Menangle Park Zone Substation | Review of Environmental Factors

Endeavour Energy

Report

JBS&G 68033 | 163,831

14 March 2025



We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.



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Abbreviations

Term	Definition
AADT	Annual Average Daily Traffic
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
APZ	Asset Protection Zone
AS	Australian Standard
ASS	Acid Sulfate Soils
BAL	Bushfire Attack Level
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act 2016*
BC SEPP	*State Environmental Planning Policy (Biodiversity and Conservation) 2021*
BDAR	Biodiversity Development Assessment Report
BEMC	Bushfire Environmental Management Consultancy Pty Ltd
BLA	Broader Landscape Assessment
BSP	Bulk Supply Point
BS	British Standard
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CLEP	*Campbelltown Local Environmental Plan 2015*
Council	Campbelltown City Council
dB(A)	A-weighted decibels
DD	Aboriginal Heritage Due Diligence Report
ECE	East Coast Ecology Pty Ltd
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environmental Protection Authority
EP&A Regulation	*Environmental Planning and Assessment Regulation 2021*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection License
FFDI	Forest Fire Danger Index
ICNG	*Interim Construction Noise Guideline 2009*
Km	Kilometre
kV	kilovolt
LEP	Local Environmental Plan
LGA	Local Government Area
LLS Act	*Local Land Services Act 2013*
m	Metre
MNES	Matters of National Environmental Significance
MVA	Mega Volt Amp

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Native Title Act	*Native Title Act 1993*
NML	Noise Management Levels
NPW Act	*National Parks and Wildlife Act 1974*
NTAR	National Trust of Australia Register
OOHW	Out of Hours Work
PBP	*Planning for Bushfire Protection 2019*
PCT	Plant Community Type
PMF	Probable Maximum Flood
POEO Act	*Protection of the Environment Operations Act 1997*
RBL	Rating Background Levels
REF	Review of Environmental Factors
RNE	Register of the National Estate
Roads Act	*Roads Act 1993*
ROP	Road Opening Permit
SEARs	Secretary's Environmental Assessment Requirements
SHI	NSW State Heritage Inventory database
SHR	State Heritage Register
SIS	Species Impact Statement
SoHI	Statement of Heritage Impact
TEC	Threatened Ecological Community
TI SEPP	*State Environmental Planning Policy (Transport and Infrastructure) 2021*
ToS	Test of Significance
UXO	*Unexploded Ordinance*
VENM	Virgin Excavated Natural Material
WPCA	Western Parkland City Authority
WPC SEPP	*State Environmental Planning Policy (Precincts – Western Parkland City) 2021*
ZS	Zone Substation

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1. Introduction

1.1 Background

NSW Department of Planning and Environment has identified the Greater Macarthur Growth Area as an area of substantial growth, with the Greater Macarthur 2040 interim plan highlighting delivery of approximately 40,000 new homes within the area by 2056.

The 66/11kV 15 MVA mobile substation currently located at the site was developed to support the increase in electricity demand in the interim. Forecasting performed by Endeavour Energy identified that the mobile substation will have load at risk from 2025 with the total capacity exceeded by 2027, which will result in unserved energy without additional electrical capacity investment in the area. This will result in customers not being able to connect to the network, which contravenes Endeavour Energy's obligation to provide connection services.

As such, the need to increase the electrical capacity in this area has been identified to meet these requirements. It is proposed to develop the Menangle Park Zone Substation (ZS) to meet this requirement, which is described and assessed herein.

The implementation of a new substation will strengthen reliability and service the large-scale infrastructure development in the Menangle Park region in line with NSW Department of Planning, Infrastructure and Environment plans. This proposal will enhance the supply security and reliability of new developments by providing a diversified 33kV supply and associated fibre optic network.

1.2 Purpose of this Review of Environmental Factors

The purpose of this review of environmental factors (REF) is to describe the proposal, document the potential impacts of the proposal on the environment and to outline proposed safeguards to be implemented. This REF is to be considered by the determining authority, Endeavour Energy, when determining the proposal.

The assessment of environmental impacts associated with the proposal has been undertaken in accordance with Part 5 of the *Environmental Planning and Assesment Act 1979* (EP&A Act), and section 171 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation), and with reference to *Guidelines for Division 5.1 Assessments* (DPE, 2022).

For this proposal, Endeavour Energy is both a public authority proponent as per section 5.3 or the EP&A Act and the determining authority as per section 5.1 of the EP&A Act.

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2. The Proposal

2.1 Proposal identification

Endeavour Energy proposes to construct and establish a permanent 66/11 kilovolt (kV) 35 Megavolt-Amperes (MVA) Menangle Park Zone Substation (ZS) (the proposal), including the decommissioning of the existing temporary mobile substation on the site. The new ZS will be supplied by two 66kV feeders; the existing feeder 85P and a new proposed feeder which will be assessed in a separate REF. This REF is for the construction and operation of the Menangle Park ZS only.

The proposal is located on Fitzpatrick Road in the suburb of Menangle Park, approximately 49 kilometres (km) southwest from Sydney Central Business District and approximately 1km east of the Nepean River. The proposal location is shown in **Figure 2-1** and the site layout in **Figure 2-2.** There is no ancillary facility proposed for the construction of the proposal.

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Figure 2-1: Site location



Figure 2-2: Site layout

2.2 Objectives

The objectives of the proposal are to:

- Service the large-scale development in the region; and
- Enhance supply security of new developments.

2.3 Needs and options

2.3.1 Options considered.

The options considered for the proposal included:

- **Option 1**: Do nothing. The site would be left in its current state with the temporary substation operating in its current capacity. In time the temporary substation would cease to be operative.
- **Option 2**: Undertake works to establish a new Zone Substation for the area.

Option 1 would not achieve the proposal objectives.

The preferred option is Option 2 as it meets the proposal objectives, justification is outlined in more detail below.

2.3.2 Justification for the proposal

Analysis of the two options was undertaken and is summarised in **Table 2-1**. The analysis found that Option 2 is the preferred, as it would meet the proposal objectives.

Option 2 is necessary to service the large-scale housing and infrastructure development in the Menangle Park region to be undertaken as part of the Macarthur Region 2040 interim plan for the area. The proposal would provide a diversified 33kV supply and associated fibre optic network which would increase capacity of the substation which would supply the increased demand resulting from development, and enhance the security for developments.

Should Option 1 be selected, the proposal would not be undertaken, and the mobile substation will have load at risk from 2025 with the total capacity exceeded by 2027. This will result in unserved energy without additional electrical capacity investment in the area, and customers will not be able to connect to the network**.**

Table 2-1 Justification table of options considered

	Proposal objectives	Options 1: Do nothing	Options 2: Proposed new substation
Objectives	Service the large-scale development in the region	Reliability of the electricity supply would decrease if increasing electricity demand for the region is not met. The large-scale development in the region would not be adequately serviced.	The proposal would improve the reliability of the electricity supply and facilitate servicing large-scale development in the region.
	Enhance supply security for new developments	The existing mobile substation would have load at risk from 2025 with the total capacity exceeded by 2027, and therefore would be unable to service large-scale development in the region.	Supply security would be increased with the proposal. This enhances supply security for new developments.
Outcome	Proposal objectives can be achieved?	No, the proposal objectives cannot be achieved with Option 1.	Yes, the proposal objectives can be achieved with Option 2.

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2.4 Proposal description

2.4.1 Proposal location

Site information related to the proposal is presented in **Table 2-2** and shown in **Figure 2-1**.

Table 2-2: Proposal location details

Location details	
Site	Lot 2013 DP1234643, Fitzpatrick Street, Menangle Park, NSW 2563
Coordinates (approximate) **GDA94-MGA56**	Easting: 292565.616 Northing: 6225220.947
Local government area	Campbelltown City Council
Address	Fitzpatrick Street, Menangle Park NSW 2563

2.4.2 Existing site and study area description

The proposal area is located in the suburb of Menangle Park within the Campbelltown City Council Local Government Area (LGA).

The proposal site is partially occupied by an existing mobile substation and is already cleared and levelled. The ground surface is unsealed comprising a mix of gravel and natural sediment. Scarce ground cover was observed including grass and weeds emerging through the gravels. A security fence surrounds the perimeter of the site, and a local road connects the proposal site to Fitzpatrick Street, providing traffic access to the ZS.

Construction will include occupation of the access road directly south of the substation site for construction parking. The access road is sealed with asphalt with restricted access from Fitzpatrick Street via a lockable gate.

The proposal site is surrounded by agricultural land to the north and north-east, a low density residential area to the south and a rail line to the west with agricultural land beyond. The site is currently in line of sight to a total of five residential lots that are located along Fitzpatrick Street, with the closest resident being 250m from the proposal site. The surrounding landscape is generally characterised by open paddocks with scattered vegetation.

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Figure 2-3: Cleared and levelled proposal site facing west.



Figure 2-4: Proposal site facing north with security fence.



Figure 2-5: Gate around existing mobile substation and access road.



Figure 2-6: South view from proposal

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2.4.3 Key design features

Key features

Key features of the proposal include:

- Establishment of a new 66/11kV ZS including:
    - Two 35MVA transformers with space for a future third 35MVA transformer; and
    - A permanent building to accommodate 66kV GIS, 11kV switchgear, protection and control panels, Supervisory Control and Data Acquisition control system, communications, batteries, Local Control Centres, process interface unit and amenities.
- Driveway from access road;
- Substation lighting, site drainage and sewer and water connection;
- Security fencing, signage and gates;
- Lightning protection including 11.5 metre (m) lightning pole, and insulation;
- Fire management system, hydrant system and deluge showers;
- Battery systems, earthing, protection and control systems;
- Communication systems including an antenna mounted on 15m concrete pole; and
- Landscaping.

2.4.4 Work Methodology

The proposal would involve the following work methodology:

- Site preparation works including;
    - Installation of temporary fencing around work areas; and
    - Excavation of transformer bunds using 35 tonne excavator to a depth of 2m.
- Decommissioning and removal of the existing mobile ZS including;
    - Relocating decommissioned equipment identified as a spar to offsite storage locations for future re-use;
    - Removal of facilities associated with the mobile ZS including the amenities building, auxiliary transformer, driveway, bund and security fence.
- Establishment of a new 66/11kV ZS including;
    - Installation of concrete slab and footings for substation;
    - Construction of building;
    - Installation of transformers;
    - Construction of the driveway to provide access to the site from the private unnamed access road; and
    - Install security fencing, signage and gates, including piling up to 10m, installation of concrete footings and erection of fence.
- Landscaping around the new Menangle Park ZS.

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2.4.5 Plant and Equipment

The plant and equipment proposed for the works consists of:

- Demolition of mobile substation:
  - Excavator with hammer; and
  - Truck loading.
- Construction of new ZS:
  - Piling rigs;
  - Excavators;
  - Trucks;
  - Concrete pumps;
  - Agitators; and
  - General hand tools.

2.4.6 Ancillary facility

There is no formal ancillary facility proposed for the construction of the proposed substation. Vehicles and equipment will utilise the carpark area proposed to the south of the ZS site during construction, shown in **Figure 2-2**.

2.4.7 Timing, duration and hours

This proposal would commence works in early-mid 2025. This timing is indicative and may change depending on weather and other conditions.

It is anticipated that the entire proposal and associated works to install the feeder (assessed separately) would take approximately 24 to 30 months to complete.

All works are proposed to be undertaken during standard construction hours:

- Monday to Friday: 7 am to 6 pm.
- Saturday: 8 am to 1 pm.
- Sunday and public holidays: no expected work.

Limited out of hours works are proposed in the following periods:

- Saturday: 7 am to 8 am, and 1 pm to 3 pm.

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3. Statutory and Planning Framework

3.1 Environmental Planning and Assessment Act 1979

The EP&A Act establishes the framework for environmental planning and assessment in NSW. The proposal is subject to the environmental impact assessment and planning approval requirements of Division 5.1 of the EP&A Act. This applies to activities carried out by public authorities, such as Endeavour Energy, which are exempt from needing development consent under Part 4 of the EP&A Act. In accordance with Part 5, section 5.5 of the EP&A Act, Endeavour Energy must examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposal.

Endeavour Energy are considered the public authority, categorised as an Authorised Network Operator by the NSW Government as per the Electricity *Network Assets (Authorised Transactions) Act 2015*, and are also the determining authority as per section 5.1(1) of the EP&A Act.

Clause 171 of the EP&A Regulation prescribes the environmental factors which must be considered when determining if an activity assessed under Division 5.1 of the EP&A Act has or is likely to have a significant effect on the environment.

Section 5 provides an environmental impact assessment of the proposal in accordance with the requirements of clause 171 of the EP&A Regulation, and **Appendix A** considers the listed factors under clause 171 of the EP&A Regulation.

3.1.1 State Environmental Planning Policy (Transport and Infrastructure) 2021

The *State Environmental Planning Policy (Transport and Infrastructure) 2021* (TI SEPP) aims to facilitate the effective delivery of infrastructure across the state. This includes electricity transmissions or distribution networks under Part 2.3 Division 5 Chapter 2 of the TI SEPP.

Clause 2.44 of the TI SEPP permits development carried out by or on behalf of a public authority, including Endeavour Energy, without consent on land owned or controlled by the public authority for the purpose of an electricity transmission or distribution network which includes above or below ground electricity substations and feeder pillars. This clause is applicable to the establishment of a new substation.

Clause 2.10 to 2.15 and clause 2.45 of TI SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation is discussed in **Section 4.1**.

3.1.2 State Environmental Planning Policy (Biodiversity and Conservation) 2021

The *State Environmental Planning Policy (Biodiversity and Conservation) 2021* (BC SEPP) outlines requirements for the clearing of vegetation in NSW on land zoned for urban and environmental purposes that is not linked to a development application. The BC SEPP works with the *Biodiversity Conservation Act 2016* (BC Act) and the *Local Land Services Act 2013* (LLS Act) to provide the Land Management and Biodiversity Conservation framework across NSW.

Chapter 2 of the BC SEPP aims to protect the biodiversity values of trees and other vegetation in non-rural areas, and to preserve the amenity of non-rural areas through the preservation of trees and other vegetation. Clause 2.3 of Chapter 2 in the BC SEPP applies to land designated as “non-rural” areas, which includes land within Campbelltown LGA. While the proposal is within a non-rural area, clause 2.7 of Chapter 2 in the BC SEPP applies to the works under the non-rural areas of the state whereby clearing is authorised as per section 60(O)(b)(ii) of the LLS Act. As such, no consent is required for the clearing of vegetation associated with these works of the proposal.

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

The *State Environmental Planning Policy (Precincts – Western Parkland City) 2021* (WPC SEPP) provides the policy framework established to guide the development and planning of the Western Parkland City region in NSW. It covers the eight local government areas of the Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly. The proposal falls within the Greater Macarthur Growth Area Precinct defined under Chapter 3 of the WPC SEPP.

Under the WPC SEPP, the Western Parkland City Authority (WPCA) is responsible for coordinating development and delivery activities across the Western Parkland City area. It is noted that the WPCA does not have authority to determine developments, however undertakes the following:

- Provides advice to the Minister for Planning and Public Spaces on draft Aerotropolis Precinct Plans (and proposed amendments) in the Aerotropolis which require consultation under Chapter 4 of the WPC SEPP.
- Participates in the Aerotropolis Technical Assurance Panel for masterplans as per the Department of Planning and Environment's Master Plan Guidelines and Supplementary Guidance.
- Provides advice on the Secretary's Environmental Assessment Requirements (SEARs) for State significant projects (development and infrastructure).
- Provides comment on State significant projects as required by SEARs.
- Provides comment to authorities proposing 'development without consent' with a capital investment value of $30 million or more under the TI SEPP.
- Provides comments at other stages of the planning process for development throughout the Western Parkland City as required.

The location of the proposal falls within the Campbelltown LGA in which the WPC SEPP covers. Given the scope of the proposal, consultation with the WPCA is not required for the proposal.

3.1.4 Campbelltown Local Environmental Plan 2015

The *Campbelltown Local Environmental Plan 2015* (CLEP) is the relevant Local Environmental Plan (LEP) for the proposal which is located within the Campbelltown LGA. The CLEP is administered by Campbelltown City Council (Council).

The land of the proposed substation and construction parking is zoned RE1 – Public Recreation and R3 – Medium Density Residential.

Electricity transmissions and distribution networks are prohibited under these land zones, however, the proposal is permissible under Division 5 of the TI SEPP which prevails over the LEP.

Land zoning is presented in **Figure 3-1**.

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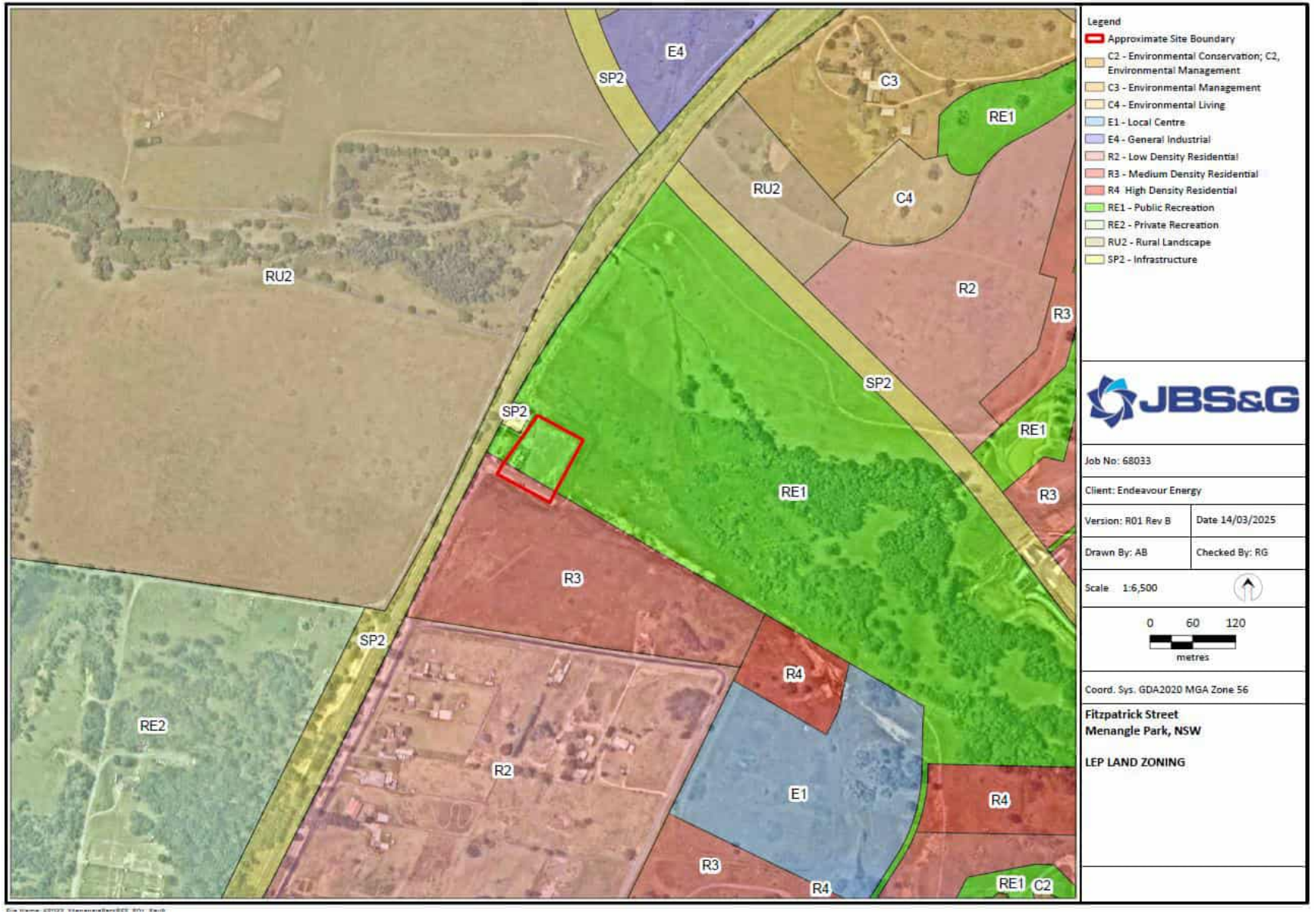


Figure 3-1: Land zoning under CLEP

3.2 Other relevant NSW legislation

3.2.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) provides the legal framework for the management of air, noise, water and waste pollution. Part 3.2 of the POEO Act stipulates the Environment Protection Licence (EPL) requirements for scheduled activities listed under the POEO Act. The proposal does not include any activities listed under Schedule 1. Therefore, the proposal is not considered a scheduled activity and does not trigger the need for an EPL under the POEO Act.

3.2.2 Local Land Services Act 2013

The objects of the Local Land Services Act 2013 (LLS Act) include 'to ensure the proper management of natural resources in the social, economic and environmental interests of the State, consistently with the principles of ecologically sustainable development'. The Act regulates the clearing of native vegetation, however, section 60(O)(b)(ii) excludes the need for consent under the LLS Act where the clearing is an activity carried out by a determining authority within the meaning of Part 5 of the EP&A Act.

Review of the transitional native vegetation regulatory map indicates the proposal site is land excluded from the LLS Act.

3.2.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife* Act (1974) (NPW Act) regulates the control and management of all national parks, historic sites, nature reserves, and Aboriginal areas. The main aim of the Act is to conserve the natural and cultural heritage of NSW. Where works will disturb and/or impact Aboriginal objects, an Aboriginal Heritage Impact Permit (AHIP) is required.

An Aboriginal Due Diligence Assessment Report was undertaken (refer **Appendix J**) in which numerous Aboriginal sites were identified within 100m of the site extent. No further assessment is required and the proposal may proceed with caution and implementation of an Unexpected Finds Protocol.

3.2.4 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (NSW) (BC Act) seeks to conserve biological diversity and promote ecologically sustainable development, to prevent extinction and promote recovery of threatened species, populations and ecological communities and to protect areas of outstanding biodiversity value.

The BC Act requires that the significance of the impact on threatened species, populations and threatened ecological communities is assessed using the test listed in Section 7.3 of the BC Act. Where a significant impact is likely to occur, a Species Impact Statement (SIS) must be prepared in accordance with the Environment Agency Head's requirements, or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM) (DPIE, 2020). The proposal will not result in a 'significant impact' on any threatened aquatic entities and therefore the Biodiversity Offset Scheme is not triggered. As such, an SIS or a BDAR is not required. The sites are not located within any Areas of Outstanding Biodiversity Value. Assessment of potential impacts to threatened species, populations and ecological communities listed under the BC Act are considered in **Section 5.1** and **Appendix D**.

The BC Act also establishes a scheme for the biodiversity certification of land which offers a streamlined biodiversity assessment process for areas of land that are proposed for development. Where land is certified, development can proceed without the usual requirements around ecological assessments for the proposed site. The proposed site is not under land mapped as biodiversity certified land, and therefore the normal provisions around biodiversity assessments apply.

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3.2.5 Crown Land Management Act 2016

The *Crown Land Management Act 2016* regulates the ownership, use and management of Crown Land in NSW. A search on the NSW Crown Lands Manager Reserves Portal undertaken on 18 November 2024 and the site is not located on mapped Crown land.

Therefore consultation with NSW Crown Lands is not required.

3.2.6 Roads Act 1993

Part 2 of the *Roads Act 1993* (Roads Act) sets out the provisions for the opening of public roads, and Part 4 of the Roads Act sets out the provisions for the closing of public roads, including notification procedures. The proposal includes use of the unnamed access road for construction parking. No road opening permits or road occupation licences are required under the Roads Act for use of this road.

3.3 Commonwealth legislation

3.3.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places which are considered Matters of National Environmental Significance (MNES). Under the EPBC Act, approval is required for actions that have, will have, or are likely to have a significant impact on MNES. Potential impacts of the proposal on MNES are considered in **Appendix A** and **Section 5.1.**

The assessment found there is unlikely to be a significant impact resulting from the proposal on matters of national environmental significance and the environment of Commonwealth land. Accordingly, referral to the Australian Government Department of Climate Change, Energy, the Environment and Water under the EPBC Act is not required. Proposed safeguards and management measures to mitigate predicted impacts to MNES are presented in **Section 5.1.4**.

3.3.2 Native Title Act 1993

The *Native Title Act 1993* (Native Title Act) recognises and protects native title. The Native Title Act covers actions affecting native title and the processes for determining whether native title exists and compensation for actions affective native title. It establishes the Native Title Registrar, the National Native Title Tribunal, the Register of Native Title Claims and the Register of Indigenous Land Use Agreements, and the National Native Title Register. Under this Act, a future act includes proposed public infrastructure on land or waters that affects native title rights or interest.

A search of the *Native Title Tribunal Native Title Vision* website (NNTT, 2024) was undertaken, on 18 November 2024 and no Native Title holders or claimants were identified at the proposal site.

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4. Community Engagement and Agency Consultation

4.1 TI SEPP consultation

Part 2.2 of the TI SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. TI SEPP consultation requirements are outlined below in **Table 4-1** and **Table 4-2**.

