	**Negligible**	This species has a negligible likelihood of occurrence as the study area is inland, with it being approximately 100km away from the coast and therefore is unsuitable habitat

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Pycnoptilus floccosus	Pilotbird	-	V	PMST	Pilotbirds are found in the ground level of wet forests on coastal mountain ranges and in moist gullies timbered with mature gumtrees and with a dense understorey of bracken, low shrubs or tree ferns.	**Negligible**	This species has a negligible likelihood of occurrence as the study area is inland, with it being approximately 100km away from the coast and therefore is unsuitable habitat.
Rostratula australis	Australian Painted Snipe	E	E	PMST	The Australian Painted Snipe inhabits many different types of shallow, brackish or freshwater terrestrial wetlands.	**Negligible**	This species has a negligible likelihood of occurrence due to the lack of suitable wetland habitat within the study area.
Stagnopleura guttata	Diamond Firetail	V	V	PMST	Found in grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland	**Negligible**	This species has a negligible likelihood of occurrence due to the lack of characteristic vegetation habitat within the study area.
Stictonetta naevosa	Freckled Duck	V, P	-	1	The Freckled Duck is found primarily in the southeast and southwest of Australia. The species habits both ephemeral breeding swamps and waterholes to more permanent ponds and dams. The species has a preference for freshwater swamps or creeks that have dense Cumbungi, Lignum or Tea-tree growth.	**Low**	This species has a low likelihood of occurrence due to the low number of records. Likewise there is marginal habitat suitability, due to the lack of supporting vegetation species that are associated with the species such as Lignum and Tea-tree.
Tringa nebularia	Common Greenshank	-	E	PMST	Common Greenshanks are found both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.	**Negligible**	This species has a negligible likelihood of occurrence as the project alignment is inland, with it being approximately 100km away from the coast and therefore is unsuitable habitat
Mammals							
Chalinolobus dwyeri	Large-eared Pied Bat	V	E	PMST	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel),* frequenting low to mid-elevation dry open forest and woodland close to these features.	**Low**	This species has a low likelihood of occurrence due to the absence of cave habitat within the study area, and a lack of associated vegetation communities that support this species.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Dasyurus maculatus maculatus	Spot-tailed Quoll	V	E	PMST	Recorded across a range of habitat types, including rainforest, open forest,woodland, coastal heath and inland riparian forest, from the sub-alpine zone to thecoastline. Quolls use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites.	**Low**	Although there were a few Eucalyptus trees with small-sized hollows located in several areas, it is unlikely that the species would be utilising the highly fragmented surround vegetation. Similarly, as the study area is highly disturbed and urbanised this makes the it unsuitable habitat.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V,P	-	9	The Eastern Coastal Free-tailed Bat occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually, solitary but also recorded roosting communally, probably insectivorous	**Low**	This species has a low likelihood of occurrence due to the absence of suitable habitat and vegetation communities that support this species. Likewise, only a few small-sized hollows were identified which are only suitable for microbats.
Miniopterus australis	Little Bent-winged Bat	V,P	-	1	This species inhibits moist eucalypt forests, rainforests and dry sclerophyll forests. It tends to roost in caves, tunnels, tree hollows, bridges, buildings and sometimes within the canopy of densely vegetated areas.	**Moderate**	This species has a moderate likelihood of occurrence as it may utilise the site for foraging, and potentially roosting as there were several small-sized hollows identified within the study area.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V,P	-	4	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	**Negligible**	This species has a negligible likelihood of occurrence due to the lack of roosting habitat (caves) within the study area or nearby.
Myotis macropus	Southern Myotis	V,P	-	18	The Southern Myotis generally roost in groups of 10 – 15 close to water in caves, mine shafts, hollow bearing trees, storm water channels, buildings, under bridges and in dense foliage. They forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.	**Low**	This species has a low likelihood of occurrence. This is due to the minimal availability of roosting habitat within the study area such as caves or storm water channels.
Petaruoides volans	Greater Glider (southern and central)	E	E	PMST	Occurs most commonly in tall, moist eucalypt forests and woodlands with old trees and abundant hollows.	**Negligible**	This species has a negligible likelihood of occurrence due to the absence of moist woodland habitat within the project alignment and study area.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Petaurus australis australis	Yellow-bellied Glider (south-eastern)	V	V	PMST	Occurs in tall, mature eucalypt forests with high rainfall and nutrient rich soils.	**Low**	Although there were a few Eucalyptus trees with hollows located in several areas, it is unlikely that the species would be utilising the highly fragmented surround vegetation. Similarly, as the study area is highly disturbed and urbanised this makes it unsuitable habitat.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	PMST	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging.	**Negligible**	This species has a negligible likelihood of occurrence due to the absence of rocky outcrops, caves and crevices within the study area.
Phascolarctos cinereus	Koala	E,P	E	PMST	The Koala inhabits eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Can live in many different eucalypt forests including dense, wet coastal forests.	**Low**	Although there were a few Eucalyptus trees located in several sites, it is unlikely that the Koala would be utilising the highly fragmented surround vegetation. Similarly, as the study area is highly disturbed and urbanised this makes it unsuitable.
Pseudomys novaehollandiae	New Holland Mouse	-	V	PMST	Occupy open healthland, open woodlands with a heathy understory and vegetated sand dunes.	**Negligible**	This species has a negligible likelihood of occurrence as the site consists highly discontinuous and fragmented woodland habitat, with the absence of sand dunes for sheltering and breeding.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V	PMST	The Grey-Headed Flying Fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. Site fidelity to camps is high; some camps have been used for over a century. Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	**Low**	This species has a low likelihood of occurrence as there are no recent records of the species within the study area and the footprint is within an urbanised and disturbed area. Likewise, there are no roosting camps within the study area (DCCEEW Cth, 2024). The National Flying-fox Monitoring Viewer indicates that the nearest Grey-headed Flying-fox camps are located in Cabramatta and Macquarie Fields.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V,P	-	1	The Yellow-bellied Sheathtail bat roosts in groups of up to six in tree hollows and buildings. The species tends to forage in most habitats with and without trees.	**Low**	This species has a low likelihood of occurrence as since there are minimal records, and it has such a broad habitat range it is likely to utilise better quality habitat in nearby conservation areas/reserves.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P	-	4	The Greater Broad-Nosed Bat utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. The species forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 – 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.	**Low**	This species has a low likelihood of occurrence due to the limited habitat suitability (lack of tall wet forests) and the site is highly disturbed.
Fish							
Macquaria australasica	Macquarie Perch	-	E	PMST	Macquarie Perch occur in waters with lots of cover such as aquatic vegetation, snags, boulders and overhanging banks.	**Low**	This species has a low likelihood of occurrence due to the absence of records for this species within the study area. Likewise, there is only marginal suitable habitat along Thompsons and South Creek due to pollution and urbanisation impacts.
Prototroctes maraena	Australian Grayling	-	V	PMST	In NSW its most northern limit is now the Clyde River.	**Negligible**	Negligible likelihood of occurrence as the study area is outside the geographic range for this species.
Reptile							
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V	PMST	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks.	**Negligible**	This species has a negligible likelihood of occurrence due to the absence of a continuous and intact native grassland habitat, rocky outcrops, and crevices within the project alignment and study area.

Scientific name	Common name	BC Act	EPBC Act	Number of records	Distribution and habitat	Likelihood of Occurrence	Rationale
Hoplocephalus bungaroides	Broad-headed Snake	E	E	PMST	Shelters in sandstone rock crevices and under flat rocks on exposed cliff edges during autumn, winter and spring. In summer, this species moves to crevices or hollows in large trees within 500m of escarpments.	**Negligible**	This species has a negligible likelihood of occurrence due to the absence of rocky outcrops on a cliff area for this species to shelter.
Invertebrate							
Austrocordulia leonardi	Sydney Hawk Dragonfly	-	E	PMST	The Sydney Hawk Dragonfly has specific habitat requirements and has only ever been collected from deep river pools with cooler water and permanent flow.	**Low**	Low likelihood of occurrence due to the absence of deep and continuous river pools. Whilst a creek does intersect with the project alignment, water levels are periodic, and it may experience periods of low water levels which is not ideal habitat for this species which requires permanent water.
Gastropod							
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	60	Primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps.	**High**	This species is known to occur in the study area. Some sites contained habitat suitability with areas of high leaf litter, logs and fallen branches and bark identified.
Pommerhelix duralensis	Dural Land Snail	E	E	PMST	It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.	**Low**	This species has a low likelihood of occurrence due to the low number of records and the limited habitat suitability as the site is highly disturbed.

Legend

Act: BC Act = *Biodiversity Conservation Act 2016*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

Status: CE= Critically Endangered, E=Endangered, V=Vulnerable, P=Protected

Migratory agreements: J=Listed on Japan Australia Migratory Bird Agreement, K= Listed on Republic of Korea Australia Migratory Bird Agreement

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Appendix D – Aboriginal Cultural Heritage Assessment Report

BADGERYS CREEK WASTEWATER
STAGE 2

Aboriginal Cultural Heritage Assessment Report

Prepared for Sydney Water

Penrith and Liverpool Local Government Areas

November 2024

Ref. 2339

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Document Information

Project Name	Badgerys Creek Wastewater – Stage 2 Aboriginal Cultural Heritage Assessment Report
Project Number	2339
Version	1.0
Client Name	Sydney Water
Issue Date	21 November 2024
Prepared by	[redacted]
Approved by	[redacted]

Executive Summary

Sydney Water propose the construction of new wastewater infrastructure within the Badgerys Creek precinct as part of the Upper South Creek Network (USCN) program. The Badgerys Creek Wastewater Stage 2 works ('the proposal') would comprise the construction of a new pumping station and wastewater infrastructure in the vicinity of Badgerys Creek between the Advanced Water Recycling Centre at Kemps Creek in the north and a proposed pumping station on the southern side of Pitt Street at Badgerys Creek in the south.

Sydney Water engaged Kelleher Nightingale Consulting (KNC) to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR) and to assist in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application for Aboriginal objects would be harmed by the proposal. The ACHAR has been prepared in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011), *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a), and *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010b).

Aboriginal archaeological assessment identified nine Aboriginal archaeological sites within the proposed Stage 2 area. The Aboriginal archaeological sites consisted of two surface artefact scatters with associated subsurface archaeological deposits (Badgerys Creek East and BC/ED1) and seven subsurface archaeological deposits (Badgerys Creek West B, EDU Badgerys Creek IF 1, Lawson Road Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 2, South Creek West T1, South Creek West T2).

The archaeological (scientific) significance of the portions of the identified Aboriginal sites within the proposed works area was assessed using the significance assessment criteria outlined in the *Australia ICOMOS Burra Charter* and in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a). Badgerys Creek East, BC/ED1, McGarvie Smith Farm Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 2, South Creek West T2 were assessed as displaying moderate archaeological (scientific) significance. Badgerys Creek West B, EDU Badgerys Creek IF 1, Lawson Road Badgerys Creek AFT 1, and South Creek West T1 were assessed as displaying low archaeological (scientific) significance.

Sydney Water has determined that the Aboriginal archaeological sites located within the proposed Stage 2 area cannot be avoided by the proposal due to the limited area in which the works can be undertaken. This will result in serious and irreversible damage to the archaeological value of the sites within the impact area. Recommendations for mitigating the identified impacts to the archaeological (scientific) significance of Aboriginal archaeological sites have been developed based on Ecologically Sustainable Development principles in relation to environmental context and condition, and archaeological research.

The archaeological (scientific) significance of the sites is based on the information they contain and the potential for that information to contribute to current research questions. Archaeological salvage excavation is recommended for the impacted portions of the sites with moderate archaeological (scientific) significance to conserve a representative sample of the artefacts and associated contextual information contained within the impacted areas. As such, the salvage excavations must be completed prior to any activities which may harm Aboriginal objects at these site locations.

The loss of the intrinsic Aboriginal cultural value of impacted Aboriginal archaeological sites often cannot be fully offset or mitigated; however, the recovery of surface artefacts from the impacted portion of the site by the Aboriginal community prior to the proposed works is recommended.

The proposal overlaps several areas that have been previously assessed for Aboriginal cultural heritage values and are already covered under existing approvals. The approvals were for the Western Sydney International (Nancy-Bird Walton) Airport, Sydney Metro — Western Sydney Airport (SSI-10051), M12 Motorway (SSI-9364) and the Upper South Creek Advanced Water Recycling Centre (SSI-8609189). Any works for the proposal which overlap the existing approval areas would be required to comply with any relevant conditions of those approvals.

A land based AHIP should be obtained under section 90 of the *National Parks and Wildlife Act 1974* for the portion of the proposal which is not already covered under existing approvals. The AHIP should include Aboriginal objects associated with sites:

Badgerys Creek East (including Fleurs 2 (Fleurs Prospect), M12 A2 and M12 A3)	45-5-5294 (45-5-0528/ 45-5-4748/ 45-5-4750)	Moderate Significance	Partial Impact
Badgerys Creek West B	45-5-5298	Low Significance	Partial Impact
BC/ED1	45-5-2309	Moderate Significance	Partial Impact
EDU Badgerys Creek IF 1	45-5-5733	Low Significance	Total Impact
Lawson Road Badgerys Creek AFT 1	45-5-5923	Low Significance	Total Impact
McGarvie Smith Farm Badgerys Creek AFT 1	45-5-5922	Moderate Significance	Total Impact
McGarvie Smith Farm Badgerys Creek AFT 2	45-5-5921	Moderate Significance	Partial Impact
South Creek West T1	45-5-5307	Low Significance	Partial Impact
South Creek West T2	45-5-5308	Moderate Significance	Partial Impact

Management measures have been recommended for Aboriginal objects situated within the non-impacted portion of the sites to ensure that these areas are avoided by any proposed activities associated with the proposal. The non-impacted portion of the sites (outside of the AHIP boundary) should be marked as an environmentally sensitive “no-go zone” on the Construction Environmental Management Plan prior to construction activities to ensure the areas are avoided and not impacted by the proposed works. Workers should be inducted as to appropriate protection measures for Aboriginal heritage.

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1 Introduction

1.1 Background

By 2056, it is estimated 90,000 new dwellings and 200,000 jobs will be in the Upper South Creek Catchment region. The Upper South Creek Catchment will also include innovative precincts focused on advanced manufacturing, technology, research, training and education, freight and logistics, agribusiness and mixed-use development.

To support growth in the region, Sydney Water are delivering an Advanced Water Recycling Centre (AWRC) at Kemps Creek. It will help provide cost-effective wastewater services, produce high-quality treated water for sustainable, non-drinking water reuse in homes and businesses, biosolid products for use in agriculture and help keep western Sydney cooler and greener.

Sydney Water are also delivering infrastructure to transfer wastewater from the region to the new AWRC as part of the Upper South Creek Network (USCN) program. The USCN program will provide wastewater infrastructure to the five precincts in the Upper South Creek Catchment:

- Cosgroves Creek and Agribusiness
- Thompsons Creek
- South Creek
- Badgerys Creek
- Lowes Creek

The new pipelines and pumping stations will transfer wastewater from the five precincts to the AWRC in Kemps Creek where it will be treated using reverse osmosis (the same technology that is used at the Sydney desalination plant). The recycled water will also be available for use for a variety of agricultural and industrial uses, as well as contributing to the environmental flows within the surrounding creeks and rivers, protecting local waterways and aquatic ecosystems.

The new wastewater infrastructure will service the new development in the area, including the Western Sydney International Airport and the surrounding suburbs. The infrastructure across the five precincts will be delivered over a 12 year period. The program will deliver over 93 kilometres of wastewater pipelines and around nine pumping stations across the precincts.

1.2 Proponent and consultants

Sydney Water propose the construction of new wastewater infrastructure within the Badgerys Creek precinct as part of the USCN program. The proposed works would constitute Stage 2 of the proposed infrastructure delivery to the precinct.

Sydney Water engaged Kelleher Nightingale Consulting (KNC) to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR) and to assist in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application for Aboriginal objects would be harmed by the proposal.

1.3 Location and scope of activity

The Badgerys Creek Wastewater Stage 2 works would comprise the construction of wastewater infrastructure in the vicinity of Badgerys Creek between the AWRC at Kemps Creek in the north and the proposed pumping station on the southern side of Pitt Street at Badgerys Creek in the south (Figure 1). The proposed works would be undertaken within the Penrith and Liverpool Local Government Areas (LGA). The proposed works would consist of the following:

- a new sewage pumping station
- approximately 10.6 kilometres of gravity carriers
- approximately 1.8 kilometres of pressure mains

The assessment area for the proposal (hereafter referred to as the ‘study area’) encompassed the proposed impact area of the new sewage pumping station and a 50 metre wide corridor that was centre on the proposed alignment to accommodate design refinements (Figure 2).

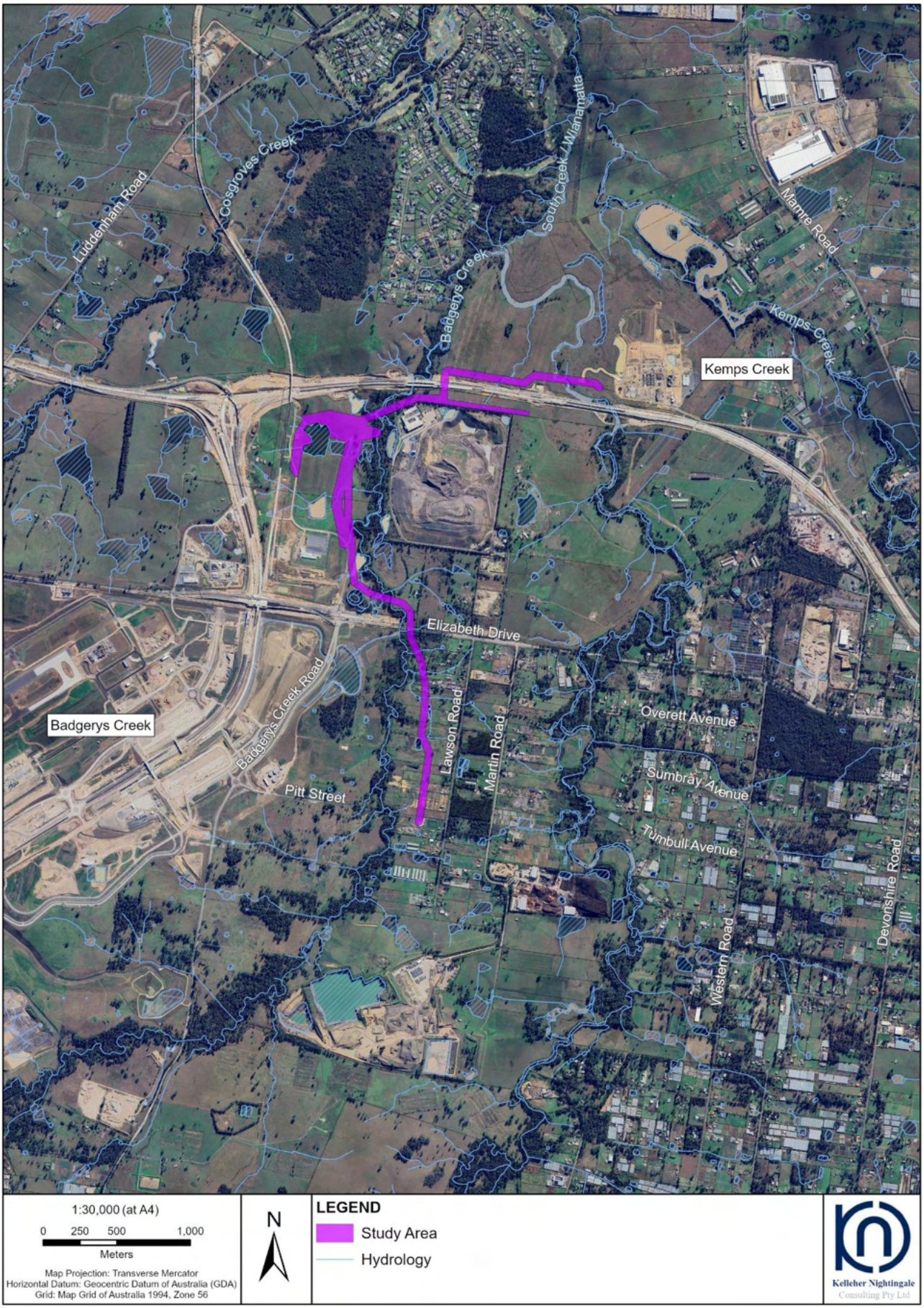


Figure 1. Project Overview



Figure 2. Details of the study area

1.4 Statutory controls

The proposal is for water infrastructure to be carried out by Sydney Water and will be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*.

Aboriginal objects will be harmed by the proposed activities and an application for an AHIP is being made under section 90A of the *National Parks and Wildlife Act 1974*. This ACHAR has been prepared to support the AHIP application. It has been prepared in accordance with the Heritage NSW *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011a).

1.5 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is the primary statutory control dealing with Aboriginal heritage in New South Wales. Items of Aboriginal heritage (Aboriginal objects) or Aboriginal places (declared under section 84) are protected and regulated under the NPW Act.

Under the Act, an "Aboriginal object" is defined as "any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains". As such, Aboriginal objects are confined to physical evidence and are commonly referred to as Aboriginal sites.

Aboriginal objects are protected under section 86 of the Act. It is an offence to harm or desecrate an Aboriginal object, either knowingly [section 86 (1)] or unknowingly [section 86 (2)].

There are offences and penalties relating to harm to, or desecration of, an Aboriginal object or declared Aboriginal place. Harm includes to destroy, deface, damage or move. Penalties are tiered according to offences, which include:

- a person must not harm or desecrate an Aboriginal object that the person knows is an Aboriginal object;
- a person must not harm an Aboriginal object (strict liability offence);
- a person must not harm or desecrate an Aboriginal place (strict liability offence);
- failure to notify Office of Environment and Heritage of the location of an Aboriginal object (existing offence and penalty); and
- contravention of any condition of an Aboriginal Heritage Impact Permit.

Section 87 (2) of the Act provides a defence against prosecution under section 86 (2) if "the defendant exercised due diligence to determine whether the act or omission constituting the alleged offence would harm an Aboriginal object and reasonably determined that no Aboriginal object would be harmed".

Under section 87 (1) it is also a defence if "(a) the harm or desecration concerned was authorised by an Aboriginal heritage impact permit, and (b) the conditions to which that Aboriginal heritage impact permit was subject were not contravened".

Section 89A of the Act relates to the notification of sites of Aboriginal objects, under which it is an offence if the location of an Aboriginal object is not notified to the Director-General in the prescribed manner within a reasonable time.

Under section 90 (1) of the Act "the Director-General may issue an Aboriginal heritage impact permit". The regulation of Aboriginal heritage impact permits is provided in Part 6 Division 2 of the Act, including regulations relating to consultation (section 90N).

An AHIP is required for an activity which would harm an Aboriginal object.

1.6 Objectives of the Aboriginal cultural heritage assessment report

The proposed infrastructure works would impact on some Aboriginal objects (sites). Approval obtained under the *National Parks and Wildlife Act 1974* is required for these Aboriginal objects prior to any impact or harm. The proponent would apply for an AHIP under section 90A of the Act.

Clause 61 of the *National Parks and Wildlife Regulation 2019* requires that an application for an AHIP is accompanied by an ACHAR. The ACHAR is to provide information on:

- The significance of the Aboriginal places that are the subject of the application;
- The actual or likely harm to those Aboriginal objects or Aboriginal places from the proposed activity that is the subject of the application;
- Any practical measures that may be taken to protect and conserve those Aboriginal objects or Aboriginal places;
- Any practical measures that may be taken to avoid or mitigate any actual or likely harm to those Aboriginal objects or Aboriginal places.

The Heritage NSW *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) provides further guidance on the preparation of an ACHAR. This ACHAR has been prepared in accordance with the requirements of the *National Parks and Wildlife Regulation 2019* and the guide.

This ACHAR has been prepared to accompany an application for an AHIP made by Sydney Water for Aboriginal objects within the study area, including those associated with Aboriginal sites: Badgerys Creek West B (AHIMS 45-5-5298), Badgerys Creek East (AHIMS 45-5-5294/45-5-0528/45-5-4748/45-5-4750), BC/ED1 (AHIMS 45-5-2309), EDU Badgerys Creek IF 1 (AHIMS 45-5-5733), Lawson Road Badgerys Creek AFT 1 (AHIMS 45-5-5923), McGarvie Smith Farm Badgerys Creek AFT 1 (AHIMS 45-5-5922), McGarvie Smith Farm Badgerys Creek AFT 2 (AHIMS 45-5-5921), South Creek West T1 (AHIMS 45-5-5307), and South Creek West T2 (AHIMS 45-5-5308).

2 Landscape Context

2.1 Topography and hydrology

The study area traverses the lower slopes and flats adjacent to Badgerys Creek and Wianamatta/ South Creek (Figure 3). Wianamatta/ South Creek and its tributaries, which include Badgerys Creek and Kemps Creek, flow generally northward between ridgelines that generally descend to the northeast and north from a main ridgeline that divides the catchment areas of the Nepean River in the west from Wianamatta/South Creek in the east.

The study area is predominantly located on the flats and lower slopes that form the floodplains adjacent to Badgerys Creek; however, the northern portion of the study area traverses the toe slope of the ridgeline separating the creek from Wianamatta/ South Creek and crosses the terrace landforms adjacent to Wianamatta/ South Creek. Badgerys Creek flows north and northeast through and adjacent to the study area before joining Wianamatta/South Creek approximately 850 metres to the north. Wianamatta/South Creek flows north and northwest across a broad floodplain for approximately 30 kilometres to the confluence of the Hawkesbury River near Pitt Town

The Sydney coastline was subject to episodic sea level fluctuations during the late Quaternary Period (within the last 120,000 years) with sea levels reaching a maximum of five metres above present sea level during the last Pleistocene high stand (120,000 years ago) and a minimum of 110-130 metres below present level during the Last Glacial Maximum (26,000-14,500 years ago). During this period, the creeks in the region are likely to have contained less water. Sea levels then rose until 5,000 years ago when they reached the present-day level.

2.2 Geology

The study area is located in the southwest of the Cumberland Plain, a low lying and gently undulating subregion of the Sydney Basin. The Sydney Basin is a large geological feature stretching from Batemans Bay in the south to Newcastle in the north and Lithgow in the west. The basin contains up to 1,350 metres of shale and sandstone geology that derived from marine and alluvial sediments deposited between the Late Permian and Triassic in a number of discrete episodes in response to tectonic events or sea level change (Carter 2011: 5-8).

Basal geology primarily comprises Triassic Wianamatta Group shales and labile sandstones intruded by a small number of volcanic vents which formed low hills in the shale landscapes. The underlying geology of the study area comprises Bringelly Shale within the lower slope landforms and Quaternary Alluvium within the flat landforms adjacent to the creek (Figure 4). Bringelly Shale formed during the late Triassic Period and consists of shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff. Quaternary Alluvium is a relatively recent deposit of fine-grained sands, silts and clays.

Stone suitable for the creation of stone artefacts is not present within the mapped geology of the study area. Silcrete, the predominant raw material type of flaked stone artefacts recovered from Aboriginal archaeological in the vicinity of the study area occurs as cobbles within the St Marys Formation geology or with indurated mudstone/tuff (IMT), quartz and hornfels in the Rickabys Creek Gravel geology. The distribution of St Marys Formation and Rickabys Creek Gravel geology are believed to have extended across a larger area of the Cumberland Plain; however, subsequent weathering has reduced the mapped distribution of St Marys Formation to the ridge tops and Rickabys Creek Gravel to areas of remnant paleochannels, both of which are primarily located in the northwestern Cumberland Plain.

Redeposited gravels suitable stone have also been noted by archaeological investigations in the region within and along the margins of the Nepean/Hawkesbury River, Wianamatta/South Creek, Eastern Creek, and other large creek systems. Outcrops of silcrete have been identified in the vicinity of Elizabeth Drive approximately one kilometre east of the study area and along the banks of Wianamatta/South Creek approximately 400 metres southeast of the study area. Blocks of unmapped sandstone have also been identified within the mapped Quaternary Alluvium in the vicinity of Elizabeth Drive approximately 700 metres south of the study area. The outcrop was utilised by Aboriginal people who left grooves from the probable edge grinding of stone hatchet heads.