Table 4-1: Consultation with council required under TI SEPP

TI SEPP clause		Applicable to proposal?
2.10	**Consultation with councils—development with impacts on council-related infrastructure or services**	
2.10 (a)	*Will the development have a substantial impact on stormwater management services provided by a council, or*	No - No impacts to the stormwater management services provided by the council are anticipated. There will be installation of building and site stormwater drainage.
2.10 (b)	Is the development *likely to generate traffic to an extent that will strain the capacity of the road system in a local government area, or*	No – the proposal is expected to generate a minor increase in traffic on the road system but will not strain the capacity of the road system in the LGA.
2.10 I	*Will the development involve connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council, or*	No - The proposal would not involve connection to a council owned sewage system.
2.10 (d)	*Will the development involve connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council, or*	No - The proposal would not involve connection to a council owned water supply system.
2.10 (e)	*Will the development involve the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential, or*	No - The proposal would not involve the installation of a temporary structure, or the enclosing of, a public space which is under local council management or control.
2.10 (f)	*Will the development involve excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the* Roads Act 1993 *(if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath).*	No – the development does not involve the excavation of the surface of, or a footpath adjacent to, a road for which a council is the roads authority.
2.11 *(a)*	**Consultation with councils—development with impacts on local heritage** *Is the development likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage item, in a way that is more than minor or inconsequential*	No - No local heritage items or heritage conservation areas are located within the study area for the works.
2.12 *(2)*	**Consultation with councils—development with impacts on flood liable land** *Is the development located on flood liable land,*	No – the development is not located on flood liable land.

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TI SEPP clause		Applicable to proposal?
	If so, will the development change flood patterns other than to a minor extent?	
2.13	**Consultation with State Emergency Service—development with impacts on flood liable land** *Is the development located on flood liable land?*	No – The development is not located on flood liable land.
2.14 *(1)*	**Consultation with councils—development with impacts on certain land within the coastal zone** *Is the development on land that is within a coastal vulnerability area and is inconsistent with a certified coastal management program that applies to that land?*	No - The proposal is not located within the coastal vulnerability area.

Table 4-2: Consultation with other public authorities required under TI SEPP

TI SEPP clause		Applicable to proposal?
2.15	**Consultation with authorities other than councils**	
2.15 (2a)	*Is the development adjacent to land reserved under the* National Parks and Wildlife Act 1974 *or to land acquired under Part 11 of that Act—the Office of Environment and Heritage*	No - The works are not located in proximity to land reserved or acquired under the NPW Act.
2.15 (2b)	*Is the development on land in Zone C1 National Parks and Nature Reserves or in a land use zone that is equivalent to that zone, other than land reserved under the* National Parks and Wildlife Act 1974*—the Office of Environment and Heritage*	No - The works are not located on land zoned as C1 or equivalent.
2.15 (2c)	*Does the development comprise a fixed or floating structure in or over navigable waters—Transport for NSW,*	No - The works do not include a fixed or floating structure in or over navigable waters.
2.15 (2d)	*May the development increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map—the Director of the Observatory (The dark sky region is land within 200 kilometres of the Siding Spring Observatory.)*	No – The works are not located within 200km of the Siding Spring Observatory.
2.15 (2e)	*Is the development on defence communications facility buffer land within the meaning of clause 5.15 of the Standard Instrument—the Secretary of the Commonwealth Department of Defence*	No – The works are not located on buffer land around the defence communications facility near Morundah.
2.15 (2f)	*Is the development on land in a mine subsidence district within the meaning of the* Mine Subsidence Compensation Act 1961*—the Mine Subsidence Board,*	Yes – the works are located on land in a mine subsidence district. Notification to the Mine Subsidence Board is required. TISEPP notification was issued to the Mine Subsidence Board on 9 December 2024. A response was received on 28 January 2025 which indicated that based on information provided in the notification, an application consistent with the proposal would be granted

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TI SEPP clause		Applicable to proposal?
		approval subject to conditions under the current development assessment policy framework.
2.15 (2g)	*Is the development on, or reasonably likely to have an impact on, a part of the Willandra Lakes Region World Heritage Property—the World Heritage Advisory Committee and Heritage NSW,*	No – The works are not likely to have an impact on a part of the Willandra Lakes Region Work Heritage Property.
2.15 (2h)	*Is the development within a Western City operational area specified in the* Western Parkland City Authority Act 2018*, Schedule 2 with a capital investment value of $30 million or more—the Western Parkland City Authority constituted under that Act.*	No - the development is within a Western City operational area specified in the Western Parkland City Authority Act 2018, Schedule 2 but it has a capital investment value of less than $30 million

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Table 4-3: Notification of certain electricity substation development required under TI SEPP

TI SEPP clause		Applicable to proposal?
2.45 *(1)*	**Notification of certain electricity substation development that may be carried out without consent** *This section applies to development (other than exempt development) that—*	
(a)	*is carried out by or on behalf of an electricity supply authority or public authority, and*	The proposal is to be carried out by Endeavour Energy, an electricity supply authority, is for the purpose of a new electricity substation and is not State Significant Infrastructure.
(b)	*is for the purpose of a new or existing electricity substation of any voltage (including any associated yard, control building or building for housing plant), and*	
(c)	*is not a project to which Part 3A of the Act applies or State significant infrastructure.*	
(2)	*Before development to which this section applies is carried out, the electricity supply authority or public authority must—*	Notification letters were distributed to occupiers of adjacent land on Wednesday 22 January 2025.
(a)	*give written notice of the intention to carry out the development to the council for the area in which the land is located (unless the authority is that council) and to the occupiers of adjoining land*	Notification was made to Council on 9 December 2024 and no response was received.

4.2 Other consultation

4.2.1 Landholder consultation

In accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), notification to occupiers of adjoining land and 1170 residents and businesses within Menangle and Menangle Park was undertaken via letterbox drop on Wednesday 22 January 2025. The letter outlined the project (ZS and the feeder route), likely environmental impacts and invited the public to make submissions to the Endeavour Energy Project team for a period of no less than 20 days. A copy of the notification is provided in **Appendix C**.

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5. Environmental Assessment

5.1 Biodiversity

5.1.1 Methodology

East Coast Ecology (ECE) were engaged to undertake a Biodiversity Assessment Report (BAR) for the proposal to evaluate the ecological values that occur within the subject land and identify how the proposal satisfies the relevant planning framework. The BAR is presented in **Appendix D** and was undertaken in accordance with the following NSW state guidelines:

- *Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method* (DPIE, 2020); and
- *Threatened Species Survey and Assessment: Guidelines for developments and activities – Working Draft* (DEC, 2004).

Desktop assessment

Searches of the publicly available databases were conducted to identify all current threatened flora and fauna, as well as migratory fauna records, within a 5km radius of the substation.

The following databases were reviewed to inform the BAR:

- State and Commonwealth databases:
  - EPBC Protected Matters Search Tool (DCCEEW, 2024);
  - NSW BioNet. The website of the Atlas of NSW Wildlife (DPE, 2024);
  - NSW BioNet. Threatened Biodiversity Data Collection (DPE, 2024a);
  - NSW BioNet. Vegetation Classification System (DPE, 2024b);
  - NSW Government Spatial Services: Search and Discovery – Historical, Aerial and Satellite Imagery (NSW Spatial Services, 2024);
  - NSW Government Spatial Services: SIXMaps Clip & Ship (Department of Customer Service, 2025);
  - Biodiversity Values and Threshold Tool Map (DCCEEW, 2024a); and
  - Key Fish Habitat Maps – Hawkesbury-Nepean (DPI, 2024).
- Vegetation and soil mapping:
  - The NSW State Vegetation Type Map (DCCEEW, 2023); and
  - eSPADE v2.2.0. (DPIE, 2024)

Field surveys

A survey was undertaken on the 16 December 2024 in accordance with the *Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method* to determine whether any threatened flora or their habitats were present, and to identify any habitat constraints.

Habitat constraints include waterbodies, rocky areas, tree hollows and microhabitats. Potential habitat constraints within the broader areas (500m buffer) were assessed using Google Earth, historical aerial imagery, soil landscape mapping and recent vegetation mapping.

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5.1.2 Existing environment

Plant community types

Review of the State Vegetation Type Map (refer **Figure 5-1**) indicated there are no Plant Community Types (PCT) mapped as occurring within the proposal site. The nearest PCT to the proposal site is PCT 3320: Cumberland Shale Plains Woodland, which is located around 45 m west, on the opposite side of the railway line, and around 140 m east of the site.

Biodiversity values

No Areas of Outstanding Biodiversity Value occur on the proposal site or surrounding area.

Biodiversity certification

A review of the relevant gazettes, orders and the Cumberland Plain Conservation Plan (DPE, 2021) was carried out on the 13 March 2025. The proposal site is mapped under excluded land within the Greater Macarthur map for biodiversity certified land, therefore is not applicable to the provisions set out in Part 8 of the BC Act for biodiversity certified land.

Groundwater dependent ecosystems

Assessment for the potential occurrence of groundwater dependent ecosystems was carried out using the Commonwealth's Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (BOM, 2025). No terrestrial groundwater dependent ecosystems are mapped within the proposal site.

Wildlife connectivity corridors

The proposal site occurs within a rural landscape which provides minimal wildlife connectivity. Vegetation within and surrounding the proposal site exists primarily as exotic species and is highly degraded and fragmented.

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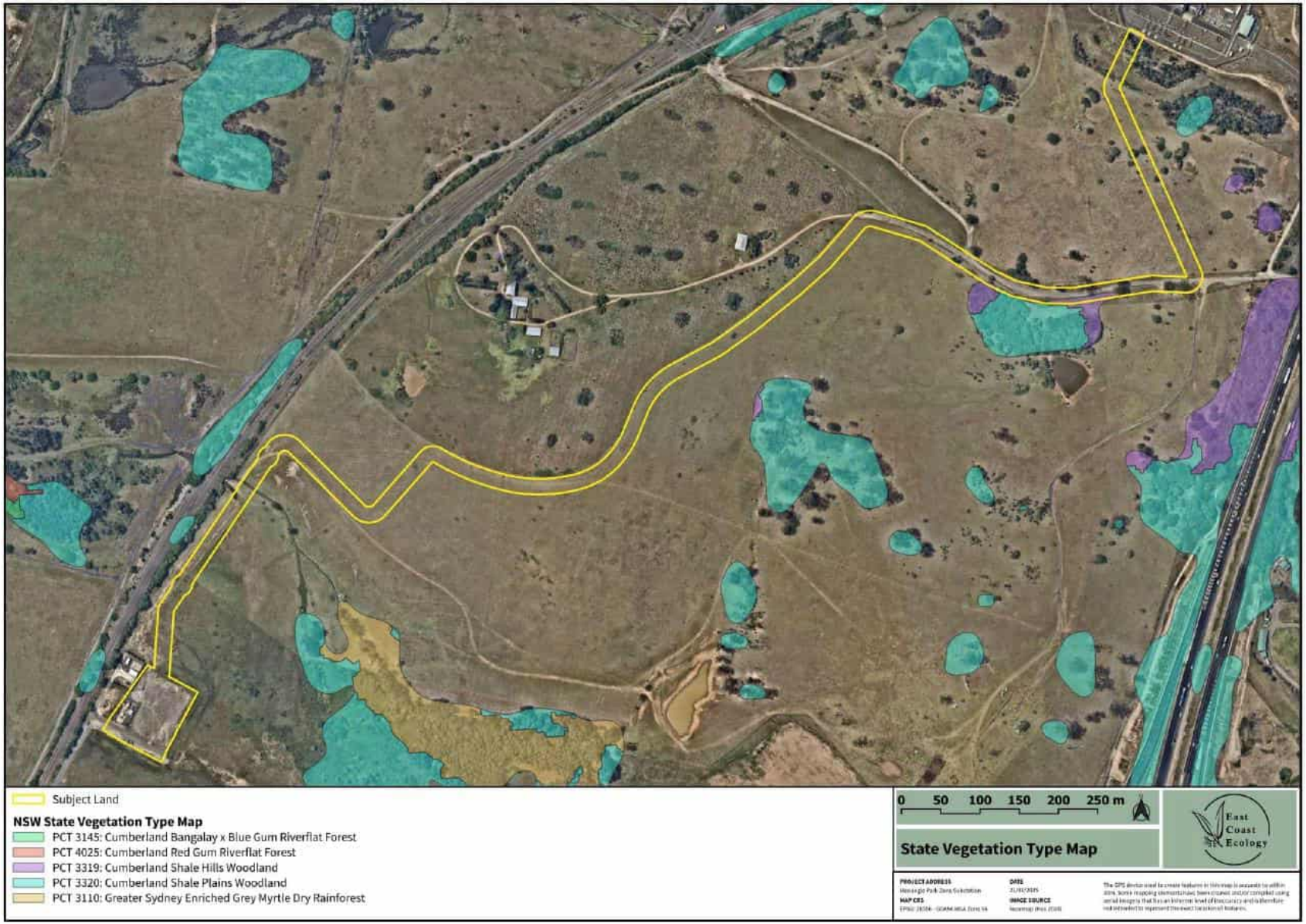


Figure 5-1: NSW State Vegetation Type map surrounding proposal site (Source: BAR (ECE 2025) Appendix D)

Threatened flora

Database searches identified 11 threatened flora species recorded within a 5km radius of the proposal site (refer to **Table 5-1**).

Table 5-1: Threatened flora with potential to occur within a 5km radius of the proposal site.

Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
Eucalytpus benthamii	Camden White Gum	CE	CE	2
Grevillea parviflora	Small-flower Grevillea	V	V	7
Hibbertia puberula	-	E	-	16
Isotoma fluviatilis subsp. *fluviatilis*	-	CE	CE	1
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflora* R. Br. Subsp. *viridiflora*	EP	-	8
Persoonia hirsuta	*Hairy Geebung*	E	E	1
Pimelea spicata	Spiked Rice-flower	E	E	854
Pomaderris brunnea	Brown Pomaderris	E	V	36
Prostanthera marifolia	Seaforth Mintbush	CE	CE	1
Pterostylis saxicola	Sydney Plains Greenhood	E	E	34
Thesium australe	Austral Toadflax	V	V	1

V = Vulnerable; E = Endangered; EP = Endangered Population; CE = Critically Endangered

Threatened fauna

Database searches revealed 40 threatened fauna species have been recorded within a 5km radius of the proposal site (refer to **Table 5-2**).

No watercourses are identified in proximity of the proposal site, however, within a 500m radius, one watercourse is mapped south of the proposal. This watercourse was found to be vegetated with exotic species however, some native ground covers were scattered throughout. The watercourse is unlikely to provide habitat for threatened fauna species given the level of degradation and presence of livestock.

Two hollow-bearing stags were identified within a 1km radius of the proposal site. It is possible that some of the hollows could provide potential breeding habitat for threatened birds and mammals, although no signs of breeding were detected during the field survey. The small and medium hollows may be occasionally used for roosting by threatened microbats (e.g. Southern Myotis).

Table 5-2: Threatened fauna with potential to occur within 5km radius of the proposal site.

Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
Bird				
Anthocaera phrygia	Regent Honeyeater	CE	CE	3
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	114
Calidris canutus	Red Knot	-	E	8
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	14
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V	V	2

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Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
Circus assimilis	Spotted Harrier	V	-	1
Climacteris picumnus victoriae	Brown Treecreeper (southern-eastern)	V	V	2
Daphnoenositta chrysoptera	Varied Sittella	V	-	50
Ephippiorhychus asiaticus	Black-necked Stork	E	-	1
Gallinago hardwickii	Latham's Snipe	V	V	17
Glossopsitta pusilla	Little Lorikeet	V	-	26
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	12
Hieraaetus morphnoides	Little Eagle	V	-	13
Hirundapus caudacutus	White-throated Needletail	V	-	1
Lathamus discolor	Swift Parrot	E	CE	178
Lophoictinia isura	Square-tailed Kite	V	-	9
Neophema pulchella	Turquoise Parrot	V	-	1
Ninox connivens	Barking Owl	V	-	1
Ninox strenua	Powerful Owl	V	-	12
Petroica boodang	Scarlet Robin	V	-	10
Stagonopleura guttata	Diamond Firetail	V	V	2
Stictonetta naevosa	Freckled Duck	V	-	1
Tyto novaehollandiae	Masked Owl	V	-	2
Frog				
Litoria aurea	Green and Golden Bell Frog	E	V	3
Mammal				
Carcartetus nanus	Eastern Pygmy-possum	V	-	1
Chalinolobus dwyeri	Large-eared Pied Bat	V	E	7
Dasyurus maculatus	Spotted-tail Quoll	V	E	1
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	8
Micronomis norfolkensis	Eastern Coastal Free-tailed Bat	V	-	23
Miniopterus australis	Little Bent-winged Bat	V	-	11
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	17
Myotis macropus	Southern Myotis	V	-	15
Petauroides volans	Southern Greater Glider	E	E	1
Petaurus norfolcensis	Squirrel Glider	V	-	1
Phascolarctos cinereus	Koala	E	E	524
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	158
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	4
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	8
Snail				
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	129

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Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
Pommerhelix duralensis	Dural Land Snail	E	E	1

V = Vulnerable; E = Endangered; EP = Endangered Population; CE = Critically Endangered

Threatened Fauna Habitat

18 threatened fauna habitats were identified within a 5km radius of the proposal during the desktop search and 10 of them presented during the field survey. Observation results were indicated in **Table 5-3** below.

Table 5-3: Observation results of threatened fauna habitats within 5km of the porposal site.

Habitat component	Subject Land
Coarse woody debris	Minor occurrence
Rock outcrops and bush rock	Minor occurrence
Caves, crevices and overhangs	Absent
Culverts, bridges, mine shafts, or abandoned structures	Absent. One large box culvert was located outside of the subject land.
Nectar/lerp-bearing Trees	Minor occurence – *Eucalyptus* spp.
Nectar-bearing shrubs	Minor occurrence
Koala Use Trees	Minor occurrence – *Eucalyptus* spp.
Large stick nests	Absent
Sap and gum sources	Minor occurrence – *Eucalyptus* spp.
She-oak fruit	Absent – *Casuarina* spp. Present outside of the subject land.
Seed-bearing trees and shrubs	Minor occurrence – *Eucalyptus* spp.
Soft-fruit-bearing trees/shrubs	Present – African Olive and Blackberry.
Dense shrubbery and leaf litter	Absent.
Tree hollows	Present – 2 stags with 1 x small, 3 x medium, 1 x large and 1 x extra-large hollows.
Decorticating bark	Absent
Wetlands, soaks, and streams	Present – two streams. *Gambusia holbrooki* were observed in the stream in the southern extent of the subject land.
Open water bodies	Absent
Estuarine, beach, mudflats, and rocky foreshores	Absent

Migratory species

Database searches revealed three migratory terrestrial species, or their habitat, are known to occur within the proposal site. These species do not breed in Australia.

Table 5-4: Migratory terrestrial species with potential to occur in the proposal site.

Habitat component	Subject Land
Cuculus optatus (Oriental Cuckoo)	Migratory, CAMBA, JAMBA, ROKAMBA
Hirundapus caudacutus (White-throated Needletail)	Vulnerable, Migratory, CAMBA, JAMBA, ROKAMBA
Motacilla flava (Yellow Wagtail)	Migratory, CAMBA, JAMBA, ROKAMBA

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CAMBA = China-Australia Migratory Bird Agreement; JAMBA = Japan-Australia Migratory Bird Agreement; ROKAMBA = Republic of Korea-Australia Migratory Bird Agreement.

5.1.3 Impact assessment

Construction

PCT and CEEC

There are no PCT's or CEEC's identified within the proposal site, and no impacts to PCT or CEEC are predicted as a result of the proposal.

Threatened Flora

Based on habitat constraints and the cleared nature of the site confirmed during the field survey, the BAR concluded that no threatened flora species are likely to occur within the proposal site, and therefore are unlikely to be impacted by the proposal. In the event that any of these species are present on the site, the activity would not pose a significant impact to a viable local population, and therefore impacts would be minor in nature. Safeguard measures will be implemented to mitigate potential impacts to threatened flora species.

Threatened Fauna

Based on the lack of habitat on the cleared site and/or historical records, the BAR concluded that no threatened fauna species are likely to be impacted by the proposal. Mitigation measures will be implemented to minimise potential impacts to surrounding fauna species.

Fauna injury and mortality

The BAR found that with implementation of proposed mitigation measures, the proposal is unlikely to result in fauna injury and mortality.

Impacts to fauna habitat

Minimal ground cover comprising weeds and grasses within the proposal site was found to provide only minor foraging habitat for protected fauna species. Impacts to vegetation at the proposal site include clearing of the site. Sensitive and/ or specialist fauna habitats are unlikely to be directly impacted by the proposal given the minor foraging habitat. There are no hollow-bearing stags at the site.

Indirect impacts to adjacent habitat outside of the proposal site would include negligible increase in noise, dust and light spill during construction.

Wildlife connectivity and habitat fragmentation

The proposal site comprises a cleared and levelled area that has already fragmented the landscape by clearing a barrier for fauna movements. The proposed activity is unlikely to cause further habitat fragmentation.

Operation

Threats to habitat

Indirect impacts to adjacent habitat outside of the proposal site would include negligible increase in noise and light spill during operation. Mitigation measures are proposed below to manage these impacts during operation.

Predatory and pest species

The proposal site is likely to be inhabited by predatory and pest species prior to construction of the proposal. Clearance of limited vegetation (grasses and weeds) associated with the proposal is unlikely to increase predatory species populations. The proposal activity would not result in an increase in available habitat for

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these species and is unlikely to lead to an increase in pest animal populations. Suitable waste disposal implemented during construction and operation would further reduce the resources available for pest species.

5.1.4 Safeguards

Table 5-5: Biodiversity safeguards

Number	Safeguard
B01	Vegetation removal will be undertaken in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B02	An unexpected threatened species finds procedure will be developed as part of the CEMP. The procedure is to be followed if unexpected threatened species or threatened ecological communities not assessed in the biodiversity assessment, are identified within the proposal site.
B03	The following will be implemented as part of the CEMP: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas; • Pre-clearing survey requirements; • Procedures for unexpected threatened species finds and fauna handling; • Procedures addressing relevant matters specified in the DPI *Policy and guidelines for fish and habitat conservation and management (2013)*; and Protocols to manage weeds, pathogens and pest species.
B04	Threatened fauna habitat removal will be minimised through detailed design in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B05	Fauna encountered on-site during construction will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Management Guideline: Protecting and managing biodiversity for NSW projects* (TfNSW, 2024).
B06	Weed species and pathogens will be managed in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

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5.2 Water, Hydrology and Flooding

5.2.1 Methodology

This section identifies and assesses the potential impacts to hydrology, flooding, surface water, and groundwater during construction and operation of the proposal, and provides mitigation measures. The assessment included a review of publicly available information including:

- Spatial information eXchange (SIXMaps) (Department of Customer Service, 2025);
- NSW State Emergency Service Flood Mapping (SES, 2024)
- WaterNSW Greater Sydney Drinking Water Catchment map (WaterNSW, 2024a);
- WaterNSW Continuous water monitoring network (WaterNSW, 2024); and
- Publicly available flood mapping from the CLEP.

5.2.2 Existing environment

Regional hydrology

The proposal is located within the Nepean River Catchment. The Hawkesbury-Nepean catchment covers an area of about 21,400 km^2. This area includes the catchments for a number of dams including Warragamba, the Upper Nepean and the Mangrove Creek dams, which form the main water supply reservoirs for the Sydney metropolitan area. The *NSW River Condition Index* (2023) reported the Hawkesbury-Nepean catchment as having a "very poor" river condition index, and a "good" water quality index.

Local hydrology and waterways

The Nepean River is located approximately 1km west of the proposal site. The substation is not located in proximity to any waterway. The closest waterway is 275m north of the ZS site and is a creek line, Howes Creek, with poor geomorphic stream condition which drains to the west into the Nepean River.

During periods of rainfall, surface water would be absorbed by the unsealed ground, and during heavy rainfall, surface water runoff would be directed to the Howes Creek as there is a slight decline in elevation to the north from the site.

Flooding

Review of the CLEP *Floodplain Risk Management Study and Plan* (Campbelltown City Council, 2018) indicated the proposal site is not within areas mapped under a probable maximum flood (PMF) as 'flood prone land'.

Groundwater

Review of Water NSW boreholes (WaterNSW, 2024) on 8 January 2025 did not identify any valid and current boreholes within 500m of the proposal site. There is one 'cancelled' test bore, GW101106, located approximately 1.1km north of the ZS site, along the entrance road into the Glenlee Estate. Within a 1km radius of the proposal site, there are no active monitoring bores.

GeoEnviro Consultancy Pty Ltd (GeoEnviro) were engaged by Endeavour Energy to undertake geotechnical investigations at the ZS site in December 2017, and reported in the Geotechnical Investigation Report (GeoEnviro 2018), presented in **Appendix E**. GeoEnviro (2018) reported groundwater seepage to be present between 2.8m and 5.5m below ground surface in test pits, and groundwater was observed to be present in monitoring wells at about 1.2m and 1.5m below ground surface.

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5.2.3 Impact assessment

Construction

There is potential for localised impacts to surface water during construction activities, mainly as a result of accidental spills of fuels, oils and or other chemicals from construction vehicles or equipment.

The topography of the works location and proximity to water bodies has the potential for localised surface flooding to occur during rainfall events. Potential localised flood risks associated with construction of the proposal would be considered prior to and during construction.

Given the proposal would not require any extraction works, it is highly unlikely that groundwater would be encountered during construction of the ZS. Piling of up to 10m is proposed as part of the scope of works which has the potential to encounter groundwater, therefore, groundwater seepage is to be monitored during construction.

With the implementation of mitigation measures impacts of the proposal on water, hydrology and flooding would be low.

Operation

The ZS proposal is not expected to affect surface water flows, hydrology or flooding during operation.

5.2.4 Safeguards

Table 5-6: Safeguards for water, hydrology and flooding

Number	Safeguard
W01	Site-specific Erosion and Sediment Control Plans will be prepared for the proposal in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), and will be implemented as part of the Construction Environmental Management Plan (CEMP).
W02	Install construction erosion and sediment control measures before construction commences consistent with 'the Blue Book' (*Managing Urban Stormwater, Soils and Construction Vol 1 and 2A* (Landcom 2004 and DECC 2008)) in order to: • Minimise sediment moving off-site and sediment laden water entering drainage lines, or drain inlets; • Reduce water velocity and capture sediment on site; • Minimise the amount of material transported from site to surrounding pavement surfaces; • Minimise in-stream soil erosion and downstream water quality impacts; and • Divert clean water around the site.
W03	The CEMP will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.
W04	No cleaning and washing of vehicles should be undertaken on site, and must be completed offsite.
W05	Water quality control measures are to be used to minimise any materials (e.g. concrete, grout, sediment etc) entering drain inlets or waterways.
W06	Spill kits will be available at the construction site in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), and all persons undertaking construction works will be made aware of Endeavour Energy's incident response procedures.
W07	Soil and water management will be conducted in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
W08	Disturbance will be restricted to those areas of the proposal required for the active stage of works.

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Number	Safeguard
W09	Refuelling and maintenance of vehicles, plant and equipment will not be carried out on the proposal site. All vehicles, plant and equipment are to be refuelled prior to arriving on-site.
W10	No fuels, oils or other chemicals are to be stored at worksites unless small amounts are required for that specific days' work.
W11	All drainage, erosion and sediment control measures will be maintained in proper working order until their function is no longer required.
W12	Where it is necessary to store spoil or other loose materials on site, sediment fences are to be constructed on the down slope side of the stockpile.
W13	Monitor for groundwater seepage during construction. Should groundwater be encountered during earthworks, the Site Supervisor would notify the Environmental Advisor and Project Manager who will co-ordinate any further actions.

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5.3 Soils and Contamination

5.3.1 Methodology

A desktop assessment was undertaken which included a review of relevant available historic and current data and background information, including:

- Local geological setting
    - Regional topographic data via SIXMaps (Department of Customer Service, 2025);
    - The 1:100 000 geological map sheet for Wollongong-Port Hacking (Stroud W.J., 1985); and
    - The NSW DPE Environment and Heritage Division eSPADE v2.2 online soil maps, including soil landscape, salinity hazard and acid sulfate soil (ASS) risk mapping (DPIE, 2024).
- Contamination
    - NSW Environment Protection Authority (EPA) Contaminated Land Register (as per section 308 of the POEO Act) (EPA, 2024);
    - NSW EPA list of Contaminated sites notified to the EPA (as per section 60 of the POEO Act) (EPA, 2024a) which details sites that have been notified to the EPA as potentially contaminated; and
    - Defence unexploded ordinance (UXO) mapping tool Version 1.0.2.21 (Australian Government-Defence, 2024).

The following technical assessments were undertaken by GeoEnviro and have been reviewed to inform this chapter:

- Geotechnical Investigation (GeoEnviro 2018) (**Appendix E**) was undertaken at the proposal site to assess the subsurface ground conditions including fill and groundwater conditions. Intrusive works were undertaken in December 2017 and included a program of seven boreholes, 32 test pits and two groundwater monitoring wells. Based on the information provided, to provide comments and recommendations on:
    - Site preparation and basement construction;
    - Soil reactivity to AS2870; and
    - Soil salinity and aggressiveness to buried structures.
- Additional Geotechnical Investigation (GeoEnviro 2024) (**Appendix F**) were undertaken to further assess the subsurface ground conditions and groundwater levels at the proposal site. Intrusive works were undertaken in July 2024 and included a program of three boreholes. The report provides comments and recommendations of the following:
    - The groundwater conditions for the control room basement design levels;
    - Earthworks and fill construction procedures; and
    - Subgrade conditions and recommendations.
- Contamination and Waste Classification Assessment (GeoEnviro 2018) (**Appendix G**) to assess the subsurface ground conditions and, based on the findings, to provide the following:
    - Assessment on the contamination of the site to ensure suitability of the site for proposed development;
    - Waste classification of the fill and natural soil for off-site disposal to a landfill; and
    - Comments and recommendations on the likely environmental issues associated with the proposed development.

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5.3.2 Existing environment

Topography

The topography of the surrounding area is characterised by undulating hills and open paddock grasslands. The proposal site has a slight decline to the north from 80 mAHD to 77 mAHD. The surrounding area decreases in elevation towards the creek line that is located 275m north of the site. Topography at the proposal site is presented in **Figure 5-2**.

Geology and Soils

The proposal site is underlain by residual soil belonging to the Blacktown soil landscape group which typically consists of shallow to moderately deep hard setting mottled texture contrast soils, moderately reactive and highly plastic. The underlying geological unit consists of Cainozoic Era high level alluvium (Tal) which generally consists of clay and weathered sandstones of the Wianamatta Group.

GeoEnviro (2018) undertook intrusive investigations and reported topsoils at the proposal site from the ground surface to depths of up to 0.4m below ground surface comprising predominantly silty sand and sandy silt of low liquid limit. Fill was encountered at seven of the test pits up to 1.5m thickness, and comprised silty sand and sandy silt with traces of foreign inclusions including concrete, tile pieces and gravel.

Natural soils were encountered at depths of between 0.8m and 2.4m below the ground surface, and comprised silty sand, sand and clayey sand. Bedrock was encountered at 14m below the ground surface comprising sandstone and siltstone.

Acid Sulfate Soils

GeoEnviro (2018 and 2024) reported that there are no known maps available for the proposal site, and the surrounding maps indicate areas with similar landscapes, topography and geology to have no known occurrence of ASS. The investigation confirmed there were no obvious signs of acid sulphate within the proposal site.

Salinity

The area of the proposed substation is in an area of moderate salinity potential per the *Salinity Potential in Western Sydney* map (DCCEEW, 2002).

GeoEnviro (2018 and 2024) undertaken for the site reported that there was no evidence of salt concentration on the surface in the form salt scalding, vegetation distress or exposed surface soils associated with a saline prone environment were present during the site inspections in 2018 and 2014.

During the site inspection undertaken by JBS&G on 16 December 2024, an area of exposed soils was observed around 312m north from the ZS site, however this was attributed to livestock observed dust bathing in the affected area. No other potential signs of salt scalding, vegetation distress or exposed surface soils associated with a saline prone environment were observed.

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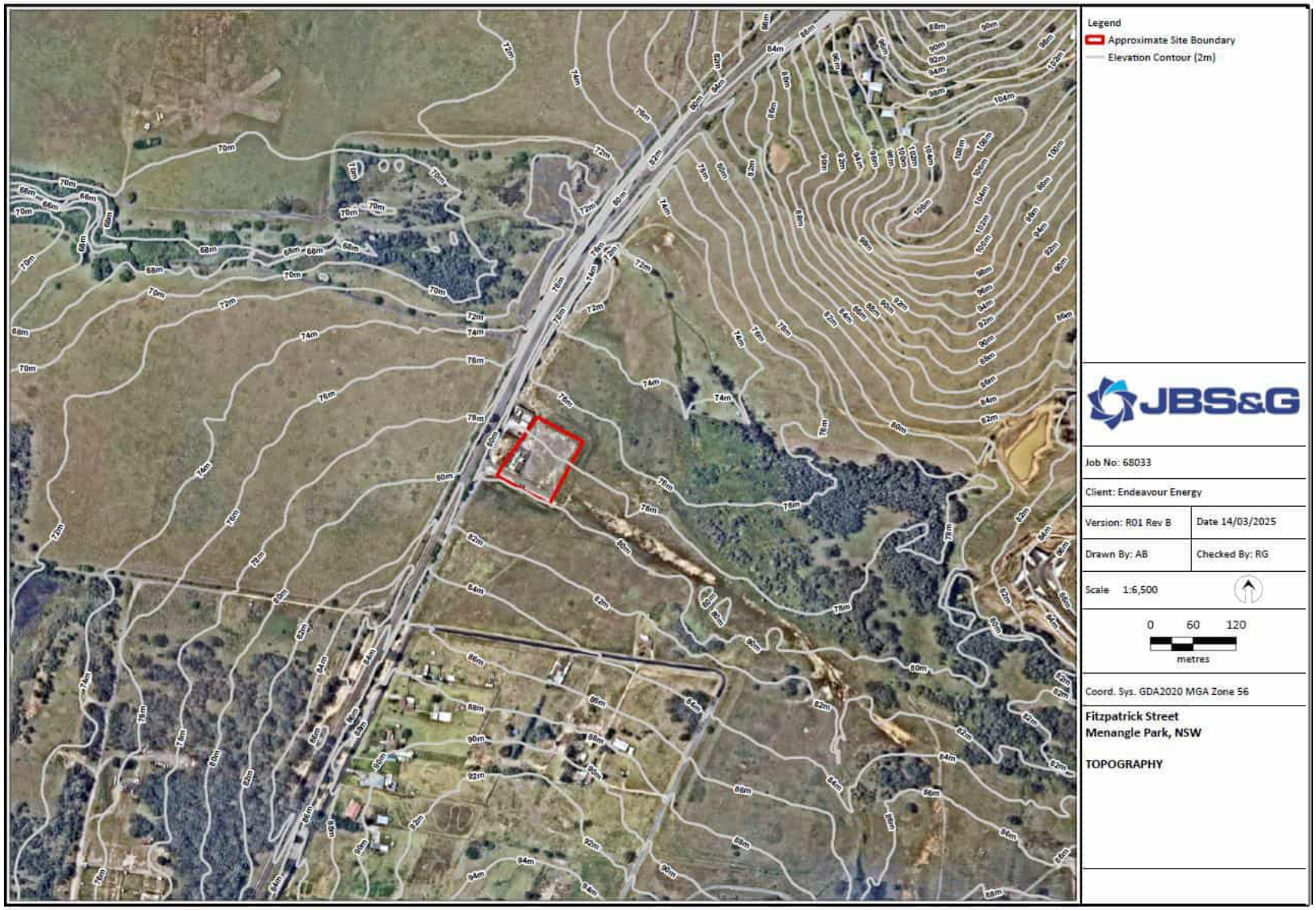


Figure 5-2: Topography at the proposal site

Contamination

The proposal site has historically been used for agricultural purposes within a rural area. The site is cleared of trees, with limited ground cover including grasses and weeds observed during the site inspection.

The proposal site and surrounds are not present on the NSW EPA list of notified sites or the contaminated land register meaning no identified known contamination is present within the site or wider suburb of Menangle Park. No EPL is currently held for the proposal site.

The proposal is not within an area identified on the Australian Governance Defence UXO mapping (Australian Government-Defence, 2024) to encounter any unexplained ordinances.

GeoEnviro (2018) reported there is no known historical contaminating activities or previous land use with high risk of contamination at the ZS site. Fill was encountered with minor foreign inclusions of concrete and tile pieces.

No evidence of fly tipping, stains or asbestos were observed by JBS&G during the site inspection on 16 December 2024.

5.3.3 Impact assessment

Construction

Soils

The following construction activities that involve soil disturbance are:

- Temporary stockpiling of material within the construction footprint; and
- Loose soil from excavation.

These activities have the potential to impact erosion and sediment run-off.

Contamination

The risk for gross ground contaminants at the ZS site from previous land use is considered low, however as the source of fill encountered at the proposal site (GeoEnviro 2018) with minor foreign inclusions of concrete and tile pieces is unknown, there is a potential for the fill to be contaminated with metals, pesticides, hydrocarbons and asbestos.

Construction of the proposal would include potentially contaminating activities including construction debris to remain at the site following construction, and residual chemical or oil from spills that may occur during works.

Operation

No operational impacts to soils or contamination are anticipated to result from the proposal. During operation, the proposal site will be sealed with hardstand. No ground disturbance will be required during operation.

5.3.4 Safeguards

Table 5-7 Soil and contamination safeguards

Number	Safeguard
SC01	An Unexpected Contaminated Finds Protocol will be implemented during construction, and will include appropriate control measures to be implemented to manage and risks of contamination. All other works that may impact on the unexpected find (contaminated area) will cease until the nature and extent of the contamination has been confirmed, and any necessary site-specific controls or further actions identified in consultation with the project manager and/or the EPA.

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Number	Safeguard
SC02	Should asbestos be identified unexpectedly on site, asbestos removal must be undertaken in accordance with *Working with Asbestos: Guide 2008* published by WorkCover NSW and by Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
SC03	A spill kit is to be available at all times during construction, in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
SC04	Monitoring should be undertaken during construction in the event that ASS are encountered. In the event that ASS are present, appropriate remedial works should be carried out in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
SC05	All topsoil, fill and natural soil to be excavated are to be disposed to an appropriately licensed landfill should be classified in accordance with the EPA's *Waste Classification Guidelines: Part 1: Classifying waste* (EPA, 2014).
SC06	Any screened and clean insitu fill intended to be reused on-site should be validated by laboratory analysis to ensure suitability of the material for reuse.
SC07	All imported fill required for bulk earthworks should be validated as Virgin Excavated Natural Material (VENM) free of organics, non-saline and not affected by ASS. This is in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

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5.4 Traffic and Transport

5.4.1 Methodology

Assessment of the potential construction impacts on traffic and transport has been carried out using existing desktop information including:

- A review of the existing conditions including the road network, public transport, amenity and property access;
- Assessment of the likely impacts during construction of the proposal and impacts on the local community and property access; and
- Identification of safeguards and management measures.

5.4.2 Existing environment

Road network and conditions

The existing temporary proposal site is accessed via an unnamed private road accessed from Fitzpatrick Street. Fitzpatrick Street is a local road that runs between Racecourse Avenue in the west to into Cummins Road in the east. The speed limit for Fitzpatrick Street is 50km/h and services the surrounding residential area and is accessed from Menangle Road to the south. Fitzpatrick Street is a two-lane bi-directional road, is sealed with asphalt in good condition and does not have stormwater infrastructure to direct surface water run-off.

Spring Farm Parkway is a proposed new four-lane divided road that will act as a connection between Menangle Road, the Hume Motorway and Menangle Park. This road is an overpass over the Hume Highway intended to service the future Menangle Park development areas to the west of the Hume Highway. The most current update on Spring Farm Parkway released in January 2025 (Transport for NSW, 2025) states the project is up to its final stage of work for Stage 1. Stage 2 involves the construction of a 3km stretch of Spring Farm Parkway that would link Liz Kernohan Drive in the west with the Stage 1 constructed road. This will provide a connection between the Camden Bypass, the Hume Highway and Menangle Road. Construction commencement timing is to be confirmed.

Public transport

The nearest train station to the proposal is Menangle Park Station, located approximately 1.3km south west. Menangle Park Station services the Main Southern Railway Line between Campbelltown and Moss Vale with an average 30-minute service interval during the peak periods.

There are no bus stops located on Fitzpatrick Street, however one bus route (889) utilises Fitzpatrick Street. The closest bus stop is located 1.25km south of the site in which bus route 889 services, connecting the public between Campbelltown and Menangle Park.

Pedestrians and Cyclists

No dedicated pedestrian and cycling infrastructure are provided on Fitzpatrick Street. The roads may be utilised by local cyclists accessing residences in the surrounding areas.

Access

Access for the proposal site would be via an unnamed access road directly south of the substation. The road is sealed with asphalt with restricted access from Fitzpatrick Street via a lockable gate. The road runs parallel to the substation site and is wide enough to allow heavy vehicle parking and movements and temporary stockpiling during construction. The unnamed access road links to a private property west of the proposal site with no public access and a lockable gate.

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5.4.3 Impact assessment

Construction

The main potential impact on traffic and transport resulting from the construction of the proposal would include a noticeable minor increase in construction vehicle movements along Racecourse Avenue and Fitzpatrick Street.

The use of Fitzpatrick Street for temporary construction traffic is not expected to affect commuters accessing Menangle Park Railway Station. While there would be a minor increase in traffic associated with construction vehicles, impacts to bus route 889 would be negligible.

Access residents on Fitzpatrick Street would remain unaffected, as no works are proposed that would require traffic control or road closures on this road.

Mitigation measures outlined below would be implemented during construction to minimise identified impacts to traffic.

Operation

The operation of the proposal is expected to have minor impacts on surrounding traffic and transport across the area. Access to the site will be limited as it will only be accessed for inspection and maintenance purposes.

5.4.4 Safeguards

Table 5-8: Traffic and transport safeguards

Number	Safeguard
T01	Access to properties and local businesses will be maintained during construction.
T02	Delivery of construction plant and materials are to be managed to minimise number of deliveries/vehicles on site.
T03	Road users and local communities will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays owing to construction activities. The affected community will be notified a minimum of five working days before any changed conditions that are likely to result in disruption.

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5.5 Noise and Vibration

5.5.1 Methodology

Construction

The construction noise assessment was undertaken in accordance with the following guidance documents:

- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009);
- *Noise Policy for Industry* (EPA, 2017);
- *Australian standard (AS) 1055.3-1997*;
- *TfNSW Construction Noise and Vibration Guideline (Roads)* (TfNSW, 2024a); and
- *TfNSW Construction and Maintenance Noise Estimator* (TfNSW Noise Tool) (TfNSW, 2022).

The construction noise assessment included the following steps:

- Description of the existing noise environment including classification of the noise area category (in accordance with AS 1055.3-1997) and determination of Rating Background Levels (RBL) and Noise Management Levels (NML);
- Identification of sensitive receivers;
- Desktop analysis using the TfNSW Noise Tool noisiest plant scenario function (refer **Appendix H**);
- Assessment of the potential construction noise and vibration impacts; and
- Identification of feasible and reasonable construction safeguards and management measures.

Criteria

Background noise level

The ambient L_{90} background noise level is a statistical measure of the sound pressure level that is exceeded for 90% of the measuring period, typically 15 minutes. The Rating Background Level (RBA) is defined by the NSW EPA as the median value of the lower tenth percentile of L_{90} ambient background noise levels for the day, evening and night time periods, measured over a number of days during the proposed days and times of operation. Noise Management Levels (NML) are defined in the ICNG as the project-specific noise criteria used to assess the level of impact at a receiver location, derived from the identified RBLs. RBLs and NMLs are expressed as A-weighted decibels (dB(A)).

Day Design (Day Design) Pty Ltd (2024) reported background noise levels for the proposal site as part of an operational noise assessment undertaken for the proposal (refer **Table 5-9**). The RBLs are most appropriately reflected in noise category R1 applied in the TfNSW noise tool for the construction noise assessment.

Construction noise management levels

The ICNG outlines the process to identify NMLs for categories of residential and non-residential receivers, with recommended noise criteria for both standard construction hours and out of hours works (OOHW). Where construction noise levels are predicted to be above the NML, appropriate safeguards are to be implemented during works in order to minimise noise emissions.

In accordance with the guidance of the ICNG, construction noise for residential receivers must not exceed:

- Standard daytime hours: RBL + 10 dB(A)
- OOHW: RBL + 5 dB(A)

The highly affected noise disturbance level is considered the point above which there may be a strong community reaction to construction noise, considered to be above 75 dB(A).

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The estimated NMLs utilised in the TfNSW Noise Tool are set out in **Table 5-9** and **Table 5-10** for residential receivers and non-residential receivers, respectively. These are considered the values of best fit in accordance with the data outlined in the Operational Noise Assessment.

Table 5-9: Site-specific RBLs and residential receiver NMLs

Noise area category (AS 1055.3-1997)	Construction hours	Rating Background Level (dB(A)) LA90 Background Level (TfNSW Noise Tool)	Noise Management Level (Residential) (dB(A)) LAeq(15 minute) (ICNG)
R1	Standard (day)	40	50
	OOHW (day)	40	45

Table 5-10: Non-residential receiver construction NMLs (ICNG)

Non-residential sensitive receiver (measure point)	Noise Management Level (Non-residential) (dB(A)) LAeq(15 minutes)
Industrial premises	75
Offices /retail outlets	70
Places of worship	55
Classrooms	55
Active recreation areas	65
Passive recreation areas	60

Construction noise assessment

The TfNSW Noise Tool was used to inform the assessment of potential noise impacts from the proposal site during construction and identify required mitigation measures. A distance-based assessment relative to the loudest plant was undertaken for two different construction scenarios including:

- Demolition of existing temporary ZS; and
- Construction of new substation.

The outcomes of the assessment have been summarised in the following sections, and outputs from the TfNSW Noise Tool are presented in **Appendix I**.

To assess the potential impacts associated with construction of the proposal for standard hours and for daytime out of hours work (OOHW) based on the proposed construction hours outlined in **Section 2.4.7**. Inputs to the TfNSW Noise Tool are presented in **Appendix H**.

The area is defined as including rural areas with low density dwellings to the south, isolated dwellings to the north, active trainline adjacent to the site and Hume Highway (carrying approximately 52,000 annual average daily traffic (AADT)).

Construction noise impacts were assessed for “line of sight” to residential receivers located at:

- 232 Racecourse Avenue located approximately 310m south of the ZS;
- 22 Fitzpatrick Street located approximately 250m south of the ZS;
- 36 Fitzpatrick Street located approximately 365m south of the ZS; and
- 46 Fitzpatrick Street located approximately 378m south of the ZS.

Construction noise impacts were assessed as “behind substantial barrier” for remaining residential sensitive receivers, with the residences considered a barrier.

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Table 5-11: Noise Tool inputs for construction phase

Input section	Demolition and site preparation	Construction of ZS
Noise area category	R1	R1
Residential receiver	Undeveloped green fields, rural areas with isolated dwellings	Undeveloped green fields, rural areas with isolated dwellings
Noisiest plant (day, and day OOHW)	13.5 excavator with hammer	Bored pilling rig
Line of sight to sensitive receivers?	Yes – line of sight to the row of residences on Fitzpatrick Street south of the ZS and isolated resident at 60 Menangle Road; and No (behind substantial barrier) – no line of site for receivers behind Fitzpatrick Street first row of residences.	Yes – line of sight to the row of residences on Fitzpatrick Street south of the ZS and isolated resident at 60 Menangle Road; and No (behind substantial barrier) – no line of site for receivers behind Fitzpatrick Street first row of residences.

Reference: *TfNSW Construction and Maintenance Noise Estimator* (TfNSW Noise Tool) (TfNSW, 2022)

Construction vibration – Human comfort

Criteria for vibration include those set out in:

- *Assessing Vibration: A Technical Guideline* (DEC, 2006);
- British Standard (BS) 6472-1992 Evaluation of human exposure to vibration in buildings; and
- BS 7385-1993 Evaluation and measurement of vibration in buildings. Guide to damage levels from ground-borne vibration.

It is noted that a bored piling rig would be used during construction of the zone substation, and no other vibration intensive plants are to be used as part of the proposal.

Operational

An operational noise assessment was conducted by Day Design (2024) in order to assess potential noise impacts during operation of the substation and is summarised below (refer **Appendix I**).

The operational noise and vibration impact assessment was undertaken in accordance with the following guidance documents:

- *Noise Policy for Industry* (EPA, 2017); and
- AS 1055.3-1997.

The operational noise and vibration assessment included the following steps:

- Measure background noise levels at one location (45 Fitzpatrick Street);
- Establish acceptable noise level criterion;
- Quantify noise emissions from the proposed ZS;
- Calculated the level of noise emission, taking into account building envelope transmission loss, screen walls and distance attenuation;
- Prepare a site plan identifying the development and nearby sensitive noise receptors; and
- Provide recommendations for noise control.

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Background noise level

An environmental noise logger was placed at 45 Fitzpatrick Street, Menangle Park in June 2022 to measure ambient noise and determine the Rating Background Level (RBL) of the site. The results are presented in **Table 5-12** and were used to derive project-specific Noise Management Levels (NMLs) below:

- 41 dBA during the day;
- 41 dBA in the evening;
- 38 dBA at night.

5.5.2 Existing environment

The proposal site is located within a rural setting, surrounded by farmland and rural residences with the trainline around 30m west of the proposal site and the Hume Highway, approximately 1km east of the proposal site.

The noise environment is characterised by the trainline which is utilised by passenger services as well as freight, the Hume Highway, and surrounding local roads. The speed limit along the Hume Highway is 110km/h, and AADT was reported by TfNSW (station 07737) as having 25,465 vehicles northbound and 26,859 vehicles southbound in 2021, which would contribute to the noise background at the proposal site.

Measured ambient noise levels from one noise logger placed near the proposal site in 2022 (**Appendix I**) is summarised in **Table 5-12** below.

Table 5-12: Measured ambient noise levels – 45 Fitzpatrick Street, Menangle Park (NIA)

Time Period	L_{90} Rating Background Level (RBL)	Existing L_{eq} Noise Level
Day (7am to 6pm)	36 dBA	54 dBA
Evening (6pm to 10pm)	47 dBA	55 dBA
Night (10pm to 7am)	45 dBA	53 dBA

Sensitive receivers

The closest residential receiver to the proposal is located around 250m to the south. A total of seven residential receivers were identified within a 500m radius of the proposal.

Two non-residential receivers were identified within 500m of the proposal, including the industrial property directly west of the site, and the Sadahan Sewana Buddhist Centre Campbelltown, around 250m south east of the site. No other non-residential receivers are located within 500m of the proposal site.