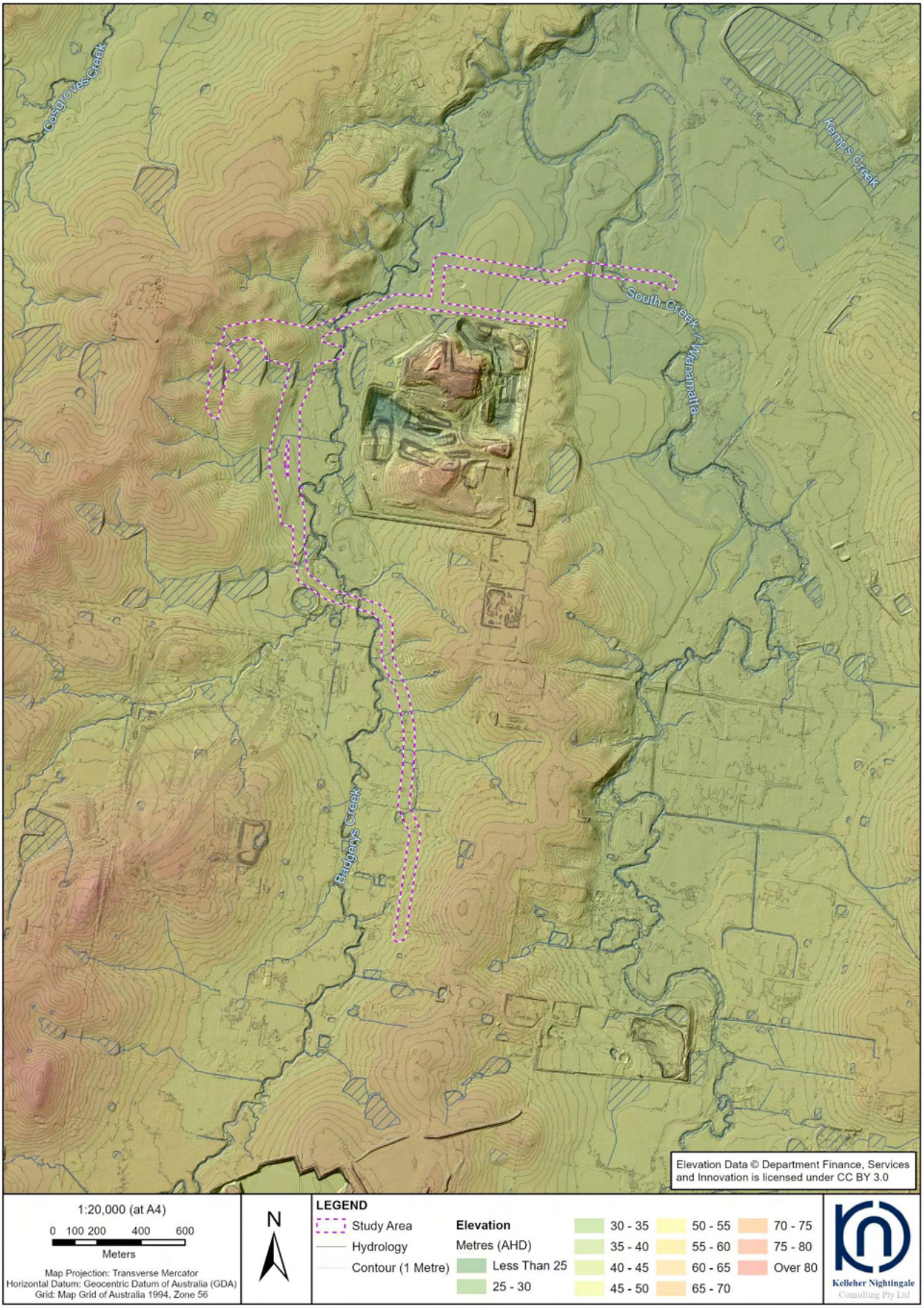


Figure 3. Topography of the study area

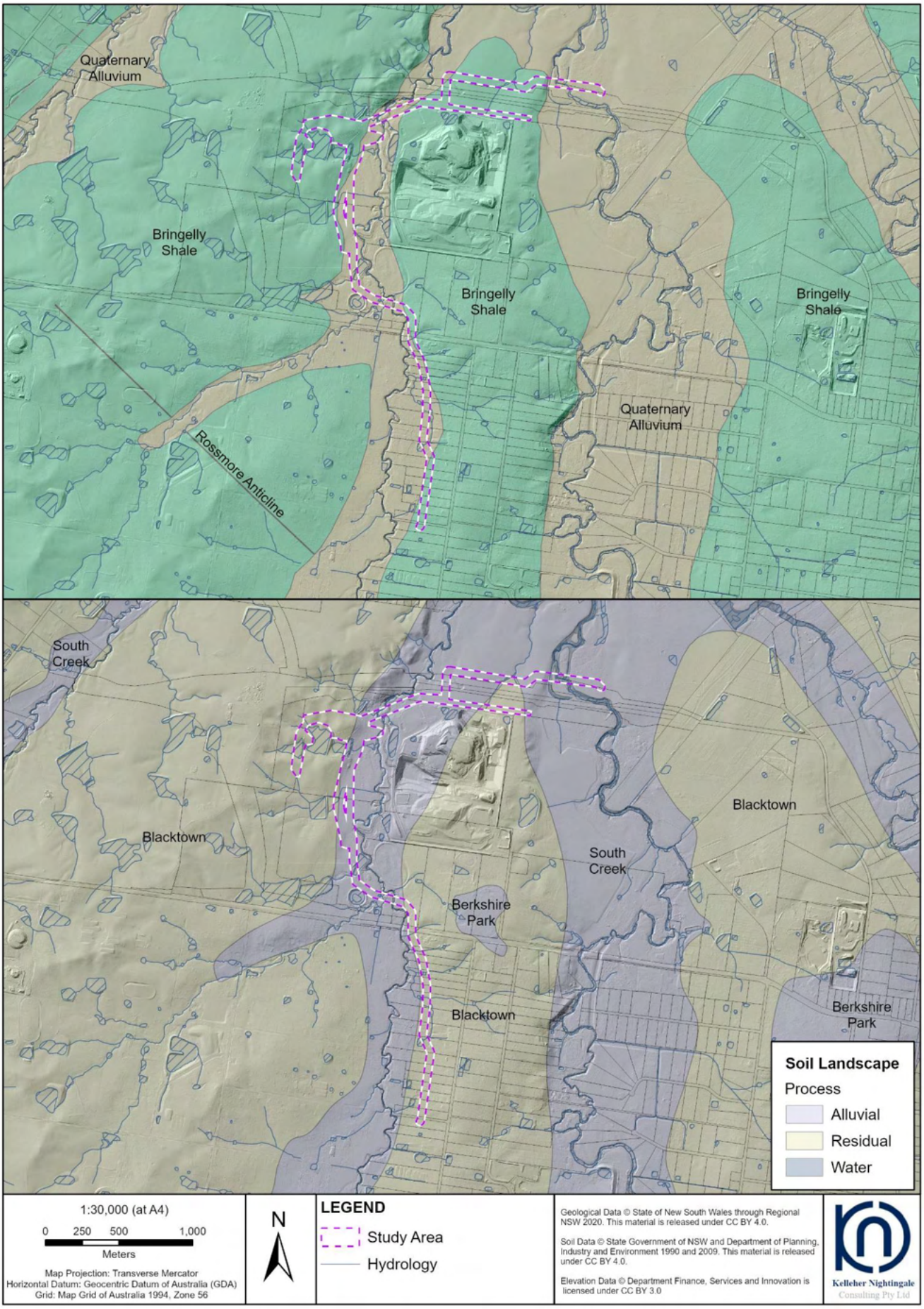


Figure 4. Geology and soil landscape of the study area

2.3 Soil landscapes

The soils within the study area derive from underlying geology, topography and the geomorphological processes acting on the landscape. The study area is located on residual Blacktown and alluvial South Creek soil landscapes. The residual Blacktown soil landscape occurs on gently undulating rises of broad rounded ridges and crests with gently inclined concave slopes. The gently undulating rises have slope gradients that are usually less than five percent. The landscape is characterised by shallow to moderately deep red and brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and drainage lines (Bannerman, Hazleton, and Tille 1990: 35).

Erosional susceptibility of this soil landscape is relatively low but is increased where surface vegetation is not maintained (Bannerman, Hazleton, and Tille 1990). Blacktown soils are conducive to the preservation of subsurface archaeological deposits; however, their acid chemistry quickly removes organics, and their deflationary tendency often results in a temporal collapse, where stone artefacts from multiple time periods accumulate within a single soil layer.

The alluvial South Creek soil landscape is characterised by flat landforms with incised channels that are subject to frequent episodes of inundation, erosion and aggradation. The landscape contains deep structured loams and clays overlying bedrock or relict soils. The South Creek soil landscape may retain archaeological deposits but due to its location on active floodplains the integrity may be compromised due to repeated episodes of erosion and deposition caused by fluvial activity.

The South Creek soil landscape is characterised by deep to very deep alluvial sediments, loams and clays. South Creek soils are located within a dynamic landscape of active floodplains and are subject to repeated episodes of erosion and deposition. Aboriginal land use and the associated discarding of stone artefacts are likely to have occurred in areas of South Creek soils due to their proximity to water sources; however, the integrity of archaeological deposits in these areas is strongly dependent on topography and fluvial activity. Aboriginal archaeological sites situated within low lying areas adjacent to the creek lines are likely to have been highly disturbed by erosion and fluvial activity while archaeological deposits within landforms that are elevated above flooding events are more likely to retain subsurface integrity.

2.4 Vegetation

The distribution of native vegetation within the study area has been affected by historic and contemporary land use practices. Prior to 1788, a mixture of native vegetation communities would have extended across the entire region with distribution determined by a combination of factors including soil, terrain and climate. Present day vegetation within the study area predominantly consists of exotic grasses with scattered small areas of Shale Plains Woodland (part of the Cumberland Plain Woodland) or Shale Gravel Transitional Forest. The vegetation within close proximity to Badgerys Creek generally comprised Alluvial Woodland (part of the Sydney Coastal River-flat Forest group) which extended along both banks of the creek.

The variety of native vegetation and sources of permanent water would have made the region an attractive locale for past Aboriginal people due to the subsistence and material resources available. Aboriginal land use practices shaped the environment and would have influenced the distribution and numbers of plants and animals within the region; however, the extensive modifications to the landscape visible today are almost entirely the result of the land use practices that occurred during the past 200 years.

2.5 Land use disturbance

The study area has been subject to ground surface disturbance from a range of land use practices in addition to natural processes. Ground surface disturbance within Aboriginal archaeological sites may have removed, deflated, mixed or redeposited the contextual information within subsurface deposits, and cleared or damaged other site types including culturally modified trees.

British occupation in the region began with the allocation of land grants, including 640 acres that were granted to James Badgery in 1809, which he named ‘Exeter Farm’. Large estates quickly developed through buying and selling, some controlled by absentee landlords, and others by families who established residential farms (Aurecon 2016:21). The land grants were primarily utilised for agricultural or pastoral land use and widespread native vegetation clearance was conducted in order to prepare the land.

Elizabeth Drive itself dates from the early 1800s and was originally constructed as a ‘corduroy’ road, using round logs as a base. It was established to provide access to the areas’ land grants and was originally known as the Orphan School Road as it extended west from the Orphan School in what is now Bonnyrigg. Its name was later changed to Mulgoa Road, in reference to its western extent, but subsequently changed again in 1952 to honour the visit of Queen Elizabeth II (Aurecon 2016:21).

Land use within the region has remained predominantly rural to the present day while several quarries have been constructed since the 1950s on ridge crests north and south of Elizabeth Drive. Other key uses include road and power infrastructure. More recently, the region has seen significant redevelopment as a result of the construction of the Western Sydney International (Nancy-Bird Walton) Airport, M12 Motorway, Sydney Metro – Western Sydney Airport and planned Aerotropolis Precinct.

Expected disturbances from these land uses include those from clearing, tillage of soils, cultivation, and grazing. More severe ground disturbance is present in areas where roads, tracks, buildings, infrastructure and dam construction have modified the land. Below ground utilities have also been constructed within the study area and where trenching has taken place this has modified the landscape and limited archaeological potential/sensitivity within these areas. Natural processes are also likely to have caused disturbance within the study area and include erosion and soil movement, particularly in higher gradient areas where clearance of original vegetation accelerates erosion, gully and stream bank erosion (incision) along the waterways, and the effects of flooding and alluvial processes along the creeks.

3 Ethnohistorical Context

Prior to the British occupation in the late eighteenth century, the study area was inhabited by Aboriginal people who generally lived in groups of one or more extended families that were associated with particular areas. These groups were interconnected through marriage and large gatherings of several groups occurred for specific purposes such as communal participation in subsistence gathering activities, initiations, funerals and ritual combat (Attenbrow 2002: 29). Aboriginal Customary law and practices, while varying across Australia "included responsibilities of various kinds for land and for objects and ideas associated with land, complex structures of kinship and family groupings, patterns and rules of marriage and childcare, and procedures for the conduct and resolution of disputes" (ALRC 1986).

In 1788, a penal colony was established by the Kingdom of Great Britain (now the United Kingdom of Great Britain and Northern Ireland), under the command of Arthur Phillip, on occupied land at Warrane (also spelt Waran, War-ran, Warrang and Wee-rong), a small bay which they would call Sydney Cove. The British generally failed to retain existing Aboriginal placenames, despite often being aware of them (as evidenced from contemporary documents) and instead "subsequently assigned European names to features that commemorated important events, people and places from their own culture" (Windsor 2009: 72). The renaming of the topographic features, animals and plants of Australia by the British often resulted in the loss of the existing Aboriginal names and associated cultural connections for future generations and alienated the contemporary Aboriginal community.

The colony contained over 1,000 people including marines, officials and convicts. Phillip, who was commissioned Captain General and Governor in Chief of the Territory of New South Wales, was instructed to take precautions to protect the British colony against attack from the Aboriginal people living in the region in addition to documenting information on their numbers and advising the British government on a "manner Our Intercourse with these people may be turned to the advantage of this country" (Governor Phillip's Instructions 25 April 1787).

The British were governed by legal regime based on common law that classified Aboriginal people living in New South Wales as British subjects who were entitled to individual protection under the law (ALRC 1986). In practice, the British were largely unable to enforce colonial laws outside the occupied areas where Aboriginal customary laws continued to be practiced, and a legal pluralism existed within the region until 1816 (ALRC 1986; Ford and Salter 2008: 74-75). Aboriginal people who the British perceived to have committed crimes such as theft or murder, were treated as enemies of the state and while "at least 17 Aboriginal people had been incarcerated in the colony before 1816, all were held as hostages, not criminals" (Ford and Salter 2008: 72).

The information available on the Aboriginal people who lived in Australia during the eighteenth and nineteenth centuries is disproportionately reliant on contemporary documents created by a small number of individuals from Europe or of European descent. Initially, the British were unable to converse with the Aboriginal people living in the Sydney region. Watkin Tench, who published a contemporary account of the British occupation in Australia during the late eighteenth century noted that his information on Aboriginal people was "made up of detached observations, taken at different times, and not from a regular series of knowledge of the customs and manners of a people with whom opportunities of communication are so scarce as to have been seldom obtained" (Tench 1793: 51).

Prior to the British invasion, Aboriginal people living in the region transferred knowledge of history and culture through oral and artistic means. An account by Werriberrie (also known as William or Bill Russell), a Burra-ga-rang man who spoke Gun-dun-gorra (now generally spelt Gundungurra) and lived during the nineteenth century, is one of very few contemporary Aboriginal accounts from the Sydney region in which the name of an Aboriginal language, as it was known to speakers of that language, was published (Russell 1914: 9, 20; Troy 1994: 1). Most of the information used to study Aboriginal languages was published in the second half of the nineteenth century by amateur anthropologists who interpreted, often without acknowledgement, information given to them by individuals from the contemporary Aboriginal community (Thomas 2007: 89; Attenbrow 2010: 30). The spatial extent of the Aboriginal languages spoken during the eighteenth and nineteenth centuries and many of the names currently used to describe them are contentious due to the issues described previously.

The study of society, culture and material culture by Europeans during the eighteenth and nineteenth centuries was influential in the development of many social sciences that exist today and, as such, prominence has been given to the documents created by Europeans during this time and, in consequence, the perceptions, beliefs and bias of their authors. As a result, the Aboriginal people who were involved in these events and the history of the eighteen and nineteenth centuries incorrectly appear "invisible, unrelated to important local historical events, or passive victims of colonisation" (OEH 2011a: 6).

Aboriginal people living throughout Australia in the late eighteenth century belonged to a multitude of groups that spoke approximately 250 distinct languages and several hundred dialects. Prior to the British invasion, the southwestern Cumberland Plain was inhabited by Aboriginal people who spoke or understood three distinct languages (Troy 1994: 1; Attenbrow 2002). Dialects of the Sydney Language were spoken or understood by Aboriginal people who lived in an area extending along the coast from Broken Bay to the Georges River and inland to the Hawkesbury River. Dharug (also

referred to as Daruk or Darug) is generally used to refer to the inland dialect and Eora (also referred to as Iyora) is generally used to refer to the coastal dialect. Dialects of the Dharawal (also referred to as Tharawal, Thurrawal or Thur'rawal) language were spoken or understood by Aboriginal people living south of Botany Bay and the Georges River, east of Camden and Appin, and north of the Shoalhaven River and Jervis Bay (Bursill et al 2007: 9; DEC 2005: 6). Dialects of the Gundungurra (also referred to as Gun-dung-gorra, Gundungura or Gandangara) language were spoken or understood by Aboriginal people living in areas to the southeast of the study area including the catchments of the Wollondilly River, the Coxs River and in some areas west of the Great Dividing Range (Russell 1914; Attenbrow 2002).

In the first years of the colony, British exploration and expansion was primarily driven by the need to produce enough food to support the colony which had less supplies than anticipated and had found the soil at Sydney Cove unsuitable for growing cereal crops. British efforts were focus along the major waterways in the Sydney Region which could be traversed relatively easily and during the first three years, Broken Bay, Botany Bay and the Hawkesbury and Georges Rivers were surveyed.

During March and May 1789, the British documented widespread fatalities amongst the Aboriginal population of the Sydney region which they attributed to an outbreak of smallpox. The British were familiar with smallpox which was the most widespread and deadly disease in the British Isles in the eighteenth century (Dowling 1997: 89). Prior exposure of the British to smallpox and the isolation of infected individuals are likely to have contributed to the low level of infection within colony (Dowling 1997: 89). Governor Phillip estimating that "one half of those who inhabit this part of the country died" (Phillip 1790: 159).

Later accounts of Aboriginal people who bore smallpox scars from the outbreak indicate that the disease spread over a large area that possibly included the Wellington Valley in the west and Jervis Bay and Port Phillip in the south (Dowling 1997: 63). The source of the smallpox outbreak is unclear due to the limited information in contemporary accounts; however, the virus was almost certainly brought to Australia from elsewhere as was the case with seven other outbreaks of smallpox in Australia that were recorded during the nineteenth century and are believed to have been brought by ship passengers (Dowling 1997: 52). The smallpox outbreak of 1789 drastically altered the size and structure of the Aboriginal population living on the Cumberland Plain and several Aboriginal children orphaned by the disease began to live in the British settlement afterwards.

Aboriginal people often played a crucial role as guides and translators for the British with Colebee and Boladaree guiding the British and acted as intermediaries with the Aboriginal people that they encountered between Parramatta and the Hawkesbury River. The British used European items as gifts during these journeys and found that metal hatchets were particularly sought after (Attenbrow 2002: 103).

Early British accounts described the Sydney region as a mosaic of Aboriginal family groups that were associated with particular areas of land (Collins 1798: 545). Several of the groups were identified during the late eighteenth and nineteenth centuries in the vicinity of the study area including the Burra-ga-rang, Cubbitch Barta, Gahbrogal, Gomerrigal and the Mulgowy. The Burra-ga-rang were associated with the Burragorang Valley (now Lake Burragorang) and the catchments of the Warragamba, Wollondilly and Coxes Rivers (Russell 1914).

The Cubbitch Barta who were associated with the area around Camden (Russell 1914: 20). The Gomerrigal (Gomerigal or Gomerrigal-Tongarra) who were possibly the later named 'South Creek Tribe' associated with Wianamatta/South Creek to the confluence of the creek with the Hawkesbury River (Attenbrow 2002: 24-26). The Gahbrogal (Cah-bro-gal or Cobrakall) who were associated with the area around Cabramatta (Gapps 2009: 30, 33). The Mulgowy (also referred to as the 'Mulgoa Tribe') were associated with the Mulgoa Valley (Attenbrow 2002: 24-26). Confusion over the names and territories attributed to Aboriginal groups by the British in this period is likely to have been the result of issues with the sources used and translation in addition to the probability that the organisation of territory and groups was more complex than the British were aware of (Yamanouchi 2007: 109).

The British noted that there were differences between the Aboriginal people living along the coast, the Aboriginal people living inland who they referred to as the 'woods tribes' (also called the Hunter's or Woodman's tribe) and the Aboriginal people who lived in the adjacent mountains. David Collins noted that the inland and coastal groups had a different dialect, songs, dances, subsistence and some implements (Collins 1798: 557-589). The British use of the term 'tribes' when referencing specific Aboriginal groups continued into the late nineteenth century and was used with other derogatory language to invoke a perception of the European social superiority over the Aboriginal people of Australia that is incorrect and inappropriate today.

The subsistence activities of Aboriginal people living inland were not as dependant on fish and shellfish as groups closer to the coast and relied on small animals and plant foods in addition to seasonally available freshwater mullet and eels (Tench 1793:230). Possums and gliders were hunted in a number of ways, including smoking out the animal by lighting a fire in the base of a hollow tree, burning tracts of land and gathering the stranded animals, as well as cutting toeholds in trees to capture them in their burrows (Tench 1793:82). Traps were constructed along waterways for catching birds and small animals (Hunter 1793). Large groups of Aboriginal people participated in hunting kangaroos, which were flushed out toward awaiting hunters by lighting small grass fires (Bladen 1897: 751).

Aboriginal people living in the region during the late eighteenth and nineteenth centuries made a range of items from perishable materials including canoes, huts, containers, nets, spears, womera, clubs and shields. Ochres of red, yellow and white were used on items and as personal decoration while body piercings and scarification were also practiced by some groups.

In November 1788, the British occupied and establish a government farm approximately 20 kilometres west of Sydney Cove at the headwaters of the Parramatta River which the British initially called Rose Hill. In 1791, Phillip noted that Parramatta had been adopted as the settlement name as it was the name that the contemporary Aboriginal people used to distinguish the location. The British also sought to explore the region in order to identify suitable land that could be granted to free settlers, emancipists (former convicts) and non-commissioned officers. In 1791, small land grants were made by Philip to time-expired convicts on the eastern and western slopes of Prospect Hill, and in an area the British called 'The Ponds' (now known as Dundas) on the northern side of the Parramatta River (Collins 1798: 140).

A second government farm was established in 1792 approximately four kilometres northwest of Parramatta at Toongabbie, which retained the name that the contemporary Aboriginal people used to distinguish the location. In the same year, acting governor Francis Grose began granting larger areas of land to marine officers and by 1794, British occupation began along the Hawkesbury River at Green Hills near Windsor and Pitt Town Bottoms near Pitt Town. Land continued to be granted by successive governors until 1831 when the system was replaced with public auctions. By 1795, an estimated 400 people occupied 30 miles of the riverfront along the Hawkesbury River (Gill 1965: 543-544).

The southwestern Cumberland Plain remained largely unoccupied by the British until the early nineteenth century due to the discovery of a herd of wild cattle by two convicts on a hunting expedition south of the Nepean River in 1795. The herd had escaped from the colony seven years earlier and access to the Campbelltown-Camden area, which became known to the British as the Cow Pastures (also called the Cowpastures Plain or Vaccary Forest), was restricted in order to preserve the herd. John Warby, a former convict who had been granted 50 acres at Prospect in 1792, was appointed stockman of the herd in 1803. The presence of the herd was known by the Aboriginal people living in the area who drew them beside a depiction of kangaroo on the wall of a sandstone rock shelter located in the suburb of Kentlyn which is known as Bull Cave.

The establishment of the colony and expansion of British occupation during the last decade of the eighteenth century took Country from the contemporary Aboriginal people. The occupied lands were often modified by a range of activities that removed resources that were utilised by Aboriginal people or restricted access to them. By August 1791, the hut of a British settler at Prospect Hill had been destroyed by a large group of Aboriginal people (Collins 1798: 141) and several droughts during the last decade of the eighteenth century are likely to have placed further strain on the resources available to Aboriginal people. In 1795, Collins reported that large groups of Aboriginal people had been taking corn from the British farms on the Hawkesbury and that "an open war seemed about this time to have commenced between the natives and the settlers" (Collins 1798: 415-416). Raiding by Aboriginal groups and retaliatory killings by Aboriginal people and the British was reported on the peripheries of the occupied areas along Hawkesbury River and at Prospect Hill, Toongabbie and outside Parramatta during the last decade of the eighteenth century (Collins 1798: 178, 275-276, 292, 304, 326-327).

In June 1795, the acting governor Captain William Paterson sent a detachment of the NSW Corps "from Parramatta, with instructions to destroy as many as they could meet with of the wood tribe (Bè-dia-gal (Collins 1798: 416). Paterson reported that the soldiers were sent to the Hawkesbury after five British settlers had been killed and several wounded in the preceding weeks and that he "very much feared they would abandon the settlement entirely and given[sic] up the most fertile spot which has yet been discovered in the colony" (Bladen 1895: 307). On the night after the arrival of the detachment, the soldiers fired on and pursued Aboriginal people that they believed had come to a farm to plunder it (Bladen 1895: 307). Patterson stated that between seven and eight people were killed and one man, five women and some children were taken captive back to Sydney, including a women and child that had been wounded by shot (Bladen 1895: 307-8; Collins 1798: 416).

Paterson sent a second party to Hawkesbury after an attack on William Rowe and his family at Richmond Hill resulted in the death of William and his child, and the wounding of his wife. The soldiers were sent to keep Aboriginal people away from the British and were distributed amongst the settlers in the region (Collins 1798: 417). The violence continued through 1795 and into 1800 along the Hawkesbury River at several locations including Sackville, Argyle Reach, Bushells Lagoon, Race Ground (Mulgrave) and Wilberforce. In 1800, Governor Hunter reported to the Duke of Portland that two Aboriginal boys had been murder by British settlers on the Hawkesbury River and that violence against the military had been caused by a soldier killing a woman and child (Bladen 1896: 2-3). He stated that

> *You will discover, my Lord, what a host of evidence is brought forward from that quarter to prove what numbers of white people have been kill'd[sic] by the natives: but cou'd[sic] we have brought with equal ease such proofs from the natives as they are capable of affording of the wanton and barbarous manner in which many of them have been destroy'd[sic], and to have*

> *confronted them with those of the white inhabitants, we shou'd[sic] have found an astonishing difference in numbers (Bladen 1896: 2)*

The subsequent trial of the five murderers is believed to have been the first time Europeans had been tried for the murder of Aboriginal people; however, they were acquitted (Nichols 2004: 5). Governor Hunter also noted that "much of the hostile disposition which has occasionally appear'd[sic] in those people has been but too often provoked by the treatment which many of them have received from the white inhabitants, and which have scarcely been heard of by those who have the power of bestowing punishment" (Bladen 1896: 2).

In March 1797, Pemulwuy led a large group of at least a hundred Aboriginal warriors in a raid on the Government Farm at Toongabbie. After the raid, Pemulwuy's group was followed to the outskirts of Parramatta by armed soldiers and settlers. During the ensuing 'Battle of Parramatta', Pemulwuy was shot at least seven times and taken to a government hospital. Although he was wearing leg irons and still had buckshot in his body and head, Pemulwuy escaped the hospital and by April appeared to have recovered when he was seen with a group of Aboriginal people on the Georges River near Botany Bay (Collins 1798: 44). In the same year, land along the Georges River and Prospect Creek was granted, which Governor Hunter called 'Bank's Town' after Sir Joseph Banks.

On 1 May 1801, Governor King issued a Government and General Order that the Aboriginal people living near Parramatta, the Georges River and Prospect Hill should be driven back from the British habitations by firing at them and in November of that year he outlawed Pemulwuy and offered a reward for his capture (Kohen 2005). Pemulwuy was killed in June 1802 and Governor King ordered that his head should be preserved in spirits and sent to Sir Joseph Banks for study in England (Philip Gidley King, Government and General Order, 1 May 1801, HRNSW Vol.V: 362; Kohen 2005). King wrote to the Botanist Joseph Banks that although Pemulwuy had been "a terrible pest to the colony, he was a brave and independent character" (Kohen 2005).

The violence between the British and Aboriginal people continued through the first decade of the nineteenth century and followed British occupation across the Cumberland Plain. The British occupation was in part driven by the British population in New South Wales which numbered approximately 10,000 in 1810 (Australian Bureau of Statistics 2008). The occupation of the southwestern Cumberland Plain began during this time with 5,000 acres of the Cowpastures granted to John Macarthur by order of the Colonial Secretary Lord Camden. Several land grants occurred within and in the vicinity of the study area during the early nineteenth century including 640 acres that were granted to James Badgery in 1809 on the northern side of Orphan School Creek Road (now Elizabeth Drive) between Wianamatta/South Creek and what would become Badgerys Creek. Badgery called the property Exeter Farm.

During 1804 and 1805 several raids were made by Aboriginal people across the region including an attack on James Dunlap at Prospect (Natives 1804: 2; Natives 1805b: 3), the killing of two stockmen on John Macarthur's Farm at Camden by Aboriginal people 'from the interior of the mountains" (Sydney 1805a: 3) and raids associated with an Aboriginal man called Musquito (also spelt Mosquito, Musquetta, Bush Muschetta or Muskito) on properties in the Hawkesbury River and Georges River districts. In June 1804, settlers at Porland Head were speared and a reprisal raid by armed settlers was repulsed.

Reverend Samuel Marsden and the residentiary magistrate Mr Arndell met with two Aboriginal men from Richmond Hill called Yaragowby and Yellomundee (also referred to as Yaramandy or Yarramundi) in July 1804 (Natives 1804b:2). They requested help from Yaragowby and Yellomundee to help in ending the conflict and provided gifts of food and clothes to take back to Aboriginal people who were friendly to the British (Natives 1804b:2). Two weeks later, it was reported that Major White and Nabbin (also referred to as Terribandy), two Aboriginal men who the British believed were involved in the violence, had been killed at Richmond Hill (Natives 1804b: 2). In April 1805, a series of meetings between Marsden and Aboriginal people under the protection of John Kennedy were held at Prospect Hill in an effort to reconcile the groups (Postscript 1805: 4). Marsden insisted that reconciliation was not possible until the names of the 'principal murders' were provided. The attendees provided Marsden with the names of six individuals.

Tedbury (also spelt Tjedboro), son of Pemulwuy, was seen by the British as one of the main perpetrators of the violence during this time and was arrested at Pennant Hills in May 1805 (Sydney 1805a: 3). Musquito was captured with the help of Aboriginal people and exiled without charge to Norfolk Island and later Tasmania. Tedbury was released in August 1805 after Aboriginal people who assisted the British in capturing Musquito gave assurances of Tedbury's future good conduct (Sydney 1805b: 2). During 1809, Tedbury was believed to part of a group of Aboriginal people who threw spears at British landholders on the Georges River and was reported waylaying a man named Tunks near Parramatta with Bundle and another assailant (Sydney 1809a: 2; Sydney 1809b: 2; Liston 1988: 58). Tedbury was shot by Edward Luttrell Jnr at Parramatta in 1810 and is believed to have died the same year.

British occupation and policy changed significantly under Lachlan Macquarie, who became Governor of New South Wales on 1 January 1810. During his time as governor, there was a rapid expansion of the British population in New South Wales to almost 30,000 in 1821 (Australian Bureau of Statistics 2008). Macquarie established several towns on the Hawkesbury/Nepean Rivers, approved the 1813 expedition, which identified a pathway across the Blue Mountains and oversaw the subsequent expansion of British occupation west of the mountains and into the Illawarra from 1815.

The expansion of British occupation and a period of drought during 1814-1816 saw another period of intensive conflict involving a series of raids and retaliatory killings at Bringelly, Appin and along the Nepean/Hawkesbury River (Liston 1988: 50-51). Macquarie, in response to conflict in the Appin region during 1814, conducted an enquiry which found that the settlers and their convict labourers had initiated the aggression. Macquarie warned the British colonists not to take the law into their own hands and that Aboriginal people were protected under colonial law (Hale and Koeneman 2010: 3).

Macquarie issued a Government and General Order for the establishment of the Native Institution at Parramatta on 10 December 1814, which would be a residential school for Aboriginal children aged between four and sixteen where they would "be instructed in common, Reading, Writing, and Arithmetic; That the Boys shall also be instructed in Agriculture, Mechanical Arts, and such common Manufactures as may best suit their Ages, and respective Dispositions; That the Girls Shall also be taught Needle-work". The order also stipulated that "no Child, after having been admitted into the Institution, shall be permitted to leave it, or be taken away by any Person whatever (whether Parents or other Relatives) until such Time as the Boys shall have attained the Age of Sixteen Years, and the Girls Fourteen Years; at which Ages they shall be respectively discharged". Land was also to be set aside for farming by former residents of the school.

On 28 December 1814, Macquarie convened a meeting at the marketplace in Parramatta which he had requested that Aboriginal people attend. The meeting, which would be the first of an annual conference, feast and distribution of goods held at Parramatta until 1835, was attended by approximately 60 Aboriginal families and several Aboriginal children who attended were enrolled in the Native Institution at Parramatta (Sydney 1814: 2). Maria, the daughter of Yellowmundee (Yarramundi) was admitted to the Native Institution in 1814 and Billy, of South Creek (possibly Billy Nurragingy) was attending the Native Institution in 1815. The establishment of the Native Institution and annual conference exerted greater control over Aboriginal people and focused on changing the way in which Aboriginal people lived by promoting Christianity, British social practices, and European farming techniques.