5.5.3 Impact assessment

Construction noise

Construction works for the proposal would include noise generating activities. Assessment of predicted noise impacts associated with the proposal for the scenarios outlined in **Section 5.5.1** above is presented below.

Demolition of ZS

Residential receivers

The demolition and site establishment for the proposal includes the use of an excavator with a hammer which is predicted to be the noisiest tool for surrounding sensitive receivers during standard hours and OOHW. Sensitive receivers and predicted noise contours for this scenario are presented in **Figure 5-3**.

Potentially affected sensitive receivers identified in **Table 5-13** are located at:

- 232 Racecourse Avenue located approximately 310m south of the ZS;

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- 22 Fitzpatrick Street located approximately 250m south of the ZS;
- 36 Fitzpatrick Street located approximately 365m south of the ZS; and
- 46 Fitzpatrick Street located approximately 378m south of the ZS.

The recommended mitigation measures include notification, respite 1 and duration respite for noise impacts during OOHW (day).

Table 5-13: Demolition of existing substation summary of affected residential receivers during standard construction hours and OOHW for 13.5T excavator with hammer (Distance-based, loudest plant)

Time of works	NML (dB(A))	Predicted noise/mitigation level dB(A)	Affected Distance (level)	Number of affected residential sensitive receivers (cumulative impact)	Recommended additional mitigation measures*
Line of sight/no barrier (LOS)					
Day (Standard construction hours)	50	60 – Moderately intrusive	215m	0	Not triggered
		70 – Highly intrusive	105m	0	Not triggered
		75 – Highly affected	60m	0	Not triggered
Day (OOHW) (Saturday 7am-8am, 1pm-3pm)	45	50 – Clearly audible	455m	4	N, R1, DR
		60 – Moderately intrusive	215m	0	Not triggered
		70 – Highly intrusive	105m	0	Not triggered
		75 – Highly affected	60m	0	Not triggered
No line of sight / with substantial barrier (no LOS)					
Day (Standard construction hours)	50	60 – Moderately intrusive	105m	0	Not triggered
		70 – Highly intrusive	35m	0	Not triggered
		75 – Highly affected	25m	0	Not triggered
Day (OOHW) (Saturday 7am-8am, 1pm-3pm)	45	50 – Clearly audible	215m	0	Not triggered
		60 – Moderately intrusive	105m	0	Not triggered
		70 – Highly intrusive	35m	0	Not triggered
		75 – Highly affected	25m	0	Not triggered

*Mitigation measures: N – Notification, R1 – Respite period 1, DR – Duration respite.

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Non-residential receivers

One industrial receiver is predicted to be affected by construction of the ZS, and is located directly adjacent to (around 6m west) the proposal site. Proposed additional mitigation measures include phone call, notification and respite offer. No other non-residential receivers are predicted to be impacted by noise generated works during this stage of the proposal.

Table 5-14: Demolition of existing substation summary of predicted impacts to non-residential receivers during standard hours with LOS.

Sensitive receiver	NML (dB(A))	Predicted noise/mitigation level dB(A)	Affected Distance (level)	Number of affected non-residential sensitive receivers	Recommended additional mitigation measures*
LOS with standard construction Hours (day)					
Place of worship	55	65 – $L_{Aeq(15\ minute)}$ noise level above NML	215m	0	Not triggered
		75 – Highly affected	60m	0	Not triggered
Passive recreation	60	70 – $L_{Aeq(15\ minute)}$ noise level above NML	105m	0	Not triggered
		75 – Highly affected	60m	0	Not triggered
Industrial	75	75 – Highly affected	60m	1	N, PC, RO

*Mitigation measures: N – Notification, R1 – Respite period 1; R2 – Respite period 2, DR – Duration respite.

Construction of zone substation

Residential receivers

The construction of the ZS includes the use of a bored pilling rig which is predicted to be the noisiest equipment for surrounding sensitive receivers during standard hours and OOHW. Sensitive receivers and predicted noise contours for this scenario are presented in **Figure 5-3**.

One sensitive receiver would be affected by the proposal, and is located at 22 Fitzpatrick Street, approximately 250m to the south. The recommended mitigation measures outlined in **Table 5-15** include notification, respite 1 and duration respite for noise impacts during OOHW (day).

Table 5-15: Construction of new ZS summary of affected residential receivers during standard construction hours and OOHW for bored pilling rig (Distance-based, loudest plant)

Time of works	NML (dB(A))	Predicted noise/mitigation level dB(A)	Affected Distance (level)	Number of affected residential sensitive receivers (cumulative impact)	Recommended additional mitigation measures*
Line of sight/no barrier (LOS)					
Day (Standard construction hours)	50	60 – Moderately intrusive	120m	0	Not triggered
		70 – Highly intrusive	45m	0	Not triggered
		75 – Highly affected	25m	0	Not triggered
Day (OOHW)	45	50 – Clearly audible	250m	1	N, R1, DR

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Time of works	NML (dB(A))	Predicted noise/mitigation level dB(A)	Affected Distance (level)	Number of affected residential sensitive receivers (cumulative impact)	Recommended additional mitigation measures*
(Saturday 7am-8am, 1pm-3pm)		60 – Moderately intrusive	120m	0	Not triggered
		70 – Highly intrusive	45m	0	Not triggered
		75 – Highly affected	25m	0	Not triggered
No line of sight / with substantial barrier (no LOS)					
Day (Standard construction hours)	50	60 – Moderately intrusive	45m	0	Not triggered
		70 – Highly intrusive	20m	0	Not triggered
		75 – Highly affected	15m	0	Not triggered
Day (OOHW) (Saturday 7am-8am, 1pm-3pm)	45	50 – Clearly audible	120m	0	Not triggered
		60 – Moderately intrusive	45m	0	Not triggered
		70 – Highly intrusive	20m	0	Not triggered
		75 – Highly affected	15m	0	Not triggered

*Mitigation measures: N – Notification, R1 – Respite period 1; R2 – Respite period 2, DR – Duration respite.

Non-residential receivers

One industrial receiver is predicted to be affected by construction of the ZS, and is located directly adjacent to (around 6m west) the proposal site. Proposed additional mitigation measures include phone call, notification and respite offer. No other non-residential receivers are predicted to be impacted by noise generated works during this stage of the proposal.

Table 5-16: Construction of ZS summary of predicted impacts to non-residential receivers during standard hours with LOS.

Sensitive receiver	NML (dB(A))	Predicted noise/mitigation level dB(A)	Affected Distance (level)	Number of affected non-residential sensitive receivers	Recommended additional mitigation measures*
LOS with standard construction Hours (day)					
Place of worship	55	65 – $L_{Aeq(15\ minute)}$ noise level above NML	75m	0	Not triggered
		75 – Highly affected	25m	0	Not triggered
Passive recreation	60	70 - – $L_{Aeq(15\ minute)}$ noise level above NML	45m	0	Not triggered

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Sensitive receiver	NML (dB(A))	Predicted noise/mitigation level dB(A)	Affected Distance (level)	Number of affected non-residential sensitive receivers	Recommended additional mitigation measures*
		75 – Highly affected	25m	0	Not triggered
Industrial	75	75 – Highly affected	25m	1	N, PC, RO

*Mitigation measures: N – Notification, PC – Phone Call; RO – Respite Offer.

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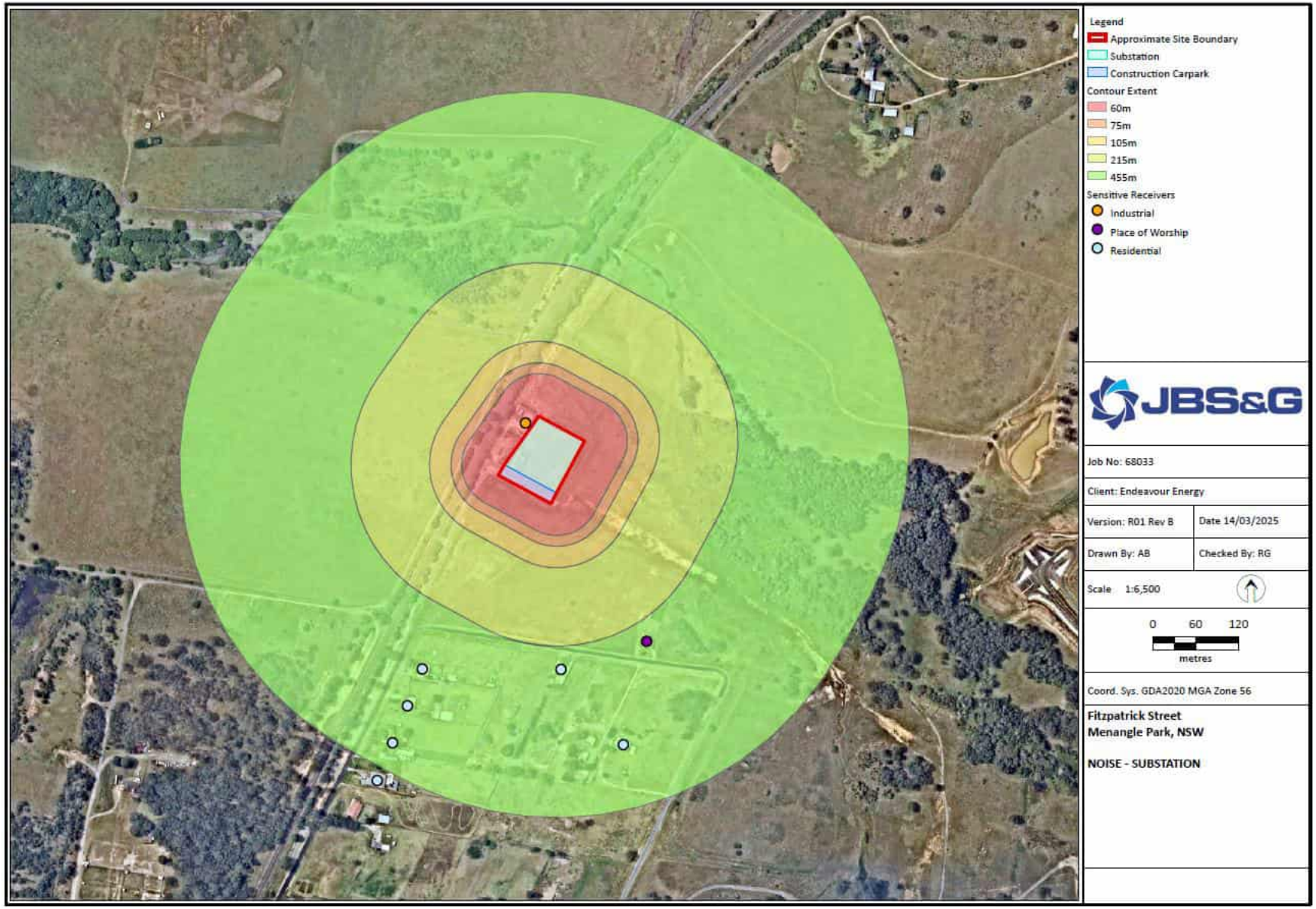


Figure 5-3: Demolition and construction noise contours for the proposal

Based on the outcomes of the TfNSW Noise Tool, The following mitigation measures are recommended to be implemented during construction to mitigate or manage predicted noise impacts during standard construction hours:

The following additional mitigation measures identified within the TfNSW Noise Tool are recommended to be implemented to mitigate or manage predicted noise impacts during OOHW to be undertaken:

- Notification (N): Notification to provide advance warning of works and potential disruptions including the use of variable message signs, letterbox drop, website/social media or a combination. Notification should detail 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.
- Respite 1 (R1): Out of hours construction noise in out of hours period 1 (Monday to Friday: 6pm – 10 pm; Saturday: 1pm-10pm; Sunday and Public Holidays: 8am-6pm) shall be limited to no more than three consecutive evenings per week except where there is a Duration Respite. For nightwork these periods of work should be separated by not less than one week and no more than 6 evenings per month.
- Duration Respite (DR): Duration respite enables the increase of the work duration, number of evenings or nights worked so that the project can be completed more quickly. Given the short term nature of the proposal of up to five weeks, and limited night works of up to five night shift, this measure is not relevant for this project as impacts may be managed by scheduled respite periods between night shifts.
- Phone Call (PC): Phone calls detailing relevant information made to identified/affected stakeholders, who have provided their contact details, within seven calendar days of construction. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed construction works and specific needs. Where the resident cannot be telephoned then an alternative form of engagement should be used.
- Respite Offer (RO): 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.

Construction vibration

Vibratory equipment is proposed to be utilised for construction of the proposal, and includes piling rigs. The safe working distance for sensitive structures for pile boring is 5m (DIN 4150). The closest structure to the proposal site is building associated with the industrial site to the west of the proposal site, which is around 6m west. Therefore, no construction vibration impacts are expected.

Operation

The main sources of noise from the proposal will be the transformers that operate continually throughout the day and night, seven days a week (Day Design 2024). These transformers are known to create a low frequency humming noise which will not change appreciably from day to night and therefore the predicted noise level at night will be the worst-case scenario.

The noise sensitive receptors that are expected to be impacted by operation noise were assessed within the Operational Noise Assessment (Day Design 2024) and are categorised in **Table 5-17**.

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Table 5-17: Noise Sensitive Receptors

Receptor and Type	Address	Direction from site	Approximate distance (m)
R1 – Residential (Existing)	45 Fitzpatrick Street	South east	300m
R2 – Residential (Existing)	22 Fitzpatrick Street	South	300m
R3 – Residential (Existing)	232 Racecourse Avenue	South west	350m
R4 – Heritage (Existing)	Glenlee Road	North	670m
R5 – Residential (Future)	Corner of Fitzpatrick Street and Racecourse Avenue	South	90m

It is proposed to stage installation of the transformers, with two 66/11kV 35 MVA transformers to be installed at the proposed Menangle Park Zone Substation initially, with the potential to install additional transformers in the future, with three options to be assessed. Endeavour Energy specifications, including sound power levels, are provided in **Table 5-18** for these options. The Operational Noise Impact was prepared assuming all three transformers will be in operation at 105% no-load with cooling and 2/3 rated load. The results of the assessment are summarised in **Table 5-19**.

Table 5-18: Transformer Type Options

Transformer Options	Transformer	Sound Power Level 66/11kV at 35 MVA
Option 1	At 105% Regulated Voltage (U_r) No-Load with cooling for maximum rating	71 dBA
Option 2	At 105% U_r No-Load with cooling for maximum rating	63 dBA
Option 3	At 105% U_r No-Load and 2/3 rated load with cooling configuration for 2/3 rated load	63 dBA

Table 5-19: Predicted L_{eq} Noise Levels for each transformer option

	Noise Sensitive Receptor Locations				
	R1	R2	R3	R4	R5
Option 1					
Predicted noise level (dBA)	27	27	22	21	35
Acceptable Noise Limit	38	38	38	38	38
Compliance	Yes	Yes	Yes	Yes	Yes
Option 2					
Predicted noise level (dBA)	<20	<20	<20	<20	26
Acceptable Noise Limit	38	38	38	38	38
Compliance	Yes	Yes	Yes	Yes	Yes
Option 3					
Predicted noise level (dBA)	<20	<20	<20	<20	22
Acceptable Noise Limit	38	38	38	38	38
Compliance	Yes	Yes	Yes	Yes	Yes

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Measurements and calculations show that the level of noise emitted by all three above options proposed for the zone substation will meet the acceptable noise level requirements for all existing and future receptors and will therefore by acceptable.

Option 1, which is identified as the worst-case scenario, meets the most stringent noise criteria by a margin of 3dB. Provided the sound power level of the new transformers are limited to a maximum sound power level of 81 dBA at 66% load (approximately 74 dBA at no load), the noise emission at all nearby existing and future sensitive receivers will meet the acceptable limits during the day, evening and night.

5.5.4 Safeguards

Table 5-20: Noise and vibration safeguards

Number	Safeguard
NV01	All sensitive receivers (as identified in **Section 5.5.3**) will be notified at least five working days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The proposal; • The construction period and construction hours; • Contact information for project management staff; • Complaint and incident reporting; and • How to obtain further information. This is in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
NV02	Additional mitigation measures presented in **Section 5.5.3** based on the TfNSW Noise Tool are to be considered in the CEMP and applied where appropriate.
NV03	Traffic flow, parking and loading/unloading areas to be planned to minimise reversing movements. Non-tonal reversing beepers are to be fitted and used on all construction vehicles and on mobile plants and during any out of hours work.
NV04	All employees, contractors and subcontractors are to receive a site-specific prestart/toolbox talk. The talk must at least include: • Any site-specific and relevant standard noise and vibration mitigation measures; • Relevant licence and approval conditions; • Permissible hours of work; • Location of nearest sensitive receivers; • Construction employee parking areas; • Designated loading/unloading areas and procedures; • Site opening/closing times (including deliveries); and • Environmental incident procedures.
NV05	Use quieter emitting methods in line with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024). Ensure plant and equipment are fitted with appropriate silencers that are maintained in good working order for the duration of the works.
NV06	The distance between noise intensive plant and nearby sensitive receivers is to be maximised. Noise emitting plant is to be directed away from sensitive receivers during use. Plant used intermittently is to be throttled down or shut down when not in use.
NV07	Limit the use of engine compression breaks during site entry/egress where possible, to minimise impact on nearby sensitive receivers. Vehicles to be fitted with fully complaint exhaust silencers.

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5.6 Aboriginal Heritage

5.6.1 Methodology

Artefact Heritage and Environment Pty Ltd (Artefact) were engaged to prepare an Aboriginal Heritage Due Diligence Report (DD) (refer **Appendix J**) to assess potential impacts to Aboriginal Heritage associated with the proposal.

The DD was undertaken in accordance with the requirements set out in the NPW Act and *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010).

5.6.2 Existing environment

Previous Aboriginal heritage investigations

A number of archaeological investigations have been completed in the vicinity of the proposal site, generally associated with the development of infrastructure and urban release projects include the following:

- Jo McDonald CHM 2009, Test excavation and archaeological assessment of proposed soil and sand extraction on Aboriginal PAD (AHIMS ID 52-2-3676), Menangle Park West;
- Jo McDonald CHM 2010, Archaeological assessment of Indigenous heritage issues, Menangle Park draft structure plan;
- Niche 2013, Archaeological Report, Menangle Park Subdivision and Infrastructure Project;
- AECOM and Aurecon joint venture (AAJV) 2014, Menangle Park Wastewater Services: technical report;
- Artefact Heritage 2018, Menangle Park Zone Substation and Feeder: Aboriginal Due Diligence Assessment;
- Artefact Heritage 2019 Menangle Park Zone Substation and Feeder: ACHAR; and
- Kelleher Nightingale Consulting 2022, Menangle Park Site-Wide bulk Earthworks & Vegetation Management: Aboriginal Cultural Heritage Assessment Report (ACHAR).

These reports are summarised in **Appendix J**.

AHIMS search

A search of the Aboriginal Heritage Information Management System (AHIMS) database was completed on 29 November 2024 for a search area measuring approximately 4km by 4km centred on the proposal site. Eighty-two sites were recorded on AHIMS, two listed as 'not a site', one listed as 'deleted', two listed as 'partially destroyed', 12 listed as 'destroyed', and the remaining 65 listed as 'valid'. These sites are categorised into features with 77 registered sites classified as 'artefact' features, three sites as 'Artefact, Potential Archaeological Deposit (PAD', one instance of 'PAD' and one instance of a 'Modified Tree'.

Within the site boundary, there are two registered 'Artefact' and 'destroyed' sites, both impacted under a now-expired Aboriginal Heritage Impact Permit (AHIP). Within a 100m buffer of the proposal, there are three registered sites, two of which are 'destroyed'. There is one site listed as 'valid' approximately 5m west of the proposal and is an artefact reburial site (refer to **Figure 5-4**).

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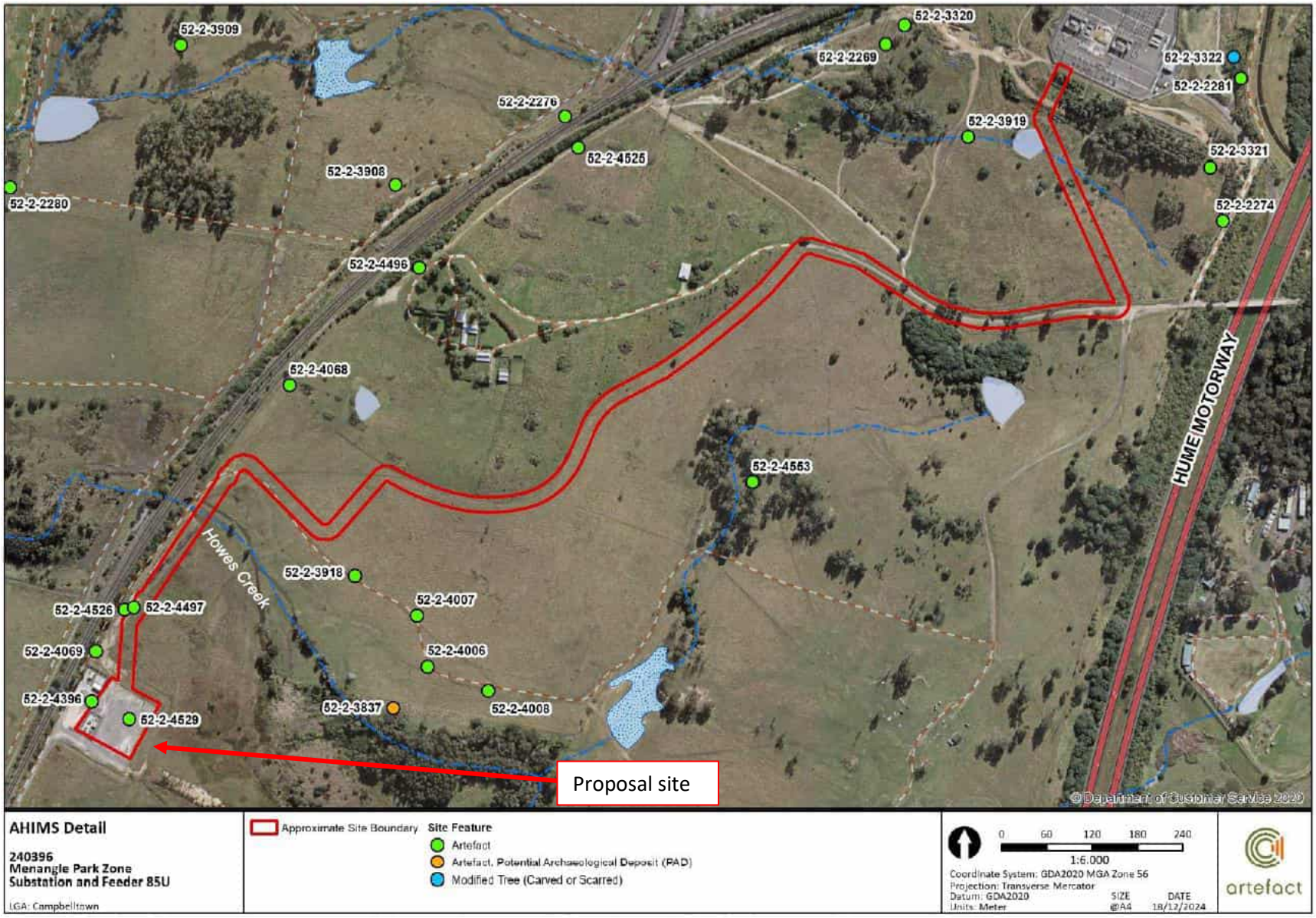


Figure 5-4: AHIMS Sites in proximity of the proposal site (Source: Artefact 2025, Appendix J)

Site inspection

A visual site inspection was undertaken on 16 December 2024 by Artefact. The artefact reburial site was inspected and confirmed to be outside of the proposal area. No confirmed Aboriginal objects were identified during the site visit.

Site setting and archaeological potential

The proposal site has been subject to historic ground disturbance and vegetation clearance associated with historical livestock grazing and more recently, construction of the existing temporary substation. The construction of the existing temporary substation would have required subsurface excavations which would have likely resulted in the removal or displacement of natural soils.

Previous investigations identified Aboriginal objects within the sites and the potential for others to be identified. The proposal site contains particular landscape features as defined by the Due Diligence Code of Practice (DECCW, 2010) as indicating the potential presence of comprise Aboriginal objects (refer **Table 5-21**).

Table 5-21: Presence of landscape features in proposal site

Landscape feature (as defined in the Due Diligence Code of Practice (DECCW, 2010)	Presence in proposal site
Within 200m of water	**No.** Howes Creek is located 275m north of the proposal site.
Located within a sand dune system	**No.** The proposal site is not located within a sand dune system.
Located on a ridge top, ridge line, or headland	**No.** The proposal site is not located on a ridge top, ridge line, or headland.
Located within 200m below of a cliff face	**No.** The proposal site is not located within 200m below of a cliff face.
Within 20m of or in a cave, rock shelter, or cave mouth	**No.** The proposal site is not located within 20m of or in a cave, rock shelter, or cave mouth.

5.6.3 Impact assessment

Potential for Aboriginal objects

The Due Diligence Code of Practice provides a series of questions that must be answered to determine the outcome of the due diligence process. The outcomes of the proposed scope can be found in **Table 5-22** below.

The proposed activity does not involve ground disturbance across the site, and would therefore not have the potential to harm Aboriginal objects should they occur within the site.

Table 5-22: Due diligence outcomes of this proposal

Due diligence question (as defined in the Due Diligence Code of Practice (DECCW, 2010)	Response and outcome
Will the activity disturb the ground surface or any culturally modified trees?	**Yes.** The proposal includes subsurface excavation, along with the removal of the existing Menangle Park Zone substation within the southern portion of the site. No culturally modified trees will be impacted by the proposal.
Are there any confirmed AHIMS records, other sources of information or landscape features?	**Yes.** There were two previously recorded AHIMS sites within the proposal site. Both are noted on AHIMS as 'destroyed' under a now-expired AHIP. The proposal site has been identified in previous investigations as being within an area of Aboriginal heritage sensitivity (Section 3.2 of the DD). The proposal site is located within 200m of

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Due diligence question (as defined in the Due Diligence Code of Practice (DECCW, 2010)	Response and outcome
	water, a landscape feature associated with Aboriginal objects. The proposal site has been subject to significant levels of ground disturbance that would have likely moved or removed Aboriginal objects.
Can harm to Aboriginal objects be avoided?	**No.** No confirmed surface Aboriginal objects were identified during visual inspection of the proposal site.
Does a desktop assessment and visual inspection confirm the presence of Aboriginal objects, or that they are likely to be there?	**Yes.** There are two registered sites within the proposal site but have been destroyed.
Is further assessment required?	**No**. No further assessment is required for the proposal.

5.6.4 Safeguards

Table 5-23: Aboriginal heritage safeguards

Number	Safeguard
AH01	An unexpected heritage finds protocol will be prepared and implemented prior to commencement of works. If unexpected Aboriginal items are uncovered during the works, all works must cease in the vicinity of the material/find, and the Endeavour Energy project manager must be contacted immediately.

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5.7 Non-Aboriginal Heritage

5.7.1 Methodology

Artefact was engaged to undertake a Statement of Heritage Impact (SoHI) to identify the potential impacts that the proposal would have on nearby heritage items or areas of archaeological potential at the site in Menangle Park.

The SoHI has been prepared in consideration of relevant state and federal heritage legislation and environmental planning instruments, including the EPBC Act, Heritage Act, EP&A Act and TISEPP. The SoHI has been informed by, and has been prepared in accordance with, relevant heritage guidelines and standards including:

- *Assessing heritage significance: Guidelines for assessing places and objects against the Heritage Council of NSW criteria* (DPE, 2023);
- *Guidelines for preparing a statement of heritage impact* (DPE, 2023a);
- *Material Threshold Policy* (DPE, 2023b);
- *Investigating Heritage Significance Guidelines* (NSW Government, 2021);
- *Levels of Heritage Significance* (NSW Heritage Office, 2008);
- *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Department of Planning, 2009); and
- *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Australia ICOMOS, 2013).

A search of relevant state and federal statutory and non-statutory heritage registers was undertaken on 17 December 2024. This included a search of the following:

- World Heritage List;
- Commonwealth Heritage List;
- National Heritage List;
- State Heritage Register (SHR);
- Section 170 Heritage and Conservation Registers;
- CLEP;
- Register of the National Estate (RNE);
- National Trust of Australia Register (NTAR); and
- NSW State Heritage Inventory (SHI) database.

The SoHI is included in **Appendix K** and summarised below.

5.7.2 Existing environment

State and local heritage items

A search of relevant state and federal statutory and non-statutory heritage registers was undertaken on 17 December 2024 and did not identify any heritage items or sites within the proposal site.

There is one item (Glenlee, outbuildings, garden and gate lodge) located approximately 500m north of the proposal which is listed on the SHR (#00009), CLEP (item I00009), RNE (#3277) and NTAR (7769). The next

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closest site, Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (SHR #01373, CLEP item I01373), is located more than 1.7km north-east the site. These sites are shown in **Figure 5-5**.

The Glenlee Estate was previously a farm used for various agricultural activities. This may have resulted in a distribution of archaeological evidence in the broader area of the Glenlee Estate, outside of the listed area. Under the SHR, the statement of heritage significance (SHI) provided for the listed Glenlee Estate states:

> *'The Glenlee estate is a rural cultural landscape of exceptional significance including elements of Aboriginal heritage significance, association with early influential European settlers and the exceptional composition of the architecture and landscape setting of the homestead group. It is the core remnant including the accessway of the Glenlee estate, an important and rare surviving early 19th century pastoral holding in the Mount Annan/Menangle district of the Cow Pastures once considered as one of the best and earliest dairy farms in the colony. The estate was one of the first farms in Sydney's west to make the change from cereal cropping to dairying in the 19th century and the property continued to prosper throughout the 19th and 20th centuries.'*

Archaeological potential

A site inspection for the proposal was undertaken on 16 December 2024 to inform the SoHI, and no surface evidence of archaeological features were observed during the site inspection.

Historical aerial imagery captured in 1945 was reviewed in the SoHI which identified individual fields, crop marks, buildings, and roads. Two areas outside of the proposal site were identified to have low archaeological potential (refer **Figure 5-6**). The SoHI concluded that the proposal site is considered to be of nil to low potential.

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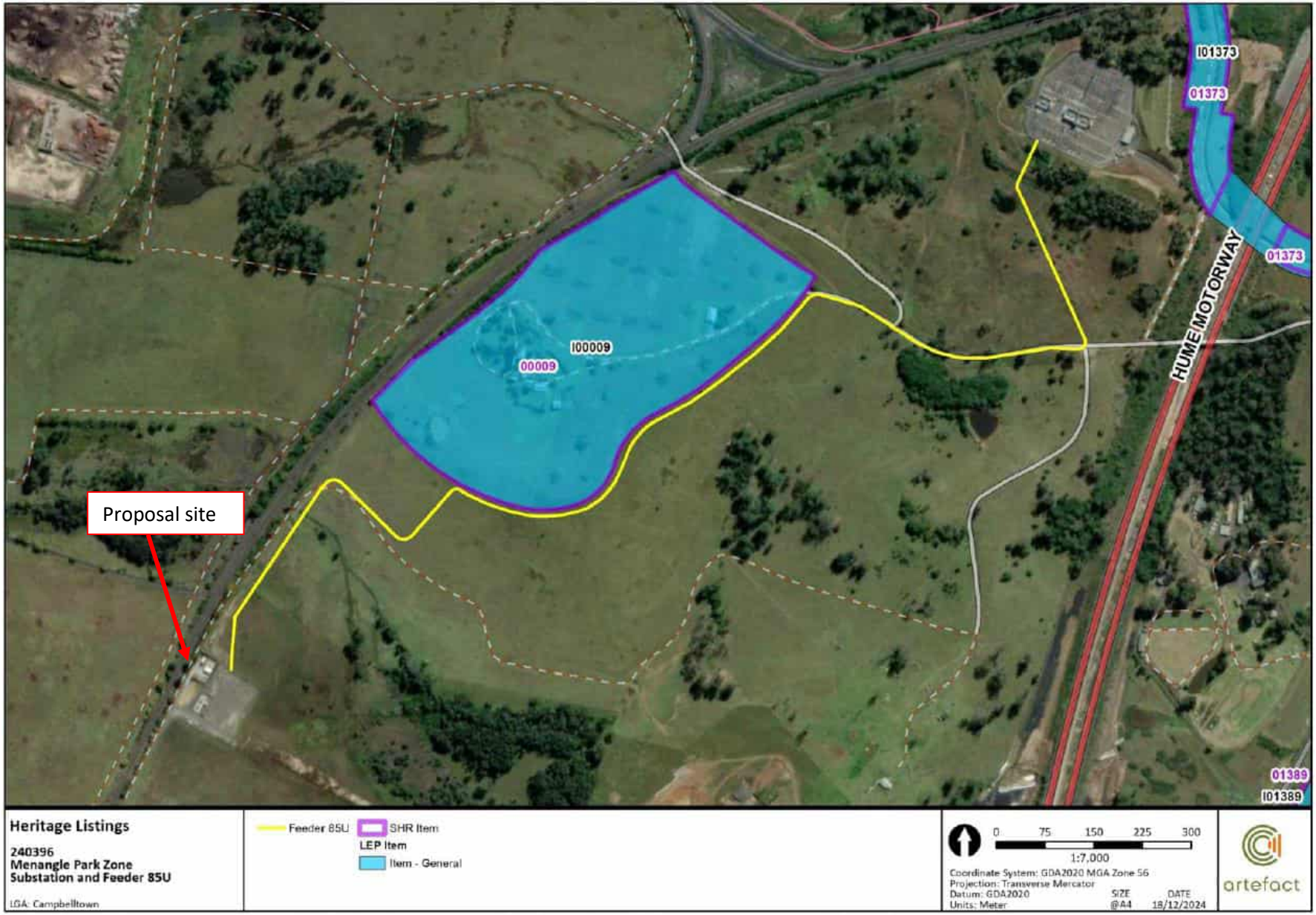


Figure 5-5: Heritage listed items north of the proposal site (Source: Appendix K)

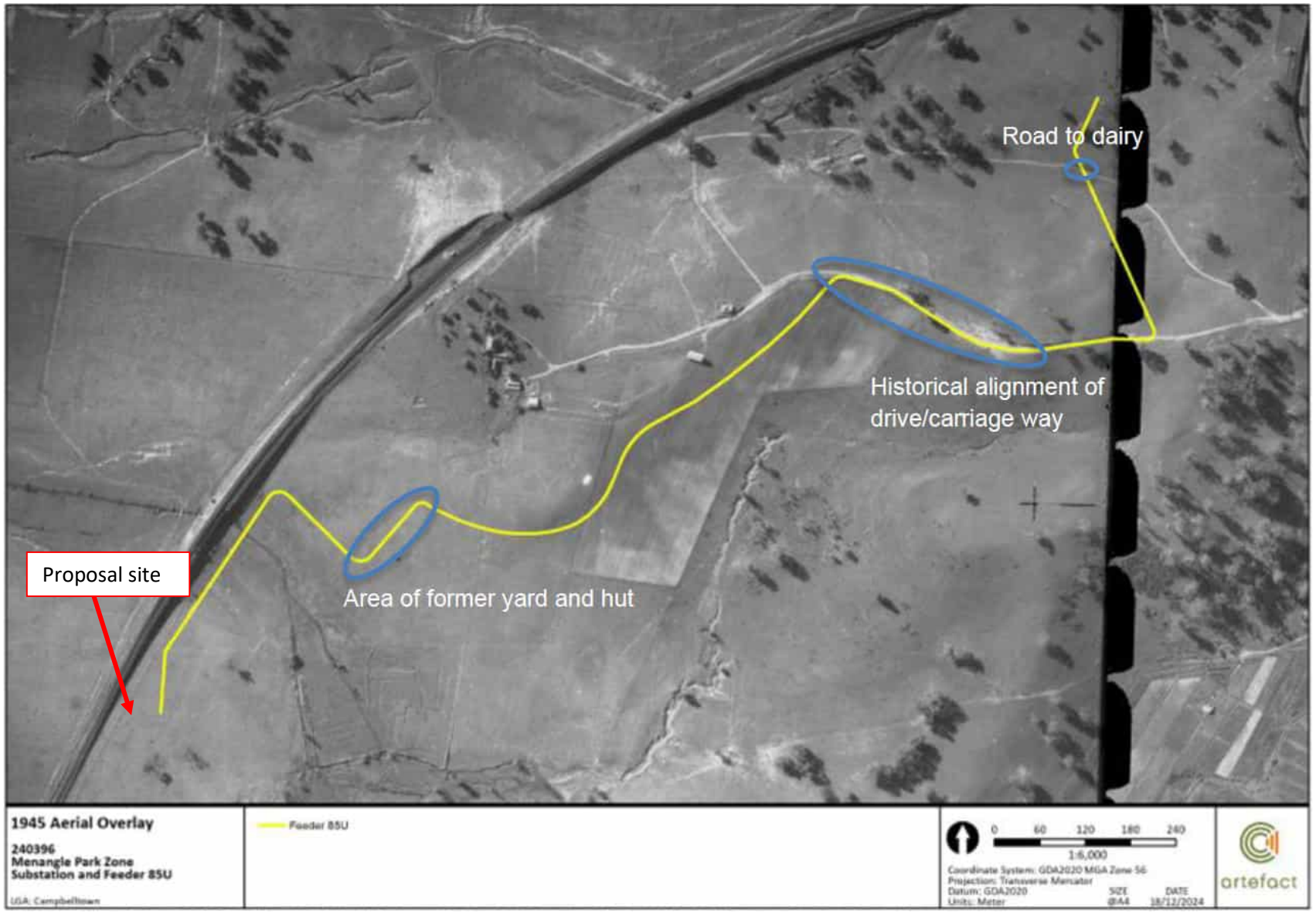


Figure 5-6: Location of areas of archaeological potential north of the proposal site (Source: Appendix K)

5.7.3 Impact assessment

Physical impact

There would be no risk of construction works inadvertently entering the heritage items listed above. Therefore, the proposal would cause little to no physical impacts to the state heritage listed items.

Visual impact

During construction, there would be temporary visual impacts caused by the presence of equipment and plants near the proposal site which would be visible for the Glenlee Estate heritage item, however, this impact would be localised and temporary in nature. The visual impact would be resolved upon completion of construction and the proposal would, therefore, cause little to no visual impacts to the Glenlee Estate.

Archaeological impact

It has been identified that construction works would be limited to areas that have been assessed as having 'nil to low' and 'low' potential to contain archaeological remains of agricultural activities that would reach the threshold of local significance. Given the nil-low archaeological potential, it is expected that the proposal would cause little to no impacts to significant archaeological remains. It is not expected that there would be any impacts to state significant archaeological remains or remains considered to be 'relics' as defined under the *Heritage Act (1977*). As a result, no approvals or permits under the *Heritage Act (1977)* are required.

5.7.4 Safeguards

Table 5-24: Heritage safeguards

Number	Safeguard
NH01	An unexpected finds procedure must be implemented during ground disturbing works. In the event that archaeological remains are discovered during the works, works must cease in that location and the remains must be protected, and a suitably qualified archaeologist must be contacted to assess the potential archaeological remains and advise on the required archaeological management. If unexpected 'relics' or state significant archaeological remains are identified, further assessment and approvals may be required.
NH02	Any substantial changes to the proposed scope of works requires further assessment to identify any additional heritage impacts.

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5.8 Air Quality

5.8.1 Methodology

A desktop assessment was undertaken to inform the air quality assessment. This included a review of current air quality data and background data on the proposal site to identify current factors influencing the existing environments air quality. Sources reviewed include:

- NSW Government Air quality data website (Air Quality NSW, 2025); and
- NSW Planning Portal (NSW Government, 2024).

5.8.2 Existing environment

Background air quality

The regional context for the proposal is characterised as predominantly rural. Influences on local air quality include vehicle and domestic emissions. The main contributors to reduced air quality in the area includes extreme weather events such as bushfires and dust storms.

Review of the NSW Government Air Quality Data Website on 4 February 2025 identified an air quality monitoring station (Site ID: Campbelltown West) around 4.9km north-east of the proposal site. The website reported hourly averages for 7am-8am on 4 February 2024 for the following parameters at the monitoring site:

- Particles (PM2.5);
- Particles (PM10);
- Ozone;
- Nitrogen dioxide;
- Sulfur dioxide; and
- Visibility.

Results are reported under categories of Good, Fair, Poor, Very Poor and Extremely Poor for all parameters except for visibility; no air quality categories are applied to visibility measurements.

Reported concentration of particles, ozone, nitrogen dioxide and sulfur dioxide were within the range for "good", and visibility was reported as 0.2 Mm^{-1}.

5.8.3 Impact assessment

Construction

Potential impacts on air quality associated with the proposal include emissions from machinery and vehicles, as well as dust and particulate emissions from ground disturbance including demolition works as well as the potential for temporary stockpiling.

The impact on local air quality from work vehicles and equipment emissions are predicted to be minor as the ground disturbance works will be staged to minimise exposed soils at any one time, and are temporary in nature. Dust generation would be dependent on soil moisture content and prevailing weather conditions. With implementation of proposed mitigation measures in **Section 5.8.4** below, impacts to air quality would be low.

Operation

There are no expected impacts on air quality from the operation of the proposal. Minor emissions may be generated by maintenance vehicles. However, these will be comparable to that of other vehicles on the roads of the local road network.

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5.8.4 Safeguards

Table 5-25: Air quality safeguards

Number	Safeguard
AQ01	Dust levels will be visually monitored during construction works in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024). If excessive dust generation is occurring on site, causing a safety issue or complaints are received, immediately follow appropriate mitigation options.
AQ02	Vehicles and machinery are to be turned off when not in use and not to be left idling during construction and operation.
AQ03	Soil/spoil tracked onto roadways will be swept up on a regular basis during construction, in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
AQ04	Vehicles transporting waste or other materials that may produce dust are to be covered during transportation to and from the site during construction.
AQ05	Any temporary stockpiles within the proposal site will be covered or stabilised during construction.
AQ06	Traffic speed and movements will be decreased over disturbed areas of ground during construction.
AQ07	Dust suppression techniques, including wetting down surfaces will be used as necessary during construction.

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5.9 Bushfire

5.9.1 Methodology

A Bushfire Risk and Operations Plan (Bushfire Assessment) was conducted by Bushfire Environmental Management Consultancy Pty Ltd (BEMC) in accordance with *Planning for Bushfire Protection* (PBP) (RFS, 2019) to address the potential impacts of the operation of the proposal associated with bushfire risk.

The Bushfire Assessment includes consideration of potential hazards and risks including but not limited to assessment of bush fire risk against PBP. The proposal is considered as 'other development' in PBP. 'Other development' includes industrial, commercial and infrastructure development. This assessment includes an analysis of the hazard, threat and subsequent bush fire risk to the proposal and provides recommendations that satisfy the aims and objectives of PBP.

The Bushfire Assessment is presented in **Appendix L** and summarised below.

Bushfire attack level

PBP identifies the methodology to determine Bush fire Attack Levels (BAL) based on calculated radiant heat levels at a site. This assessment is based on mapping of vegetation formations and slope assessment in accordance with PBP. This assessment is based on a detailed GIS analysis of the site with accessible public data layers utilising the following resources:

- *Planning for Bushfire Protection (2019)*;
- Aerial mapping, and
- Detailed GIS analysis.

Broader landscape assessment

A Broader Landscape Assessment (BLA) of the bushfire risk was undertaken with review of the *Macarthur Bushfire Risk Management Plan 2012* to gain an appreciation of the broader risk affecting the proposal. Multiple factors have been considered for the BLA.

Key considerations included:

- Extent and continuity of vegetation;
- Topography;
- Prevailing winds;
- The potential fire run and area that is likely to be impacted by the fire;
- The impact on evacuation routes to safer places considering road networks, distances, and landscape factors;
- The location and exposure of the development to Bush fire;
- The ability to seek Bush fire shelter on site or at alternative locations; and
- The extent of neighbourhood-scale damage the Bush fire may produce.

Bushfire attack level

The BAL ratings measure the severity of a building or assets potential exposure to ember attack, radiant heat and direct flame contact. The BAL for the site have been determined in accordance with PBP and the *Australian Standards for Construction of Buildings in Bushfire Prone Areas* (AS3959:2018). The process to determine Bushfire Attack Level (BAL) includes:

- Step 1: Determine vegetation formation in all directions around the building to a distance of 140 metres;

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- Step 2: Determine the effective slope of the land from the building for a distance of 100 metres;
- Step 3: Determine the relevant Forest Fire Danger Index (FFDI) for the council area in which the development is to be undertaken;
- Step 4: Determine the separation distance by measuring from the edge of the unmanaged vegetation to the closest external wall of an asset; and
- Step 5: Match the relevant FFDI, appropriate vegetation, distance and effective slope to determine the appropriate BAL using the relevant tables in PBP.

5.9.2 Existing environment

Desktop review of the *Campbelltown Council Bushfire Prone Lands* map identified the proposal site is located on land mapped under bushfire prone land, as defined in section 10.3 of the EP&A Act. The majority of the proposal is mapped under Vegetation Category 3, which includes grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands and is considered a moderate risk category. The proposed transmission line traverses Category 1 land which includes areas of forest, woodland, heath, forested wetland and timber plantation and is the highest risk category. The location of the proposal within land mapped as Category 1 requires that a detailed assessment of the bushfire risks be prepared for the proposal.

There are no historical records of fire occurrence within 5km of the site. Whilst not being subject to direct bushfires, the surrounding 10km radius of the site has a history of high intensity bushfires. The site is not identified within the Macarthur Bushfire Risk Management Plan, however the broader the context of the area is categorised as a Land Management Zone.

5.9.3 Impact assessment

Bushfire attack level

BALs calculated for the proposal site are presented in **Table 5-26** and **Figure 5-7** identifies the BAL ratings for the proposal site. The predominant threat to the substation is from grassfire being driven by north westerly or westerly winds into the Site. This risk posed by grassland fire is possible with the potential for large runs of uncontrolled fire through the landscape to the north west, hence increasing ember potential.

Table 5-26: Bushfire Attack Levels (BAL) (source: BEMC 2025)

Bushfire Attack Level (BAL)	Radiant Heat Flux exposure	Description of predicted bushfire attack and levels of exposure
BAL – Low	N/A	There is insufficient risk to warrant specific construction requirements
BAL – 12.5	<12.5kW/m^2	Ember attack
BAL - 19	>12.5kW/m^2 - <19kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux
BAL - 29	>19kW/m^2 - <29kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux
BAL - 40	>29kW/m^2 - <40kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux with the increased likelihood of exposure to flames
BAL – Flame Zone	>40kW/m^2	Direct exposure to flames from the fire front in addition to radiant heat flux and ember attack

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Broader landscape assessment

The broader landscape assessment rated the proposal site's bushfire risk as a 'moderate' threat. The proposal site has a FFDI of 100 which may result in fire scenarios where environmental conditions challenge survivability of buildings and their occupants. To ensure the construction and operation of the proposed development is managed safely in relation to bushfire risk, mitigation measures, outlined in **Table 5-27**, will be implemented.

Construction and operation bushfire risk

Other key potential impacts relating to bushfire risk during construction and operation include:

- On-site ignitions which may result in a fire escaping to the surrounding land and spreading in an uncontrolled manner causing damage to assets external to the site;
- Occupational fire risk being the risk of workers being caught by out-of-control bushfire impacting the site or while using the access and egress routes;
- Provision of access for first responders;
- Water for firefighting – an adequate supply of water is essential for first response firefighting purposes;
- Emergency management during construction;
- Disruption to power supply if the site is impacted by fire; and
- Loss of critical infrastructure.

Proposed mitigations to be implemented at the site are presented in **Figure 5-7** below, and would reduce potential bushfire impacts caused by the proposal.