The actions taken by Macquarie in 1814 did not stop the hostilities and by April 1816, he ordered soldiers from the 46th Regiment (South Devonshire) under the command of Captain Schaw, Captain James Wallis and Lieutenant Charles Dawe to form three military reprisal raids to track down, capture or kill all Aboriginal people they came across with no distinction between 'friendly' and 'hostile' (Sydney 1816: 2; Brook and Kohen 1991: 22-36).

The response of Aboriginal people and the British to the reprisal raids varied. A group of Aboriginal people including Kogi, Bundle, Boodbury and their families sheltered with Charles Throsby at Glenfield during this period and were actively protected by Throsby who stopped Kogi from being apprehended (Organ 1990: 61). Throsby was a large landholder at this time and had previously used his connections with two Aboriginal men to find a route into the Illawarra in 1815 which further expanded his landholdings (Organ 1990: 48). The reprisal raids were provided with Aboriginal guides including Bundle, Budbury, Colebee (son of Yellowmundee), Nurragingy (also referred to as Creek Jemmy or Jamie) and Tindale. The raids had met with little success prior to Captain Wallis being deserted by his Aboriginal guides Bundle and Budbury and his British guide John Warby (Liston 1988: 54).

Reported sightings of Aboriginal people on Broughton's farm at Appin led Wallis' group further south and on the morning of 17 April 1816 they killed at least 14 Aboriginal men, women and children by shooting and driving the group over the gorge of the Cataract River. The bodies of two men, Durelle and Conibigal (Cannabayagal) were "hung from trees on Broughton's farm as a warning to others" (Liston 1988: 54).

In May 1816, Governor Macquarie proclaimed that in response to the killing of British settlers and the destruction of cattle, grain and property along the Nepean, Grose and Hawkesbury Rivers a military force had been sent to drive Aboriginal people away from the settlements which resulted in the death and wounding of several Aboriginal people that may have included innocent men, women and children (Macquarie 1816: 1). The proclamation declared that Aboriginal people were no longer allowed to be armed with weapons within one mile of British settlements or farms occupied or owned by a British subject and were no longer allowed to gather in groups exceeding six individuals near a farm "on Pain of being considered Enemies, and treated accordingly" (Macquarie 1816: 1). Governor Macquarie's proclamation from May 1816 also stated that Aboriginal people:

> *assembling in large Bodies or Parties armed, and or fighting and attacking each other on the Plea of inflicting Punishments on Transgressors of their own Customs and Manners, at or near Sydney, and other principle Towns and Settlements in the Colony, shall be henceforth wholly abolished, as a barbarous Custom, repugnant to the British Laws, and strongly militating against the Civilisation of the Natives, which is an Object of the Highest Importance to effect, if possible* (Macquarie 1816: 1).

Accounts of combat between Aboriginal parties practicing customary law were relatively frequent prior to Macquarie's proclamation (Natives 1805a: 3; Konishi 2016: 15). Despite Macquarie's attempt to stop the practice within the occupied area, combat associated with customary law continued to be reported in the region until at least the 1820s. The conflict

eventually ended through the outlawing of individuals and an eventual amnesty in November 1816 (Liston 1988: 54-55). On 25 May 1816, Macquarie noted in his journal that:

> *On this occasion I invested Nurragingy, alias Creek Jemmy with my Order of Merit by presenting him with a handsome Brass Gorset or Breast Plate, having his name inscribed thereon in full - as chief of the South Creek Tribe - I also promised him and his friend Colebee a Grant of 30 acres of land on the South Creek between them as an additional Reward for their fidelity to Government and their recent good conduct.*

Macquarie established the practice of giving metal breastplates (also referred to as kingplates, gorgets or badges) to individuals that the British identified as 'chief' of the district they resided in and who would be accountable to the British governor for the conduct of Aboriginal people in that district (Irish 2017: 30-31). The practice of giving breastplates was "an attempt in many instances at social control and domination in the form of 'a badge of distinction', equating and imposing European values and social hierarchy on Aboriginal people and societies (Norris 2019: 32)

Colebee and Nurragingy selected an area in the present-day suburb of Colebee as the location for the grant. Brook and Kohen (1991: 44-45) suggest the location was chosen based on its proximity to the abundant raw materials located at Plumpton Ridge and proximity to the important watercourses of Eastern Creek and Bells Creek; however, it should be noted that several large land grants had been made along Wianamatta/South Creek and Eastern Creek in the years preceding the grant and that the selection was not without limitations. The grant was registered on 31 August 1819 in Colebee's name alone and his heirs "to have and to hold for ever" (Macquarie 1819 [in Brook and Kohen 1991: 38]). A further three land grants along Richmond Road were registered on the same date to three British colonists, including Reverend Robert Cartwright, who Brook and Kohen (1991: 42-43) suggest were part of a plan by Macquarie to shape the nature of the settlement.

During the first half of the nineteenth century, the lives of Aboriginal people of the Sydney Region were increasingly entangled with those of the British. Settlements and land grants restricted movement across and access to traditional lands that Aboriginal people relied upon for subsistence and cultural activities. The displaced had to either move away from their Country or seek employment, often as labourers in settlements, on rural properties or ships (Backhouse 1843: 304; Hassall 1902: 3). Some access to traditional lands continued, possibly associated with employment on the larger estates, with corroborees documented until at least the 1850s on properties including Camden Park, Denbigh and Denham Court (Liston 1988: 57; Hassall 1902: 3). Charles Darwin, who travelled through the region on his way to Bathurst in 1836 noted that he had met a group of Aboriginal people at Penrith who continued to hunt using spears and other weapons (Darwin 1933: 378).

James Backhouse recorded visiting Charles Marsden and his family at their property on Wianamatta/South Creek in the 1830s. In his account, Backhouse noted that Aboriginal people from a group associated with Wianamatta/South Creek were living beside the creek in the vicinity of the property and that they assisted with the agricultural operations of settlers (Backhouse 1943: 304). Charles Marsden provided Backhouse with Simeon as a guide for his onward journey to Penrith who was noted as a member of the Wianamatta/South Creek group (Backhouse 1943: 304).

Aboriginal people continued to act as guides for the British as they explored areas outside the Cumberland Plain with Budbury guiding Governor Macquarie to the Nattai River in 1815 and Bundle guiding Meehan, Throsby and Hume on their attempt to find an overland route to Jervis Bay in 1818 (Yamanouchi 2007: 24). Some individuals were appointed as constables including Bundle, who was appointed a constable of Upper Minto in 1822 and Colebee, who was appointed a constable of the District of Windsor in 1825 (CSO 1825: 4. Liston 1988: 57-59).

Daniel Moowattin (also spelt Mow-watty, Mowwatting, Moowatting and Moowattye), a Darug man born at Parramatta around 1791, became the guide, interpreter and helper of George Caley who collected botanical specimens for Joseph Banks and travelled to Norfolk, Tasmania and England with him (Smith 2005). The trial, conviction and execution of Daniel Moowattin in 1816 represented a shift in British judicial practice from the existing legal pluralism to the enforcement of territorial sovereignty (Ford and Salter 2008). While the trial ultimately focused on Daniel Moowattin's familiarity with British law and customs, it was also part of the wide scale reform of colonial governance in the Macquarie period which sought to expand British territorial sovereignty and jurisdiction (Ford and Salter 2008: 64-65).

The expansion of British occupation beyond the Cumberland Plain increased the number of Aboriginal people attending the annual feasts at Parramatta and included groups from west of the Blue Mountains and Port Macquarie. Reverend James Hassell noted that on one occasion in the 1830s, an estimated 600 to 700 Aboriginal people were camped between Paramatta and Prospect for the annual feast (Hassell 1902: 17). The annual feasts appear to have been a time when the parents were able to see their children at the Native Institution, as noted by Macquarie in his journal on 12 January 1817:

> *This day Nurragingy (als. Creek Jemmy) the Chief of the South Creek, and Mary-Mary the Chief of the Mulgowy – Natives – with their respective Tribes amounting to 51 (men, women & children) Persons, paid me a visit at Parramatta – and were entertained in the Govt. Domain there by*

> *direction of Mrs. Macquarie with Breakfast and Dinner this Day; the 17 Native Children at the Institution having also been entertained with Fruit and presented to their Parents & Relatives belonging to those two Tribes.*

A settlement developed around the Colebee and Nurragingy land grant as the colonial government attempted to entice Aboriginal people into adopting European practices. Robert (Bobby) Nurragingy, son of Nurragingy, and Michael Yarringguy, a constable at Richmond were granted land along Richmond Road that were equipped with huts and farming equipment after their marriages to former residents of the Native Institution, Polly and Betty Fulton, on 15 March 1821. By 1821, thirteen residents were living in the area which known as Black Town (GML 2004: 22).

In 1823, the Native Institution was moved to land adjacent to the Colebee and Nurragingy land grant, on the western side of Richmond Road. Reverend Samuel Marsden was appointed the school committee's chairman by Governor Brisbane in 1823 but was dismissed in 1824. The Native Institution and the policies implemented by Lauchlan Macquarie appear to have been largely unpopular with the Aboriginal people living in the region at the time. In October 1818, Reverend Walter Lawry noted in his diary the following meeting with Yellowmundee:

> *As I approached, the women and children ran away; but the king (Yellowmonday), with several men, came to meet me. I enquired why the children were carried off; they replied that many of them had been taken away by men in black clothes, and put to school at Parramatta, and they feared I was come on that errand. After assuring them to the contrary, the King dispatched messengers after the absentees, who presently mustered them on the spot where I was conversing with their Chief.* (Brook and Kohen 1991: 263)

From 1823 onwards, historical records also indicate that a number of Aboriginal people were present in the area and were camping along Bells Creek in order to remain near their children who were in the Institution (Bickford 1981:15). Archdeacon Scott noted in 1827 that regarding Nurragingy's son leaving his child at the Native Institution, "he has taken her away and will not suffer her to return on any consideration whatever" (HOC 1831: 16). Governor Darling wrote in 1828 that some of individuals with whom he had spoken:

> *were brought up at the School established by the late Governor Macquarie, and learned not only to read, but write. They returned however to their Tribes as soon as their education was finished, and having remained with them in the woods, though accustomed for some considerable time to the comforts of a house, good food and clothing.* (HOC 1831: 13)

As the British occupation expanded beyond the Sydney region, the institution became increasingly remote from its boundaries and Aboriginal people whose Country was being taken. Archdeacon Scott reported to Governor Darling in August 1827 that there was no chance that Aboriginal people living beyond the Sydney region would consent to sending their children to the Native Institution at Blacktown (HOC 1831: 15). A proposal for the establishment of missions within the newly occupied areas was adopted and by 1833, the institution at Blacktown was closed.

The allocation of land to Aboriginal people for European farming also seems to have met with little success. Reverand Cartwright, in a letter to Lauchlan Macquarie from January 1820, believed that the "settling" of individuals at Blacktown as in the case of an individual who is most likely Nurragingy, had meet with limited success because of the isolation from their mob which Cartwright believed was "a trial too great" (HOC 1831: 5-6). Scott noted that in 1827, Nurragingy's cattle had increased and that he often asked Scott to sell them (HOC 1831: 16)

Colebee returned to Windsor where he became a constable in 1822 (CSO 1825: 5). Colebee, Nurragingy and his son Bobby were reported to have attended a meeting of Aboriginal people in Windsor on 28 August 1826 (To the Editor 1826: 4). The meeting discussed the beneficial effect of employing Aboriginal people in the police department and Colebee made several resolutions that included the districts embracing Black Town, cruelty to animals be prevented and that rivers to the most insignificant jet should be protected.

William Walker recalled that during the late 1830s that Nurragingy (who he called Jamie), his wife and their sons Bobby and Billy camped on Wianamatta/South Creek, near Macquarie Street at Windsor and that Billy occasionally worked on some farms in the region (Walker 1890: 7). He noted that "Jamie wore a brass plate suspended by a string from his neck, bearing his name, and which he said had been given him by good Governor Macquarie" (Walker 1890: 7).

In 1824, Maria married convict carpenter Thomas Lock in the first officially sanctioned marriage between a convict and an Aboriginal woman. The newlyweds settled on a small farm at Blacktown but later moved to Liverpool. In 1831, Maria petitioned Governor Darling for her deceased brother Colebee's lands at Blacktown as his heir and in exchange for a small grant that had been promised to her as a marriage portion. The petition failed; however, Maria continued to petition successive governors for the grant until 1843 when it was transfer to her. Maria and her family relocated to the land grant the following year and soon after acquired the 30 acres originally granted to Sylvanus Williams. Maria, who died in 1878 was recorded on the parish burial registration as the "Last of the Aboriginals from Blacktown" despite her

descendants owning the land grant until the 1920s when the title was revoked by the Aborigines Protection Board (Parry 2005).

The humanitarian movement in Britain in the 1830's drove a change in government policy towards the Indigenous inhabitants of the British Empire that recognised the harmful process of colonisation and dispossession (Perche 2015: 51). In 1837, a British Parliamentary Select Committee published a report on the situation of Aboriginal peoples in British colonies around the world that acknowledged that it didn't appear that the territorial rights of Aboriginal people in Australia were considered, and that Aboriginal people had been the victims of many acts of murder and violence that had been committed by British civilians and military parties (PSCAPS 1837: 10). Aboriginal cultural and traditions were not acknowledged by the report which instead recommended the protection of Aboriginal people from abuses, the provision of critical supplies and conversion to Christianity. In 1840, the governor of New South Wales was directed by the Colonial Office:

> *that it is necessary from the moment the Aborigines of this Country are declared British Subjects they should, as far as possible, be taught that the British Laws are to supersede their own, so that any native, who is suffering under their own customs, may have the power of an appeal to those of Great Britain, or, to put this in its true light, that all authorized persons should in all instances be required to protect a native from the violence of his fellows, even though they be in the execution of their own laws.* (CoA 1924: 34)

The publication of Darwin's *On the Origin of Species* in 1859 and an increasing interest in the study of human behaviour and societies during the mid-nineteenth century in Europe resulted in the publication of several studies on Aboriginal culture and languages by anthropologists including M. Everritt, R. H. Matthews, A.W. Howitt and W Baldwin Spencer (Thomas 2007: 89). The information within the publications was gathered from Aboriginal people who were often unacknowledged including Emma Timbery, a Dharawal woman who was living at La Perouse and Jimmy Lowndes who provided Matthews with information on the Darug, Dharawal and Gundungurra (Goodall and Cadzow 2009: 86; Thomas 2007: 3).

In February 1883, the NSW Legislative Assembly established the NSW Board for the Protection of Aborigines (NSWBPA) to financially support existing stations, administer missions, and to provide blankets and rations (Doukakis 2006: 9). The protection advocated by the NSWBPA was not the preservation of Aboriginal culture and beliefs, but instead a continuation of the belief that Aboriginal people needed to change their lifestyle and beliefs in order to assimilate (SCLCA 2006: 14). The NSWBPA was tasked with "the elevation of the race, by affording rudimentary instruction, and by aiding in the cost of maintenance or clothing where necessary, as well as by grants of land, gifts of boats, or implements of industrial work" (NSWLA 1883: 920). The NSWBPA determined whether an individual was Aboriginal, primarily on the basis of skin colour which resulted in the separation and alienation of members of the Aboriginal community (HREOC 1997: 24).

The migration of Aboriginal people from outside the Cumberland Plain for economic or social reasons was also documented in the second half of the nineteenth century and became a dominant issue for George Thornton (Goodall and Cadzow 2009: 110-113). The formation of the NSWBPA saw the adoption of an isolationist policy that shut down most informal Aboriginal settlements across the Sydney region and moved the inhabitants into reserves at La Perouse, Sackville, the Burragorang Valley and elsewhere in the state. The Aboriginal people living within the reserves were effectively segregated from the rest of the population and many were moved away from their traditional lands.

On 1 January 1901, the Commonwealth of Australia was established, and the Constitution of Australia came into effect. The constitution mentioned Aboriginal people in Section 51(xxvi) where they were excluded from part of the people which the Commonwealth government could make *laws for the peace, order and good government* and Section 127 which excluded Aboriginal people from *reckoning the numbers of the people of the Commonwealth, or of a State or other part of the Commonwealth*. The reason for the wording of these sections was not recorded; however, the ramifications of Section 51(xxvi) was to keep the administration and control of Aboriginal people in the hands of the state governments while Section 127 excluded Aboriginal people from having a role in Federal politics (Gardiner-Garden 2007: 4).

Between 1909 and 1969, the NSW Government introduced legislation that is commonly referred to as the 'Protection Acts' which gave the NSWBPA increasing control over the lives of Aboriginal people and were used to implement "policies of protection, separation, absorption and assimilation of Indigenous populations, depending on the prevailing philosophy of governments at the time" (SCLCA 2006: 7). The *Aborigines Protection Act 1909* gave the NSWBPA statutory powers in relation to reserves which it defined as "area of land heretofore or hereafter reserved from sale or lease by the Governor, or given by or acquired from any private person, for the use of aborigines". The statutory powers included the appointment of managers, power to remove people from reserves, ownership of structures, livestock and other items within the reserves, and the ability to apprentice Aboriginal children living in the reserve. The *Aborigines Protection Amending Act 1915* gave the board full control of Aboriginal children, including with the ability to apprentice Aboriginal children under circumstances the board thought were desirable, and to removing them to a home or institution if they refused.

The Protection Acts were used by the NSWBPA to implement policies separating Aboriginal children from their parents in order to encourage "the conversion of the children to Christianity and distancing them from their Indigenous lifestyle" (SCLCA 2006: 8). The children were placed into state run homes including Cootamundra Girls Home and Kinchela Aboriginal Boys Training Home and would become known as the stolen generation. The *Bringing them Home Report*, published in 1997 documented the harsh and often abusive treatment of the children in state run homes that lead to multitude of disadvantages (HREOC 1997: 11-13).

In 1937, the Australian Aborigines' League was established to campaign against discriminatory legislation. The Aborigines Progressive Association was cofounded in the same year. On 26 January 1938, the 150th anniversary of the beginning of British occupation in Australia, the Aborigines Progressive Association supported by the Australian Aborigines' League, held the Day of Mourning & Protest in Sydney. The Day of Mourning & Protest was organised to generate public awareness of the civil rights issues and included many Aboriginal civil rights activists. An appeal to the citizens of the Australian Commonwealth was published as part of the Day of Mourning & Protest in which it was argued that state policies towards Aboriginal people were hypocritical and did not protect them but instead made Aboriginal people "deprived of ordinary civil legal rights and citizenship, and we[sic] are made a pariah caste within this so-called democratic community" (Patten and Ferguson 1938: 3). It argued against charity and instead demanded "FULL CITIZEN STATUS and EQUALITY WITHIN THE COMMUNITY" (Patten and Ferguson 1938: 12).

By the mid-1960's, Aboriginal opposition to assimilation was strengthening and an Indigenous civil rights movement was growing under the banner of self-determination. On 27 May 1967, a referendum was held in which Australians voted to change the Australian Constitution to give the Commonwealth Parliament power to make laws with respect to Aboriginal people wherever they lived in Australia and to make it possible to include Aboriginal people in national censuses. The Protection Acts were predominantly repealed by the *Aborigines Act 1969* and the Aboriginal community were, for the first time since 1788, granted the same rights as other Australian citizens.

In 1972, the Whitlam government officially changed the approach to Aboriginal affairs from a policy of assimilation to one of self-determination. The Aboriginal and Torres Strait Islander Commission (ATSIC) was established, composed of Indigenous peoples whose role was to maximise participation of the community in the development and implementation of policies that affected them. Self-determination brought significant challenges to many Aboriginal communities, who were often left under-resourced and unequipped to meet the challenges imposed upon them by top-down approach of the new system. ATSIC was abolished following election of the Howard government in 1996.

The long struggle for recognition, self-determination and acknowledgement forms part of the Aboriginal cultural heritage story and lived experience of contemporary Aboriginal people. New South Wales has the largest Aboriginal population in Australia and the Aboriginal people of New South Wales "continue to fight to protect cultural heritage and maintain cultural practices" (Hunt and Ellsmore 2016: 78). Members of the contemporary Aboriginal community continue to experience connection with the area through cultural and family associations.

4 Archaeological Context

The current scientific understanding of the human occupation of the Australian continent is that Aboriginal people have lived in Australia for at least the last 40,000 years (Attenbrow 2010: 182). Archaeological evidence shows that the Sydney Region has been occupied since at least 18,000 years ago (Attenbrow 2010: 3). Aboriginal archaeological sites with deposits that have returned earlier dates have been reported; however, these dates are problematic due to the limitations of the technology and evidence being used.

Archaeological investigation is reliant on the artefacts or physical evidence of human activities which have survived anywhere from centuries to thousands of years. The oldest of these artefacts are likely to represent a small fraction of the objects that were used by Aboriginal people with even the most robust organic materials unlikely to survive in contexts older than 6,500 years (Attenbrow 2010: 3). As a result, activities involving objects made from less survivable materials are almost invisible within the archaeological record of the region and the spatial distribution of Aboriginal archaeological sites in the region is unlikely to be an accurate indicator of the extent or nature of the land use practices of past Aboriginal people.

Aboriginal people living in the region during the late eighteenth and nineteenth centuries made a range of items from organic materials including watercraft, shelters, containers, nets, spears, clubs and shields. Cloaks made from skins were also worn by Aboriginal people living in the mountainous areas (Russell 1914: 10; Bladen 1897: 753). Variations are likely to have occurred in the types of items made from organic materials over time, across regions and between groups; however, these items are largely unknown in the archaeological record and the small number that have survived were acquired by museum collections in Australia and around the world (Megaw 1993).

Aboriginal archaeological sites with art provide insight into the Aboriginal people who lived in the region. Art preserved at Aboriginal archaeological sites in the region was created as pictographs (paintings, drawings) or stencils using pigments and petroglyphs (engravings). Aboriginal archaeological sites with art are restricted to areas where outcropping of the underlying sandstone geology occur and are predominately found around the edges of the Cumberland Plain. Analysis of the motifs, colours used, and composition of pigments indicate that spatial and temporal variations occurred between and within regions (McDonald 2008; Dibden 2019; Huntley, Watchman and Dibden 2011).

The most numerous objects recovered from sites in the Sydney Region are the result of the procurement, modification and/or use of specific types of lithic material by past Aboriginal people. The objects (lithics) consist of artefacts, which have technical attributes from intentional flaking (flakes and cores), grinding (ground-edge implements) and/or pitting (hammerstones and anvils), and other lithic items that were transported to the site but do not exhibit sufficient attributes to be identifiable as an artefact. Non-artefactual lithic items may lack modification (manuport) or may be a fragment of a larger item that was subject to heat (heat shatter), trampling or other breakage.

Stone artefacts and non-artefactual lithic items were discarded in either open landscape settings (known as artefact scatters or isolated artefacts) or within closed landscape settings (primarily rock shelters) within the sandstone geology surrounding the Cumberland Plain. The accumulation of stone artefacts in both settings may have occurred over a large time span and have been subject to a range of geomorphic processes and human activities; however, due to the nature of closed context sites, the artefacts deposited within these sites may retain some level of chronological association within stratigraphically distinct units while open context sites are generally palimpsests in which chronological association between stone artefacts and any datable features present are often difficult to determine (see Attenbrow 2010; White 2018).

Archaeological investigations have shown that significant changes have occurred within the types of artefacts used, artefact raw materials and the spatial distribution and density of Aboriginal archaeological sites in addition to the landscape and environment. Around 10,000 years ago, the artefact assemblage from Aboriginal archaeological sites in the region was characterised by a preference for relatively large artefacts made from indurated mudstone/tuff (IMT) using free hand percussion. Formal tools were predominantly retouched flakes while flaked pebble tools have also found at some sites dating to this phase.

Approximately 5,000 years ago, there was a general decline in IMT artefacts, an increase in smaller artefacts made from locally available materials and higher artefact density. In addition, backed artefacts and edge ground artefacts are believed to have been introduced into the region. Small, flaked stone artefacts with steep retouch known as backed artefacts were extensively made across the region between 3,500 and 1,500 years ago (Robertson, Attenbrow, and Hiscock 2009: 296). Residue and use-wear analysis of backed artefacts indicate that they were used for cutting, incising, and scraping of animal and plant materials (Robertson, Attenbrow, and Hiscock 2009: 298).

Edge ground hatchets, which are frequently referred to by the British during the late eighteenth and early nineteenth centuries, occur in the archaeological record of southeastern Australia from around 4,000 years ago while significantly older examples have been recovered in the north of Australia (Attenbrow 2012: 102). Edge ground hatchets were made primarily made from water worn metamorphic stone that was ground on an abrasive surface, such as sandstone, to

produce an edge and were used primarily for cutting wood, stripping bark and other woodworking tasks (Corkill 2005: 48; Stokes 2015: 70). Analysis of edge ground hatchets from the region have shown that the metamorphic and igneous stone required were only accessible at certain locations such as the Hawkesbury/Nepean River and the Shoalhaven River (Stokes 2015). The distribution of sandstone outcrops would have also influenced the creation and maintenance of edge ground hatchets.

During the last 1,500 years, the use of backed artefacts substantially decreased or disappeared across the region and there was a general increase in edge ground hatchets. Along the coast and within sandstone geology, archaeological assemblages from this period contain a larger proportion of quartz and bipolar artefacts while silcrete and IMT continued to be used on the western Cumberland Plain. The general variation in artefact assemblages between coastal and inland sites has been interpreted as suggesting social changes occurred during this period which restricted the access of coastal groups to the raw materials of the western Cumberland Plain (Attenbrow 2012: 156).

4.1 Archaeological assessment – Badgerys Creek Wastewater Stage 2

An archaeological assessment was undertaken for the Badgerys Creek Wastewater Stage 2 project (KNC 2024). The assessment included a desktop review of the environmental context and previous archaeological investigations within and in the vicinity of the proposed works area, archaeological field survey, and archaeological test excavations. The review of the environmental context is summarised in Section 2 and the results of the assessment are summarised in the following sections.

4.1.1. Desktop assessment

The archaeological assessment undertook a desktop review of archaeological investigations in the region to verify the location of previously recorded Aboriginal archaeological sites and identifying locations within the assessment area where there was potential for Aboriginal archaeological sites to occur. The desktop review conducted a search for previously recorded Aboriginal archaeological sites and declared Aboriginal places in the Aboriginal Heritage Information Management System (AHIMS), a database operated by Heritage NSW and regulated under Section 90Q of the *National Parks and Wildlife Act 1974*, within 500 metres of the assessment area.

The search results identified 79 AHIMS registered items that had been previously recorded in the wider region, including BC/ED1 (AHIMS 45-52309), M12 A2 (AHIMS 45-5-4748), and EDU Badgerys Creek IF 1 (AHIMS 45-5-5733) that were registered within the assessment area and a further 24 items that were registered within 250 metres. A review of the available information identified a further four AHIMS registered items with mapped extents that overlapped the assessment area (Badgerys Creek East - AHIMS 45-5-5294, Badgerys Creek West B – AHIMS 45-5-5298, South Creek West T1 – AHIMS 45-5-5307, and South Creek West T2 – AHIMS 45-5-5308). The mapped extent for Badgerys Creek East (BCE) encompassed M12 A2 and two additional AHIMS registrations (Fleurs 2 - AHIMS 45-5-0528 and M12 A3 - AHIMS 45-5-4750) which were surface artefact scatters within the larger archaeological site (Figure 5).

The AHIMS registered items were almost entirely open context (artefact scatter or isolated artefact) sites containing stone artefacts (n=73); however, an area of grinding grooves, a culturally modified tree and three areas of potential archaeological deposit (PAD) had also been recorded. The AHIMS registrations were the result of several archaeological investigations that had been undertaken in the wider region since the 1980s and included archaeological field surveys, test excavations and salvage excavations. Previous archaeological investigations were generally undertaken in association with infrastructure projects, including the Western Sydney International (Nancy-Bird Walton) Airport, the Sydney Metro — Western Sydney Airport, the M12 Motorway, Elizabeth Drive and the Upper South Creek Advanced Water Recycling Centre. As such, in areas where infrastructure projects had not occurred, significantly fewer Aboriginal archaeological sites had been recorded.

The archaeological investigations for the Upper South Creek Advanced Water Recycling Centre (AWRC) overlapped the northeastern portion of the current study area on the eastern side of Wianamatta/ South Creek. The AWRC investigation area also included a linear corridor of approximately 32 kilometres that extended from Warragamba in the west to Lansdowne in the east, and the footprint of ancillary facility at Wallacia. The investigations, which included archaeological field survey and test excavation identified three Aboriginal archaeological sites in the vicinity of the northeastern portion of the current study area. The sites consisted of an archaeological site complex (South Creek East - AHIMS 45-5-5306), an area of grinding grooves (South Creek), and a culturally modified tree (South Creek, Exeter House TRE 1).

South Creek (AHIMS 45-5-0215) comprised a sandstone slab with at least 12 grinding grooves that was located on the bank of a minor drainage gully west of Wianamatta/ South Creek approximately 700 metres south of the current study area. South Creek, Exeter House TRE 1(AHIMS 45-5-5878) consisted of a tree with a bark removal scar and was located approximately 20 metres east of the grinding grooves and 700 metres south of the current study area. The elongate oval scar was partially covered by regrowth at the top and measured 105 centimetres in length and 25 centimetres in width with a regrowth thickness of six centimetres.