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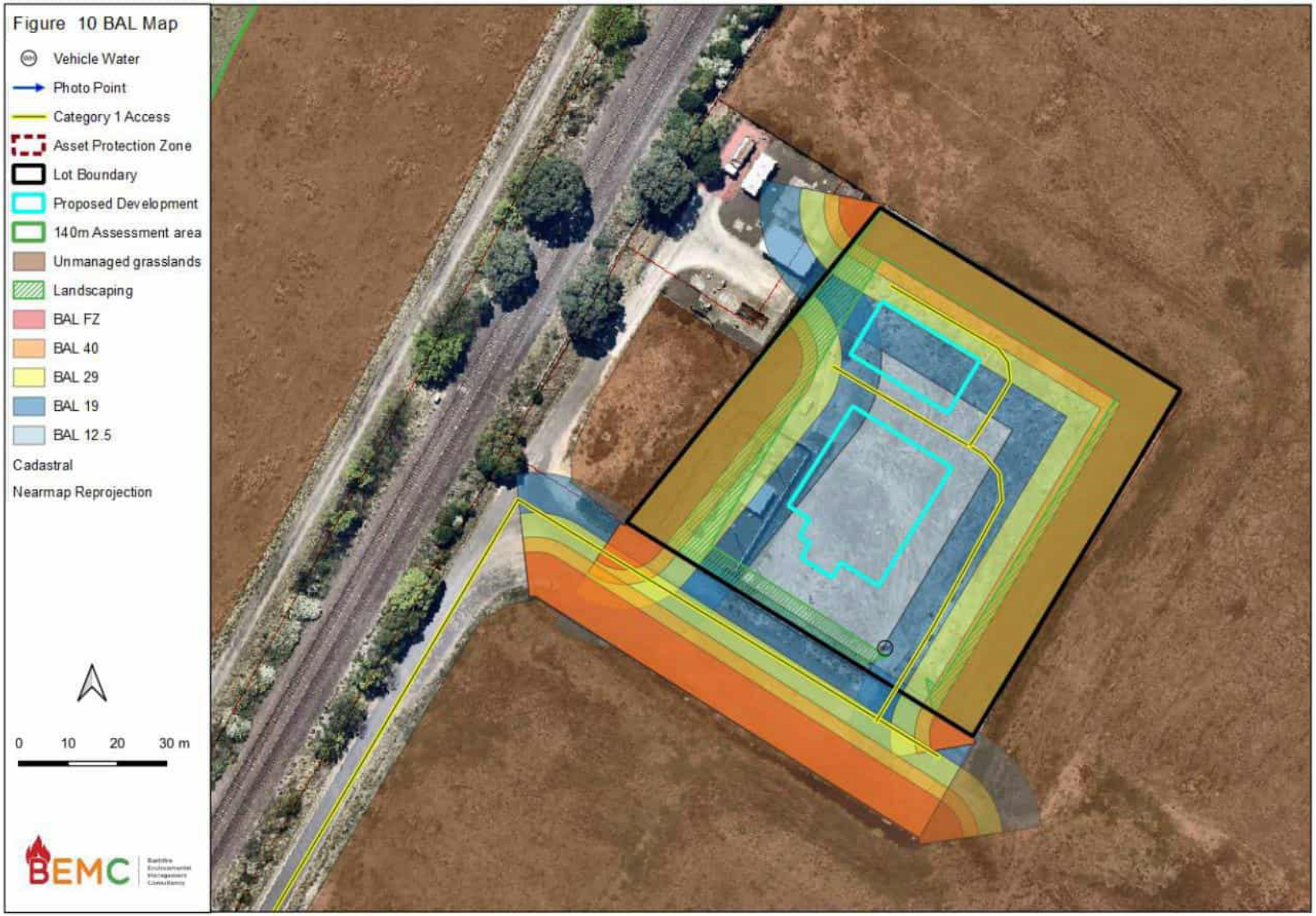


Figure 5-7: BAL at proposal site (Source:BEMC 2025)

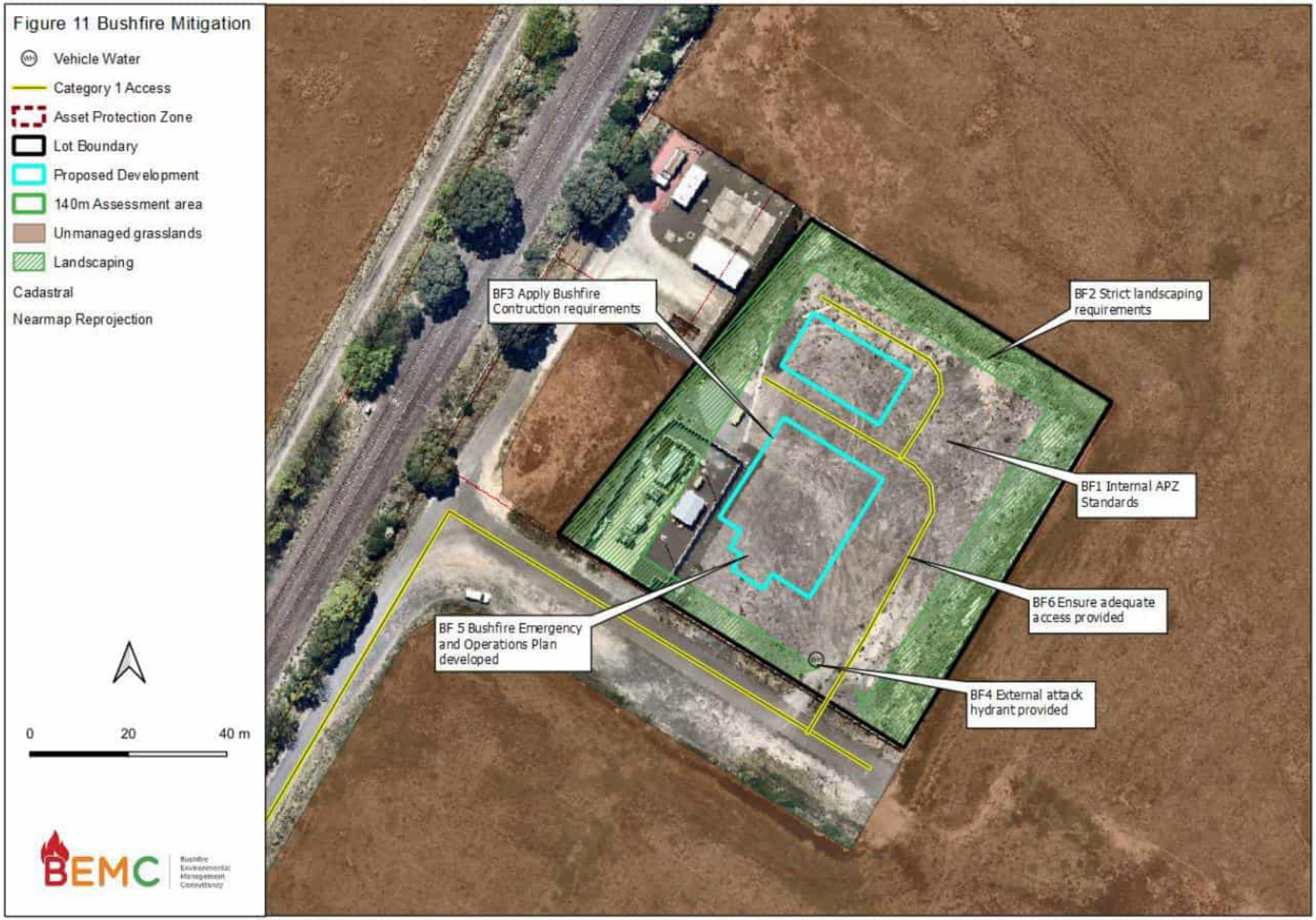


Figure 5-8: Bushfire mitigation for proposal site (Source: BEMC 2025 (Appendix L))

5.9.4 Safeguards

Table 5-27: Bushfire safeguards

Number	Safeguard
BF01	The Construction site and substation facility would be managed as an Asset Protection Zone (APZ) in accordance with *RFS Standards for Asset Protection Zones* (SAPZ 2005) (RFS, 2005). At the commencement of building works, the construction site would be managed as an APZ as outlined in Appendix 4 of the PBP and the SAPZ 2005. APZ requirements include: • Screening vegetation and related landscaping features shall be placed outside the designated APZ; • Trees: Tree canopy should be less than 15% of maturity; Trees at maturity should not touch or overhang the building; Lower limbs should be removed up to a height of 2m above the ground; Tree canopies should be separated by 2 to 5m; Preference should be given to smooth barked and evergreen trees; • Shrubs: Create large discontinuous or gaps in the vegetation; Shrubs should not be located under trees or form more than 10% of ground cover; Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation; and • Grass: Grass should be kept low (no more than 100 millimetres (mm) in height); Leaves and vegetation debris should be removed.
BF02	The landscaping provided to provide a visual buffer shall comply with the following provisions: • No vegetation or yard storage within 10m of buildings or transformers; • A 1.5m clear egress is provided around within the immediate curtilage of all structures; • Fencing and gates in a Bushfire Attack Level (BAL) of 29 or within 6m of a building should be of non-combustible materials; • Garden mulch will not be permitted. Alternatives shall be applied; • No timbers permitted within landscaping area; • Tree branches less than 2m from ground surface are to be trimmed annually; • No shrubs to be planted under tree canopy; • Gaps of more than 1m shall be applied between shrubs; • Grasses removed annually; and • Designed in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
BF03	Vulnerable buildings and/or critical assets are to be constructed to appropriate BAL levels in accordance with the *Australian Standard for the Construction of Buildings in Bushfire Prone Zones* (AS3959:2018). This will be refined during detailed design. The following shall be applied: • The external wall and roof will be non-combustible, and all vents metal screened with aperture <2mm; • External critical elements are those deemed to be essential for return to service following a bushfire event shall be located in areas exposed to <12kW/m^2 radiant heat load; • All external doors must match the fire performance FRL of the building and be fitted with fire resistant smoke seals at the base of the door to prevent embers entering under the door; and • Covering openings with a steel, bronze or aluminium to maximum allowable aperture of 2mm or weather strip with a flammability index not greater than 5 (AS1530.2).
BF04	Reticulated water must be provided. External attack hydrant through the fire hydrant booster is to be provided.
BF05	Emergency management during construction phase should be administered through site specific construction operations and risk plans. The principles within this document shall be used to guide to the site-specific operations and risk plans during the construction phase.

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Number	Safeguard
	A comprehensive Bushfire Emergency Management and Evacuation Plan would be completed for the operational phase of the proposal. The bushfire evacuation procedures would be completed in accordance with NSW *RFS Guide to Developing A Bushfire Emergency Management Plan*. This includes: • Ignition prevention: ○ Hot work (activities involving high temperatures) and fire risk work (activities involving heat or with the potential to generate sparks) from construction activities may cause fire ignition. These works will be managed under a Hot Work and Fire Risk Work procedure, with measures including suspension of activities on days of elevated fire danger; ○ Certain construction activities, including hot works, are prohibited by law on any day declared to be a total fire ban; ○ Essential work during construction may be completed on a total fire ban, providing it complies with the Hot Work and Fire Risk Work procedure exemption from the NSW RFS; and ○ Substations must be inspected and cleaned regularly to prevent the build-up of combustible matter. • Ignition suppression: ○ Firefighting equipment will be maintained and accessible to active construction site during the declared bushfire danger season, and site personnel should be trained in its use. Equipment should be appropriate to the activities being conducted and the fire danger at the time of works, but as a minimum should include extinguishers, knap sacks and hand tools (e.g. fire rakes).
BF06	The public road provides Category 1 fire appliances access to the south of the facility. Within the fenced compound, unobstructed pedestrian access is required to enable fire fighters to operate. The following access requirements are recommended: • A vehicle access gate be provided; • Internal access to all buildings and north side of transformer 1 and 2 to have a trafficable surface with capacity of 23T with a maximum grade of not more than 15 degrees, crossfall not more than 6 degrees, minimum vertical clearance of 4m is provided above the surface of the trafficable surface clear of obstructions, curves have a minimum inner radius of 6m, minimum distance between inner and outer curves is 6m; and • Turn-a-round provided in accordance with Appendix 3 of PBP.

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5.10 Landscape Character and Visual Amenity

5.10.1 Methodology

A landscape and visual impact assessment was completed for the proposal in accordance with the *Guideline for landscape and visual impact assessment* (TfNSW, 2023).

A site inspection of the site was completed on 16 December 2024 which informed this assessment.

Visual impact

To assess the visual impact of the proposal, the following steps were taken in accordance with (TfNSW, 2023):

- Identify extent of visibility of the proposal;
- Identify existing viewpoints and their sensitivity to change;
- Determine the magnitude of change for each viewpoint; and
- Assess visual impact using the impact rating matrix (refer **Table 5-28**).

Landscape character impact

To assess the landscape character impact of the proposal, the following steps were taken in accordance with (TfNSW, 2023):

- Identify landscape character zones and sensitivity;
- Determine magnitude of impact; and
- Assess landscape character impact of the proposal using the impact rating matrix (refer **Table 5-28**).

Table 5-28: Landscape character and visual impact rating matrix (TfNSW, 2023)

		Magnitude			
		High	**Moderate**	**Low**	**Negligible**
Sensitivity	**High**	High	High-Moderate	Moderate	Negligible
	Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
	Low	Moderate	Moderate-Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

5.10.2 Existing environment

Visual amenity assessment

The proposal site has an elevation of around 78m AHD with a slight decline north towards the creek line. The proposal site and surrounding land is characterised by paddocks utilised for agricultural purposes and subject to future development under the Greater Macarthur 2040 Interim Plan. Visibility of the proposal site is limited to train commuters directly west of the proposal, residents located along Fitzpatrick Street to the south of the proposal, and road users of Fitzpatrick Street during construction and operation.

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Specifically, there are five residents south of the proposal with direct line of sight to the site of the proposed ZS. The closest residence is 250m south east of the site. There is currently an existing construction ancillary site along Fitzpatrick Street in which the same residents have direct line of sight.

The visual sensitivity is considered low given the proposal site is located adjacent to a construction ancillary site for unrelated construction works, the site currently has an existing mobile substation located on it and there is a low number of residents with visibility to the proposal site.

Landscape character assessment

The ZS and construction parking is located on land zoned as RE1 Public Recreation and R3 Medium Density Residential under the CLEP.

The site is already cleared and levelled for the existing mobile substation. The surrounding landscape is generally characterised by open paddocks with scattered vegetation, and rural residential lots. There is an industrial lot directly west of the proposed ZS. It is noted that under the Greater Macarthur 2040 Interim Plan, the surrounding land is slated for redevelopment from agricultural land use to residential. There are construction sites for residential areas present in the wider landscape, including a construction ancillary facility to the south of the proposal site.

The sensitivity of the landscape character zone is considered low given the site is already cleared and levelled to support the existing mobile substation.

5.10.3 Impact assessment

Construction

Visual assessment

Visual impacts during construction would be associated with the use of heavy machinery and vehicles, temporary security fencing, ground disturbance and the temporary storage of construction materials within the proposal site. Given the limited extent of the proposal, the magnitude of construction visual impacts is considered low.

With a low sensitivity and low magnitude of impact, the visual amenity impact rating during construction is considered to be low (refer **Table 5-28**).

Landscape character assessment

Impacts to landscape character during construction would be the presence of heavy machinery and vehicles and the use of temporary fencing. Given the nature of the surrounding landscape including widespread redevelopment areas, and remnant agricultural land use and rural residential areas, the magnitude of impact is considered to be moderate.

With a low sensitivity and low-moderate magnitude of impact, the landscape character impact rating during construction is considered to be low-moderate (refer **Table 5-28**).

Operation

Visual assessment

The proposal will be noticeable to existing visual receptors, and future receptors associated with the future redevelopment of the area. Landscaping is proposed which will soften the visual impact of the ZS by providing screening for visual receptors including residences and drivers along Fitzpatrick Street. As such, the magnitude of change to visual amenity is considered to be moderate.

With a moderate sensitivity and moderate magnitude of impact, the visual impact rating is considered to be moderate (refer **Table 5-28**).

Landscape character assessment

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The proposal is industrial in nature which is consistent with the existing use of the temporary substation and the adjacent industrial site. While the proposal would be noticeable within an agricultural landscape, the widespread construction development occurring in the region and proximity to existing industrial facilities would result in a minor change to landscape character.

With a low sensitivity and low magnitude of impact, the landscape character impact rating during operation is considered to be low (refer **Table 5-28**).

5.10.4 Safeguards

Table 5-29: Landscape character and visual amenity safeguards

Number	Safeguard
LV01	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.
LV02	Fencing with material attached (e.g. shade cloth) to be provided around the construction compounds to screen views from roads and neighbouring properties.
LV03	Landscaping around the ZS will be maintained during operation.

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5.11 Socio-economic

5.11.1 Existing environment

The proposal occurs within an area comprising residential and rural land uses. The closest retail areas are Macarthur Square to the northeast of the site and the spring farm shopping centre to the northwest of the proposal.

5.11.2 Impact assessment

Construction

The proposal would affect the local community during construction due to the following:

- Impacts to local traffic during construction, particularly to users of Fitzpatrick Street (refer to **Section 5.4**);c
- Increase in noise during construction (refer to **Section 5.5**);
- Minor increases in dust due to ground disturbance (refer to **Section 5.8**); and
- Visual impacts due to construction work (refer to **Section 5.10**).

These impacts have been considered in the REF and mitigation measures proposed to manage and/or mitigate them, which will be minor and/ or temporary in nature.

The main positive impact of the proposal would include increased patronage at local businesses during the construction phase as well as an increase in employment to undertake the works.

Operation

The proposal would affect the local community during operation with minor impacts to visual amenity and landscape character due to the proposal. No other negative operational impacts are predicted from the proposal. These impacts have been considered in the REF and mitigation measures proposed to manage and/or mitigate them.

Long-term positive impacts of the proposal would include:

- Servicing the large-scale ongoing and future development in the region; and
- Enhance supply security of new developments.

5.11.3 Safeguards

Table 5-30: Socio-economic safeguards

Number	Safeguard
SE01	In accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), Community notification to occur prior to construction, to advise on the construction and operation of the proposal and expected impacts (as per **Section 4.2**).

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5.12 Waste

5.12.1 Impact assessment

Construction

The proposal is not expected to generate large quantities of waste materials during construction. The following waste streams have been identified:

- General garbage and refuse from workers;
- Organic waste;
- Surplus construction materials;
- Wastewater; and
- Excess backfill materials.

All waste generated during construction will be classified and reused if appropriate, or removed and disposed from site in accordance with the *NSW Waste Classification Guidelines* (EPA, 2014) and disposed of at a suitably licensed facility.

Operation

Once constructed, the proposal will generate minimal waste, with the exception of any maintenance works that may be required throughout the operational life of the ZS.

5.12.2 Safeguards

Table 5-31: Waste and hazardous materials safeguards

Number	Safeguard
WH01	The following resource management hierarchy principles will be followed in line with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024): • Avoid unnecessary resource consumption as a priority; and • Avoidance will be followed by resource recovery (including reuse of materials reprocessing and recycling and energy recovery. Disposal will be undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act 2001*).
WH02	Waste material generated on site will not be left on site once the construction works have been completed.
WH03	The site is to be kept clean and tidy at all times.
WH04	Waste mitigation and management strategies will be documented in the CEMP and in accordance with Endeavour Energy's Environmental Management Standard EMS 0007 Waste Management.
WH05	Any excess waste or spoil including, fill material and VENM, will be disposed of at a licensed waste or recycling facility as appropriate.
WH06	All excavated spoil will be classified prior to disposal and/or re-use. Waste disposal dockets will be obtained from the licensed waste disposal facility and copies retained for audit purposes.
WH07	In accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), report any third party illegal dumping into MySafe or to site Environmental Representative. Do not inspect it until an appropriate Worksite Hazard and Risk Assessment (WHRA) has been completed. Secure the waste if required by covering with plastic and erecting barricading where appropriate to reduce safety risks.

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5.13 Utilities and Services

5.13.1 Existing environment

The location of buried services are not known, however they are likely to occur along Glenlee Road, 1km north of the proposal site.

5.13.2 Impact assessment

The proposal does not include excavation works and is not expected to impact underground services.

A detailed Before You Dig Australia search will be conducted prior to commencement of works for all services in the vicinity of the site. Where necessary, relevant authorities and customers will be contacted and notified regarding any potential impacts on their utilities and services.

5.13.3 Safeguards

Table 5-32: Utilities and services safeguards

Number	Safeguard
US01	Before You Dig Australia searches will be undertaken prior to commencement of construction works on site.
US02	Impacted residents or businesses will be notified prior to any potential interruptions to electricity supply occurring during construction in accordance with National Energy Customer Framework requirements.

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5.14 Electromagnetic Fields

5.14.1 Existing environment

Electromagnetic fields (EMF) are physical fields that represent the influences of electric charges. EMFs have both electric and magnetic components that propagate oscillating waves. EMF can be produced wherever electricity or electrical equipment is in operation.

At its current state, the existing mobile substation located on the proposal site would produce an EMF as well as the Macarthur BSP, approximately 1.5km north east of the proposal site. Other forms of EMF producing infrastructure includes the surrounding transmission lines, the closest line being 1.1km north of the ZS site.

5.14.2 Impact assessment

Construction

During demolition of the existing mobile substation and construction of the new ZS, no electrical or magnetic components would be operating and therefore, no EMF is expected to be generated within this phase. Any unexpected works in proximity to existing electrical infrastructure would not create any risks of EMF as they have previously been designed to meet relevant EMF standards.

Operation

During operation of the ZS, the proposal is expected to produce electromagnetic emissions. It is expected that all electrical infrastructure, including substations, are designed to meet relevant EMF standards. Therefore, the operation of the proposal would not create any EMF risks.

5.14.3 Safeguards

Table 5-33: Electromagnetic fields safeguards

Number	Safeguard
EM01	All designs are to comply with the standards outlined in Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) *Radiation Protection Series no. 3: Maximum exposure limits to radiofrequency fields* (ARPANSA, 2002).
EM02	When designing and scoping proposal, EMF is to remain below 2000 miiligaus in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

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5.15 Cumulative impacts

Cumulative impacts may arise from the interaction of the proposal and other existing or planned projects in the wider area. This may include large scale projects surrounding the proposal.

5.15.1 Study area

Ongoing or proposed projects within Menangle Park and the immediate surrounding suburbs and their associated impacts have been considered.

5.15.2 Other projects and developments

A search of the Department of Planning and Environment's Major Projects website was carried out on 19 November 2024 for projects within the Campbelltown LGA. No major projects were identified that would be likely to interact with the proposal.

Spring Farm Parkway is a proposed new four-lane divided road that will act as a connection between Menangle Road, the Hume Motorway and Menangle Park. Stage 2 of the project involves the construction of a 3km stretch of Spring Farm Parkway that would link Liz Kernohan Drive in the west with the Stage 1 constructed road. Timing for construction has not been confirmed, however would have an impact on the surrounding environment which would need to be taken into consideration during construction of the proposal.

Other developments likely to occur within the locality would be small-scale projects and would be unlikely to result in a cumulative impact with the proposal.

Additional works will be undertaken (and assessed separately) to construction the feeder between the proposal and the BSP. These works would be minor in nature and stage such that impacts would be minimal.

5.15.3 Safeguards

Table 5-34 Cumulative safeguards

Number	Safeguard
CI01	Current and upcoming projects with the potential to interact with the proposal will be monitored. Where potential cumulative impacts are identified (including Spring Farm Parkway), the scheduling of works will be coordinated with interacting projects to minimise potential impacts, including scheduling of works to minimise consecutive construction noise and access impacts of local projects.

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6. Summary of Safeguards

6.1 Environmental safeguards

Table 6-1: Summary of safeguards and mitigation measures for the proposal

Number	Safeguards
General	
G01	An environmental management plan will be prepared prior to construction and will document measures to be implemented to reduce or mitigate environmental impacts as identified in this REF.
Biodiversity	
B01	Vegetation removal will be undertaken in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B02	An unexpected threatened species finds procedure will be developed as part of the CEMP. The procedure is to be followed if unexpected threatened species or threatened ecological communities not assessed in the biodiversity assessment, are identified within the proposal site.
B03	The following will be implemented as part of the CEMP: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas; • Pre-clearing survey requirements; • Procedures for unexpected threatened species finds and fauna handling; • Procedures addressing relevant matters specified in the DPI *Policy and guidelines for fish and habitat conservation and management (2013)*; and Protocols to manage weeds, pathogens and pest species.
B04	Threatened fauna habitat removal will be minimised through detailed design in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B05	Fauna encountered on-site during construction will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Management Guideline: Protecting and managing biodiversity for NSW projects* (TfNSW, 2024).
B06	• Weed species and pathogens will be managed in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
Water, hydrology and flooding	
W01	Site-specific Erosion and Sediment Control Plans will be prepared for the proposal in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), and will be implemented as part of the Construction Environmental Management Plan (CEMP).

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Number	Safeguards
W02	Install construction erosion and sediment control measures before construction commences consistent with 'the Blue Book' (*Managing Urban Stormwater, Soils and Construction Vol 1 and 2A* (Landcom 2004 and DECC 2008)) in order to: • Minimise sediment moving off-site and sediment laden water entering drainage lines, or drain inlets; • Reduce water velocity and capture sediment on site; • Minimise the amount of material transported from site to surrounding pavement surfaces; • Minimise in-stream soil erosion and downstream water quality impacts; and • Divert clean water around the site.
W03	The CEMP will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.
W04	No cleaning and washing of vehicles should be undertaken on site, and must be completed offsite.
W05	Water quality control measures are to be used to minimise any materials (e.g. concrete, grout, sediment etc) entering drain inlets or waterways.
W06	Spill kits will be available at the construction site in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), and all persons undertaking construction works will be made aware of Endeavour Energy's incident response procedures.
W07	Soil and water management will be conducted in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
W08	Disturbance will be restricted to those areas of the proposal required for the active stage of works.
W09	Refuelling and maintenance of vehicles, plant and equipment will not be carried out on the proposal site. All vehicles, plant and equipment are to be refuelled prior to arriving on-site.
W10	No fuels, oils or other chemicals are to be stored at worksites unless small amounts are required for that specific days' work.
W11	All drainage, erosion and sediment control measures will be maintained in proper working order until their function is no longer required.
W12	Where it is necessary to store spoil or other loose materials on site, sediment fences are to be constructed on the down slope side of the stockpile.
W13	Monitor for groundwater seepage during construction. Should groundwater be encountered during earthworks, the Site Supervisor would notify the Environmental Advisor and Project Manager who will co-ordinate any further actions.
Soils and contamination	
SC01	An Unexpected Contaminated Finds Protocol will be implemented during construction, and will include appropriate control measures to be implemented to manage and risks of contamination. All other works that may impact on the unexpected find (contaminated area) will cease until the nature and extent of the contamination has been confirmed, and any necessary site-specific controls or further actions identified in consultation with the project manager and/or the EPA.
SC02	Should asbestos be identified unexpectedly on site, asbestos removal must be undertaken in accordance with *Working with Asbestos: Guide 2008* published by WorkCover NSW and by Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

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Number	Safeguards
SC03	A spill kit is to be available at all times during construction, in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
SC04	Monitoring should be undertaken during construction in the event that ASS are encountered. In the event that ASS are present, appropriate remedial works should be carried out in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
SC05	All topsoil, fill and natural soil to be excavated are to be disposed to an appropriately licensed landfill should be classified in accordance with the EPA's *Waste Classification Guidelines: Part 1: Classifying waste* (EPA, 2014).
SC06	Any screened and clean insitu fill intended to be reused on-site should be validated by laboratory analysis to ensure suitability of the material for reuse.
SC07	All imported fill required for bulk earthworks should be validated as Virgin Excavated Natural Material (VENM) free of organics, non-saline and not affected by ASS. This is in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
Traffic and transport	
T01	Access to properties and local businesses will be maintained during construction.
T02	Delivery of construction plant and materials are to be managed to minimise number of deliveries/vehicles on site.
T03	Road users and local communities will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays owing to construction activities. The affected community will be notified a minimum of five working days before any changed conditions that are likely to result in disruption.
Noise and vibration	
NV01	All sensitive receivers (as identified in **Section 5.5.3**) will be notified at least five working days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The proposal; • The construction period and construction hours; • Contact information for project management staff; • Complaint and incident reporting; and • How to obtain further information. This is in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
NV02	Additional mitigation measures presented in **Section 5.5.3** based on the TfNSW Noise Tool are to be considered in the CEMP and applied where appropriate.
NV03	Traffic flow, parking and loading/unloading areas to be planned to minimise reversing movements. Non-tonal reversing beepers are to be fitted and used on all construction vehicles and on mobile plants and during any out of hours work.
NV04	All employees, contractors and subcontractors are to receive a site-specific prestart/toolbox talk. The talk must at least include: • Any site-specific and relevant standard noise and vibration mitigation measures;

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Number	Safeguards
	• Relevant licence and approval conditions; • Permissible hours of work; • Location of nearest sensitive receivers; • Construction employee parking areas; • Designated loading/unloading areas and procedures; • Site opening/closing times (including deliveries); and • Environmental incident procedures.
NV05	Use quieter emitting methods in line with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024). Ensure plant and equipment are fitted with appropriate silencers that are maintained in good working order for the duration of the works.
NV06	The distance between noise intensive plant and nearby sensitive receivers is to be maximised. Noise emitting plant is to be directed away from sensitive receivers during use. Plant used intermittently is to be throttled down or shut down when not in use.
NV07	Limit the use of engine compression breaks during site entry/egress where possible, to minimise impact on nearby sensitive receivers. Vehicles to be fitted with fully complaint exhaust silencers.
Aboriginal heritage	
AH01	An unexpected heritage finds protocol will be prepared and implemented prior to commencement of works. If unexpected Aboriginal items are uncovered during the works, all works must cease in the vicinity of the material/find, and the Endeavour Energy project manager must be contacted immediately.
Non-Aboriginal heritage	
NH01	An unexpected finds procedure must be implemented during ground disturbing works. In the event that archaeological remains are discovered during the works, works must cease in that location and the remains must be protected, and a suitably qualified archaeologist must be contacted to assess the potential archaeological remains and advise on the required archaeological management. If unexpected 'relics' or state significant archaeological remains are identified, further assessment and approvals may be required.
NH02	Any substantial changes to the proposed scope of works requires further assessment to identify any additional heritage impacts.
Air Quality	
AQ01	Dust levels will be visually monitored during construction works in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024). If excessive dust generation is occurring on site, causing a safety issue or complaints are received, immediately follow appropriate mitigation options.
AQ02	Vehicles and machinery are to be turned off when not in use and not to be left idling during construction and operation.
AQ03	Soil/spoil tracked onto roadways will be swept up on a regular basis during construction, in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
AQ04	Vehicles transporting waste or other materials that may produce dust are to be covered during transportation to and from the site during construction.

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Number	Safeguards
AQ05	Any temporary stockpiles within the proposal site will be covered or stabilised during construction.
AQ06	Traffic speed and movements will be decreased over disturbed areas of ground during construction.
AQ07	Dust suppression techniques, including wetting down surfaces will be used as necessary during construction.
Bushfire	
BF01	The Construction site and substation facility would be managed as an Asset Protection Zone (APZ) in accordance with *RFS Standards for Asset Protection Zones* (SAPZ 2005) (RFS, 2005). At the commencement of building works, the construction site would be managed as an APZ as outlined in Appendix 4 of the PBP and the SAPZ 2005. APZ requirements include: • Screening vegetation and related landscaping features shall be placed outside the designated APZ; • Trees: Tree canopy should be less than 15% of maturity; Trees at maturity should not touch or overhang the building; Lower limbs should be removed up to a height of 2m above the ground; Tree canopies should be separated by 2 to 5m; Preference should be given to smooth barked and evergreen trees; • Shrubs: Create large discontinuous or gaps in the vegetation; Shrubs should not be located under trees or form more than 10% of ground cover; Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation; and • Grass: Grass should be kept low (no more than 100 millimetres (mm) in height); Leaves and vegetation debris should be removed.
BF02	The landscaping provided to provide a visual buffer shall comply with the following provisions: • No vegetation or yard storage within 10m of buildings or transformers; • A 1.5m clear egress is provided around within the immediate curtilage of all structures; • Fencing and gates in a Bushfire Attack Level (BAL) of 29 or within 6m of a building should be of non-combustible materials; • Garden mulch will not be permitted. Alternatives shall be applied; • No timbers permitted within landscaping area; • Tree branches less than 2m from ground surface are to be trimmed annually; • No shrubs to be planted under tree canopy; • Gaps of more than 1m shall be applied between shrubs; • Grasses removed annually; and • Designed in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
BF03	Vulnerable buildings and/or critical assets are to be constructed to appropriate BAL levels in accordance with the *Australian Standard for the Construction of Buildings in Bushfire Prone Zones* (AS3959:2018). This will be refined during detailed design. The following shall be applied: • The external wall and roof will be non-combustible, and all vents metal screened with aperture <2mm; • External critical elements are those deemed to be essential for return to service following a bushfire event shall be located in areas exposed to <12kW/m^2 radiant heat load;

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Number	Safeguards
	• All external doors must match the fire performance FRL of the building and be fitted with fire resistant smoke seals at the base of the door to prevent embers entering under the door; and • Covering openings with a steel, bronze or aluminium to maximum allowable aperture of 2mm or weather strip with a flammability index not greater than 5 (AS1530.2).
BF04	Reticulated water must be provided. External attack hydrant through the fire hydrant booster is to be provided.
BF05	Emergency management during construction phase should be administered through site specific construction operations and risk plans. The principles within this document shall be used to guide to the site-specific operations and risk plans during the construction phase. A comprehensive Bushfire Emergency Management and Evacuation Plan would be completed for the operational phase of the project. The bushfire evacuation procedures would be completed in accordance with NSW *RFS Guide to Developing A Bushfire Emergency Management Plan*. This includes: • Ignition prevention: ○ Hot work (activities involving high temperatures) and fire risk work (activities involving heat or with the potential to generate sparks) from construction activities may cause fire ignition. These works will be managed under a Hot Work and Fire Risk Work procedure, with measures including suspension of activities on days of elevated fire danger; ○ Certain construction activities, including hot works, are prohibited by law on any day declared to be a total fire ban; ○ Essential work during construction may be completed on a total fire ban, providing it complies with the Hot Work and Fire Risk Work procedure exemption from the NSW RFS; and ○ Substations must be inspected and cleaned regularly to prevent the build-up of combustible matter. • Ignition suppression: ○ Firefighting equipment will be maintained and accessible to active construction site during the declared bushfire danger season, and site personnel should be trained in its use. Equipment should be appropriate to the activities being conducted and the fire danger at the time of works, but as a minimum should include extinguishers, knap sacks and hand tools (e.g. fire rakes).
BF06	The public road provides Category 1 fire appliances access to the south of the facility. Within the fenced compound, unobstructed pedestrian access is required to enable fire fighters to operate. The following access requirements are recommended: • A vehicle access gate be provided; • Internal access to all buildings and north side of transformer 1 and 2 to have a trafficable surface with capacity of 23T with a maximum grade of not more than 15 degrees, crossfall not more than 6 degrees, minimum vertical clearance of 4m is provided above the surface of the trafficable surface clear of obstructions, curves have a minimum inner radius of 6m, minimum distance between inner and outer curves is 6m; • Turn-a-round provided in accordance with Appendix 3 of PBP.
Landscape character and visual amenity	
LV01	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.

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Number	Safeguards
LV02	Fencing with material attached (e.g. shade cloth) to be provided around the construction compounds to screen views from roads and neighbouring properties.
LV03	Landscaping around the ZS will be maintained during operation.
Socio-economic	
SE01	In accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), Community notification to occur prior to construction, to advise on the construction and operation of the proposal and expected impacts (as per **Section 4.2**).
Waste and hazardous materials	
WH01	The following resource management hierarchy principles will be followed in line with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024): • Avoid unnecessary resource consumption as a priority; and • Avoidance will be followed by resource recovery (including reuse of materials reprocessing and recycling and energy recovery. Disposal will be undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act 2001*).
WH02	Waste material generated on site will not be left on site once the construction works have been completed.
WH03	The site is to be kept clean and tidy at all times.
WH04	Waste mitigation and management strategies will be documented in the CEMP and in accordance with Endeavour Energy's Environmental Management Standard EMS 0007 Waste Management.
WH05	Any excess waste or spoil including, fill material and VENM, will be disposed of at a licensed waste or recycling facility as appropriate.
WH06	All excavated spoil will be classified prior to disposal and/or re-use. Waste disposal dockets will be obtained from the licensed waste disposal facility and copies retained for audit purposes.
WH07	In accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024), report any third party illegal dumping into MySafe or to site Environmental Representative. Do not inspect it until an appropriate Worksite Hazard and Risk Assessment (WHRA) has been completed. Secure the waste if required by covering with plastic and erecting barricading where appropriate to reduce safety risks.
Utilities and services	
US01	Before You Dig Australia searches will be undertaken prior to commencement of construction works on site.
US02	Impacted residents or businesses will be notified prior to any potential interruptions to electricity supply occurring during construction in accordance with National Energy Customer Framework requirements.
Electromagnetic fields	
EM01	All designs are to comply with the standards outlined in Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) *Radiation Protection Series no. 3: Maximum exposure limits to radiofrequency fields* (ARPANSA, 2002).
EM02	When designing and scoping proposal, EMF is to remain below 2000 miiligaus in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

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Number	Safeguards
Cumulative impacts	
CI01	Current and upcoming projects with the potential to interact with the proposal will be monitored. Where potential cumulative impacts are identified (including Spring Farm Parkway), the scheduling of works will be coordinated with interacting projects to minimise potential impacts, including scheduling of works to minimise consecutive construction noise and access impacts of local projects.

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6.2 Licensing and other approvals

Table 6-2: Summary of licensing and other approvals required

Instrument	Requirement	Timing
Coal Mine Subsidence Compensation Act 2017	Mine Subsidence District approval Approval must be obtained from Subsidence Advisory NSW for any development within a Mine Subsidence District (South Campbelltown) in accordance with section 22 of the *Coal Mine Subsidence Compensation Act 2017*.	Prior to construction

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7. Certification, Review and Determination

7.1 Certification

This REF provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses, to the fullest extent possible, all matters affecting or likely to affect the environment as a result of the proposal.

Prepared by:

Name:	Rachel Gray
Position:	Senior Environmental Consultant
Company name:	JBS&G Australia Pty Ltd
Signature	
Date:	14/03/2025

REF reviewed by:

Name:	Louisa Rebec
Position:	Senior Principal
Company name:	JBS&G Australia Pty Ltd
Signature	
Date:	14/03/2025

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7.2 Endeavour Energy Determination

In accordance with the above recommendation, I certify that I have reviewed and endorsed the contents of this REF, and to the best of my knowledge, it is in accordance with the EP&A Act, the EP&A Regulation and the Guidelines approved under Section 170 of the EP&A Regulation, and the information is neither false nor misleading.

I determine that Endeavour Energy may:

☐ proceed with the activity or

☐ not proceed with the activity as the environmental impacts are not acceptable or

☐ not proceed with the activity as a project REF is required.

Name:

Position:

Signature

Date:

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8. Limitations

Scope of services

This report ("the report") has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. JBS&G has also not attempted to determine whether any material matter has been omitted from the data. JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to JBS&G. The making of any assumption does not imply that JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made, including to any third parties, and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G or reproduced other than in full, including all attachments as originally provided to the client by JBS&G.

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Appendix A Project Design Drawings

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MENANGLE PARK ZONE SUBSTATION

D.P. NUMBER 1234643

FITZPATRICK STREET, MENANGLE PARK, NSW

Endeavour Energy

JULY 2024

DRAWING LIST - REF - ISSUED FOR APPROVAL

DWG No:	DRAWING NAME	Current Revision	Current Revision Date
DA-000	COVER SHEET	3	26.07.24
DA-001	DESIGN CHARACTER STATEMENT	1	16.07.24
DA-002	EXISTING VIEW 1 - FROM CNR FITZPATRICK ST	1	16.07.24
DA-003	PHOTOMONTAGE 1 - FROM CNR FITZPATRICK ST	3	26.07.24
DA-004	EXISTING VIEW 2 - FROM ACCESS RD	1	16.07.24
DA-005	PHOTOMONTAGE 2 - FROM ACCESS RD	3	26.07.24
DA-006	LOCALITY PLAN	3	26.07.24
DA-007	SITE / ROOF PLAN	3	26.07.24
DA-008	BUILDING BASEMENT PLAN	3	26.07.24
DA-009	BUILDING GROUND FLOOR PLAN	3	26.07.24
DA-010	STREET ELEVATIONS - SHEET 1	3	26.07.24
DA-011	STREET ELEVATIONS - SHEET 2	3	26.07.24
DA-012	BUILDING ELEVATIONS - SHEET 1	3	26.07.24
DA-013	BUILDING ELEVATIONS - SHEET 2	3	26.07.24
DA-014	BUILDING SECTION 1	3	26.07.24
DA-015	BUILDING SECTION 2	3	26.07.24
DA-016	BUILDING SECTION 3	3	26.07.24
DA-017	FINISHES SCHEDULE	2	22.07.24
LA-01	LANDSCAPE PLAN	1	16.07.24
LA-02	PLANTING SCHEDULE - SHEET 1	1	16.07.24
LA-03	PLANTING SCHEDULE - SHEET 2	1	16.07.24

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Development Application Design & Character Statement
Endeavour Energy

MENANGLE PARK ZONE SUBSTATION

THE PROPOSAL

MENANGLE PARK ZONE SUBSTATION IS LOCATED ON AN EXISTING SUBSTATION SITE - PROPOSED NORTH OF FITZPATRICK STREET, MENANGLE PARK 2563. THE SITE IS ADJACENT TO THE MAIN SOUTHERN RAILWAY CORRIDOR.

THE NEW INDOOR ZONE SUBSTATION WILL COMPRISE OF THE FOLLOWING:

- CONSTRUCTION OF 2 NEW 66/11 kV 35 MVA TRANSFORMERS WITH ASSOCIATED BUNDS, FIRE WALLS, OIL SEPARATORS AND SPILL BARRIER.
- CONSTRUCTION OF 1 NEW 66 kV GIS SWITCH ROOM BUILDING, 11 kV SWITCH ROOM, CONTROL ROOM AND AMENITIES BUILDING WITH A LOWER CABLE MARSHALLING AREA, GANTRY CRANES AND CONCRETE LOADING DOCK/STAIRS.
- INSTALLATION OF ALL ASSOCATED UNDERGROUND CABLE CONDUITS.
- CONSTRUCTION OF ALL RELATED SITE-WORKS INCLUDING DRIVEWAY PAVEMENTS, GRAVEL YARD SURFACING AND SECURITY FENCING.
- INSTALLATION OF BUILDING AND SITE STORMWATER DRAINAGE.
- STAGING OF WORKS FOR THE REMOVAL OF THE EXISTING MOBILE SUBSTATION AND PROPOSED CONSTRUCTION WORKS ON-SITE.

DESIGN VERIFICATION

THE FOLLOWING DESIGN VERIFICATION STATEMENT WAS PREPARED BY MR. MICHAEL BULLEN, DIRECTOR OF BREWSTER MURRAY PTY. LTD. - ARCHITECTS, INTERIOR & URBAN DESIGNERS.

CONTEXT

MENANGLE PARK ZONE SUBSTATION IS SURROUNDED BY A LARGE AREA OF RURAL PARKLANDS, WITH AN EXISTING SYDNEY WATER PUMPING STATION TO THE NORTH-EAST OF THE LOT.

THE SITE HAS ROAD FRONTAGE TO

- NORTHERN BOUNDARY - EXISTING RURAL PARKLANDS
- EASTERN BOUNDARY - EXISTING RURAL PARKLANDS
- SOUTHERN BOUNDARY - EXISTING RURAL PARKLANDS, RESIDENTIAL SETTING, AND ACCESS ROAD/DRIVEWAY TO FITZPATRICK STREET
- WESTERN BOUNDARY - EXISTING ACCESS ROAD, MAIN SOUTHERN RAILWAY, AND SYDNEY WATER'S PUMPING STATION

DESIGN RESPONSE

IN LIGHT OF THE ABOVE CONTEXT, THE FOLLOWING CONSIDERATIONS HAVE BEEN APPLIED TO THE DESIGN OF MENANGLE PARK ZONE SUBSTATION:

- ONLY HIGH-QUALITY, LOW-MAINTENANCE DURABLE EXTERNAL MATERIALS HAVE BEEN SELECTED.
- A TIMBER POST AND GALVANISED STEEL ROD FENCE WILL SURROUND THE SITE BOUNDARY.
- A HIGH-SECURITY MESH FENCE AND SIMILAR GATES WILL SURROUND THE SWITCHYARD, MAIN SWITCH ROOM BUILDING AND TRANSFORMER BAYS.
- THE PROPOSED DESIGN UTILISES A SERIES OF SKILLION ROOFS - STEEL FRAMING WITH LIGHTWEIGHT METAL CLADDING AND METAL ROOF SHEETING. A CONTINUOUS LOUVRE FACADE WRAPS AROUND THE EXTENT OF THE CABLE MARSHALLING AREA, PROVIDING A SEAMLESS TRANSITION BETWEEN THE METAL CLADDINGS.
- A NEW STORMWATER SYSTEM WILL BE INSTALLED TO COLLECT ALL STORMWATER RUN-OFF FROM THE SITE.

MATERIAL FINISHES

MC1 MD1		COLORBOND 'SOUTHERLY'
MS1		COLORBOND 'BLUEGUM' ROLLER SHUTTER
MC2		ALPOLIC 'DARK GRAY METALLIC'
MC3		ALPOLIC 'GREEN METALLIC'
MC4		ALPOLIC 'MANGANESE METALLIC'
MC5		COLORBOND 'BLUEGUM'
GALV		GALVANISED STEEL
C1		NATURAL CONCRETE FINISH
P1		DULUX 'ENDLESS DUSK'
PC1		POWDER COATED PAINT FINISH TO MATCH COLOURBOND 'BLUEGUM"
PC2		POWDER COATED PAINT FINISH TO MATCH COLOURBOND 'WOODLAND GREY'

SCHEDULE OF EXTERNAL COLOURS AND MATERIALS

REFER TO MATERIAL PALETTE FOR PROPOSED FINISHES LISTED BELOW.

NEW 66 & 11 kV SWITCH ROOM BUIILDING (S)

WALL CLADDING:
- **MC1** - LIGHTWEIGHT METAL CLADDING - COLORBOND 'SOUTHERLY'
- **MC2** - LIGHTWEIGHT METAL CLADDING - ALPOLIC 'DARK GRAY METALLIC'
- **MC3** - LIGHTWEIGHT METAL CLADDING - ALPOLIC 'GREEN METALLIC'
- **MC4** - LIGHTWEIGHT METAL CLADDING - ALPOLIC 'MANGANESE METALLIC'

METAL ROOF CLADDING:
- **MD1** - LIGHTWEIGHT METAL CLADDING - COLORBOND 'SOUTHERLY'
- **PC2** - GUTTERS - TO MATCH COLORBOND 'WOODLAND GREY'
DOWNPIPES - TO MATCH COLORBOND 'WOODLAND GREY'
FASCIA BOARD - TO MATCH COLORBOND 'WOODLAND GREY'
- **MC5** - METAL CLAD ROOF SOFFIT - COLORBOND 'BLUEGUM'

EXTERNAL DOOR FRAMES, DOORS & VENTILATION LOUVRES:
- **PC1** - POWDER COATED PAINT FINISH TO MATCH COLOURBOND 'WOODLAND GREY'
- **PC2** - POWDER COATED PAINT FINISH - TO MATCH COLORBOND 'BLUEGUM'
- **P1** - PAINT FINISH - DULUX 'ENDLESS DUSK'
- **GALV** - STAIR HANDRAILS

NEW CONTROL ROOM & AMENITIES BUILDING

WALL CLADDING:
- **MC1** - LIGHTWEIGHT METAL CLADDING - COLORBOND 'SOUTHERLY'

METAL ROOF CLADDING:
- **MD1** - LIGHTWEIGHT METAL CLADDING - COLORBOND 'SOUTHERLY'
- **PC2** - GUTTERS - TO MATCH COLORBOND 'WOODLAND GREY'
DOWNPIPES - TO MATCH COLORBOND 'WOODLAND GREY'
FASCIA BOARD - TO MATCH COLORBOND 'WOODLAND GREY'
- **MC5** - METAL CLAD ROOF SOFFIT - COLORBOND 'BLUEGUM'

EXTERNAL DOOR FRAMES, DOORS & VENTILATION LOUVRES:
- **PC1** - POWDER COATED PAINT FINISH - TO MATCH COLORBOND 'BLUEGUM'
- **P1** - PAINT FINISH - DULUX 'ENDLESS DUSK'
- **GALV** - STAIR HANDRAILS

NEW TRANSFORMER BUND & FIREWALLS
- **CONC** - CONCRETE - NATURAL FINISH

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Issue	Date	Description
1	16.07.24	ISSUED FRO APPROVAL

Consultants

Client: Endeavour Energy

Project: MENANGLE PARK ZONE SUBSTATION
FITZPATRICK STREET, MENANGLE PARK

Drawing: DESIGN CHARACTER STATEMENT

North

Scale: N/A

Date: JUL. 2024

Job No.: 24_6614

Drawing No.: DA-001 / 1

Issued for: REF

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1 | EXISTING VIEW FROM CNR FITZPATRICK ST & ACCESS RD

SCALE: N/A

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Issue	Date	Description
1	16.07.24	ISSUED FRO APPROVAL

Consultants

Client

Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

EXISTING VIEW 1 - FROM CNR FITZPATRICK ST

North	Scale	Date	Job No.	Drawing No.
	N/A	JUL. 2024	24_6614	DA-002 / 1

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1 | PROPOSED VIEW FROM CNR FITZPATRICK ST & ACCESS RD

SCALE 1 : 2000

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Issue	Date	Description
1	16.07.24	ISSUED FRO APPROVAL
2	22.07.24	LAYOUT UPDATED
3	26.07.24	PLANS UPDATED

Consultants

Client

Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

PHOTOMONTAGE 1 - FROM CNR FITZPATRICK ST

North	Scale	Date	Job No.	Drawing No.
	N/A	July 2024	24_6614	DA-003 / 3

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1 | EXISTING VIEW FROM ACCESS RD

SCALE: N/A

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Issue	Date	Description
1	16.07.24	ISSUED FRO APPROVAL

Consultants

Client

Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

EXISTING VIEW 2 - FROM ACCESS RD

North

Scale

N/A

Date

JUL. 2024

Job No.

24_6614

Drawing No.