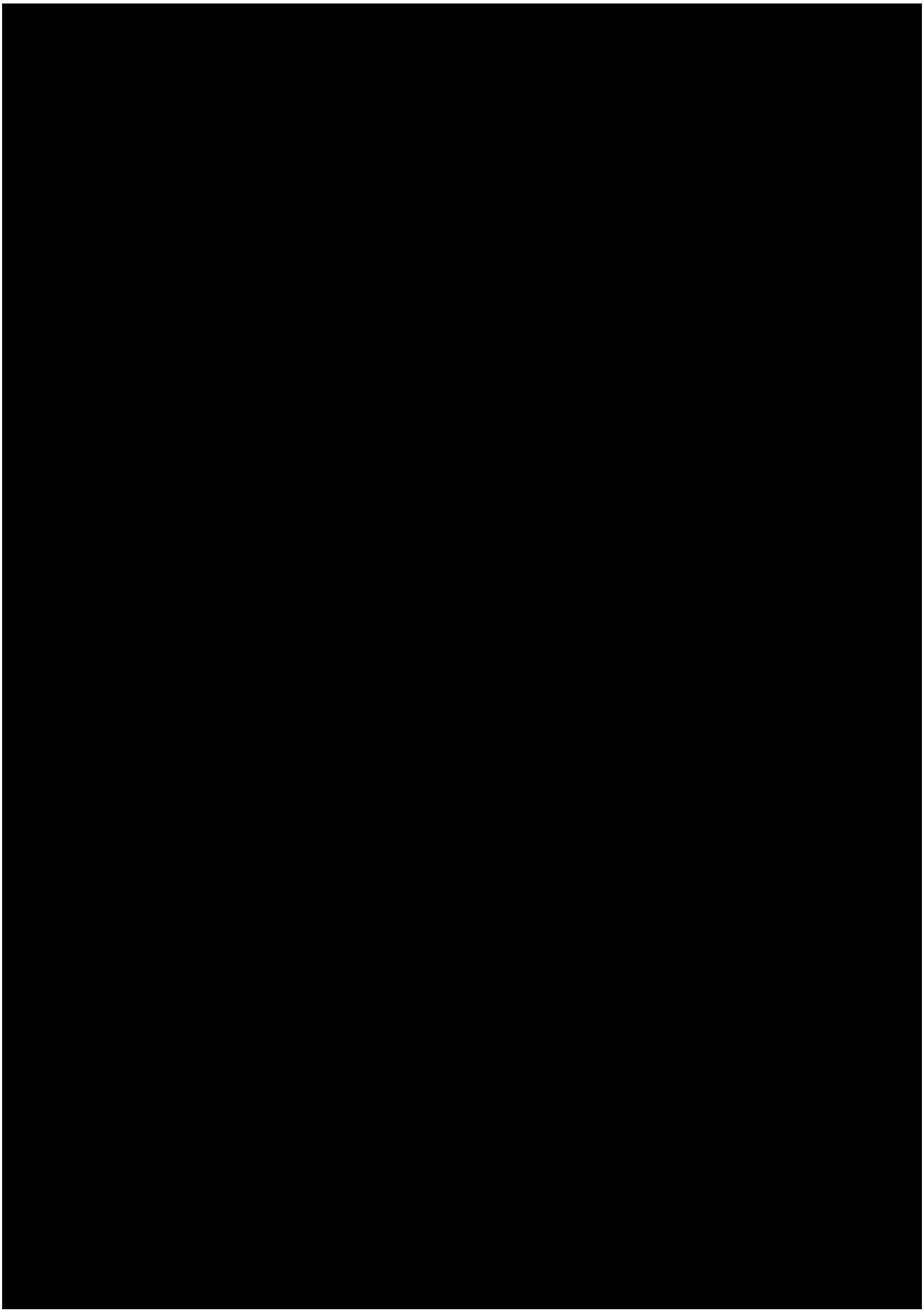


Figure 5. Previously identified sites within and in the vicinity of the study area

South Creek East (AHIMS 45-5-5306) was located on the southern side of the confluence of the north flowing Wianamatta/South Creek and Kemps Creek approximately 60 metres east of the current study area. The site complex extended across the crest at the northern extent of spur and low rises within flats to the north, east and west. The spur descended to the northwest from a north-south oriented ridge. South Creek East was situated on the southern side of the confluence of the north flowing Wianamatta/South Creek and Kemps Creek. The site complex included surface artefact scatters Fleurs 1 (AHIMS 45-5-0496) and M12 A4 (AHIMS 45-5-4749) which were identified within and in the vicinity of a track that was located on the western edge of the spur and lead from a concrete bridge spanning Wianamatta/South Creek towards the former Fleurs Radio Telescope facility in the northeast. An outcrop of silcrete nodules was identified along the eastern bank of Wianamatta/ South Creek, approximately 200 metres south of the bridge. As discussed in Section 2.2, the silcrete and sandstone identified in the vicinity of South Creek East are not part of the mapped geological units of the area and it is likely that the area would have been a focal point for activities that required these resources.

Archaeological test excavations were undertaken at South Creek East as part of the investigations for the Upper South Creek Advanced Water Recycling Centre and the M12 Motorway which ran east-west through the southern portion of the site complex approximately 100 metres southeast of the current study area. A total of 76.25 square metres were excavated during the test excavations at SCE and 871 lithics were recovered. The lithics comprised 567 artefacts and 304 non-diagnostic angular fragments. The artefacts and non-diagnostic angular fragments were predominantly silcrete (n=631) or IMT (n=176); however smaller quantities of other raw materials including quartz (n=37), and chert (n=5) were also recovered. The artefacts included unmodified complete flakes (n=227) and flake fragments (n=262), cores and core fragments (n=38), backed artefacts (n=9), and retouched artefacts (n=14). The horizontal distribution of artefacts within the tested area was irregular and generally characterised by three low density areas on crest and elevated landforms in the north, low to high density across the crest and slope landforms in the southwest and dispersed isolated artefacts within a former drainage line and on a low lying crest in the southeast.

The subsurface deposit varied in depth across the tested area with test squares on the crest of the elevated landform and elevated predominantly less than 40 centimetres in depth and characterised by silty or sandy loam overlying basal clay. The test squares located on slopes and within open drainage depressions were generally between 50 and 60 centimetres deep sandy silty loam. An transect of slightly deeper deposit was uncovered approximate 85 metres southwest of the intersection of two of the former telescope arms. The deposit within this area comprised a bleached silty loam with ferromanganese overlying basal clay.

Archaeological salvage excavations were undertaken at SCE to mitigate the impacts of the Upper South Creek Advanced Water Recycling Centre and the M12 Motorway in accordance with State Significant Infrastructure (SSI) approvals SSI-9364 and SSI-8609189. The M12 Motorway salvage excavations at SCE were undertaken in two phases (Phase 1 and 2) and consisted of 44 Phase 1 squares that were excavated at regular intervals across the western edge of the spur crest and 206 Phase 2 squares that were excavated around a Phase 1 square to form two large excavation areas (Open Area 1 and Open Area 2).

A total of 4,467 lithics were recovered from 43 of the 44 the Phase 1 squares excavated at SCE. The horizontal distribution of lithics across the salvage excavation area at SCE was characterised by high to very high densities within most squares with moderate to high densities within the squares along the northern and southern boundaries. The lithics consisted of 2,952 artefacts and 1,515 non-diagnostic angular fragments, with an average mean artefact density of 67.1 per square metre. The artefacts and non-diagnostic angular fragments were predominantly silcrete (n=3,306) while smaller quantities of other raw materials including IMT (n=582), quartz (n=454), and chert (n=63) were also recovered. The artefacts included unmodified complete flakes (n=961) and flake fragments (n=1,842), cores and core fragments (n=72), backed artefacts (n=42), and retouched artefacts (n=32).

The Phase 2 excavation at Open Area 1 comprised 156 squares that were excavated around a Phase 1 square (813E 030N) that contained 222 artefacts and 155 non-diagnostic angular fragments. The open area was situated at the western extent of the spur crest, approximately 20 metres southeast of concrete bridge. A total of 28,931 lithics were recovered from the Phase 2 squares excavated at Open Area 1 that consisted of 16,859 artefacts and 12,072 non-diagnostic angular fragments, with an average mean artefact density of 108 per square metre. The horizontal distribution of lithics within Open Area 1 was characterised by high to very high densities with very high densities in the northwest and small clusters of moderate to high density.

The Phase 2 excavation at Open Area 2 comprised 50 squares that were excavated around a Phase 1 square (828E 000N) that contained 105 artefacts and 47 non-diagnostic angular fragments. The open area was situated at the western extent of the spur crest, approximately 20 metres southeast of Open Area 2 and 50 metres southeast of concrete bridge. A total of 7,014 lithics were recovered from the Phase 2 squares excavated at Open Area 2 that consisted of 4,345 artefacts and 2,669 non-diagnostic angular fragments, with an average mean artefact density of 86.9 per square metre. The horizontal distribution of lithics within Open Area 2 was characterised by high to very high densities with moderate to high densities within the squares along the southwestern boundary.

A total of 35,945 lithics were recovered from the Phase 2 squares excavated at SCE. The lithics consisted of 21,204 artefacts and 14,741 non-diagnostic angular fragments, with an average mean artefact density of 102.9 per square metre. The artefacts and non-diagnostic angular fragments were predominantly silcrete (n=28,741) while smaller quantities of other raw materials including IMT (n=3,321), quartz (n=3,276), and chert (n=285) were also recovered. The artefacts included unmodified complete flakes (n=6,015) and flake fragments (n=13,898), cores and core fragments (n=635), backed artefacts (n=425), and retouched artefacts (n=197).

The M12 Motorway construction area also encompassed parts of the northern portion of the current study area and included an area approximately 70 metres south of the current study area and immediately north of Elizabeth Drive and west of Badgerys Creek. The archaeological investigations for the project identified three Aboriginal archaeological sites in the northern portion of the current study area (BCE, South Creek West T1 - AHIMS 45-5-5307, and South Creek West T2 - AHIMS 45-5-5308) and one site that was identified to the south and west of the study area (Badgerys Creek West B - AHIMS 45-5-5298).

BCE (AHIMS 45-5-5294) was an archaeological site complex that was situated on a low spur and adjacent flat that separated the north flowing Badgerys Creek from an unnamed north flowing tributary. The site complex was immediately west of South Creek West T2. Badgerys Creek West B (BWB) was a subsurface archaeological deposit that was identified by the investigations on gentle lower slopes and elevated flats that were bound by an unnamed tributary creek and inline dams to the north and west, Badgerys Creek to the east, and Elizabeth Drive to the south. The site was approximately 30 metres southwest of BC/ED1 (AHIMS 45-5-2309).

South Creek West T1 (SCW T1) was a subsurface archaeological deposit that was located on an elevated flat and was bound by Wianamatta/ South Creek to the north and east, the gentle northern slope of a spur to the south and the steep eastern slopes of a spur to the west. The site was immediately east of South Creek West T2 and on the opposite side of Wianamatta/ South Creek to South Creek East. South Creek West T2 (SCW T2) was a subsurface archaeological deposit that was located on the crest of a north oriented spur that separated Wianamatta/ South Creek to the east from a north flowing tributary to the west. The site was immediately west of SCW T1 and east of BCE. Archaeological test and salvage excavations were undertaken at the four Aboriginal archaeological sites and the results are summarised in Section 6.2.

Archaeological investigations were undertaken prior to the construction of the Sydney Metro — Western Sydney Airport which extend for approximately 23 kilometres between St Marys in the north and the Aerotropolis Core precinct, near the intersection of Badgerys Creek Road and The Northern Road in the south. The project, which was granted State Significant Infrastructure approval (SSI-10051) on 23 July 2021 and the construction area of the project overlapped two portions of the current study area on the northern side of Elizabeth Drive and west of Badgerys Creek (see Figure 6). The investigations identified two Aboriginal archaeological sites within 100 metres of the current study area (SMWSA-AS8 – AHIMS 45-5-5535 and SMWSA-IA2 – AHIMS 45-5-5537) and determined that BWB (AHIMS 45-5-5298) extended north of the northeast flowing tributary onto the adjacent slopes and lower spur crest which included a portion of the current study area. An archaeological salvage excavation was undertaken within the western portion of BWB (AHIMS 45-5-5298) to mitigate the impacts of the Sydney Metro — Western Sydney Airport. The results of the salvage excavation are summarised in Section 6.1.3.

SMWSA-AS8 (AHIMS 45-5-5535) was a subsurface archaeological deposit that was located approximately 75 metres west of the current study area. The site was situated on a southeastern mid slope which descended from a north-south oriented ridge crest to the west and overlooked the confluence of two minor tributaries of Badgerys Creek that flowed from headwaters on the slopes of the ridge either side of the site. The test excavation recovered two artefacts at the site; however, no further information on the test excavation program or artefacts is available.

SMWSA-IA2 (AHIMS 45-5-5537) was an isolated subsurface artefact that was located approximately 75 metres west of the current study area. The site was situated on a spur crest that descended to the east from a north-south oriented ridge crest and overlooked the confluence of two minor tributaries of Badgerys Creek that flowed from headwaters on the slopes of the ridge either side of the site. The test excavation recovered one artefact at the site; however, no further information on the test excavation program or artefact is available.

Several archaeological investigations have been undertaken for proposed upgrades to Elizabeth Drive that included the portion of the current study area within and in the vicinity of the road corridor. The investigations identified two Aboriginal archaeological sites that were within the current study area: BC/ED1 (AHIMS 45-52309) and EDU Badgerys Creek IF 1. The sites were identified within a property that was being used as an equestrian facility on the northern side of Elizabeth Drive and east of Badgerys Creek.

A surface artefact scatter (BC/ED1 - AHIMS 45-52309) was identified within a paddock that was located on a terrace between the slopes of a spur to the east and a lower flat to the west which was adjacent to the eastern bank of Badgerys Creek. EDU Badgerys Creek IF 1 (AHIMS 45-5-5733) was initially identified as an area of potential archaeological deposit that was located on the same terrace as BC/ED1, approximately 120 metres to the southeast. An archaeological test

excavation at the site recovered one silcrete medial flake fragment from one of the nine test squares excavated at the site. The results of the test excavation at EDU Badgerys Creek IF 1 are summarised in Section 6.1.4.

An archaeological investigation was carried out as part of the planning process for a proposed industrial redevelopment at 125-175 Lawson Road, which overlapped a portion of the current study area, south of Elizabeth Drive and east of Badgerys Creek. The investigation identified six stone artefacts within two large areas of ground exposure that were created by infilling and levelling of preexisting dams. The artefacts were assigned individual identifiers (LR 1-6) and registered on AHIMS separately (AHIMS 45-5-5696-AHIMS 45-5-5701). The artefacts consisted of two silcrete flakes, two silcrete flake fragments, one IMT flake, and one IMT angular fragment that were approximately 20 metres to 150 metres west of the current study area.

The investigation also identified traces of charcoal and burnt clay were identified within the truncated deposit in the northern disturbance area, approximately 205 metres west of the current study area. Despite stated uncertainties relating to the origin of the charcoal and burnt clay, the area was assigned the designation LR07 and registered on AHIMS (AHIMS 45-5-5702). In addition, an area of potential archaeological deposit, designated PADLR was registered on AHIMS (AHIMS 45-5-5703) approximately 20 metres to the west of the current study area. The area of PAD and recorded artefacts were located in an area that had been heavily disturbed by market gardening and bulk earthworks. The artefacts were identified on basal clay which appeared to be covered, in the areas beyond the exposures, by a thin deposit that was unlikely to exhibit archaeological potential.

Several approvals had been issued for projects within the region that authorised impacts to Aboriginal archaeological sites, including the Western Sydney International (Nancy-Bird Walton) Airport, the M12 Motorway and the Upper South Creek Advanced Water Recycling Centre. While only one of the AHIMS items within the search area was listed as partially destroyed, several were located in areas that had been at least partially impacted by construction activities associated with these projects. The current study area overlapped the approval areas of the Western Sydney International (Nancy-Bird Walton) Airport, Sydney Metro — Western Sydney Airport (SSI-10051), M12 Motorway (SSI-9364) and the Upper South Creek Advanced Water Recycling Centre (SSI-8609189). Any works for the current project which overlap the existing approval areas would be required to comply with any relevant conditions of those approvals.

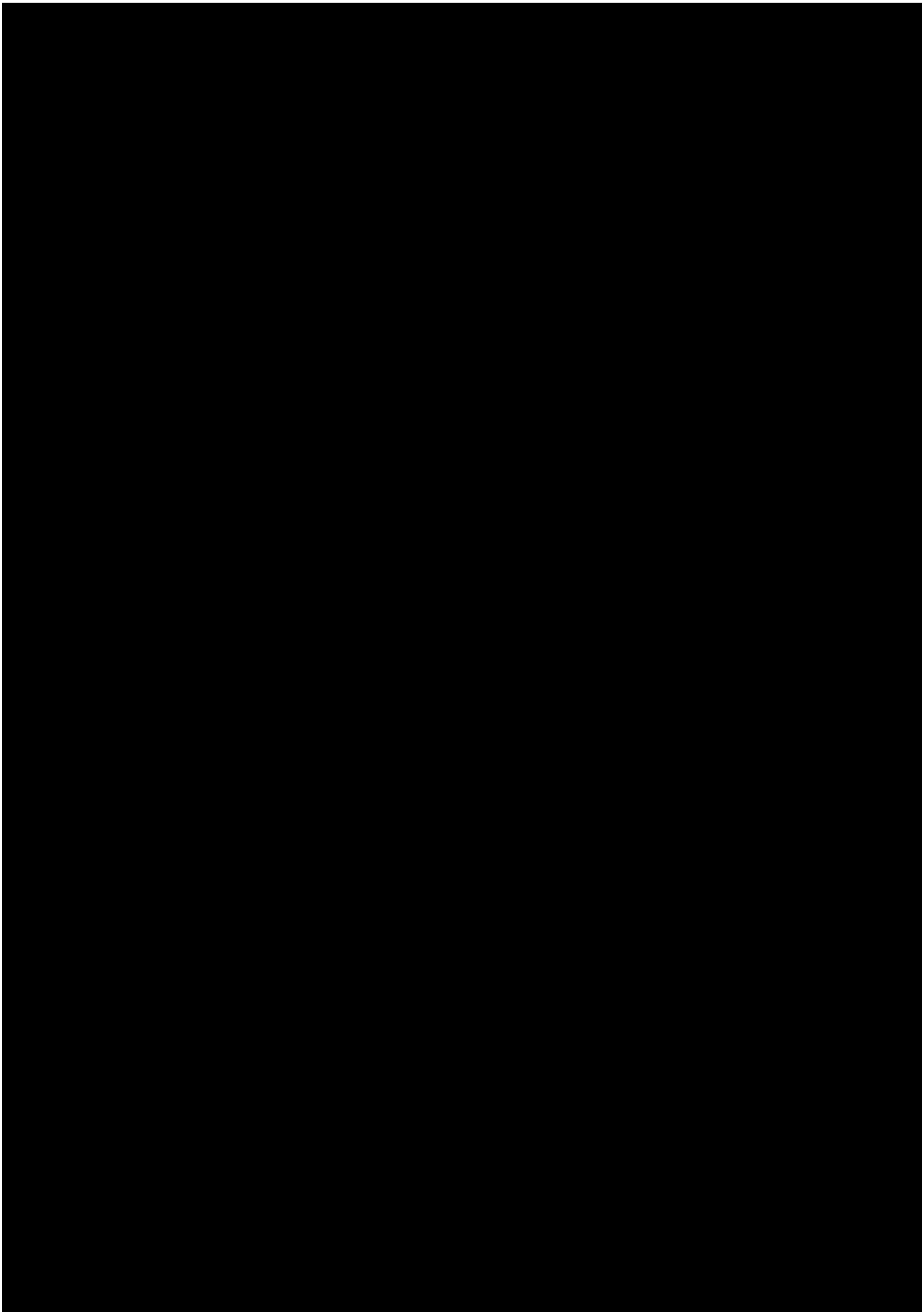
Previous archaeological investigations indicated that the survivability of archaeological sites containing subsurface stone artefacts within the region was variably affected by natural processes and land use practices. The landscape context within the current study area indicated that past land use practices associated with the construction of structures, roads, pipelines, drainage channels and inline dams, in addition to cultivation and market gardening were likely to have impacted any subsurface archaeological deposits within these areas. Natural processes, including fluvial activity adjacent to creeks and erosion were also likely to have impacted subsurface deposits. The desktop assessment determined that elevated flat, crest or gently sloping landforms within the assessment area that had not been subject to these past land uses or natural processes may retain subsurface archaeological deposits as had been identified in similar contexts in the region.

4.1.2. Archaeological field survey

Archaeological field survey of the assessment area was carried out by archaeologists from KNC on multiple dates between April 2023 and May 2024. The survey focused on identifying Aboriginal objects and determining the spatial extent of any associated subsurface deposits with archaeological potential. Areas of exposed sediment were closely inspected for stone artefacts and the nature of subsurface deposits while mature trees were inspected for evidence of Aboriginal bark removal or carving. The survey also sought to define the extent of the previously recorded Aboriginal archaeological sites within the assessment area in relation to the proposed works and visible surface disturbance.

Areas of exposed ground surface/sediment were generally found in areas where natural processes, such as erosion, or land use practices, such as animal movement and recent clearance or earthworks had removed vegetation or restricted its growth. Limitations to visibility within these areas included leaf litter, regrowth and introduced material such as blue metal along the road corridors. The ground surface was not visible within the majority of the assessment area due to vegetation cover in addition to built structures, concrete pathways and sealed roads.

No surface stone artefacts were identified within the assessment area during the survey; however, four area with potential for subsurface archaeological deposits were identified: Lawson Road Badgerys Creek PAD 1, Lawson Road Badgerys Creek PAD 2, McGarvie Smith Farm Badgerys Creek PAD 1, and McGarvie Smith Farm Badgerys Creek PAD 2.



Lawson Road PAD 1 and Lawson Road PAD 2 were located within cleared paddocks on a wide floodplain approximately 160 metres and 140 metres east of Badgerys Creek. Lawson Road PAD 1 was situated on a low rise at the confluence of two tributary creeks which flowed west and northwest to the confluence before flowing into Badgerys Creek approximately 250 metres to the northwest. The area of PAD was located within Lot 5 DP3050, approximately 220 metres west of Rawson Road and 440 metres south of Elizabeth Drive. Lawson Road PAD 1 was situated on the western side of a tributary creek which flowed northwest into Badgerys Creek approximately 320 metres to the northwest. The area of PAD was located within Lot 6 DP3050, approximately 220 metres west of Rawson Road and 510 metres south of Elizabeth Drive. The areas were assessed as exhibiting potential for subsurface deposits due to similarities with the topography of previously identified sites with subsurface deposits in the region.

McGarvie Smith Farm PAD 1 was located within a cleared paddock on the western side of Badgerys Creek. The area of potential archaeological deposit encompassed the crest of a spur and the elevated flat between the spur slope in the west and Badgerys Creek in the east. The spur descended to the east and southeast from a north-south oriented ridge and the flat was bound to the north and south by two tributary creeks that flowed east from headwaters on the slopes of the ridge into Badgerys Creek. The site was located within Lot 72 DP1277011, approximately 270 metres south of the M12 Motorway and 1.2 kilometres north of Elizabeth Drive. The area was assessed as exhibiting potential for subsurface deposits due to similarities with the topography of previously identified sites with subsurface deposits in the region and low visible disturbance.

McGarvie Smith Farm PAD 2 was located within a cleared paddock that was situated on an elevated flat that extended from the western bank of Badgerys Creek to the base of a spur slope. The area of PAD was bound by lower lying floodplain to the north and south, Badgerys Creek to the east and the slopes of the spur to the west. McGarvie Smith Farm PAD 2 was located within Lot 74 DP1277011, approximately 600 metres north of Elizabeth Drive. The area was assessed as exhibiting potential for subsurface deposits due to similarities with the topography of previously identified sites with subsurface deposits in the region and low visible disturbance.

The survey inspected the locations of the Aboriginal archaeological sites which had been previously recorded within or in close proximity to the assessment area. The northern portion of the assessment area overlapped the previously recorded sites BCE (AHIMS 45-5-5294), SCW T1 (AHIMS 45-5-5307), and SCW T2 (AHIMS 45-5-5308) which were located on two spur crests and an elevated flat between Badgerys Creek in the west and Wianamatta/ South Creek in the east. The sites had been split by the construction of the M12 Motorway (SSI-8609189) into remnant site areas into north and south of the construction area. Beyond the construction area, the remnant portions of the sites had low visible disturbance that was limited to past tree clearance and drainage works.

The previously recorded site BWB (AHIMS 45-5-5298) had been impacted by the construction of the M12 Motorway (SSI-8609189) in an area adjacent to Elizabeth Drive, approximately 70 metres south of the assessment area, and by the Sydney Metro — Western Sydney Airport (SSI-10051) which had impacted the western half of the site and partially overlapped the western boundary of the assessment area. The area of the site within the construction area of the Sydney Metro — Western Sydney Airport had been heavily disturbed by the construction of a sealed road on an embankment, and associated drainage works. Beyond the construction area, the eastern edge of a low spur on the northern side of a tributary creek and the elevated flat on the southern side of the creek were assessed as having potential for subsurface archaeological deposits.

The western portion of the spur had contained the highest artefact densities recovered during the archaeological excavations that were undertaken to mitigate the impact from the construction of the Sydney Metro — Western Sydney Airport while moderate densities were recovered on the elevated flat immediately to the west. The area north of the M12 Motorway had been variable disturbed by the construction of several inline dams and associated drainage works; however, the two elevated areas north and south of the southernmost tributary creeks and immediately south of Badgerys Creek were assessed as having potential for subsurface archaeological deposits.

The survey inspected the previously identified artefact scatter and associated area of PAD at BC/ED1. The previously recorded surface artefacts were located within cleared paddocks and the associated area of PAD was bound by visible disturbance from access roads to the north and east, in addition to earthworks to the south, and Badgerys Creek to the west. The western portion was located on a low lying flat adjacent to Badgerys Creek and appeared to be subject to periodic waterlogging; however, the eastern portion of the mapped site extent was assessed as having potential for subsurface archaeological deposits.

Outside of the identified Aboriginal archaeological sites and areas of potential archaeological deposit, the assessment area had low archaeological potential due to ground surface disturbance from land use practices and natural processes. The assessment determined that the results of the survey were unable to provide sufficient information to characterise the subsurface archaeological deposits within the Aboriginal archaeological sites and areas of potential archaeological deposit in the assessment area and an archaeological test excavation was recommended to acquire additional information on the nature and extent of any subsurface archaeological deposits within these areas.

4.1.3. Archaeological test excavation

Archaeological test excavations were undertaken at the four areas of potential archaeological deposit (Lawson Road PADs 1-2 and McGarvie Smith Farm PADs 1-2) and five previously identified archaeological sites (BCE, BWB, BC/ED1, SCW T1, and SCW T2) that were assessed as requiring additional archaeological investigation during the archaeological field survey. The excavations were carried out in August and September 2024 by archaeologists from KNC and representatives of the registered Aboriginal stakeholder groups in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a).

The test excavations aimed to provide additional information on the nature and extent of any subsurface archaeological deposits within the tested areas in order to determine the archaeological significance and potential impact of the proposed works. A total of 88 test squares, each measuring 50 square centimetres horizontally, were excavated at the 12 test areas. The test excavations confirmed the presence of subsurface stone artefacts at three areas of potential archaeological deposit and the five previously identified archaeological sites. No artefacts recovered from the Lawson Road PAD 2 Test Area. The results are summarised below.

The test excavation program at BCE consisted of eight test squares that were excavated along one east-west oriented transect that was approximately 30 metres north of the M12 construction area. The majority of the squares were positioned at 15 metre intervals across the crest of the spur while a test square was excavated 90 metres to the west and another 65 metres to the east to investigate the deposit on the adjacent slopes. The deposit within the test squares excavated at BCE contained shallow silty clay loam with iron/manganese nodules increasing with depth overlying basal clay.

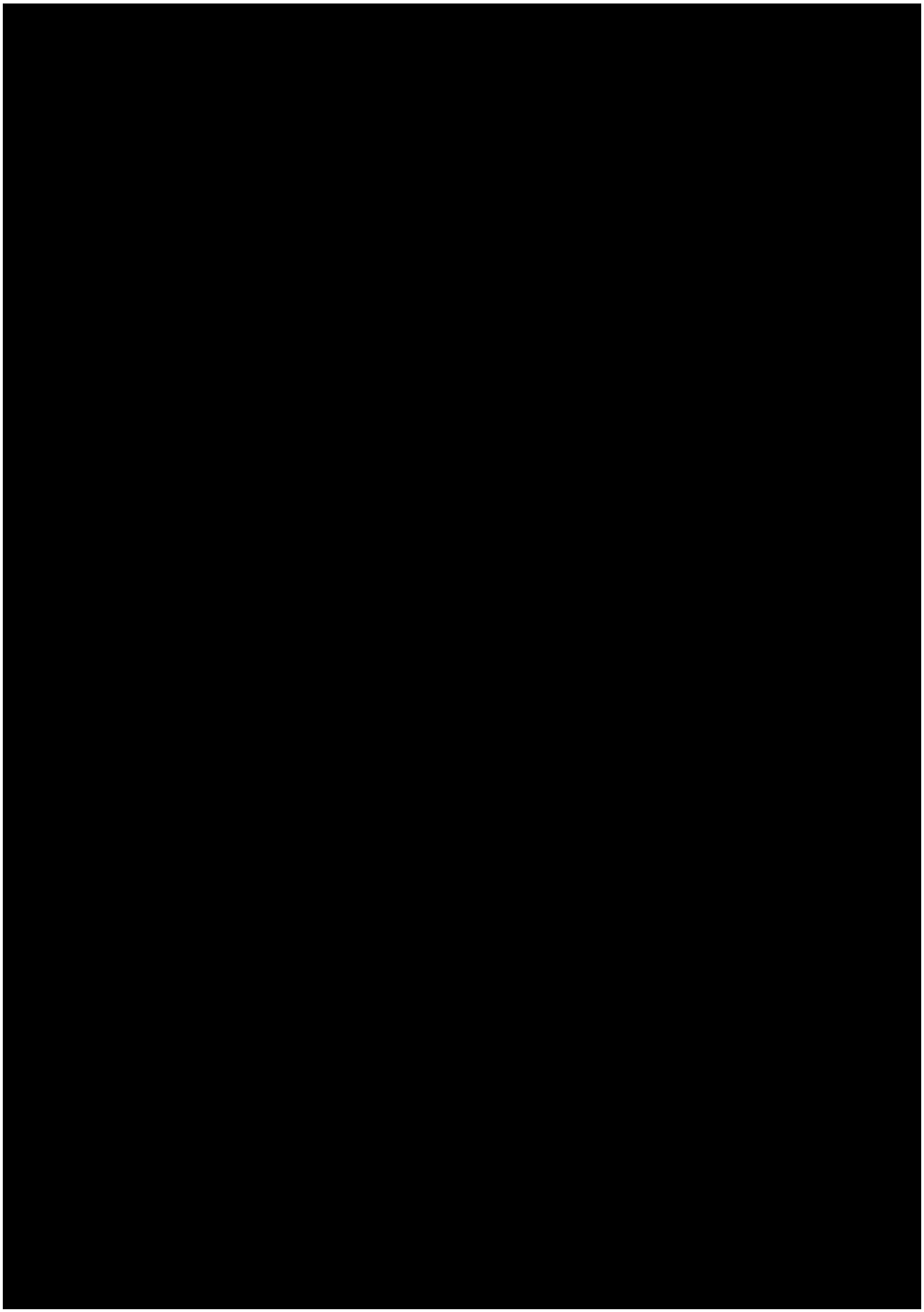
A total of 34 lithics were recovered from five of the eight test squares excavated at BCE. The lithics were predominantly silcrete (n=17) and IMT (n=9) while a small quantity of quartz (n=5) and chert (n=4) lithics were also recovered. The lithics consisted of 16 artefacts and 18 non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 8.0 artefacts per square metre. The horizontal distribution of artefacts across the tested area was characterised by discontinuous low densities in the west and isolated artefacts in the east. The artefacts were predominantly unmodified complete flakes and flake fragments (n=13). The assemblage also contained one silcrete retouched artefact, one IMT core fragment, and one quartz core.

The test excavation program at SCW T1 consisted of one test squares that was excavated within the northern portion of the site approximately 50 metres north of the M12 construction area. The test square was excavated to investigate the northern portion of the mapped site extent which narrowed due to Wianamatta/ South Creek in the east and a drainage channel in the west. Previous archaeological excavations at the site were located approximately 120 metres south of the test square and the nature and extent of the site within the assessment area was unclear. The deposit within the test square excavated at SCW T1 consisted of moderately deep silty clay loam soils with iron/manganese nodules increasing with depth overlying basal clay. No lithics were recovered during the test excavation at SCW T1. The results of the test excavation indicated that whilst artefacts were likely to occur within the assessment area due to landform and limited visible disturbance, the deposit would likely contain very low artefact densities.

The test excavation program at SCW T2 consisted of two test squares that were excavated along one southwest-northeast oriented transect that was approximately 20 metres north of the M12 construction area. The squares were positioned 90 metres apart to investigate the deposit on the western slope where previous archaeological excavations had not occurred. The deposit within the test squares excavated at SCW T2 consisted of moderately deep silty to sandy clay loam soils with iron/manganese nodules increasing with depth overlying basal clay.

The test excavations at SCW T2 recovered six lithic from the southern test square which was approximately 30 metres west of the test excavations undertaken at the site as part of the M12 Motorway. The lithics were silcrete (n=3) and IMT (n=2), and chert (n=1). The lithics consisted of three artefacts and three non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 6.0 artefacts per square metre. The artefacts consisted of one unmodified complete flake and two flake fragments.

The test excavation program at McGarvie Smith Farm PAD 1 consisted of 29 test squares that were excavated across the crest of a spur and the elevated flat between of the spur slope in the west and Badgerys Creek in the east. The excavation on the crest of the spur comprised 12 test squares which were positioned at 15 metre intervals along three east-west oriented transects. The deposit within the test squares excavated on the spur crest consisted of shallow silty clay loam soils overlying basal clay. A total of five lithics were recovered from four of the 12 test squares and comprised four artefacts and one non-diagnostic angular fragment. The test squares that contained the artefacts were located along the western and northern edges of the crest.



The lithics recovered from the test excavations at McGarvie Smith Farm PAD 1 were predominantly made from silcrete (n=57) while a small quantity of IMT (n=12) and petrified wood (n=1) lithics were also recovered. The lithics consisted of 53 artefacts and 17 non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 7.3 artefacts per square metre. The artefacts were predominantly unmodified complete flakes and flake fragments (n=47). The assemblage also contained one silcrete backed artefact, one IMT backed artefact, and one silcrete retouched artefact. Most artefacts (n=51) did not retain cortical surfaces while two silcrete flake fragments (IDs 34 and 49) retained less than 30 percent cortex on the dorsal surface. As a result of the test excavation, the site was renamed McGarvie Smith Farm Badgerys Creek AFT 1 (AHIMS 45-5-5922).

The test excavation program at McGarvie Smith Farm PAD 2 consisted of four test squares that were excavated along one north-south oriented transect. The squares were generally positioned at 15 metre while the distance between TS 1 and TS 2 was increased to 30 metre in order to avoid an area of waterlogged ground. The test area was limited by the assessment area, visible disturbance and waterlogged ground in the adjacent areas. The deposit within the test squares excavated at McGarvie Smith Farm PAD 2 consisted of moderately deep silty or sandy clay loam duplex soils with iron/manganese nodules increasing with depth overlying basal clay.

A total of 22 lithics were recovered from the four test squares excavated at McGarvie Smith Farm PAD 2. The horizontal distribution of lithics across the tested area was characterised by low to moderate densities within the test squares in the centre of the transect that and low densities within the northern and southern squares. The vertical distribution of lithics within the test squares was characterised by almost half of lithics being recovered from between 10 and 20 centimetres below the ground surface while most (n=18) were recovered from the deposit less than 30 centimetres below the ground surface. The remaining lithics (n=4) were recovered from between 30 and 40 centimetres below the ground surface. The lithics were predominantly made from silcrete (n=17) while small quantities of quartz (n=3), IMT (n=1) and quartzite (n=1) lithics were also recovered. The lithics were predominantly less than 19 millimetres in in maximum length in most raw materials besides the one example of quartzite which was between 30 and 34 millimetres in maximum length.

The lithics consisted of 19 artefacts and three non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 19 artefacts per square metre. The non-diagnostic lithics comprised one quartzite and two silcrete angular fragments. The artefacts were predominantly unmodified complete flakes and flake fragments (n=15). The assemblage also contained two backed artefacts, one core, and one retouched artefact. Most artefacts (n=18) did not retain cortical surfaces while one silcrete flake retained between 40 and 60 percent cortex on the dorsal surface. As a result of the test excavation, the site was renamed McGarvie Smith Farm Badgerys Creek AFT 2 (AHIMS 45-5-5921).

The test excavations at BWB were undertaken within a 50 metre wide corridor that traversed three elevated flats and a low spur approximately 15 to 90 metres south and southwest of Badgerys Creek and 140 to 300 metres north of Elizabeth Drive. The flats were divided into three by two northeast flowing unnamed tributaries of Badgerys Creek and extended approximately 140 to 660 to the west from Badgerys Creek to the slopes of several spurs that descended to the east from a north-south oriented ridge. Due to the fragmentary nature of the site within the assessment area, it was divided into four test areas (BWB Test Areas 1-4).

BWB Test Area 1 encompassed the low spur and elevated flat on the northern side of a tributary creek and was approximately 300 metres north of Elizabeth Drive and 40 metres north of BWB Test Area 2. The test area was bound by low lying ground to the north, the tributary creek and a large inline dam to the east and south and the construction area of the Sydney Metro - Western Sydney Airport to the west. The test excavation program at BWB Test Area 1 consisted of four test squares that were excavated at 15 metre intervals along two north-south oriented transects with two squares north and south of a modified drainage line that descended to the east into the inline dam.

The test excavation on the elevated flat comprised 17 test squares that were positioned at 15 metres along two north-south oriented transects and two east-west oriented transects. The test area was limited by the study area, visible disturbance and waterlogged ground in the adjacent areas. The deposit within the test squares that were located on the elevated flat consisted of moderately deep silty clay loam with iron/manganese nodules increasing with depth overlying basal clay. A total of 65 lithics were recovered from 12 of the 17 test squares excavated on the elevated flat at McGarvie Smith Farm PAD 1. The horizontal distribution of lithics was generally characterised by very low to moderate densities within the test squares in the south and east with a very low density within one square in the north. The highest lithic density (n=16) was recovered from TS 2 which was in the south.

The deposit within the test squares excavated at BWB Test Area 1 varied in composition between the northernmost test square and the remaining three test squares. The northernmost test square contained sandy clay loam with a high gravel content overlying basal clay while the deposit within the remaining squares consisted of sandy clay or silty loam duplex soils overlying basal clay. A total of one IMT and three silcrete artefacts were recovered from two of the four test squares excavated at BWB Test Area 1 with an extrapolated mean average density of four artefacts per square metre. A IMT medial flake fragment was recovered from the northernmost test square and one medial and two distal silcrete flake fragments were recovered from the test square on the southern side of the drainage channel.



Figure 8. Archaeological test excavation squares and artefact densities - south

BWB Test Area 2 was located on an elevated flat on the southern side of a tributary creek and was approximately 260 metres north of Elizabeth Drive and 40 metres south of BWB Test Area 1. The test area was immediately south of the tributary and an associated inline dam, west of a drainage channel and low lying ground adjacent to Badgerys Creek, and east of the construction area of the Sydney Metro - Western Sydney Airport. The test excavation program at BWB Test Area 2 consisted of seven test squares that were excavated along two northwest-southeast oriented transects. Most test squares (TS 1-4) were located at 10 metre intervals while there was an interval of 15 metres between TS 5 and TS 7 to avoid waterlogged ground, and 20 metres between TS 2 and TS 3 to avoid a fence line.

A total of 16 lithics were recovered from five of the seven test squares excavated at BWB Test Area 2. The horizontal distribution of lithics was characterised by low densities within test squares in the centre of the test area while the northernmost and southernmost test squares did not contain lithics. The lithics consisted of 12 artefacts and four non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density within the test area was 9.1 artefacts per square metre. The artefacts were predominantly unmodified complete flakes and flake fragments (n=11). The assemblage also contained one silcrete core.

BWB Test Area 3 was located on an elevated flat on the western side of the southernmost tributary creek and was approximately 190 metres north of Elizabeth Drive, 80 metres west of BWB Test Area 4 and 120 metres southeast of BWB Test Area 2. The test area was immediately south of a lower lying ground on the southern side of Badgerys Creek, and west, north, and east of the southernmost tributary creek and three inline dams. The test excavation program at BWB Test Area 3 consisted of two test squares that were excavated 15 metres apart along one northwest-southeast oriented transect. The deposit within the test squares excavated at BWB Test Area 3 consisted of silt clay loam with iron/manganese nodules increasing with depth overlying basal clay. A total of three lithics were recovered from the southernmost test square (TS 2) excavated at BWB Test Area 3. The lithics from BWB Test Area 3 consisted of two complete silcrete flakes and one silcrete distal flake fragment. Extrapolated to square metres, the mean average artefact density within the test area was six artefacts per square metre.

BWB Test Area 4 was located on an elevated flat that formed a narrow peninsula between a bend in Badgerys Creek to the north and east, and the southernmost tributary creek to the west. The test area was approximately 150 metres north of Eizabeth Drive, 80 metres east of BWB Test Area 3, and 40 metres west of Badgerys Creek/Elizabeth Drive 1 (AHIMS 45-5-2309). The test excavation program at BWB Test Area 4 consisted of three test squares that were excavated at 15 metres intervals along one northwest-southeast oriented transect. The test area was limited by artificial mounds to the north and west in addition to dense vegetation and waterlogged ground. The deposit within the test squares excavated at BWB Test Area 4 consisted of sandy clay loam with iron/manganese nodules increasing with depth overlying basal clay. A total of three lithics were recovered from one (TS 1) of the three test squares excavated at BWB Test Area 4. The lithics from BWB Test Area 4 consisted of one proximal flake fragment, one backed artefact and one non-diagnostic angular fragment. Extrapolated to square metres, the mean average artefact density within the test area was 2.7 artefacts per square metre.

The test excavation program at Lawson Road PAD 1 consisted of three test squares that were excavated at 10 metre intervals along one north-south oriented transect. The test area was limited by visible disturbance and waterlogged ground in the adjacent areas. The deposit within the test squares consisted of shallow to moderately deep sandy clay loam overlying basal clay. The deposit was waterlogged during the test excavation with water pooling along the basal clay at the base of the test squares.

A total of three artefacts were recovered from two of the three test squares excavated at Lawson Road PAD 1. The artefacts were recovered from TS 1 (n=1) at the northern end of the transect and TS 3 (n=2) at the southern end of the transect. The artefact recovered from TS 1 was a silcrete proximal fragment that was between 20 and 24 millimetres in maximum length and did not retain cortex. The artefact was located less than five centimetres below the ground surface.

The artefacts recovered from TS 3 consisted of an unmodified silcrete flake between 10 and 14 millimetres in maximum length and an IMT distal flake fragment between 20 and 24 millimetres in maximum length. The artefacts did not retain cortical surfaces and were recovered between 10 and 20 centimetres below the ground surface. The low number of small, fragmented artefacts recovered during the test excavation at Lawson Road Badgerys Creek AFT 1, in addition to the waterlogged deposit, indicated that the subsurface deposit at the site had been impacted by fluvial activity associated with Badgerys Creek and its tributaries. As a result of the test excavation, the site was renamed Lawson Road Badgerys Creek AFT 1 (AHIMS 45-5-5923).

The test excavation program at Lawson Road PAD 2 consisted of three test squares that were excavated at 10 metre intervals along one north-south oriented transect. The deposit within the test squares consisted of shallow to moderately deep sandy clay loam overlying basal clay and was waterlogged during the test excavation with water pooling along the basal clay at the base of the test squares. No artefacts or non-diagnostic angular fragments were recovered from Lawson Road PAD 2.

The results of the test excavations were consistent with the result of archaeological investigations in the region (see Section 4.1.1). Stone artefacts were recovered from all but one area identified as having potential for subsurface archaeological deposits; however, the nature of the subsurface archaeological deposits varied within and between the tested areas. The artefact densities within the test squares excavated within sites BCE, SCW T1 and SCW T2 were significantly lower than in previous excavations at these sites. The results from SCW T2 were anticipated as the test squares excavated at the site sought to confirm that the deposit diminished on the slope and was focused on the spur crest; however, the test squares at BCE and SCW T1 were located on landforms where moderate to high artefacts had previously been recovered.

The test excavation demonstrated that archaeological subsurface deposits were present within the area of potential archaeological deposit associated with the previously identified surface scatter (BC/ED1), three of the four areas of potential archaeological deposit Lawson Road PAD 1, McGarvie Smith Farm PAD 1 and McGarvie Smith Farm PAD 2) and three previously recorded sites that overlapped the assessment area (BWB, BCE, and SCW T2). No artefacts were recovered from the test excavation at SCW T1; however, the results were consisted with previous excavations at the site and indicated that while artefacts may occur within the portion of the site within the study area, this portion of the site was of low archaeological potential. As a result of the test excavations, the names of Lawson Road PAD 1, McGarvie Smith Farm PAD 1 and McGarvie Smith Farm PAD 2 were changed to Lawson Road Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 1 and McGarvie Smith Farm Badgerys Creek AFT 2

5 Aboriginal Community Consultation

5.1 Consultation for the ACHAR and future AHIP application

The aim of consultation is to integrate cultural and archaeological knowledge and ensure registered stakeholders have information to make decisions on Aboriginal cultural heritage. For the preparation of this ACHAR, consultation with Aboriginal people has been undertaken in accordance with the Heritage NSW *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010b) and the requirements of Clause 60 of the *National Parks and Wildlife Regulation 2019*.

The formal consultation process has included:

- Notification of Aboriginal persons, including register of native title determinations search and government agency notification letters;
- advertising for registered stakeholders in local media (*Western Weekender*, 17/05/2024: Appendix A);
- notification of closing date for registration (31/05/2024)
- record of registration of interest (Heritage NSW and LALC notified 11/06/2024);
- provision of project information;
- provision of proposed cultural heritage assessment and test excavation methodologies (allowing 28 day review period);
- invitation to advise on Aboriginal cultural value of the study area;
- provision of draft ACHAR for review (allowing 28 day review period); and
- ongoing consultation with the local Aboriginal community.

5.2 Registration of interest

Aboriginal people who hold knowledge relevant to determining the cultural heritage significance of Aboriginal objects and Aboriginal places in the study area were invited to register their interest in a process of community consultation. Investigations for the current project have included consultation with the Aboriginal community individuals and groups as listed in Table 1.

[redacted]

[redacted]

* Two additional Aboriginal stakeholders have registered for the project but have chosen to withhold their details in accordance with item 4.1.5 of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010b)

5.3 Provision of project information and proposed ACHAR and test excavation methodologies

Following on from Stage 1 of the consultation process (stakeholder identification and registration), project-specific consultation was undertaken. Information regarding the proposal was provided to registered Aboriginal stakeholder groups in letters dated 4/06/2024. Information included an outline of the proposal, location of the study area and an invitation to consult during the assessment.

Stakeholders were also provided with the proposed assessment methodology for the Aboriginal Cultural Heritage Assessment Report and proposed test excavation methodology. An invitation was extended for Aboriginal cultural knowledge holders and stakeholders to review and provide comments on the proposed cultural heritage assessment and test excavation methodologies, including any protocols regarding the gathering of information and any matters such as issues/areas of cultural significance that might affect, inform or refine the assessment methodology (review period closed on 3/07/2024).

5.4 Stakeholder responses to the proposed assessment methodology for the ACHAR

Formal responses to the proposed assessment methodology were received from [redacted] and an Aboriginal stakeholders that has chosen to withhold their details in accordance with item 4.1.5 of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*.

[redacted] stated that they had reviewed and supported the methodology (email received 11/06/2024).

[redacted] advised that they supported the methodology (email received 26/06/2024).

[redacted]tated that they had reviewed and agreed the methodology (email received 12/06/2024).

[redacted] advised that they had reviewed the information and were happy for the assessment to proceed (email received 4/06/2024)

[redacted] stated that they agreed and supported the methodology (email received 29/06/2024).

[redacted] stated that they agreed and supported the methodology (email received 14/06/2024).

[redacted] advised that they agreed with the methodology (email received 4/06/2024).

[redacted] stated that they had read the methodology and endorsed the recommendations made (email received 7/06/2024).

[redacted] advised that they agreed with the methodology (email received 7/06/2024).

[redacted] stated that they agreed with the methodology (email received 24/06/2024).

An Aboriginal stakeholder that has chosen to withhold their details advised that they supported the methodology (email received 5/06/2024).

5.5 Review of draft ACHAR

All registered stakeholders were provided with a copy of the draft ACHAR for review and comment. All registered Aboriginal stakeholders were provided a minimum 28 day period for review (closing date 12/11/2024). Comments and information received from the stakeholders during this period are attached in full in Appendix B and summarised in Section 5.6.

5.6 Stakeholder responses to the draft ACHAR

Formal responses to the draft ACHAR were received from [redacted].

[redacted] stated that they agreed and supported the recommendations (email received 7/11/2024). [redacted] recommended artefact reburial.

[redacted] stated that they had read the draft ACHAR and endorsed the recommendations (email received 7/11/2024).

[redacted] advised that they had nothing further to add at this stage (email received 15/10/2024).

5.7 Aboriginal cultural values

It has been identified during the consultation process that the study area has cultural heritage value to the local Aboriginal community.

[redacted] advised that the “project area is significant to the Dharug people as it would have been used for hunting purposes” (email received 4/06/2024).

Some of the Aboriginal cultural heritage values expressed by stakeholders include:

- strong association with the land
- responsibility to look after the land, including the heritage sites, plants and animals, creeks and the land itself
- scarred trees
- artefact sites and landscape features
- creek lines and prominent watercourses such as Badgerys Creek and Wianamatta/South Creek.
- indigenous plants and animals
- general concern for burials, as their locations are not always known, and they can be found anywhere.

6 Summary and Analysis of Background Information

Analysis of the background information, Aboriginal community consultation and results of the archaeological field survey and test excavation presented in the preceding chapters allows an assessment of the cultural heritage values within the study area to be made. Combining data from historical/ethnographic sources, Aboriginal community consultation, landscape evaluation and archaeological context provides an insight into how the landscape within and around the study area was used and what sort of events took place in the past.

The study area and surrounding region are known to have been important to and extensively used by past Aboriginal people. The resources of Wianamatta/ South Creek and Badgerys Creek were utilised by Aboriginal people living in the region prior to the British occupation. The subsequent British occupation these areas restricted access to and removed resources used by Aboriginal people. Response to the occupation varied between groups, individuals and over time due a range of factors that included proximity to the occupied areas, and personal associations.

Aboriginal culture endures to this day across the Cumberland Plain and has influenced many aspects of contemporary Australian culture including in the names of animals, plants and localities. The long struggle for recognition, self-determination and acknowledgement forms part of the Aboriginal cultural heritage story and lived experience of contemporary Aboriginal people. Members of the contemporary Aboriginal community continue to experience connection with the area through cultural and family associations.

Archaeological investigations of Aboriginal archaeological sites in the Cumberland Plain have occurred since the early twentieth century; however, investigations in the vicinity of the study area have generally occurred over the past 20 years (see Section 4). Investigations have shown that changes occurred in the spatial distribution and density of Aboriginal archaeological sites, the types of artefacts and artefact raw materials over the last 10,000 years that are likely to reflect the adaptation of Aboriginal people to an ever-changing landscape and environment.

A total of 79 Aboriginal archaeological sites were previously recorded within one kilometre of the study area by previous archaeological investigations. The Aboriginal archaeological sites identified in the vicinity of the study area predominantly contain stone artefacts in either surface and/or subsurface contexts of varying density and integrity. Grinding grooves and a culturally modified tree have also been identified on the western side of Wianamatta/ South Creek, approximately 700 metres south of the study area.

Previous archaeological investigations identified six sites that were located within or overlapped the study area and consisted of one surface artefact scatter and associated area of potential archaeological deposit (BC/ED1), one surface artefact scatter and associated subsurface archaeological deposit (BCE), and four subsurface archaeological deposits (BWB, EDU Badgerys Creek IF 1, SCW T1, and SCW T2). The sites were identified in the northern portion of the study area on elevated landforms adjacent to one or more of the major creeks in the regions.

Archaeological excavations were undertaken at five of the Aboriginal archaeological sites that overlapped the study area as part of assessments for three State Significance Infrastructure projects: the M12 Motorway (SSI-8609189), Sydney Metro — Western Sydney Airport (SSI-10051), and Upper South Creek Advanced Water Recycling Centre (SSI-9364). The excavations comprised initial test excavation and subsequent salvage excavations which were generally divided into two phases (see Section 4.1.1). The overall size and extent of the excavated areas at each site varied due to the requirements of the projects and approvals, with approximately 60 square metres excavated at BCE while approximately 320 square metres were excavated at SCE.

The number of artefacts recovered from the excavations varied between approximately 2,200 at SCW T1 and 24,000 at SCE. The results are likely to have been distorted by the different size and extents of the excavation programs; however, general trends can be observed by averaging the mean artefact density per square metre of each site. The highest mean artefact density was recovered from SCE (75.7) while the three sites that were located between Badgerys Creek and Wianamatta/South Creek, BCE (45.2), SCW T1 (36.1), and SCW T2 (42.0), contained similar artefact densities. The lowest mean artefact density was recovered from the salvage excavations at BWB (18.4) which was located approximately one kilometre southwest of the other sites.

The results of archaeological investigations in the region have shown that the distribution of Aboriginal archaeological sites containing stone artefacts has been highly influenced by the reliability and permanence of fresh water. Aboriginal archaeological sites containing stone artefacts have been predominantly identified on elevated and stable micro-topographic landforms along the margins of watercourses that are reliable sources of fresh water. The occurrence of outcrops containing raw material suitable for making flaked stone artefacts also appears to have influenced the number of Aboriginal archaeological sites within the vicinity and the density of stone artefacts within the sites.

Silcrete, the predominant raw material type of flaked stone artefacts recovered from Aboriginal sites in the region is known to occur within the geology of the northwestern Cumberland Plain; however, outcrops have been identified in the vicinity of Elizabeth Drive approximately one kilometre east of the study area and along the banks of Wianamatta/South Creek approximately 400 metres southeast of the study area.

Soil landscapes, vegetation and land use practices have been identified as factors influencing the preservation of Aboriginal archaeological sites in the region. Soil landscapes subject to high levels of erosion or fluvial activity are unlikely to retain in situ Aboriginal objects while areas where the sediment has been deposited contain Aboriginal objects that lack the contextual information important for archaeological research. Land use practices, including vegetation clearance, construction, ploughing and bulk earthworks have had impacted the preservation of Aboriginal archaeological sites in the region. Conversely, stone artefacts are often identified within these areas due to the disturbance of underlying deposits and increased visibility from the removal or restricted growth of vegetation. These processes, and the intensity of previous archaeological studies, distort the spatial distribution of known sites.

Archaeological investigations that were undertaken for the current project confirmed that the six previously identified Aboriginal archaeological sites extended into the study area and identified a further three previously unrecorded Aboriginal archaeological sites: Lawson Road Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 1, and McGarvie Smith Farm Badgerys Creek AFT 2. Outside of the identified Aboriginal archaeological sites and areas of potential archaeological deposit, the study area had low archaeological potential due to ground surface disturbance from land use practices and natural processes.

6.1 Aboriginal archaeological sites identified within the study area

Review of background information, Aboriginal community consultation and archaeological assessment, including archaeological field survey and test excavation, have resulted in the identification of nine Aboriginal archaeological sites within the study area. The Aboriginal archaeological sites identified within the study area are shown on Figure 9 and detailed in the table below.

Table 2. Identified Aboriginal archaeological features within the study area

Name	AHIMS ID	Type
BCE (including Fleurs 2, M12 A2 and M12 A3)	45-5-5294 (including 45-5-0528/ 45-5-4748/ 45-5-4750)	Surface artefacts and subsurface archaeological deposit
BC/ED1	45-5-2309	Surface artefacts and subsurface archaeological deposit
BWB	45-5-5298	Subsurface archaeological deposit
EDU Badgerys Creek IF 1	45-5-5733	Subsurface archaeological deposit
Lawson Road Badgerys Creek AFT 1	45-5-5923	Subsurface archaeological deposit
McGarvie Smith Farm Badgerys Creek AFT 1	45-5-5922	Subsurface archaeological deposit
McGarvie Smith Farm Badgerys Creek AFT 2	45-5-5921	Subsurface archaeological deposit
SCW T1	45-5-5307	Subsurface archaeological deposit
SCW T2	45-5-5308	Subsurface archaeological deposit

The Aboriginal archaeological sites identified within the study area are summarised in the following sections.

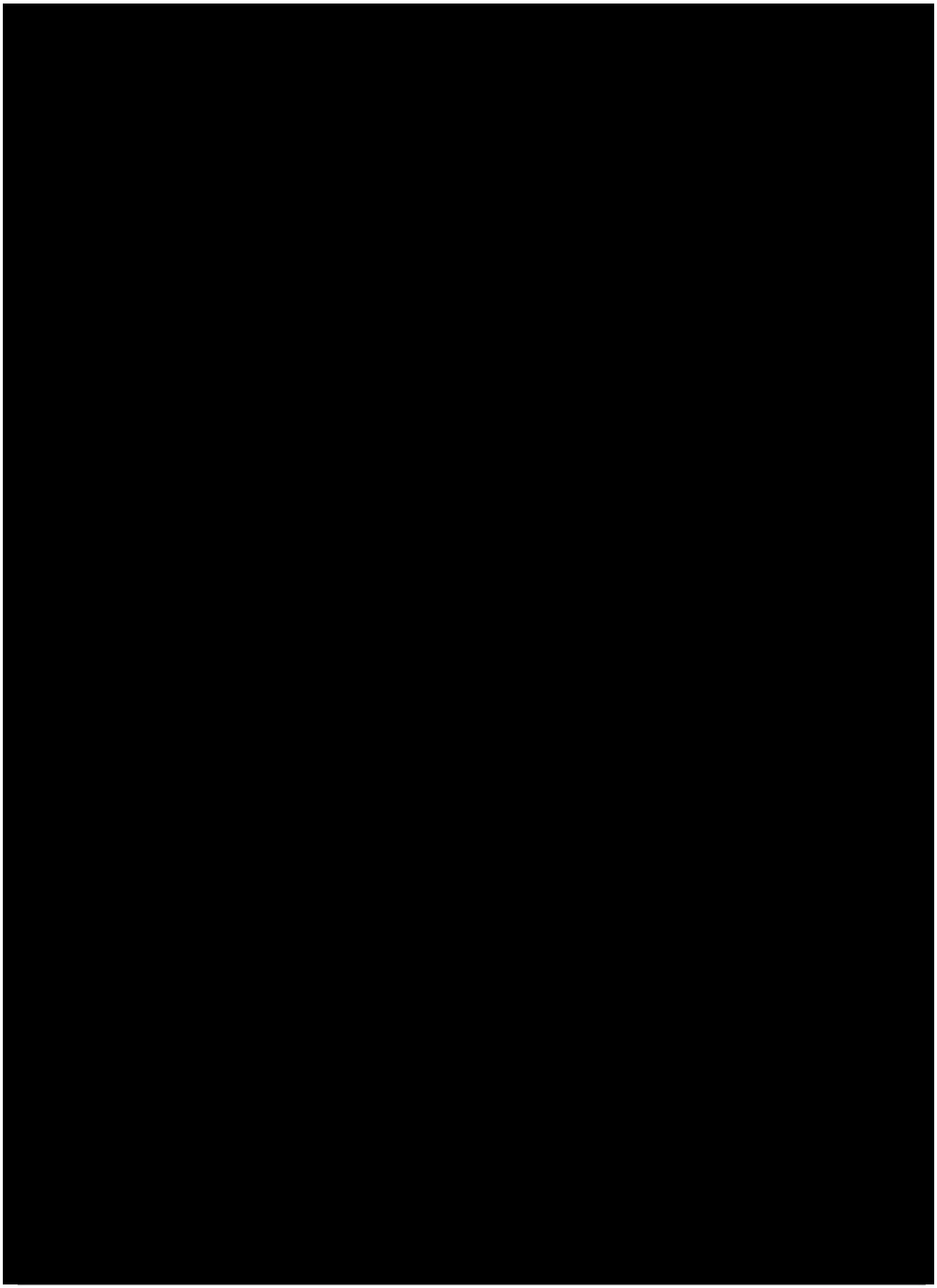


Figure 9. Identified Aboriginal archaeological sites within the study area

6.1.1. Badgerys Creek East (BCE)

[redacted] The artefact scatter consisted of one retouched flake, one Elouera and three pieces of flaking debitage that were identified on a large ground surface exposure. The artefacts were predominantly silcrete (n=3) with single artefacts of chert and quartz also recorded.

Subsequent archaeological investigations of BCE were undertaken as part of the planning for the M12 Motorway and included archaeological field survey, test excavations and salvage excavations. The archaeological field survey identified two surface artefact scatters (M12 A2 and M12 A3) on the s[redacted]

M12 A2 (AHIMS 45-5-4748) consisted of a silcrete complete flake that was identified on a ground surface exposure at the base of a tree. [redacted]

The test excavation consisted of 10 squares, each measuring one square metre, that were placed at 40 metre intervals along two east-west oriented transects. The transects were located within the proposed impact corridor for the M12 Motorway on either side of the dam where surface artefacts had been previously identified (M12 A3). [redacted]

A total of 38 lithics were recovered from the six of the nine squares excavated at BCE. The horizontal distribution of artefacts was characterised by very low densities in the middle of the transects and moderate densities in the squares at either end of the western transect (T1 100E and T1 200E). [redacted]

Three larger excavation areas (known as 'geotech pits') were also excavated at the site. The geotech pits measured three metres by one metre horizontally and were positioned [redacted]. A total of 119 lithics were recovered from the three geotech pits. The majority were recovered from [redacted]

The lithics recovered from the test excavations at BCE comprised 117 artefacts, 42 non-diagnostic angular fragments and four manuports. The mean average artefact density from the test excavations at BCE was 9 per square metre. The angular fragments were predominantly silcrete (n=32) with lower quantities of IMT (n=8) and quartz (n=2). The artefacts consisted of unmodified complete flakes(n=55) and flake fragments (n= 55), two silcrete backed artefacts, one silcrete core, and four silcrete retouched artefacts. The artefacts were predominantly silcrete (n=100) while artefacts of IMT (n=9), quartz (n=7), and petrified wood (n=1) were also recovered. As a result of the test excavations at BCE the low spur in the vicinity of the tested area which included the previously recorded surface artefact scatters Fleurs 2 (AHIMS 45-5-0528), M12 A2 (AHIMS 45-5-4748), and M12 A3 (AHIMS 45-5-4750) was registered on AHIMS as Badgerys Creek East (AHIMS 45-5-5294).

The M12 Motorway Project was approved by the Minister for Planning and Public Spaces in April 2021. An archaeological salvage excavation program was undertaken at BCE in accordance with the conditions of the approval (SSI 9364) and the Aboriginal Cultural Salvage Strategy developed for the project. The salvage excavation at BCE was located on the [redacted]. The Phase 1 excavation at BCE consisted of 14 squares that were excavated at 10 metre intervals along several east-west oriented transects. A total of 529 lithics were recovered from the 14 Phase 1 squares. The horizontal distribution of lithics was characterised by a moderate to high density deposit with a slight decrease in density towards [redacted]

The lithics consisted of 237 artefacts and 292 non-diagnostic angular fragments, with a mean average of 16.9 artefacts per square metre. The artefacts were predominantly unmodified complete flakes (n=19) and flake fragments (n=161); however, the assemblage also included six silcrete backed artefacts, one quartz backed artefact, seven silcrete retouched artefacts, one IMT utilised artefact, one eight silcrete cores, one quartz core and 33 core fragments were also recovered. The core fragments were predominantly silcrete (n=26) with core fragments of IMT (n=3), chert (n=2) and quartz (n=2) also recovered. The non-diagnostic fragments were recovered from 12 of the 14 test squares; however, the

horizontal distribution of the fragments was variable with 38 percent recovered from one Phase 1 square and two other Phase 1 squares containing over 30. The fragments were predominantly silcrete (n=239) with 194 exhibiting characteristics of heat.

The Phase 2 excavation at BCE comprised one open area of 75 square metres that was located [redacted]. A total of 8,045 lithics were recovered from the open area at BCE. The Phase 2 squares within the open area contained moderate to very high lithic densities with 35 squares containing 100 or more and seven containing over 200. The highest lithic densities were generally concentrated within two areas while the squares with the lowest densities were located around the edges of the open area. The lithics comprised 3,788 artefacts and 4,257 non-diagnostic angular fragments with a mean average of 50.5 artefacts per square metre. The artefacts were predominantly unmodified complete flakes (n=815) and flake fragments (n=2,328). The assemblage also contained 132 cores, 219 core fragments, 205 backed artefacts and 39 retouched artefacts.

The portion of the mapped site extent within the study area overlaps the construction area of the M12 Motorway (SSI 9364). Any works related to the current proposal undertaken within the approval area will be required to comply with the existing conditions of the approval.

The archaeological assessment area for the current project included portions of the site north and south of the M12 Motorway. The assessment noted that the results of previous investigations indicated that the [redacted]

The test excavation program at BCE consisted of eight test squares that were excavated along one east-west oriented transect that was [redacted] The majority of the squares were positioned at 15 metre intervals across the crest of the spur while a test square was excavated 90 metres to the west and another 65 metres to the east to investigate the deposit on the adjacent slopes. The deposit within the test squares excavated at BCE contained shallow silty clay loam with iron/manganese nodules increasing with depth overlying basal

A total of 34 lithics were recovered from five of the eight test squares excavated at BCE. The lithics were predominantly silcrete (n=17) and IMT (n=9) while a small quantity of quartz (n=5) and chert (n=4) lithics were also recovered. The lithics consisted of 16 artefacts and 18 non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 8.0 artefacts per square metre. The horizontal distribution of artefacts across the tested area was characterised by discontinuous low densities in the west and isolated artefacts in the east. The artefacts were predominantly unmodified complete flakes and flake fragments (n=13). The assemblage also contained one silcrete retouched artefact, one IMT core fragment, and one quartz core.

The test excavation at confirmed that the subsurface archaeological deposit was present within the study area and was generally consistent with the results from the previous archaeological investigations that had been undertaken at the site. The deposit within the western half of the tested area contained higher artefact densities than the east where isolated artefacts were recovered. [redacted].

6.1.2. Badgerys Creek/Elizabeth Drive 1 (BC/ED1)

Site Badgerys Creek/Elizabeth Drive 1 was a surface artefact scatter and associated subsurface archaeological deposit that was situated [redacted]

The artefact scatter was identified across an area [redacted] The artefacts included a chert flake, a unifacial silcrete core, two conjoined pieces of flaked IMT, a conjoined red/brown silcrete flake and a multiplatform IMT core. An associated area of potential archaeological deposit was identified [redacted] and was estimated to extend across an [redacted].

BC/ED1 was inspected as part of the archaeological field survey for the current project. The survey noted that the area had been variably disturbed by past land use practices and natural processes. [redacted] appeared to be subject to periodic waterlogging. An area of potential archaeological deposit was identified within the [redacted] A test excavation

program was recommended at the site to determine the extent of any subsurface disturbance and to identify subsurface archaeological deposits that may have been present.

A test excavation was subsequently undertaken for the current project within a 25 metre wide corridor that was oriented [redacted] The test area sloped gently from approximately 50 metres AHD in the southeast to 45 metres AHD on the elevated terrace in the northwest. The test excavation program at BC/ED1 consisted of five test squares that were excavated [redacted] Most test squares (TS 1-4) were located at 20 metre intervals across the gentle slope landform and the remaining square (TS 5) was located on the elevated terrace 40 metres to the northwest. The deposit within the test squares excavated consisted of moderately deep deposits of sandy clay loam overlying basal. The deposit within the test square excavated [redacted].

A total of 14 lithics were recovered from four of the five test squares excavated at BC/ED1, with no lithics recovered from the test square that was excavated on the flat (TS 5). The lithics were predominantly made from silcrete (n=10) while smaller quantities of IMT (n=3) and quartz (n=1) lithics were also recovered. The lithics consisted of 12 artefacts and two non-diagnostic angular fragments (IDs 11 and 17). Extrapolated to square metres, the mean average artefact density within the test area at BC/ED1 PAD 1 was 10.4 artefacts per square metre. The artefacts were predominantly unmodified complete flakes and flake fragments (n=9). The assemblage also contained two silcrete retouched medial flake fragments and one quartz core. Most artefacts (n=9) did not retain cortical surfaces while one IMT proximal flake fragment, one quartz core and one silcrete retouched medial flake fragment retained less than 30 percent cortex.

The test excavations at BC/ED1 demonstrated that a subsurface archaeological deposit existed within the terrace slope in the southern portion of the mapped site extent. The deposit within the mid slope of the terrace contained higher artefact densities than the lower slope, where very low artefact densities were recovered. No artefacts were recovered from the [redacted] As a result of the archaeological investigations, the southeast portion of the site was assessed as exhibiting moderate archaeological significance.

6.1.3. Badgerys Creek West B (BWB)

Badgerys Creek West B was a subsurface archaeological deposit that was situated on [redacted]

[redacted]ring an archaeological assessment for a proposed upgrade to [redacted] and the area was subsequently subject to an archaeological test excavation as part of planning for the M12 Motorway. The test excavation consisted of 14 squares, each measure one square metre, which were positioned at 40 metre intervals [redacted]. [redacted] A total of 72 lithics were recovered from 13 of the 14 test squares. The horizontal distribution of lithics was characterised by a low density across the tested area with a localised moderate density within a square approximately [redacted] The lithics comprised 54 artefacts and 18 non-diagnostic angular fragments, giving a mean artefact density of 3.9 per square metre. The artefacts consisted of unmodified complete flakes (n=32) and flake fragments (n=19), one backed artefact, three cores. The artefacts were made of silcrete (n=35), IMT (n=19) and quartz (n=1). As a result of the test excavation, the site was registered as Badgerys Creek West B (BWB) on AHIMS (AHIMS 45-5-5298).

The site was subsequently subject to two archaeological salvage excavations which were undertaken to mitigate the impacts two State Significant Infrastructure projects: the M12 Motorway (SSI 9364) and the Sydney Metro - Western Sydney Airport (SSI-10051). The M12 Motorway construction area consisted of a corridor [redacted]

The salvage excavations were undertaken in two main phases (Phase 1 and 2) during which a series of salvage squares, each measuring one square metre horizontally, were excavated while an initial test phase was undertaken across the [redacted] (BWB East). The initial phase comprised 27 test squares, each measuring 50 square centimetres horizontally, that were placed at 10 metre intervals along east-west oriented transects. A total of 78 lithics were recovered from 18 of the 27 test squares. The lithics consisted of 46 artefacts and 32 non-diagnostic angular fragments, with a mean average artefact density of 6.8 per square metre. The artefacts were unmodified complete flakes (n=6) and flake fragments (n=24), five silcrete cores, nine silcrete core fragments, one chert core fragment and one silcrete retouched artefact. The artefacts

were made from silcrete (n=38), IMT (n=5), chert (n=2), and quartz (n=1). A total of seven artefacts retained cortical surfaces and consisted of two silcrete cores, two silcrete core fragments, one chert core fragment, one chert flake and one quartz medial flake fragment.

The Phase 1 salvage excavations at BWB consisted of 82 squares that were [redacted] The expansion of the six test squares resulted in the recovery of an additional 219 lithics, of which 102 were artefacts. The western Phase 1 squares were excavated [redacted]. A total of 835 lithics were recovered from 78 of the 82 Phase 1 squares and included 497 artefacts, with a mean average artefact density of 6.1 per square metre. The Phase 1 squares in the eastern portion of the sites generally contained low artefact densities with low to moderate densities within the squares [redacted]. The Phase 1 squares that were excavated in the western portion of the site generally contained low artefact densities with areas of low to [redacted].

The Phase 2 excavations at BWB were undertaken in five open areas that were excavated [redacted], [redacted]BWB North OA 1). BWB East OA 1 was situated on an elevated flat approximately [redacted] The open area was approximately [redacted] The open area consisted of 11 Phase 2 squares that were excavated around the Phase 1 square (249E 601N) to form a rectangle four metres north-south and three metres east-west. A total of 246 lithics were recovered from BWB East OA 1. The horizontal distribution of lithics within the open area was characterised by a very low to low density along the northern, eastern and western squares with an area of moderate density in the centre and southeast. The lithics comprised 136 artefacts and 110 non-diagnostic angular fragments. The artefacts were recovered from 11 of the 12 squares excavated at BWB East OA 1 with an average mean density of 11.3 artefacts per square metre. The horizontal distribution of artefacts within the open area was characterised by a very low to low density with a localised moderate density within the Phase 1 square (249E 601N).

BWB East OA 2 [redacted]he open area consisted of 30 Phase 2 squares that were excavated around the Phase 1 square (056E 621N) to form an irregular shape six metres north-south and east-west at maximum extent. A total of 1,376 lithics were recovered from BWB East OA 2. The horizontal distribution of lithics within the open area was characterised by high densities within the centre that transitioned to a low to moderate density with infrequent isolated squares containing very low density along the edges. The lithics comprised 716 artefacts and 660 non-diagnostic angular fragments. The artefacts were recovered from all 31 squares excavated at BWB East OA 2 with an average mean density of 23.1 artefacts per square metre. The horizontal distribution of artefacts within the open area was characterised by low to moderate densities with moderate to high densities within the centre.

BWB West OA 1 was [redacted] BWB West OA 1 comprised 22 Phase 2 squares that were excavated around a Phase 1 square (946E 653N) to form an irregular rectangle five metres north-south and four metres east-west at maximum extent. A total of 1,151 lithic were recovered from BWB West OA 1. The horizontal distribution of lithics within the open area was characterised by high densities in the centre, moderate to high densities in the northwest, moderate densities along the eastern edge and very low to low densities along the southern edge. The lithics comprised 691 artefacts and 460 non-diagnostic angular fragments giving an average mean artefact density of 31.4 per square metre. The artefacts were recovered from 22 or the 23 squares excavated at BWB West OA 1 with an average mean density of 30 artefacts per square metre. The horizontal distribution of artefacts within the open area was characterised by low to moderate densities with moderate to high densities within the centre.

BWB West OA 2 was situated [redacted]. BWB West OA 2 comprised 21 Phase 2 squares that were excavated around a Phase 1 square (956E 663N) to form an irregular shape six metres north-south and east-west at maximum extent. A total of 1,210 lithic were recovered from BWB West OA 2. The horizontal distribution of lithics within the open area was characterised by low to moderate densities with an area of moderate to high densities running northwest to southeast through the centre. The lithics comprised 637 artefacts and 573 non-diagnostic angular fragments, giving an average mean artefact density of 30.3 per square metre. The artefacts were recovered from all squares excavated at BWB West OA 2 with an average mean density of 29 artefacts per square metre. The horizontal distribution of artefacts within [redacted]

BWB North OA 1 was situated on a [redacted] total of 2,121 lithics were recovered from the Phase 2 squares excavated at BWB which included 1,707 artefacts giving an average mean artefact density of 34.8 per square metre. The horizontal distribution of artefacts within the open area was characterised by moderate densities with areas of moderate to high densities in the centre and along the northern, northeastern and northwestern edges.

A total of 5,617 lithics were recovered from 126 of the 128 Phase 2 squares excavated at BWB. The lithics consisted of 3,630 artefacts and 1,987 non-diagnostic angular fragments. The artefacts were predominantly unmodified complete flakes (n=1,113) and flake fragments (n=1,952); however, 187 backed artefacts, 67 retouched artefacts, 154 cores, and 145 core fragments were also recovered. The artefacts were predominantly silcrete (n=2,882) with smaller quantities of other materials including IMT (n=433), quartz (n=181) and chert (n=58). The mapped extent of the site was subsequently impacted by the approved works of the M12 Motorway (SSI 9364) and the Sydney Metro - Western Sydney Airport (SSI-10051).

The archaeological assessment area for the current project, which included the study area, partially overlapped the previously investigation area in the vicinity of BWB North OA 1 and included the landforms immediately east and north of the previous archaeological investigations at BWB. [redacted]

The desktop assessment for the current project determined that the results of the previous investigations indicated that the [redacted]

The site was inspected as part of the archaeological field survey for the current project (see Section 4.1.2). The survey noted that the area had been variably disturbed by past land use practices and natural processes. [redacted]. An archaeological test excavation program was recommended within these areas to determine the nature of any archaeological subsurface deposits that maybe present these areas.

An archaeological test excavation was subsequently undertaken at BWB for the current project (see Section 4.1.3.). The excavation comprised 16 test squares that were excavated in four areas (BWB Test Areas 1-4). BWB Test Area 1 encompassed [redacted]

BWB Test Area 3 was located on an [redacted]

A 26 lithics were recovered from nine of the 16 test squares excavated at BWB. The lithics consisted of 21 artefacts and five non-diagnostic angular fragments, which extrapolated to square metres gives a mean artefact density of 5.25 per square metre. The horizontal distribution of artefacts was characterised by a fragmented very low density deposit across the four tested areas with extrapolated mean artefact densities between 2.7 (BWB Test Area 4) and 9.1 (BWB Test Area

2) per square metre. The assessment noted that the variation in the number of artefacts recovered from the test areas was potentially influenced by the number of test squares excavated in each area.

The artefacts included one silcrete backed artefact, two silcrete cores, four unmodified flakes and 14 flake fragments. The artefacts were made of silcrete (n=11), IMT (n=9), and fine grained silicious material (n=1). Cortical surfaces were identified on four of the artefacts recovered from the test excavation at BWB and were made from silcrete, IMT (n=2), and fine grained silicious material.

The test excavation at BWB demonstrated that the archaeological subsurface deposit extended into the study area; however, the artefact density within the deposit was generally lower than had been recovered from archaeological excavations which had previously been undertaken at the site to the south and west of the study area. A portion of the mappe Any works related to the current proposal undertaken within the approval area will be required to comply with the existing conditions of the approval. Outside of the Sydney Metro - Western Sydney Airport construction area, the portion of the site within the study area was assessed as exhibiting low archaeological significance.

6.1.4. Elizabeth Drive Upgrade Badgerys Creek IF 1 (EDU Badgerys Creek IF 1)

EDU Badgerys Creek IF 1 was an isolated subsurface artefact that was situated e

An archaeological test excavation was undertaken at the site as part of an archaeological assessment for a proposed upgrade to Elizabeth Drive. The test excavation program at the site consisted of nine test squares that were excavated at regular intervals along three transects that were oriented north-south. A total of one artefact was recovered during the test excavation program at EDU Badgerys Creek IF 1. The artefact consisted of a silcrete medial flake fragment that was recovered from the upper 10 centimetres of a deposit within a test square that was situated on the terrace crest.

EDU Badgerys Creek IF 1 was inspected as part of the archaeological field survey for the current project. The survey noted that the area had been variably disturbed by past land use practices associated with the construction of a sealed road which was located to east. The assessment determined that the while further artefacts were likely to occur at the deposit would likely contain very low artefact densities with low archaeological significance.

6.1.5. Lawson Road Badgerys Creek AFT 1

Lawson Road Badgerys Creek AFT 1 was a subsurface archaeological deposit that was located

The site was identified as an area of potential archaeological deposit by the archaeological field survey undertaken for the current project due to similarities with the topography of previously identified Aboriginal archaeological sites in the region and low visible disturbance. The area of potential was bound by lower lying g A test excavation program was recommended to determine the extent of any subsurface disturbance and to identify subsurface archaeological deposits that may have been present.

The test excavation program at Lawson Road Badgerys Creek AFT 1 consisted of three test squares that were excavated at 10 metre intervals along one north-south oriented transect. The deposit within the test squares consisted of shallow to moderately deep sandy clay loam overlying basal clay and was waterlogged during the test excavation with water pooling along the basal clay at the base of the test squares. A total of three artefacts were recovered from two of the three test squares excavated at Lawson Road Badgerys Creek AFT 1.

The artefacts were recovered from TS 1 (n=1) at the northern end of the transect and TS 3 (n=2) at the southern end of the transect. The artefacts consisted of silcrete proximal fragment, an unmodified silcrete flake and an IMT distal flake fragment. The low number of small, fragmented artefacts recovered during the test excavation at s a result, the site was assessed as having low archaeological significance.

6.1.6. McGarvie Smith Farm Badgerys Creek AFT 1

McGarvie Smith Farm Badgerys Creek AFT 1 was an archaeological site that was

[redacted]

The archaeological field survey undertaken for the current project determined that the site had potential for subsurface deposits due to similarities with the topography of previously identified sites with subsurface deposits in the region and low visible disturbance. [redacted]. A test excavation program was recommended to determine the extent of any subsurface disturbance and to identify subsurface archaeological deposits that may have been present.

The test excavation program at McGarvie Smith Farm PAD 1 consisted of 29 test squares that were excavated across the [redacted] A total of five lithics were recovered from four of the 12 test squares and comprised four artefacts and one non-diagnostic angular fragment. The test squares that contained the artefacts were located along the [redacted].

A total of 65 lithics were recovered from 12 of the 17 test squares excavated on the [redacted]. The horizontal distribution of lithics was generally characterised by very low to moderate densities within the test squares in the south and east with a very low density within one square in the north. The highest lithic density (n=16) was recovered from TS 2 which was located in the south. The lithics consisted of 53 artefacts and 17 non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 7.3 artefacts per square metre. The artefacts were predominantly unmodified complete flakes and flake fragments (n=47). The assemblage also contained one silcrete backed artefact, one IMT backed artefact, and one silcrete retouched artefact.

The test excavation demonstrated that a subsurface archaeological deposit was present within the [redacted]. The variation in the subsurface artefact densities of the [redacted]ere consistent with the results of previous archaeological investigations in the region (see Section 4.1.1.). The site was assessed as having moderate archaeological significance due to subsurface artefact density and low levels of visible disturbance.

6.1.7. McGarvie Smith Farm Badgerys Creek AFT 2

McGarvie Smith Farm Badgerys Creek AFT 2 was located [redacted]

The archaeological field survey undertaken for the current project determined that the site had potential for subsurface deposits due to similarities with the topography of previously identified sites with subsurface deposits in the region and low visible disturbance. The area of [redacted] A test excavation program was recommended to determine the extent of any subsurface disturbance and to identify subsurface archaeological deposits that may have been present.

The test excavation program at McGarvie Smith Farm PAD 2 consisted of four test squares that were excavated along one north-south oriented transect that was split into two by an area of waterlogged ground. The deposit within the test squares excavated at McGarvie Smith Farm Badgerys Creek AFT 2 consisted of moderately deep silty or sandy clay loam duplex soils with iron/manganese nodules increasing with depth overlying basal clay. A total of 22 lithics were recovered from the four test squares excavated at McGarvie Smith Farm PAD 2. The horizontal distribution of lithics across the tested area was characterised by low to moderate densities within the test squares in the centre of the transect that and low densities within the northern and southern squares. The lithics consisted of 19 artefacts and three non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 19 artefacts per square metre. The artefacts were predominantly unmodified complete flakes and flake fragments; however, the assemblage also contained two backed artefacts, one core, and one retouched artefact.

The test excavation demonstrated that a subsurface archaeological deposit was present at McGarvie Smith Farm Badgerys Creek AFT 2. The site was assessed as having moderate archaeological significance due to subsurface artefact density and low levels of visible disturbance.

6.1.8. South Creek West T1 (SCW T1)

[redacted]

[redacted]

The area formed part of an area of potential archaeological deposit (South Creek West) that was identified by predictive modelling undertaken during an archaeological assessment as part of the planning for the M12 Motorway and was subsequently tested. The test excavation at SCW T1 consisted of 12 test squares, each measure one square metre, that were generally excavated at 40 metre intervals along one east-west oriented transect (T1). Some squares were offset to avoid the [redacted] The transect extended from the base of the spur in the west to the top of the slope descending to Wianamatta/ South Creek in the east.

A total of 109 lithics were recovered from eight of the 12 test squares excavated at SCW T1. The horizontal distribution of artefacts across the tested area was characterised by low to moderate densities across the western half of the transect with a localised low density deposit and a localised high density deposit in the eastern half of the transect. The lithics consisted of 88 artefacts and 21 non-diagnostic angular fragments, giving an average mean artefact density of 7.3 per square metre. The artefacts consisted of unmodified complete flakes (n=53) and flake fragments (n=32), one silcrete retouched flake, three silcrete cores, one IMT core and one igneous core. The retouched artefact and the IMT core were recovered from the test square at the base of the spur slope with 19 other artefacts. Three silcrete cores were recovered from the square in the eastern half of the transect where a further 46 silcrete artefacts and one IMT artefact were recovered. The artefacts were made of silcrete (n=76), IMT (n=9),

The M12 Motorway Project was approved (SSI 9364) by the Minister for Planning and Public Spaces in April 2021. An archaeological salvage excavation program was undertaken at SCW T1 in accordance with the conditions of the approval (SSI 9364) and the Aboriginal Cultural Salvage Strategy developed for the project. The salvage excavation area at SCW T1 was located within the approximately 100 metre wide corridor that ran east-west through the centre of the mapped site extent.

The Phase 1 excavation at SCW T1 comprised 13 squares that were excavated at 10 metre intervals along east-west oriented transects on the northern and southern sid[redacted]CW T1. A total of 211 lithics were recovered from 10 of the 13 Phase 1 squares excavated at the site. The horizontal distribution of lithics was characterised by a low to moderate deposit across the salvage excavation area. The lithics recovered from the Phase 1 squares at SCW T1 comprised 171 artefacts and 40 non-diagnostic angular fragments with a mean average artefact density of 13.2 per square metre. The artefacts were predominantly unmodified complete flakes (n=143) and flake fragments (n=26); however, two silcrete backed artefacts were also recovered. The artefacts were mostly silcrete (n=164) while smaller quantities of IMT(n=6) and quartz (n=1) were also recorded.

The Phase 2 excavation at SCW T1 comprised one open area of 37 square metres that was located [redacted] A total of 2,476 lithics were recovered from the open area. The horizontal distribution of lithics within the open area was characterised by a moderate to very high density deposit that was concentrated in the centre of the open area. The lithics consisted of 1,982 artefacts and 494 undiagnosed angular fragments with a mean average density of 53.56 per square metre. The artefacts recovered during the Phase 2 excavation at SCW T1 consisted of 1,607 unmodified complete flakes, 275 flake fragments, 42 backed artefacts, seven retouched artefacts, 43 cores, seven core fragments, and one ground edge hatchet fragment.

The artefacts were generally made of silcrete (n=1,880) or IMT (n=93) while few were made of a range of materials including quartz (n=2) and chert (n=1). Cortical surfaces were present on 482 artefacts with most (n=343) retaining less than 30 percent cortex. Almost all the cores and core fragments (n=49) were made of silcrete while the remaining core was made of IMT. Most cores and core fragments, including the IMT core, retained cortical surfaces (n=40) with 11 silcrete cores and one silcrete core fragment retaining between 31 and 69 percent. The proportion of silcrete artefacts in the assemblage, large number of silcrete cores and proportionally high retention of cortical surfaces indicated that the silcrete was locally sourced and may have been obtained from [redacted] however, the presence of formalised tools within the assemblage demonstrated that the activities undertaken at the site were not limited to the primary reduction of locally sources stone.

The archaeological assessment area for the [redacted]. The site was inspected as part of the archaeological field survey for the current project (see Section 4.1.2). The survey noted that the area immediately to the east had been disturbed by [redacted]. Disturbance within the portion of the site in the study area was limited and was identified as exhibiting potential for subsurface archaeological deposits. An archaeological test excavation program was recommended to determine the nature of any archaeological subsurface deposits that maybe present this area.

The test excavation program at SCW T1 was undertaken to investigate the northern portion of the mapped site extent which narrowed [redacted] The deposit within the test square excavated at SCW T1 consisted of moderately deep silty clay loam soils with iron/manganese nodules increasing with depth overlying basal clay. No lithics were recovered during the test excavation and indicated that whilst artefacts were likely to occur within the portion of the site in the study area the deposit would likely contain very low artefact densities. As a result, the portion of the site within the study area was assessed as having low archaeological significance.

6.1.9. South Creek West T2 (SCW T2)

South Creek West T2 was a subsurface archaeological deposit that was located [redacted] that was identified by predictive modelling undertaken during an archaeological assessment as part of the planning for the M12 Motorway and was subsequently tested. The test excavation at SCW T2 consisted of 19 test squares, each measure one square metre, that were generally excavated at 40 metre intervals along two transects. The first transect was aligned north-south along the spine of the spur crest. The second transect was aligned east-west, intersecting the first transect at the southern end and traversing the spur crest, gentle western slope adjacent to the tributary and steep eastern slope that descended to the elevated flat adjacent.

A total of 298 lithics were recovered from 18 of the 19 test squares excavated at SCW T2. The horizontal distribution of lithics across the test area was characterised by a moderate to high density along the spin of the spur crest with low densities on the steep eastern slope and gentle western slope. Two larger excavation areas (known as 'geotech pits') were also excavated at the site [redacted] TP225. A total of 58 lithics were recovered from the two geotech pits. The majority were recovered from TP224 (n=54).

The lithics recovered during the test excavation at SCW T2 comprised 252 artefacts and 104 non-diagnostic angular fragments. The non-diagnostic angular fragments were predominantly silcrete (n=78) or IMT (n=17). The artefacts were made of silcrete (n=173), IMT (n=52), quartz (n=18), quartzite (n=1), and petrified wood (n=1). The artefacts consisted of unmodified complete flakes (n=124) and flake fragments (n=91), seven silcrete backed artefacts, eight retouched artefacts, and 22 cores.

The backed artefacts were made from silcrete (n=6) and IMT (n=1) with most recovered from 100E40N (n=2) and 100E80N (n=3) which were located on the spine of the spur crest, approximately 40 to 80 metres north of the east-west transect. The retouched artefacts were made from silcrete (n=8) and quartzite (n=1). Most were recovered from 100E80N (n=4). The cores were predominantly made of silcrete (n=20) with two quartz cores also recovered. Most cores (n=12) were recovered from a single test square (100E80N) which was located on spine of the spur crest approximately 80 metres north of the east-west oriented transect while five cores were recovered from a test square (100E160N) 80 metres to the north.

The M12 Motorway Project was approved (SSI 9364) by the Minister for Planning and Public Spaces in April 2021. An archaeological salvage excavation program was undertaken at SCW T2 in accordance with the conditions of the approval (SSI 9364) and the Aboriginal Cultural Salvage Strategy developed for the project.

The salvage excavation area at SCW T2 was located on the crest of a spur, approximately 10 metres east of the current study area. The Phase 1 excavation at SCW T2 consisted of 51 squares that were excavated at 10 metre intervals along several north-south oriented transects. A total of 1,532 lithics were recovered from 49 of the 51 Phase 1 squares with a mean average of 30.04 lithics per square metre. The horizontal distribution of lithics was characterised by a moderate to high density deposit that became moderate to very high in the northern portion of the salvage excavation area.

The lithics consisted of 1,133 artefacts and 399 non-diagnostic angular fragments. The artefacts were predominantly unmodified complete flakes (n=753) and flake fragments (n=304). A total of 23 backed artefacts, 18 retouched artefacts, 17 cores and one core fragment were recovered during the Phase 1 excavation. The recovered cores, backed artefacts, and retouched artefacts were almost entirely made from silcrete. The Phase 1 assemblage also contained one ground edge hatchet fragment, four ground stone fragments and one hammerstone fragment.

The Phase 2 excavation at SCW T2 comprised one open area of 97 square metres that was located northern portion of the salvage area and [redacted] The deposit within the open area was generally shallow and compacted with iron/manganese inclusions and overlying an undulating basal clay. The

excavation noted several burnt root systems within the open area which were interpreted as associated with past tree clearance. A backfilled water pipeline was also noted running east-west through the open area.

A total of 7,500 lithics were recovered from 95 of the 97 square metres excavated within the open area with a mean average of 77.32 lithics per square metre. The horizontal distribution of lithics within the open area was characterised by a general low to high density with clusters of high and very high densities in the north, southwest and southeast. The lithics consisted of 5,888 artefacts, five fragments of ochre and 1,607 non-diagnostic angular fragments. The artefacts were predominantly unmodified complete flakes (n=4,004) and flake fragments (n=1,559). The Phase 2 assemblage also contained 55 backed artefacts, 70 backed artefact fragments, 46 retouched artefacts, 71 cores, 24 core fragments, and 12 ground stone fragments. The artefacts were mostly made from silcrete (4,582), with smaller numbers of artefacts made from IMT (n=294), chert (n=206)

[redacted] The site was inspected as part of the archaeological field survey for the current project (see Section 4.1.2). The northern portion of the site was identified as exhibiting potential for subsurface archaeological deposits; however, information from the previous archaeological excavations at the site was limited to the [redacted] An archaeological test excavation program was recommended to determine the nature of any archaeological subsurface deposits that maybe present this area.

The test excavation program at SCW T2 was undertaken to investigate the deposit on the [redacted] he deposit within the test squares excavated at SCW T2 consisted of moderately deep silty to sandy clay loam soils with iron/manganese nodules increasing with depth overlying basal clay.

The test excavations at SCW T2 recovered six lithic from the southern test square which [redacted] The lithics were silcrete (n=3) and IMT (n=2), and chert (n=1). The lithics consisted of three artefacts and three non-diagnostic angular fragments. Extrapolated to square metres, the mean average artefact density was 6.0 artefacts per square metre. The artefacts consisted of one unmodified complete flake and two flake fragments. The test excavation at SCW T2 confirmed that the subsurface archaeological deposit was present within the study area and was generally consistent with the results from the previous archaeological investigations that had been undertaken at the site. As a result, the northern portion of the site was assessed as exhibiting moderate archaeological significance.

7 Cultural Heritage Values and Statements of Significance

7.1 Significance assessment criteria

One of the primary steps in the process of cultural heritage management is the assessment of significance. Not all sites are equally significant and not all are worthy of equal consideration and management (Sullivan and Bowdler 1984; Pearson and Sullivan 1995:7). The determination of significance can be a difficult process as the social and scientific context within which these decisions are made is subject to change (Sullivan and Bowdler 1984). This does not lessen the value of the heritage approach but enriches both the process and the long term outcomes for future generations as the nature of what is conserved and why, also changes over time.

Significance assessments can generally be described under three broad headings (Pearson and Sullivan 1995:7):

- Value to groups such as Aboriginal communities
- Value to scientists and other information gatherers
- Value to the general public in the context of regional, state and national heritage.

The assessment of significance is a key step in the process of impact assessment for a proposed activity as the significance or value of an object, site or place will be reflected in resultant recommendations for conservation, management or mitigation.

The *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a) requires significance assessment according to criteria established in the *Australia ICOMOS Burra Charter* (Australia ICOMOS 2013). The *Burra Charter* and its accompanying guidelines are considered best practice standard for cultural heritage management, specifically conservation, in Australia. Guidelines to the *Burra Charter* set out four criteria for the assessment of cultural significance:

- Aesthetic value - relates to the sense of the beauty of a place, object, site or item
- Historic value - relates to the association of a place, object, site or item with historical events, people, activities or periods
- Scientific value - scientific (or research) value relates to the importance of the data available for a place, object, site or item, based on its rarity, quality or representativeness, as well as on the degree to which the place (object, site or item) may contribute further substantial information
- Social value - relates to the qualities for which a place, object, site or item has become a focus of spiritual, political, national or other cultural sentiment to a group of people. In accordance with the Heritage NSW *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*, the social or cultural value of a place (object, site or item) may be related to spiritual, traditional, historical or contemporary associations. According to Heritage NSW, "social or cultural value can only be identified though consultation with Aboriginal people" (OEH 2011a:8).
- Spiritual value - refers to the intangible values and meanings embodied in or evoked by a place which make it important to the spiritual identity, traditional knowledge, art or practices of a cultural group. Spiritual value is strongly connected to social value.

The significance assessments for the archaeological sites identified within the study area have focussed on the social/cultural, historic, scientific and aesthetic significance of Aboriginal heritage values as identified in The Burra Charter.

7.1.1. Cultural/social values

This area of assessment concerns the value/s of a place, feature or site to a particular community group, in this case the local Aboriginal community. Aspects of social significance are relevant to sites, objects and landscapes that are important or have become important to the local Aboriginal community. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for sites generally and their continued protection.

Aboriginal cultural significance may include social, spiritual, historic and archaeological values. Regarding Aboriginal archaeological sites identified within the study area, no specific cultural value has been identified to date.

7.1.2. Historic values

Community consultation and historical research have not identified any information regarding specific historical significance of identified Aboriginal archaeological features in or near the study area. The broader cultural landscape of western Sydney includes historical Aboriginal heritage values; however, the study area does not demonstrate these values in relation to Aboriginal heritage or archaeology.

No historical values have been identified within the study area by the registered Aboriginal stakeholders to date.

7.1.3. Scientific/ archaeological values

For archaeologists, scientific significance refers to the potential of a site to contribute to current research questions. Alternately, a site may be an *in situ* repository of demonstrably important information, for example rare artefacts of unusually high antiquity. Scientific significance is assessed using criteria to evaluate the contents of a site, state of preservation, integrity of deposits, representativeness of the site type, rarity/uniqueness and potential to answer research questions on past human behaviour. Thee recommended criteria for assessing archaeological significance include:

- Archaeological Research Potential - significance may be based on the potential of a site or landscape to explain past human behaviour and can incorporate the intactness, stratigraphic integrity or state of preservation of a site, the association of the site to other sites in the region (connectivity), or a datable chronology.

- Representativeness - all sites are representative of those in their class (site type/subtype) however the issue here relates to whether particular sites should be conserved to ensure a representative sample of the archaeological record is retained. Representativeness is based on an understanding of the regional archaeological context in terms of site variability in and around the study area, the resources already conserved and the relationship of sites across the landscape.

- Rarity – which defines how distinctive a site may be, based on an understanding of what is unique in the archaeological record and consideration of key archaeological research questions (*i.e.* some sites are considered more important due to their ability to provide certain information). It may be assessed at local, regional, state and national levels.

High significance is usually attributed to sites which are so rare or unique that the loss of the site would affect our ability to understand an aspect of past Aboriginal use/occupation of an area. In some cases, a site may be considered highly significant because it is now rare due to destruction of the archaeological record through development.

Moderate (medium) significance is attributed to sites which provide information on an established research question. Sites with moderate significance are those that offer the potential to yield information that will contribute to the holistic understanding of the Aboriginal cultural landscape of the study area. Archaeological investigation of moderately significant sites will contribute knowledge regarding site type interrelationships, cultural use of landscape features and occupation patterns.

Low significance is attributed to sites which cannot contribute new information about past Aboriginal use/occupation of an area. This may be due to site disturbance or the nature of the site's contents.

7.1.4. Aesthetic values

Aesthetic values are often closely related to the social values of a site or broader cultural landscape. Aspects may include scenic sights, smells and sounds, architectural fabric and creative aspects of a place. The study area displays a low level of aesthetic value in relation to Aboriginal heritage. European land use practices, drainage modifications and dams, structures, vegetation clearance, agricultural practices, tracks and roads have altered the natural landscape within and around the identified Aboriginal archaeological sites.

No specific aesthetic values have been identified within the study area to date.

7.2 Statements of Significance

The study area contains nine extant Aboriginal archaeological sites as defined under the *National Parks and Wildlife Act 1974*. The values assessment outlined in the previous section has determined that the Aboriginal archaeological sites or the portions of sites within the study area exhibit low to moderate archaeological (scientific) significance.

Aboriginal archaeological sites (or the portions of sites) within the study area assessed as exhibiting low archaeological (scientific) significance contained stone artefacts that were typical of assemblages from sites in the region in terms of raw materials and types. The artefacts occurred in very low or low densities and were often dispersed across large areas as a result of disturbance from land use activities and/or natural processes. Beyond the information already exhibited by the artefacts, the sites lack research potential and further archaeological investigations are unlikely to contribute further to our understanding of Aboriginal landscape use in the region.

Aboriginal archaeological sites (or the portions of sites) within the study area assessed as exhibiting moderate archaeological (scientific) significance also contained stone artefacts that were typical of assemblages from sites in the region in terms of raw materials and types; however, the artefacts generally occurred in greater densities and/or within discrete areas that are indicative of limited disturbance. As a result, further archaeological investigations at sites exhibiting moderate archaeological (scientific) significance are likely to contribute further to our understanding of Aboriginal landscape use in the region.

Based on the values assessment, the following levels of significance were attached to the Aboriginal archaeological sites within the study area, as summarised in Table 3 below.

Table 3. Summary of significance of archaeological features located in the study area

Name	AHIMS ID	Site Feature	Assessed significance
BCE (including Fleurs 2, M12 A2 and M12 A3)	45-5-5294 (including 45-5-0528/ 45-5-4748/ 45-5-4750)	Artefacts	Moderate
BC/ED1	45-5-2309	Artefacts	Moderate
BWB	45-5-5298	Artefacts	Low (within study area)
EDU Badgerys Creek IF 1	45-5-5733	Artefacts	Low
Lawson Road Badgerys Creek AFT 1	45-5-5923	Artefacts	Low
McGarvie Smith Farm Badgerys Creek AFT 1	45-5-5922	Artefacts	Moderate
McGarvie Smith Farm Badgerys Creek AFT 2	45-5-5921	Artefacts	Moderate
SCW T1	45-5-5307	Artefacts	Low (within study area)
SCW T2	45-5-5308	Artefacts	Moderate

8 Impact Assessment

The Badgerys Creek Wastewater Stage 2 works would comprise the construction of wastewater infrastructure in the vicinity of Badgerys Creek between the AWRC at Kemps Creek in the north and a proposed pumping station on the southern side of Pitt Street at Badgerys Creek in the south. The proposed works would consist of the following:

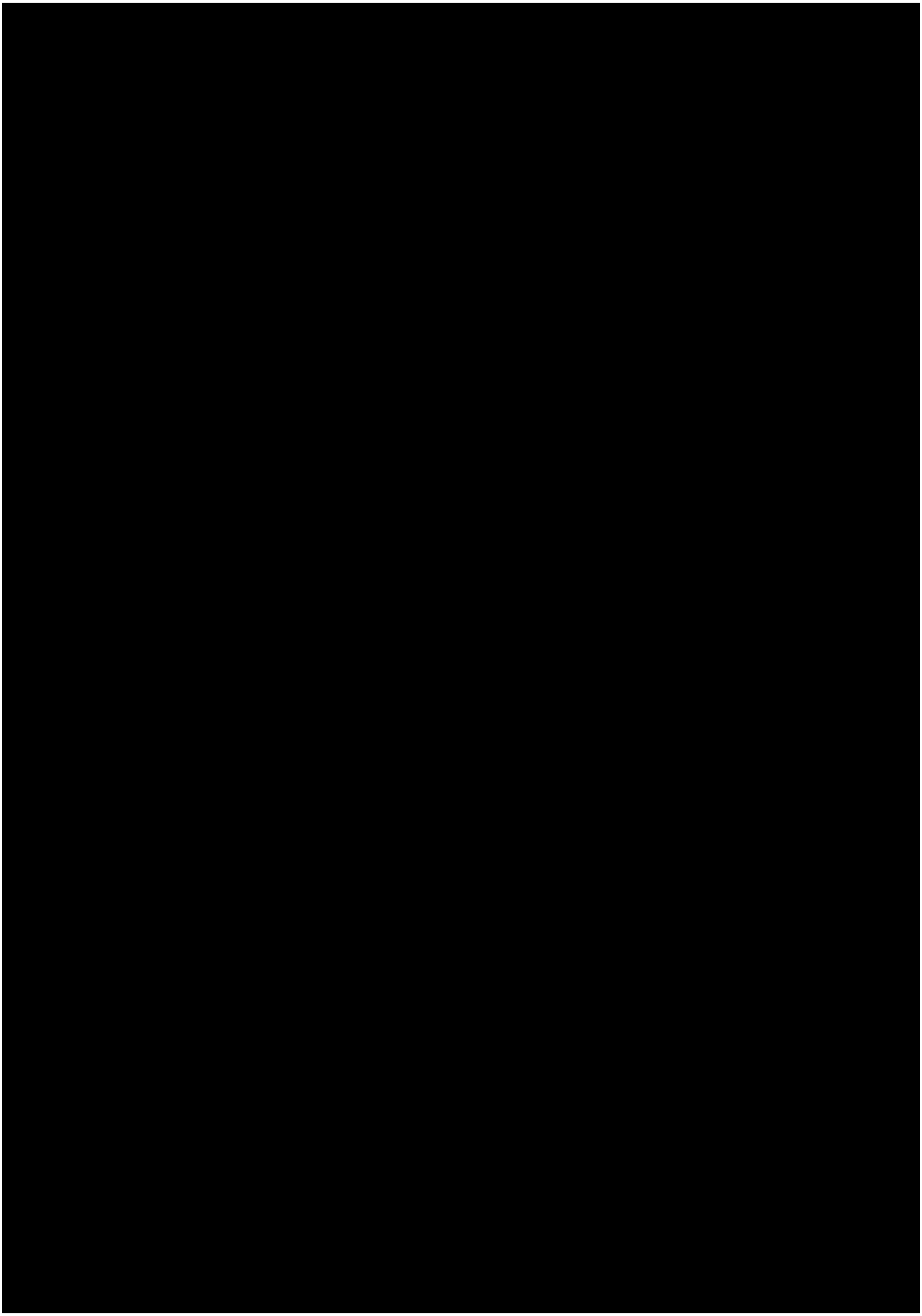
- a new sewage pumping station
- approximately 10.6 kilometres of gravity carriers
- approximately 1.8 kilometres of pressure mains

The construction methodology for the project includes trenchless and open excavation techniques. The trenchless methodology is expected to be used for sections with waterways/ creek crossings.

A total of nine Aboriginal archaeological sites would be at least partially impacted by the proposal. Proposed impacts to the sites identified within the study area are detailed in Table 4 and shown in Figure 10.

Table 4. Impact of proposed activities on Aboriginal archaeological sites within the study area

Name	AHIMS ID	Significance	Type / Degree of Harm	Consequence of Harm
BCE (including Fleurs 2 (Fleurs Prospect), M12 A2 and M12 A3)	45-5-5294 (including 45-5-0528/ 45-5-4748/ 45-5-4750)	Moderate	Direct / Partial	Partial loss of value
BC/ED1	45-5-2309	Moderate	Direct / Partial	Partial loss of value
BWB	45-5-5298	Low (within study area)	Direct / Partial	Partial loss of value
EDU Badgerys Creek IF 1	45-5-5733	Low	Direct/ Total	Total loss of value
Lawson Road Badgerys Creek AFT 1	45-5-5923	Low	Direct/ Total	Total loss of value
McGarvie Smith Farm Badgerys Creek AFT 1	45-5-5922	Moderate	Direct / Total	Total loss of value
McGarvie Smith Farm Badgerys Creek AFT 2	45-5-5921	Moderate	Direct / Partial	Partial loss of value
SCW T1	45-5-5307	Low (within study area)	Direct / Partial	Partial loss of value
SCW T2	45-5-5308	Moderate	Direct / Partial	Partial loss of value



9 Mitigating Harm

The assessment applied the principles of Ecologically Sustainable Development (ESD) to the current proposal. The principles of Ecologically Sustainable Development are defined in Section 6 of the NSW *Protection of the Environment Administration Act 1991*. The ESD principles relevant to Aboriginal cultural heritage within the study area are the Precautionary Principle and the Principle of Inter-Generational Equity. The application of these principles in relation to the current proposal is discussed below.

9.1 The Precautionary Principle

The Precautionary Principle states "that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation". The impact assessment determined that the proposal would result in serious or irreversible damage to the Aboriginal archaeological sites located within the study area (see Section 8).

Scientific confidence has been achieved through archaeological investigations including a detailed review of previous archaeological work in the region, archaeological field survey and test excavation (see Section 4.1). Landscape and environmental context have also been considered, particularly the effects of land use and natural processes (see Section 2). As detailed in Section 7.2, the assessment has determined that the Aboriginal archaeological sites identified within the study area contain low to moderate archaeological (scientific) significance. Regarding Aboriginal cultural heritage value confidence, no specific cultural or social values expressed by the sites have been identified to date (see Section 7). As such, measures for mitigating the proposed degradation to the archaeological (scientific) significance of the sites are presented in Section 9.3.

9.2 The Principle of Inter-Generational Equity

The Principle of Inter-Generational Equity states "that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations".

Aboriginal archaeological sites and objects are non-renewable resources. As such, the conservation of archaeological sites is generally seen as a method of increasing intergenerational equity in relation to archaeological (scientific) value (Bonnie 2011). Conservation is often promoted due to the potential that archaeological investigations in the future will be able to harness yet unknown technological innovations or research to derive more archaeological value from archaeological sites than we could today.

Aboriginal archaeological sites and objects, in addition to the landscape in which they are located, may have differing heritage values for the Aboriginal community, archaeologists and others (see Section 7). In general, activities that modify the landscape, such as bulk earthworks and construction, result in serious and often irreversible damage to the heritage values of the impacted areas and have a cumulative impact on the heritage values of the wider region. As such, the avoidance of areas with heritage value by such activities is often advocated as a form of conservation; however, avoidance does not generally equate to conservation and may not be the best outcome or even necessary for intergenerational equity in relation to archaeological (scientific) value.

Natural processes and land use practices, amongst other issues have been noted as causing significant difficulties when conserving archaeological sites (Bonnie 2011; Willems 2012; Williams 2014). The Aboriginal archaeological sites identified within the study area have been variably impacted by past land use activities, including tree clearance, ploughing and the construction of dams and roads, in addition to natural processes, including erosion. In this context, the partial or total avoidance of the sites would not constitute permanent protection of their archaeological value as natural processes and land use practices would result in further impact.

The archaeological value of Aboriginal archaeological sites and objects varies; however, it is often related to the information they contain or can provide (see Section 7). As discussed in Section 4, archaeological investigations have identified Aboriginal archaeological sites in the region that predominantly contained the same features as the sites identified within the study area. Many of the Aboriginal archaeological sites were recorded during investigations undertaken as part of the planning process for redevelopment or infrastructure projects and were subsequently destroyed by associated works. Known Aboriginal archaeological sites have become rarer due to the cumulative impact of these projects; however, the nature and extent of Aboriginal archaeological sites in the wider region is largely unknown, and as such, the overall rarity of specific site type can only be inferred from the results of previous investigations.

The results of previous archaeological investigations indicate that similar site types are likely to occur on elevated landforms in the vicinity of water sources where disturbance from natural processes and modern land use are low. As such, similar landforms to those within the study area are likely to contain similar Aboriginal archaeological sites.

9.3 Management and mitigation measures

The study area contains nine Aboriginal archaeological sites. Recommendations for mitigating the impact of the proposed works on the identified Aboriginal archaeological sites have been developed based on the principles of Ecologically Sustainable Development (ESD), environmental context and condition, background research and consultation with stakeholders documented in the preceding sections.

Sydney Water has determined that the Aboriginal archaeological sites located within the study area cannot be avoided by the proposal due to the limited area in which the works can be undertaken. This will result in serious and irreversible damage to the archaeological value of the sites within the impact area.

In instances where impacts to Aboriginal archaeological sites exhibiting moderate or higher archaeological value are unavoidable, archaeological salvage excavations are recommended to conserve a representative sample of the artefacts and associated contextual information contained within the impacted area for future generations. The conservation of artefacts and contextual information from salvaged archaeological sites would allow further study by future generations; however, this may not be possible due to conflicting cultural mitigation strategies, such as the reburial of stone artefacts. In instances where the reburial of stone artefacts is required to mitigate the impact on cultural values, detailed recording and additional analysis may be required to offset the impact to intergenerational equity (see Section 9.2).

The loss of the intrinsic Aboriginal cultural value of impacted Aboriginal archaeological sites often cannot be fully offset or mitigated; however, the recovery of surface artefacts from the sites by the Aboriginal community may help to mitigate the impact of the proposed works.

An AHIP is required for impacts to land and identified sites/objects prior to the commencement of pre-construction or construction activities associated with the proposal that would affect the sites. Measures for mitigating harm to the sites are outlined in Table 5 below.

Table 5. Management and mitigation measures for impacted Aboriginal archaeological sites

Site Name	Degree of Harm	Significance of Harm	Management and mitigation measures
BCE (including Fleurs 2 (Fleurs Prospect), M12 A2 and M12 A3)	Partial	Moderate	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. Archaeological salvage excavation of impacted portion of site to be completed prior to commencing construction works. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
BC/ED1	Partial	Moderate	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. Archaeological salvage excavation of impacted portion of site to be completed prior to commencing construction works. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
BWB	Partial	Low (within study area)	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
EDU Badgerys Creek IF 1	Total	Low	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area

Site Name	Degree of Harm	Significance of Harm	Management and mitigation measures
			should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
Lawson Road Badgerys Creek AFT 1	Total	Low	A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
McGarvie Smith Farm Badgerys Creek AFT 1	Total	Moderate	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. Archaeological salvage excavation of impacted portion of site to be completed prior to commencing construction works. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
McGarvie Smith Farm Badgerys Creek AFT 2	Partial	Moderate	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. Archaeological salvage excavation of impacted portion of site to be completed prior to commencing construction works. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
SCW T1	Partial	Low (within study area)	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.
SCW T2	Partial	Low (within study area)	Barrier fencing to be erected on the AHIP boundary for the extent of the site area to ensure that no construction impact extends into the portion of the site outside the proposal area. Portion of area outside of proposal area should be identified on the CEMP as environmentally sensitive no-go zone to ensure no impact. Archaeological salvage excavation of impacted portion of site to be completed prior to commencing construction works. A surface collection of Aboriginal objects within impacted portion of site to be completed prior to commencing construction works. AHIP required prior to commencement of works affecting the site.

10 Summary and Recommendations

A total of nine Aboriginal archaeological sites have been identified within the study area. An AHIP is being sought for Aboriginal objects within the boundaries of the study area, incorporating the Aboriginal archaeological sites listed in Table 6.

Aboriginal Heritage Impact Permit
An application for an Aboriginal Heritage Impact Permit should be made under section 90A of the *National Parks and Wildlife Act 1974* for the land and associated objects within the boundaries of the proposed impacted area (Figure 11). The AHIP should also be sought for the specified Aboriginal sites and Aboriginal objects contained within the sites listed below.

Table 6. Aboriginal archaeological sites and scope for which an AHIP is being sought.

Name	AHIMS ID	Significance	Scope of AHIP
BCE (including Fleurs 2 (Fleurs Prospect), M12 A2 and M12 A3)	45-5-5294 (45-5-0528/ 45-5-4748/ 45-5-4750)	Moderate	Partial Impact
BC/ED1	45-5-2309	Moderate	Partial Impact
BWB	45-5-5298	Low (within study area)	Partial Impact
EDU Badgerys Creek IF 1	45-5-5733	Low	Total Impact
Lawson Road Badgerys Creek AFT 1	45-5-5923	Low	Total Impact
McGarvie Smith Farm Badgerys Creek AFT 1	45-5-5922	Moderate	Total Impact
McGarvie Smith Farm Badgerys Creek AFT 2	45-5-5921	Moderate	Partial Impact
SCW T1	45-5-5307	Low (within study area)	Partial Impact
SCW T2	45-5-5308	Moderate	Partial Impact

Site Protection
The boundary of the AHIP area adjacent to the non-impacted parts of the sites should be demarcated with protective fencing and listed in the CEMP. These areas should be identified as “no-go zones” on the CEMP maps and workers inducted as to appropriate protection measures and requirements to comply with conditions in the AHIP.

Salvage Excavation
The AHIP would include provision for impact mitigation through archaeological salvage excavation. Salvage excavation would be required at sites BCE, BC/ED1, McGarvie Smith Farm Badgerys Creek AFT 1, McGarvie Smith Farm Badgerys Creek AFT 2, and SCW T2. Salvage excavation must be completed prior to any activities (including pre-construction activities) which may harm Aboriginal objects at these locations. Salvage excavation activities would be undertaken in accordance with the methodology attached as Appendix C.

Surface Collection
The AHIP should include provision for impact mitigation through surface collection at the impacted Aboriginal archaeological sites within the AHIP area. The surface collections must be completed prior to any activities (including pre-construction activities) which may harm Aboriginal objects at the sites. Surface collection would be undertaken in accordance with the methodology outlined below:

- Surface artefact collection within the sites would be restricted to the approved AHIP area.
- The collection of surface artefacts would be undertaken with Aboriginal site officers.
- Photographs and the details of each artefact collected, including attributes and location/context would be recorded during the surface collection.
- The AHIMS site records would be updated to include the details of the collected surface artefacts.

Salvaged and Collected Aboriginal Objects
The short term management of collected Aboriginal objects would be as follows:

- Any Aboriginal objects that are removed from the land by actions authorised by an AHIP, must be moved as soon as practicable to the temporary storage location (see below) pending any agreement reached about the long term management of the Aboriginal objects.
- The temporary storage location: Kelleher Nightingale Consulting Pty Ltd, Suite 505-507, 155 King Street, Sydney NSW 2000.
- Any Aboriginal objects stored at the temporary storage location must not be further harmed, except in accordance with the conditions of the AHIP.

The long term management of collected Aboriginal objects would be determined in consultation with the project's registered Aboriginal stakeholders and in accordance with the conditions of the AHIP.

- If objects are to be transferred under a Care and Control Agreement to an Aboriginal person or organisation representing Aboriginal people in accordance with Section 85A(1)(c) of the *National Parks and Wildlife Act 1974*, an application for a Care Agreement must be completed.
- If reburial is to be undertaken of objects, Requirement 26 "Stone artefact deposition and storage" in the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* must be complied with, unless the registered Aboriginal stakeholders agree to an alternative deposition method.
    - If reburial is to take place, registered Aboriginal stakeholders would be notified and given the opportunity to attend, and the reburial recorded on AHIMS

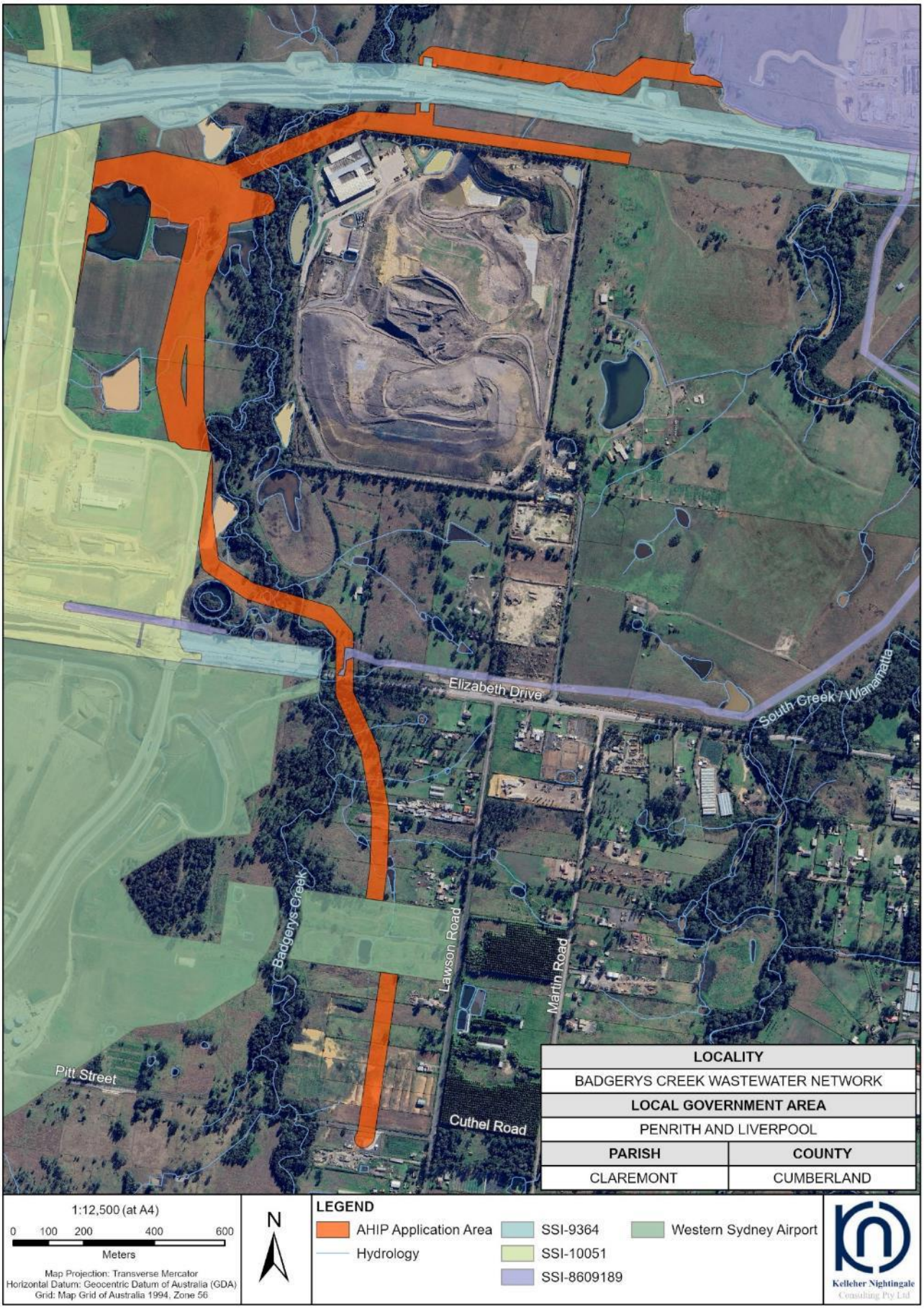


Figure 11. AHIP application area boundary

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Appendix A Advertisement for registration of interest

ADVERTISEMENT

Notice for Registration of Interest

Sydney Water are proposing Stage 2 of the Badgerys Creek wastewater network at Badgerys Creek, NSW. The project is located in the Liverpool and Penrith local government areas. The proponent is Sydney Water ([redacted] Project Manager: Level 11, 1 Smith Street, Parramatta NSW 2150).

The proposal may be the subject of Aboriginal Heritage Impact Permit (AHIP) applications made under section 90A of the National Parks and Wildlife Act 1974. Sydney Water proposes to carry out consultation with Aboriginal communities in accordance with the Heritage NSW Aboriginal cultural heritage consultation requirements for proponents 2010. Information obtained from the consultation process may be used in the preparation of AHIP applications and will assist Heritage NSW in the consideration and determination of the AHIP applications. Kelleher Nightingale Consulting Pty Ltd has been engaged to facilitate the consultation process.

Sydney Water invites Aboriginal groups and/or Aboriginal people who hold cultural knowledge relevant to determining the significance of Aboriginal objects and/or places at Badgerys Creek to register interest in a process of community consultation with the contact shown below (on behalf of Sydney Water):

Kelleher Nightingale Consulting
Suite 505-507, 155 King Street
Sydney NSW 2000
phone 02 9232 5373

The closing date for registration is 31 May 2024.

Please be advised that in accordance with Heritage NSW requirements, we are required to record the names and contact details of each Aboriginal person who has registered an interest in this project and provide a copy of that record to the relevant Heritage NSW office and Local Aboriginal Land Council. If you are registering your interest, please let us know if you do not want your details forwarded to these organisations.

WW53804

Appeared in: The Western Weekender

Publication date: Friday, 17 May 2024

Appendix B Aboriginal Stakeholder Comments

Appendix C Archaeological Salvage Methodology

Salvage Excavation Area
Salvage excavation would be undertaken at the following Aboriginal archaeological sites to mitigate the impacts of the proposed works:

- BCE
- BC/ED1
- McGarvie Smith Farm Badgerys Creek AFT 1
- McGarvie Smith Farm Badgerys Creek AFT 2
- SCW T2

Salvage Excavation Aims
The main aims of the proposed salvage excavation program are:

- To salvage a representative sample of the cultural deposit from the identified archaeological sites prior to impact from the proposed works using established techniques (see Field Methods below).
- To analyse the salvaged archaeological material to gain and conserve knowledge and understanding of the scientific and cultural information exhibited by the sites.
- To use the excavation results to gain insight into the subsurface archaeology of the adjacent areas not being impacted by the proposal. This would increase future educational opportunities and allow more informed management of Aboriginal heritage.

The further scientific aim of the salvage excavation program would be to determine the following characteristics of the subsurface cultural deposit:

- Subsurface integrity. Determining the integrity of the deposit involves assessing the degree of disturbance which is present.
- Statistical extent of the sites and/or activity areas. Determining the statistical extent of sites and/or activity areas involves identifying the boundaries associated with the identified archaeological deposit.
- Spatial distribution of the cultural deposit. Assessing the spatial distribution involves identifying the presence/absence of archaeological material across archaeological sites
- Nature of the cultural deposit. The nature of the cultural deposit/archaeological site refers to the type of activities indicated by the artefactual material (e.g. primary production, domestic knapping, hunting camps). The goal would be to retrieve entire assemblages from specific activities if such activities are present.

Research Questions
The results of the proposed salvage excavation would increase our understanding of subsurface archaeology of the study area. In particular, research would focus on the archaeologically identifiable cultural activities that took place at the sites and any connections between the artefacts recovered from the sites and the raw materials available along Wianamatta/ South Creek.

Question 1: Are cultural activities archaeologically identifiable at the Aboriginal archaeological sites?

Question 2: Do the artefacts recovered during the archaeological salvage excavations differ in raw material or artefact type to those recovered from other Aboriginal archaeological sites in the region and in particular, those located on landforms adjacent to Badgerys Creek and Wianamatta/South Creek?

Question 3: What are the taphonomic features of the sites and what do they indicate about site integrity and artefact survivability for similar landforms?

In this context, taphonomic indicators are generalised to include biospherical process such as bioturbation and geomorphic features such as soil lenses and soil laminates as indicators of post-depositional factors affecting site formation.

METHODOLOGY

The salvage excavation would focus on the extraction of collections of artefacts related to activity areas and geomorphic information in order to address the research aims and questions specified on the preceding page. In this regard interpretation would not precede data collection.

The proposed archaeological program would systematically sample the identified salvage excavation areas using standard techniques with the outcome being a viable, robust and comparable sample. Analysis of the sample would follow, and interpretations would be made distinctly separate from the results.

It is anticipated that the salvage excavation program would be undertaken in two phases (Phases 1 and 2) as described in the following sections. It is anticipated that the following excavations would be undertaken during the salvage excavation program:

Name	Phase 1 squares	Phase 2 squares
BCE	10 (Maximum)	8 (Minimum if warranted)
BC/ED1	10 (Maximum)	8 (Minimum if warranted)
McGarvie Smith Farm Badgerys Creek AFT 1	10 (Maximum)	8 (Minimum if warranted)
McGarvie Smith Farm Badgerys Creek AFT 2	10 (Maximum)	8 (Minimum if warranted)
SCW T2	10 (Maximum)	8 (Minimum if warranted)

Field Methods

The salvage excavation would consist of a number of excavation squares, horizontally measuring one square metre that would be aligned to and positioned within a predetermined grid that encompasses the entire salvage excavation area.

The location of the excavated square would be accurately recorded on a surveyed plan of the archaeological salvage area. The coordinates from the northwest corner of each excavation square located at beginning and end of each Phase 1 transect or containing information bearing deposits (see below) would be recorded using handheld GPS receivers in the projected coordinate system: GDA 94 Zone 56.

Each excavation square would be excavated by hand until the basal layer, or a culturally sterile deposit is reached. The excavation squares would be excavated in stratigraphic units (Unit A, Unit B, etc.) were present or as a single unit (bulk) where stratigraphic units are not present. Soil horizons, disturbance and artefacts identified during the excavation of each square will be recorded on a detailed and standardised recording form.

Soil samples as well as thin section profiles (where feasible) would also be collected. Where possible, carbon samples will be collected and analysed for material relating to both the archaeology and geomorphology. Where appropriate cosmogenic and radiometric dating of soils and rock surfaces will be applied.

The sections of each excavation square will be photographed and contextual photographs showing the excavation square in relation to the overall salvage excavation area will be taken. The sections of excavation squares containing archaeological features will be accurately drawn and photographed.

All excavated deposit would be sieved using nested 5.0 millimetre and 2.5 millimetre sieves. Where potential micro-debitage is recovered 1.0 millimetre sieves will be utilised.

Phase 1

The first phase of the salvage excavation would comprise a series of excavation squares that would be excavated at 15 metre intervals along one or more parallel transects. The Phase 1 transects would be sited to investigate the subsurface deposit in relation to the spatial extent of lithics, geomorphological variations and subsurface disturbance.

The results of the Phase 1 excavation would be used to identify areas where Phase 2 salvage excavation would be appropriate. Statistical salvage following this method is highly beneficial because it creates a robust inter-site sample, sufficiently random, critical for regional comparative analysis.

Phase 2

The second phase of the salvage excavation would be undertaken if information bearing deposits were identified during the Phase 1 salvage excavation. Information bearing deposits are identified by triggers including:

- Significant quantities of artefacts
- Variations in raw material
- Unusual artefacts
- Chronological material. In this context chronologic material is anything that can be used to date artefacts or deposit: charcoal or charcoal bearing deposit (e.g., hearth ash), sandy deposit, gravels (e.g., aluminium feldspar).
- Taphonomic indicators.

Additional excavation squares, constituting an open area, will be excavated around information bearing deposits and aligned to the excavation grid. Phase 2 open area investigation would expand to encompass entire activity areas.

LITHIC ANALYSIS

Field Analysis
A preliminary analysis of recovered artefacts would occur on site during the salvage excavation. The analysis would record basic data, such as material type, number and type of artefacts, number of non-diagnostic fragments, and any significant depositional characteristics, such as conjoining artefacts, artefact fragmentation or heat damage for each excavated unit (stratigraphic or single/bulk unit) for each excavation square.

The purpose of the field analysis would be to establish a basic recording of artefacts retrieved and to allow on-going assessment of the excavation regime (e.g., whether higher stratigraphic resolution is required while digging).

Detailed (Laboratory) Analysis
Artefacts recovered during the excavation program would be further analysed offsite. The analysis would entail the recording a larger number of characteristics for each individual artefact. These details would be recorded in matrices suitable for comparative analysis (e.g., multivariate and univariate) of the excavated assemblage on a local and regional basis. A range of stone artefacts may be present, and the analysis would expand accordingly to account for artefact variability.

Information derived from this analysis; in particular the identification of specific artefact types and their distributions and associations; would be used to put together interpretations about how sites were used, where sites were located across the landscape, the age of sites and to assess cultural heritage values. By comparing different areas, it would be possible to determine whether there were differences in the kinds of activities carried out and if different activities were related to specific topographic features.

All information would be recorded in database form (MS Excel). For consistency, terms and category types would in large part be derived from Holdaway and Stern (2004). Minimum Number of Flake (MNF) calculations would be undertaken where applicable (although past experience indicates MNF calculations would not be required for this excavation program). A detailed explanation and glossary would be provided with the final excavation report.

The analysis of artefacts recovered during the salvage excavation program would be undertaken in a consistent and replicable fashion so as to permit the comparison of the entire excavated assemblage with data from other areas. This would also allow for an interpretation of the study area's archaeological significance.

Appendix E – Noise Memo

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1 Proposal details

1.1 Proposed scope of works

The scope of work is to construct New wastewater pumping station SP1230, 10.6 km of gravity carriers and 1.8km of pressure mains to provide wastewater servicing for the growth expected within the Badgerys Creek catchment as part of the Western Sydney Aerotropolis Growth Area (WSAGA). The proposal involves excavation, rock breaking and construction in a rural residential/agricultural land use setting.

1.2 Duration and timing of works

Construction of the proposal is expected to start early 2025 and take about 2 years to complete.

The standard construction work hours are as follows:

- Monday to Friday: 7 am – 6 pm
- Saturday: 8 am – 1 pm
- Sunday and public holidays: no work.

Out of hours work are defined as:

- Out of hours day: Saturday 7 am to 8 am and 1 pm to 6 pm, Sunday and public holidays 8 am to 6 pm
- Out of hours evening: daily 6 pm to 10 pm
- Out of hours night: all other times.

The proposal will occur during standard hours. However, to minimise disruption to traffic and potential safety risks to construction personnel and road users, some of the work along Elizabeth Drive may be carried out outside of standard hours if required by the Road Occupancy Licence (ROL).

If required by the ROL, night work are anticipated to occur for approximately 25 night shifts across the whole project duration.

1.3 Proposed activities/ equipment (noisiest plant details)

The proposed activities involve the following:

- excavation of ground and earthworks by excavators and other mobile plant
- rock breaking
- backfill and compaction of ground by tip trucks, excavators and compactors

The equipment required during construction includes:

- Pumps (various sizes)
- Piling equipment
- HDD Equipment
- Excavators
- Grinders
- Pipe welding equipment

- Air compressors
- Compaction equipment
- Generators
- Jackhammers
- Davit systems
- Fall arrest equipment
- Temporary fencing
- Hand tools
- Skip bins
- Day makers
- Jersey kerbs
- Water-filled barriers
- Portable amenities.

- Based on the above details, the noisiest activity would be use of 36 t excavators with hammer both within and outside of standard daytime construction hours. This activity may occur at night at the underbore crossing of Elizabeth Drive and during the day at all above ground construction locations of the proposal.

1.4 Community consultation

Consultation with Council has been undertaken. Additional consultation with Council and residential receivers will be undertaken prior to construction and a Community Engagement Advisor will be assigned to the project.

2 Methodology

Transport for NSW (TfNSW) Construction and Maintenance noise estimator tool (TfNSW, 2022) can be used to perform a basic noise assessment to capture predicted noise impacts at different distances for different types of receivers. Section 2 of this memo details the inputs required for the assessment. Section 3 of this memo details the output of the assessment.

2.1 Noise sensitive receivers and distance to receivers

The proposal is in a rural residential/agricultural setting with some of the surrounding areas currently subject to infrastructure development. At its closest, the proposal is approximately 20 m from sensitive receivers while most of the proposal is located at least 610 m from sensitive receivers. The proposal will be constructed progressively along the alignment, nearby sensitive receivers will be impacted by works for up to 25 nights of works depending on their location.

2.2 Noise area category

The noise area category is chosen from the noise estimator tool to define an approximate background noise level for the environment surrounding the proposal. The noise area category is chosen based on several factors, including:

- surrounding land use and receiver types (refer section 2.1 above)
- traffic volumes on nearby roads
- other transport infrastructure eg trains, airports/flight paths.

The noise area category for the area surrounding the proposal area is R1.

2.3 Background noise levels and noise management levels

Table 1 provides the assumed background noise levels and noise management levels. These noise management levels have been taken from the noise area category identified in section 2.2 above.

Where the assessment identifies noise impacts above the noise management level (refer section 3 of the memo), reasonable and feasible mitigation measures (refer section 4 of the memo) should be applied.

Table 1 Background noise levels and noise management levels

Noise area category		R1
RBL or L_{A90}[1] Background level (dB(A))	**Day**	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Management Level[2] (dB(A))	**Day**	50
	Day (OOHW)[3]	45
	Evening	40
	Night	35

Notes: [1]L_{A90} = Background noise level

[2]*Noise Management Level for works during standard hours = Background level plus 10dB(A)*

[3]*Noise Management Level (NML) for out of hours works = Background level plus 5dB(A).*

2.4 Type of noise assessment

The next step requiring input to the noise estimator is to select either the noisiest plant or scenario. This will calculate the predicted worst-case construction noise levels. These construction noise levels will be assessed against the noise management levels identified above. Based on the plant and equipment proposed to be used, there may be different worst-case construction noise levels at different times of the day or night. Based on section 1.3 of this memo, the noisiest plant chosen is the 36 t excavator with hammer. The Transport for NSW (TfNSW) Construction and Maintenance noise estimator tool gives the 36 t excavator with hammer a noise level of 122 SWL LAeq (dB(A)) however it is not available in the tool for distance based assessment which was undertaken. Therefore a similarly noisy plant, the airtrack drill with noise level of 124 SWL LAeq (dB(A)) was used to complete the assessment.

2.5 Line of sight to receivers

A receiver may have line of sight, or no line of sight, to the proposal.

Line of sight is the straight line between the noise source and the receiver. Receivers with line of sight would typically include those in front of the work, who do not have their view blocked by barriers such as terrain (eg a large hill), permanent noise walls or other buildings.

Receivers with no line of sight (all other factors being equal, such as distance to the work and type of equipment) will experience less noise than receivers with line of sight. Typically, these include the receivers who have their view blocked from the works by barriers including those listed above.

The nearest line of sight receivers are located approximately 20 m from the proposed works at an entry/exit pit located approximately 90 m north of Elizabeth Drive.

As a result, the noise estimator will run based on the following activities:

- Activity 1: Use of 36 t excavator with hammer at night with line of sight to receptors. This activity may occur at the underbore crossing of Elizabeth Drive.
- Activity 2: Use 36 t excavator with hammer during standard daytime construction hours with line of sight to receptors. This activity may occur at all above ground construction locations of the proposal.

3 Assessment of impacts

3.1 Activity 1: Activity 1: Use of 36 t excavator at night with line of sight

Activity 1 is defined as use of 36 t excavator with hammer at night with direct line of sight to residential receivers. Activity 1 may occur at the underbore crossing of Elizabeth Drive. Activity 1 will occur for a cumulative 25 nights total during the construction phase. Activity 1 is anticipated to be moderately intrusive for sensitive receivers within 610 m (up to 15 sensitive receivers), highly intrusive for sensitive receivers within 290 m (up to 6 sensitive receivers) and up to 2 sensitive receivers within 95 m would be highly affected.

Notification, a phone call, specific notifications, respite period 2 and duration respite are the recommended additional mitigation measures for receivers within 610 m of the works. Alternative accommodation, notification, a phone call, specific notifications, respite period 2 and duration respite are the recommended additional mitigation measures for receivers within 290 m of the works. Notification, a phone call and respite offer are the recommended additional mitigation measures for receivers within 95 m of the works. Table 4 provides a description of the additional mitigation measures. Further details are shown in Table 2 and Section 4.2 of this memo.

3.2 Activity 2: Use of 36 t excavator during standard daytime construction hours with line of sight

Activity 2 is defined as use of 36 t excavator during standard daytime construction hours with line of sight to residential receivers. Activity 2 may occur at all above ground construction locations of the proposal, excluding access tracks. Activity 2 is anticipated to be moderately intrusive for residential receivers within 290 m (up to 22 sensitive receivers), highly intrusive for receivers within 140 m (up to 10 sensitive receivers) and up to 10 sensitive receivers within 95 m would be highly affected. The nearest resident is 280 m from the work site.

Notification, a phone call, specific notifications, respite period 2 and duration respite are the recommended additional mitigation measures for receivers within 290 m of the works. Alternative accommodation, notification, a phone call, specific notifications, respite period 2 and duration respite are the recommended additional mitigation measures for receivers within 140 m of the works. Notification, a phone call and respite offer are the recommended additional mitigation measures for receivers within 95 m of the works. Table 4 provides a description of the additional mitigation measures. Further details are shown in Table 2 and Section 4.2 of this memo and may be applied at the discretion of the Community Engagement Advisor.

Table 2 Affected distance (metres) for residential receivers during Activity 1 and Activity 2

Activities	$L_{Aeq(15minute)}$ noise level above background (L_{A90})		
	20 to 30 dB(A)	> 30 dB(A)	$L_{Aeq(15minute)}$ 75dB or greater
	Moderately intrusive	Highly intrusive	Highly affected
Activity 1 – 36 t excavator at night with line of sight	610 m	290 m	95 m

Activities	$L_{Aeq(15minute)}$ noise level above background (L_{A90})		
	20 to 30 dB(A)	> 30 dB(A)	$L_{Aeq(15minute)}$ 75dB or greater
	Moderately intrusive	Highly intrusive	Highly affected
	Recommended mitigation measures: N, PC, SN, R2, DR	Recommended mitigation measures: AA, N, PC, SN, R2, DR	Recommended mitigation measures: N, PC, RO
Activity 2 – 36 t excavator during daytime hours with line of sight	290 m Recommended mitigation measures: N, PC, SN, R2, DR	140 m Recommended mitigation measures: AA, N, PC, SN, R2, DR	95 m Recommended mitigation measures: N, PC, RO

3.3 Vibration

Rock breaking may be required during all above ground works. The large hydraulic hammer (1600 kg – 18 to 34t excavator) was selected as the most representative equipment and is anticipated to generate the most vibration of all construction equipment. The Construction and Maintenance noise estimator tool recommends minimum working distances of 22 m from light-framed structures (BS 7385) and 60 m from heritage and other sensitive structures (DIN 4150) to avoid cosmetic damage. The entry/exit pit and MH location approximately 100 m north of Elizabeth is within 22 m of a residential structure and could therefore potentially be impacted by use of a 36 t excavator with hammer. To avoid impacts to this structure use of smaller and less vibratory plant will be adopted within 22 m of the structure. A dilapidation survey will also be completed before and after construction.

In relation to human comfort, the minimum working distance of 73 m for 36 t excavator with hammer relates to continuous vibration. Vibration emissions will be intermittent in nature and for this reason higher vibration levels, occurring over shorter periods are consistent with *Assessing vibration – a technical guideline* (DEC 2006). Significant vibration impacts to structures or people are therefore considered to be unlikely.

Operational vibration due to the proposal will be negligible as the facilities are pumping stations with minimal plant and no activities associated with generating vibration. As such no additional construction or operational mitigation or management measures are required to minimise the potential impacts of vibration.

4 Mitigation measures

4.1 Standard mitigation measures

Standard techniques for controlling noise impacts during construction are presented in the ICNG. A construction noise and vibration management plan (CNVMP) should be prepared before work starts, incorporating the measures summarised below in Table 3, 4, and 5.

Table 3 Standard mitigation measures

Standard measures
Works must comply with the Interim Construction Noise Guideline (DECC 2009), including schedule work and deliveries during standard daytime working hours of 7am to 6pm Monday to Friday and 8am to 1pm Saturday. No work to be scheduled on Sundays or public holidays. The Proposal will also be carried out in accordance with: • Sydney Water's Noise Management Procedure SWEMS0056 • Noise Policy for Industry (EPA, 2017) • Reasonable and feasible noise mitigation measures should be implemented to mitigate noise impacts.

Incorporate **standard daytime hours noise management safeguards** into the CEMP:
• identify and consult with the potentially affected residents prior to the commencement:
  ○ describe the nature of works; the expected noise impacts; approved hours of work; duration, complaints handling and contact details.
  ○ determine need for, and appropriate timing of respite periods (eg times identified by the community that are less sensitive to noise such as mid-morning or mid-afternoon for works near residences)
  ○ acceptance by the community of longer construction periods in exchange for restriction to construction times.
• implement a complaints handling procedure for dealing with noise complaints
• plant or machinery will not be permitted to warm-up near residential dwellings before the nominated working hours.
• appropriate plant will be selected for each task, to minimise the noise impact (eg all stationary and mobile plant will be fitted with residential type silencers)
• engine brakes will not be used when entering or leaving the work site(s) or within work areas.
• regularly inspect and maintain equipment in good working order
• arrange work sites where possible to minimise noise (eg generators away from sensitive receivers, minimise use of vehicle reversing alarms).
• schedule noisy activities around times of surrounding high background noise (local road traffic or when other noise sources are active).

For works **beyond standard daytime hours**, the Contractor would: • justify the need for out of standard daytime work • consider potential noise impacts and: implement the relevant standard daytime hours safeguards; Sydney Water's Noise Management Code of Behaviour (SWEMS0056.01) and other reasonable and feasible management measures • notify all potentially impacted residents and sensitive noise receivers not less than one week prior to commencing night work. • identify community notification requirements

Standard measures
• seek approval from the Sydney Water Project Manager in consultation with Sydney Water's Environment and communications representatives.

4.2 Additional mitigation measures

Table 4 provides a list of the recommended mitigation measures from TfNSW noise estimator tool in relation to the assessment outcome (refer section 3.2 of this document). Not all mitigation measures are recommended at all locations (refer commentary for further detail). Table 5 also includes further information on why some of these mitigation measures will or will not be implemented.

Table 4 Additional mitigation measures

Abbreviation	Additional mitigation measure and description	Commentary
N	Notification (letterbox drop or equivalent) Advance warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of using variable message sign, letterbox drop (or equivalent), web site / social media or a combination to distribute information detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of five working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.	Will be implemented – refer Table 5 – letterbox drops at least one week out from starting
SN	Specific notifications Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than five working days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops. This form of communication is used to support periodic notifications, or to advertise unscheduled works.	Recommended by the noise estimator tool. Specific notifications will be done within 610 m of Activity 1 and 290 m of Activity 2 – refer Table 5 – letterbox drops at least one week out from starting
PC	Phone calls Phone calls detailing relevant information made to identified/affected stakeholders, who have provided their contact details, within seven calendar days of construction start. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposal and specific needs. Where the resident cannot be telephoned then an alternative form of engagement should be used.	Will be implemented – refer Table 5 – phone calls at least one week out from starting
IB	Individual briefings Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. Where the resident cannot be met with individually then an alternative form of engagement should be used.	Not recommended by the noise estimator tool.

Abbreviation	Additional mitigation measure and description	Commentary
RO	Respite offer Respite Offers should be considered where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis, and may not be applicable to all projects, or when duration respite has been agreed (see below)	Recommended by the noise estimator tool. Respite offers will be considered for highly affected sensitive receivers within 290 m of Activity 1 and 140 m of Activity 2
R1	Respite Period 1 Out of hours construction noise in out of hours period 1 shall be limited to no more than three consecutive evenings per week except where there is a duration respite. For night work these periods of work should be separated by not less than one week and no more than 6 evenings per month	Not recommended by the noise estimator tool.
R2	Respite Period 2 Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month. Where possible, high noise generating works shall be completed before 11pm.	Recommended by the noise estimator tool for Activity 1 and Activity 2. Adoption of this mitigation measure would extend the duration of Activity 1 and Activity 2 which may increase community impacts and impact to road users by extending roadworks duration. To reduce overall impacts, this mitigation measure will not be adopted.
DR	Duration Respite Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly. RDC staff should engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite.	Adoption of this mitigation measure would extend the duration of Activity 1 and Activity 2 which may increase community impacts and impact to road users by extending roadworks duration. To reduce overall impacts, this mitigation measure will not be adopted.
AA	Alternative accommodation Alternative accommodation options may be offered (as a last resort) to residents living in close proximity to construction works (within the distance nominated by the noise estimator) that are likely to experience highly intrusive noise levels.	Recommended by the noise estimator tool for Activity 1, however will not be adopted due to the limited durations of this activity.
V	Verification Verification may be required for building or asset condition where works are likely to cause vibration impact or for noise levels following reasonable complaints.	Not recommended by the noise estimator tool.

4.3 Reasonable and Feasible assessment

A Reasonable and Feasible Assessment has been completed to determine the appropriate additional mitigation measures. Additional measures recognised in this assessment has been included in Table 5 below.

The adopted mitigation measures from the Reasonable and Feasible Assessment should form part of the CEMP and/or NVMP, and any changes to the mitigation option from the assessment would be documented with sufficient justification as to why changes are required.

Table 5 Reasonable and feasible table

Mitigation option	Feasible mitigation test (can it be done)	Reasonable mitigation test (should it be done)	Adopted/ Partially Adopted/ Not Adopted	Justification or comment
Planning the work				
Consideration of alternatives / options	*Yes*	*Yes*	***Adopted***	The current and future residents and commercial premises in the area require wastewater infrastructure to be installed to provide this service. There are no comparative alternatives to a wastewater main and pump station. Alternative sites were considered. The proposed location were chosen as the optimal locations preferred for the wastewater infrastructure. Not constructing the main proposal is not feasible as future growth in the area needs wastewater servicing.
Do nothing	*No*	*No*	***Not Adopted***	Do nothing is not a feasible option. The proposal provides essential infrastructure to remove wastewater from the area.
Conduct the works during standard daytime hours	*No*	*No*	***Partially Adopted***	Most of the works will be completed during standard daytime hours. Night works may be required if the ROL for lane closures of Elizabeth Drive limits work being done during the day.
Consultation/ notifications/ complaints management				
Community consultation prior to works	*Yes*	*Yes*	***Adopted***	Community engagement will commence before work starts, with notification to residents within the affected distance as shown in the Appendix.

Mitigation option	Feasible mitigation test (can it be done)	Reasonable mitigation test (should it be done)	Adopted/ Partially Adopted/ Not Adopted	Justification or comment
Consultation with residents during works	*Yes*	*Yes*	***Adopted***	Ongoing engagement will continue on an ad-hoc basis. For sensitive receivers / highly impacted residents, regular follow-up will be done (i.e. one-on-one meetings, emails, texts, phone discussions). Engagement during construction will be ongoing and include proactive management of issues to minimise complaints. Where complaints and enquiries arise, action will be taken to address these with appropriate mitigation adopted.
Project updates	*Yes*	*Yes*	***Adopted***	Regular project update newsletters will be sent to surrounding community and emailed to key stakeholders including Council.
Notification to residents prior to out of hours work	*Yes*	*Yes*	***Adopted***	If required, residents will be notified of night work at least seven days' in advance of work starting. An Out of Hours Work Plan (OHWP) will be completed in advance of any out of hours work starting.
Ongoing community complaints management	*Yes*	*Yes*	***Adopted***	A Community Engagement Advisor will be assigned to the project. All consultation with community and stakeholders will be recorded on Sydney Water's Consultation Manager database.
Daily register of planned activities on site	*Yes*	***No***	***Not Adopted***	A daily register will be considered if complaints are received.
Selection of construction methodology / plant and equipment				
Smaller excavator	*No*	*No*	***Not Adopted***	An excavator of maximum 36 t is required to complete the works.
Noise and vibration verification / monitoring				
Attended noise and vibration monitoring	*Yes*	*No*	***Not Adopted***	Continuous monitoring will be considered if complaints are received.

Mitigation option	Feasible mitigation test (can it be done)	Reasonable mitigation test (should it be done)	Adopted/ Partially Adopted/ Not Adopted	Justification or comment
Unattended continuous noise monitoring	*Yes*	*No*	***Not Adopted***	Continuous monitoring will be considered if complaints are received.
HSEQ Site Presence	*Yes*	*Yes*	***Adopted***	Increase of site presence and inspections occurring to ensure proactive management of site issues. A Project Environmental Mentoring session will be held in advance of work starting to induct all site crew members on the requirements of the REF and CEMP**.**
Noise attenuation at source/ site				
Noise barriers	*Yes*	*Yes*	***Adopted***	Generators will be used during the construction period of the proposal. Noise mitigation, such as noise barriers, will be used around the generators which will be located as far from sensitive receivers as practicable.
Respite periods				
Duration respite periods	*Yes*	*No*	***Not Adopted***	Duration respite periods would increase community impacts and impact to road users due to extended roadworks duration. To reduce overall impacts, this mitigation measure will not be adopted.
Respite periods – Noisy works completed prior to midnight	*Yes*	*No*	***Not Adopted***	Respite periods would increase community impacts and impact to road users due to extended roadworks duration. To reduce overall impacts, this mitigation measure will not be adopted.
Respite periods for high impact noise works – other options (such as three hour blocks with a one hour respite period)	*Yes*	*No*	***Not Adopted***	Respite periods would increase community impacts and impact to road users due to extended roadworks duration. To reduce overall impacts, this mitigation measure will not be adopted.
Respite – Alternate Accommodation	*Yes*	*No*	***Not Adopted***	As no long term night works are anticipated to affect specific receivers, alternate accommodation is not required.

Mitigation option	Feasible mitigation test (can it be done)	Reasonable mitigation test (should it be done)	Adopted/ Partially Adopted/ Not Adopted	Justification or comment
Consultation for high impact noise works	*Yes*	*Yes*	***Adopted***	High impact noise affected residents will be identified during community engagement consultation.
Architectural treatments at properties – ie double glazing, soundproofing, door/window sealing	*No*	*No*	***Not Adopted***	Architectural treatments have not been offered due to the temporary nature of proposed night works.

5 Conclusion

The TfNSW Construction and Maintenance noise estimator tool has been used to predict noise levels and maps for the worst case scenario. It should be noted that these noise levels are for the worst-case scenario and that noise levels will vary and be intermittent during the construction program. The assessment identified that the construction of the proposal will have the potential to generate noise noticeable at nearby sensitive receivers.

Activity 1 comprises use of 36 t excavator with hammer at night. Activity 1 is anticipated to be moderately intrusive for sensitive receivers within 610 m (up to 15 sensitive receivers), highly intrusive for sensitive receivers within 290 m (up to 6 sensitive receivers) and up to 2 sensitive receivers within 95 m would be highly affected.

Activity 2 is defined as use of 36 t excavator during standard daytime construction hours. Activity 2 is anticipated to be moderately intrusive for residential receivers within 290 m (up to 22 sensitive receivers), highly intrusive for receivers within 140 m (up to 10 sensitive receivers) and up to 10 sensitive receivers within 95 m would be highly affected. The nearest resident is 280 m from the work site.

Vibration impacts from the proposal are not anticipated.

Standard and additional measures are recommended to mitigate and manage noise during construction. Implementation of these mitigation measures will reduce noise impacts on surrounding residents.

6 Appendix

Figure 1 Residential receivers within affected distance of Activity 1

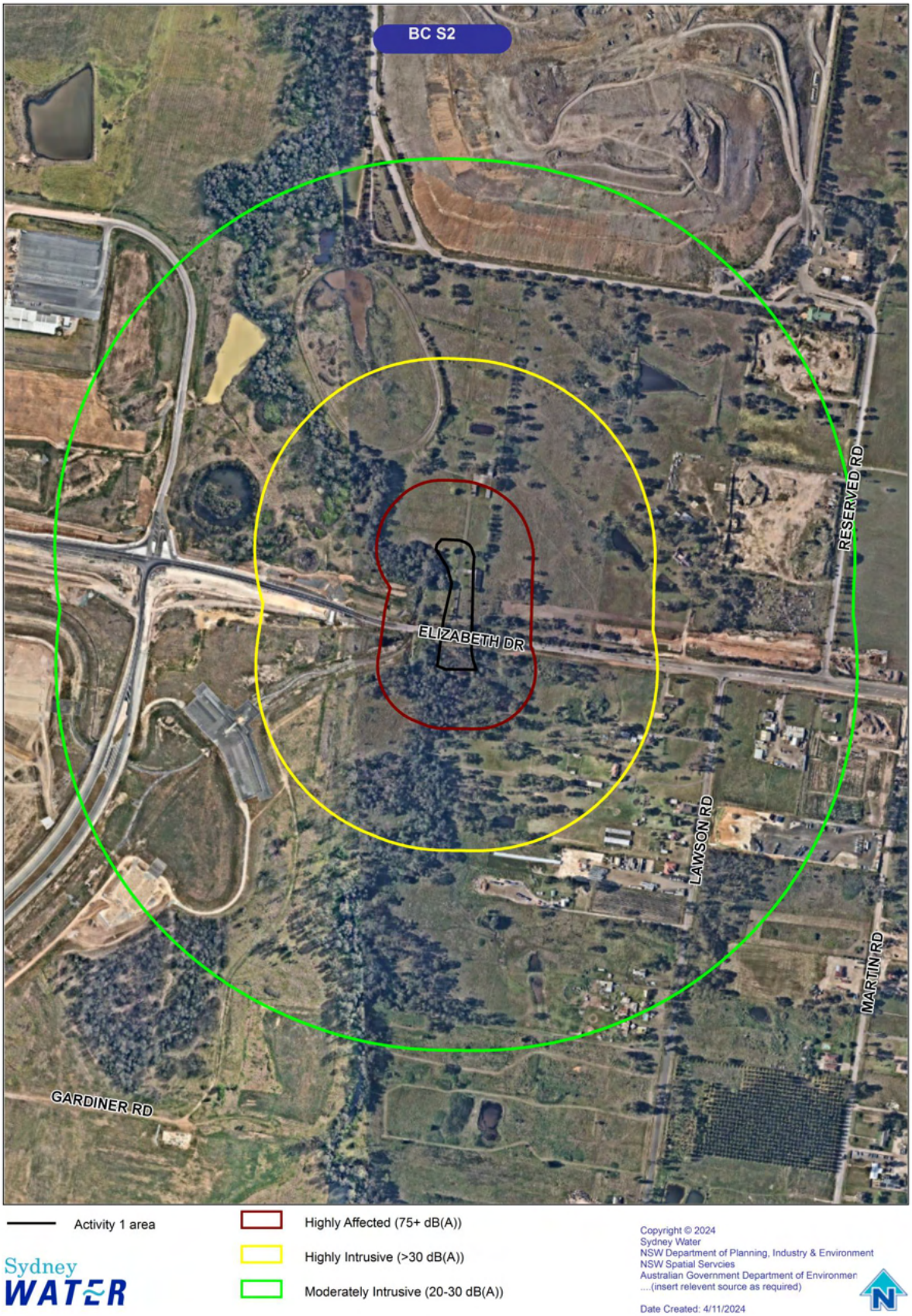

Figure 2 Residential receivers within affected distance of Activity 2