DA-004 / 1

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1 | PROPOSED VIEW FROM ACCESS RD

SCALE 1 : 2000

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Issue	Date	Description
1	16.07.24	ISSUED FRO APPROVAL
2	22.07.24	LAYOUT UPDATED
3	26.07.24	PLANS UPDATED

Consultants

Client

Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

PHOTOMONTAGE 2 - FROM ACCESS RD

North	Scale	Date	Job No.	Drawing No.
	N/A	16/07/24	24_6614	DA-005 / 3

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1 | LOCALITY PLAN

SCALE 1 : 1000

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1	16.07.24	ISSUED FRO APPROVAL
2	22.07.24	LAYOUT UPDATED
3	26.07.24	PLANS UPDATED

Consultants

Client

Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET,
MENANGLE PARK

Drawing

LOCALITY PLAN

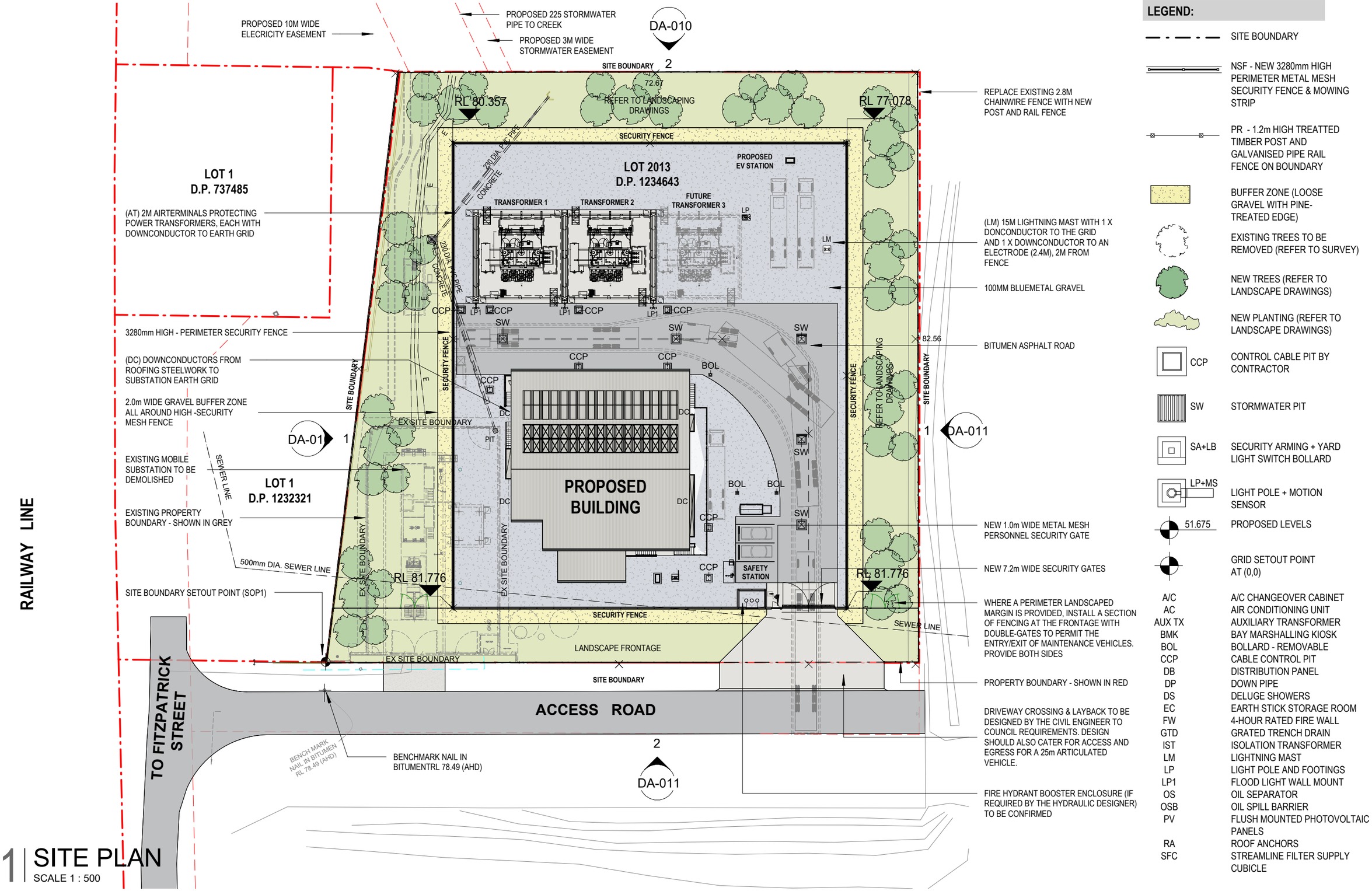
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	1 : 1000@A3	July 2024	24_6614	DA-006 / 3

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1 | SITE PLAN

SCALE 1 : 500

LEGEND:

- SITE BOUNDARY
- NSF - NEW 3280mm HIGH PERIMETER METAL MESH SECURITY FENCE & MOWING STRIP
- PR - 1.2m HIGH TREATTED TIMBER POST AND GALVANISED PIPE RAIL FENCE ON BOUNDARY
- BUFFER ZONE (LOOSE GRAVEL WITH PINE-TREATED EDGE)
- EXISTING TREES TO BE REMOVED (REFER TO SURVEY)
- NEW TREES (REFER TO LANDSCAPE DRAWINGS)
- NEW PLANTING (REFER TO LANDSCAPE DRAWINGS)
- CCP — CONTROL CABLE PIT BY CONTRACTOR
- SW — STORMWATER PIT
- SA+LB — SECURITY ARMING + YARD LIGHT SWITCH BOLLARD
- LP+MS — LIGHT POLE + MOTION SENSOR
- 51.675 — PROPOSED LEVELS
- GRID SETOUT POINT AT (0,0)

A/C	A/C CHANGEOVER CABINET
AC	AIR CONDITIONING UNIT
AUX TX	AUXILIARY TRANSFORMER
BMK	BAY MARSHALLING KIOSK
BOL	BOLLARD - REMOVABLE
CCP	CABLE CONTROL PIT
DB	DISTRIBUTION PANEL
DP	DOWN PIPE
DS	DELUGE SHOWERS
EC	EARTH STICK STORAGE ROOM
FW	4-HOUR RATED FIRE WALL
GTD	GRATED TRENCH DRAIN
IST	ISOLATION TRANSFORMER
LM	LIGHTNING MAST
LP	LIGHT POLE AND FOOTINGS
LP1	FLOOD LIGHT WALL MOUNT
OS	OIL SEPARATOR
OSB	OIL SPILL BARRIER
PV	FLUSH MOUNTED PHOTOVOLTAIC PANELS
RA	ROOF ANCHORS
SFC	STREAMLINE FILTER SUPPLY CUBICLE

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1	16.07.24	ISSUED FRO APPROVAL
2	22.07.24	PLANS UPDATED
3	26.07.24	PLANS UPDATED

Consultants

Client: Endeavour Energy

Project: MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

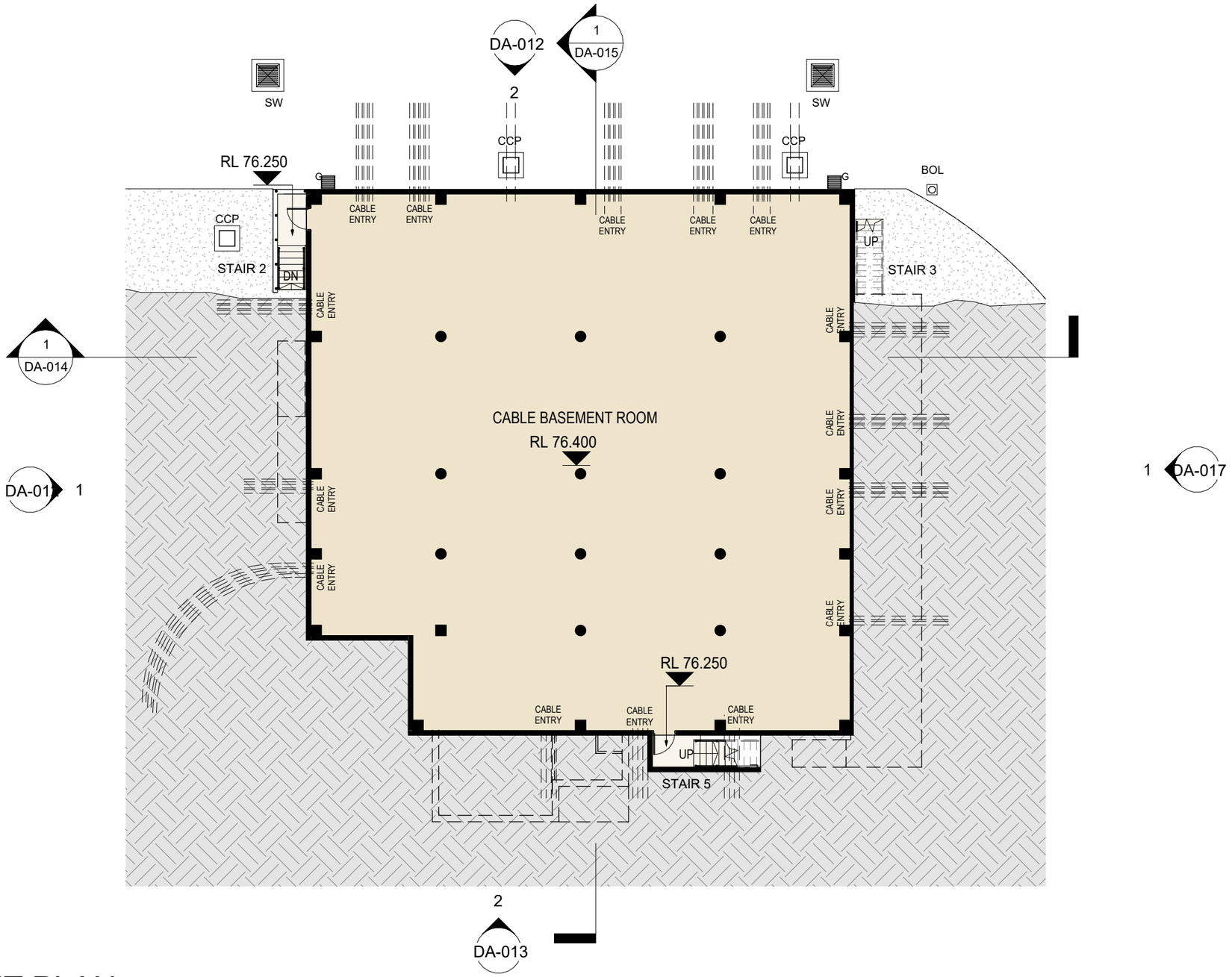
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	As indicated@A3	July 2024	24_6614	DA-007 / 3

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1 | BASEMENT PLAN

SCALE 1 : 200

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2	22.07.24	PLANS UPDATED
3	26.07.24	PLANS UPDATED

Consultants

Client: Endeavour Energy

Project: MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing: BUILDING BASEMENT PLAN

North

Scale: 1 : 200@A3

Date: July 2024

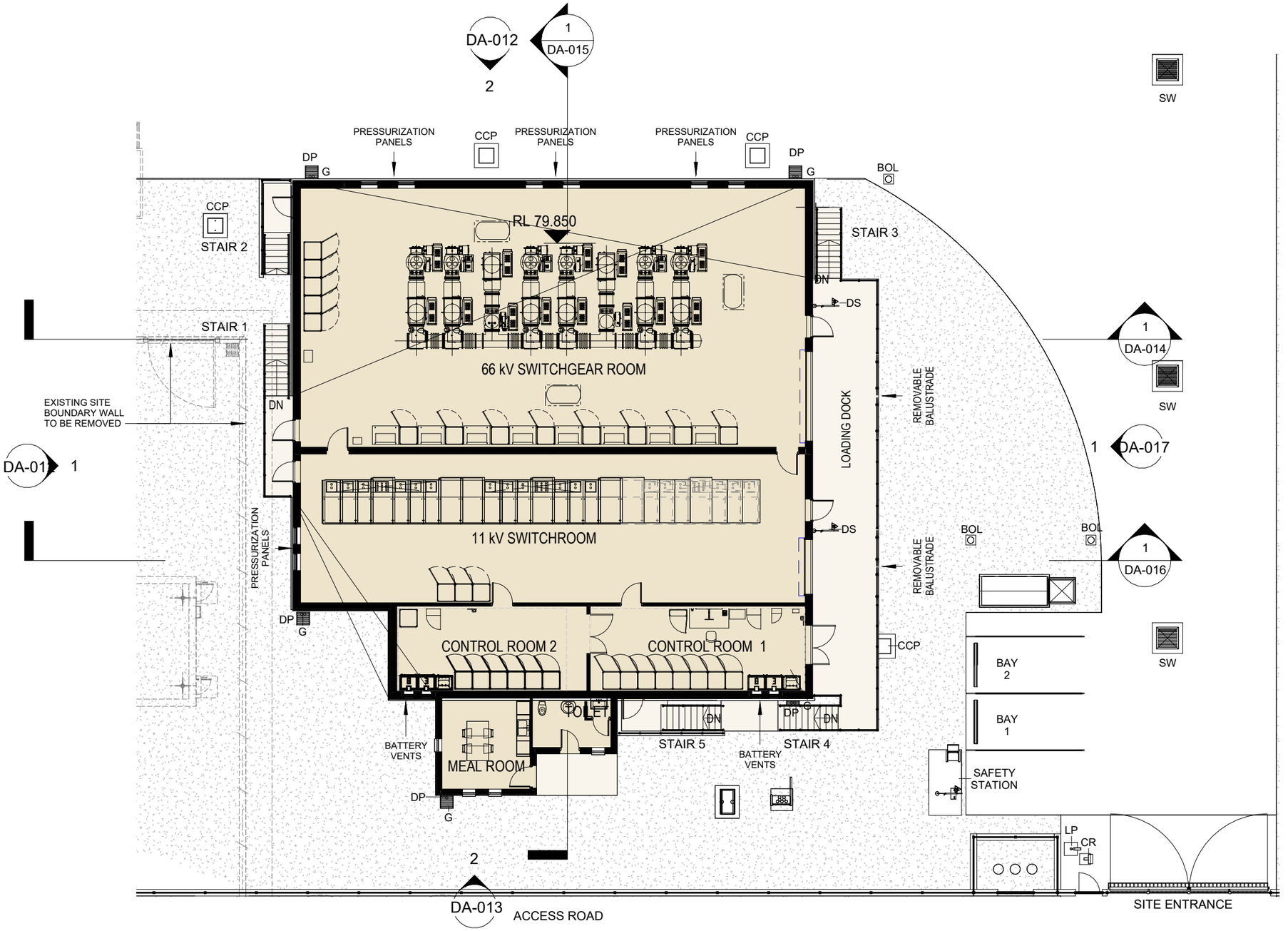
Job No.: 24_6614

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1 | GROUND FLOOR PLAN

SCALE 1 : 200

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3	26.07.24	PLANS UPDATED

Consultants

Client

Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

BUILDING GROUND FLOOR PLAN

North	Scale	Date	Job No.	Drawing No.
	1 : 200@A3	July 2024	24_6614	DA-009 / 3

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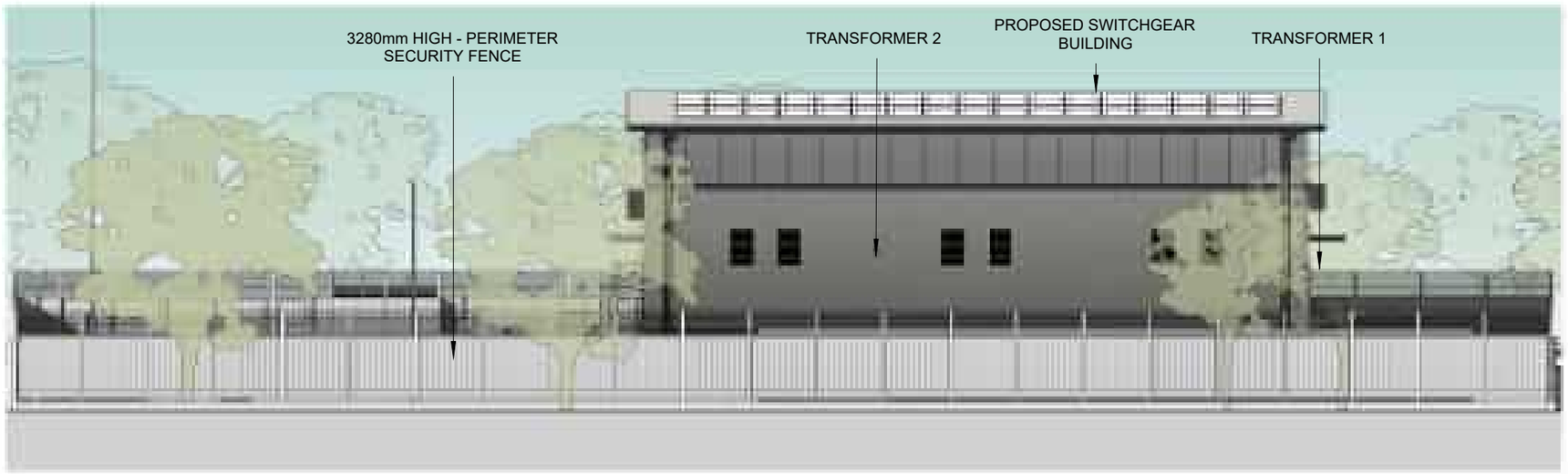
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1 | STREET ELEVATION 1- NORTH WEST

SCALE 1 : 200



2 | STREET ELEVATION 2 - NORTH EAST

SCALE 1 : 200

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3	26.07.24	PLANS UPDATED

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Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

STREET ELEVATIONS - SHEET 1

North	Scale	Date	Job No.	Drawing No.
	1 : 200@A3	July 2024	24_6614	DA-010 / 3

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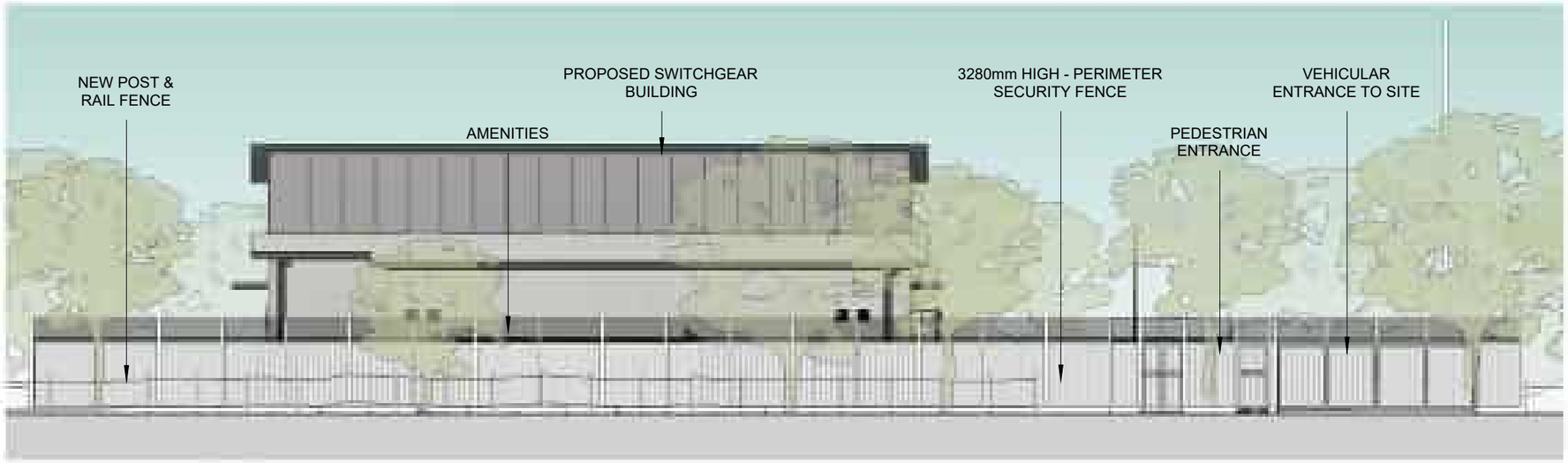
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1 | STREET ELEVATION 3 - SOUTH EAST

SCALE 1 : 200



2 | STREET ELEVATION 4 - SOUTH WEST

SCALE 1 : 200

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Consultants

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Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

STREET ELEVATIONS - SHEET 2

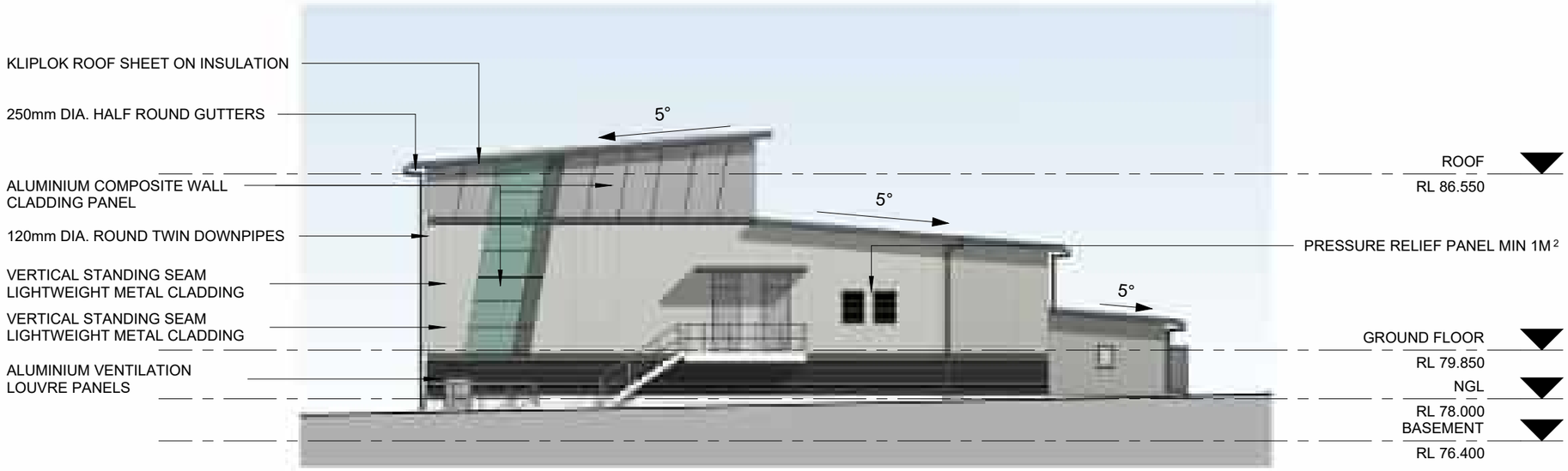
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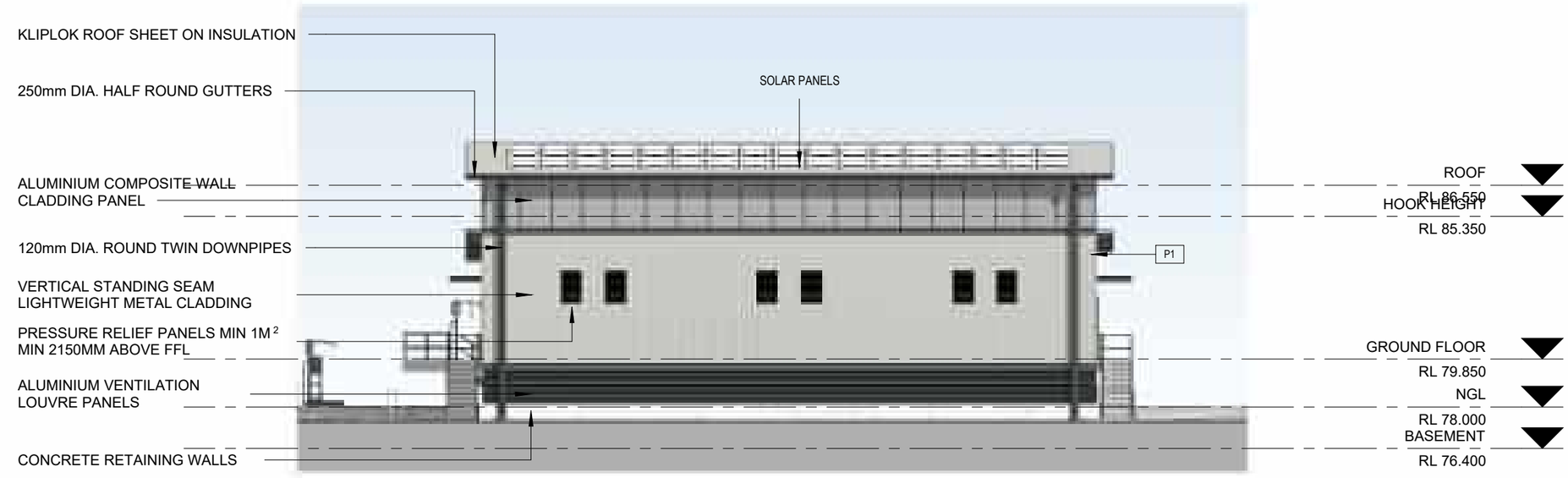
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1 | ELEVATION 1 - NORTH WEST

SCALE 1 : 200



2 | ELEVATION 2 - NORTH EAST

SCALE 1 : 200

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MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

BUILDING ELEVATIONS - SHEET 1

North

Scale

1 : 200@A3

Date

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Job No.

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Drawing No.

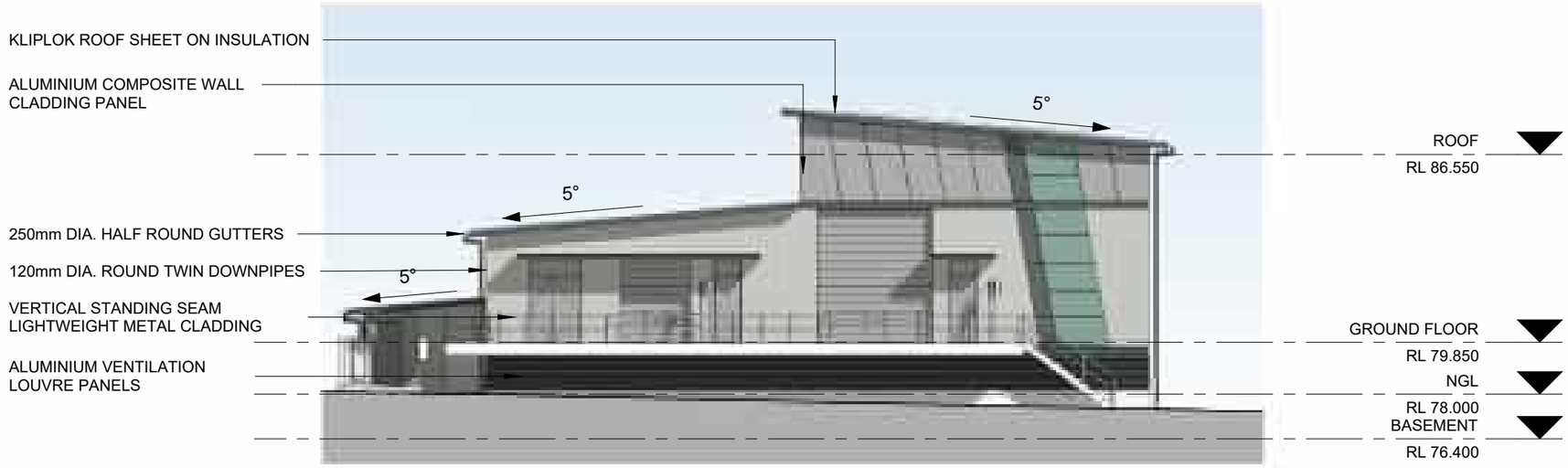
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1 | ELEVATION 3 - SOUTH EAST

SCALE 1 : 200



2 | ELEVATION 4 - SOUTH WEST

SCALE 1 : 200

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MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

BUILDING ELEVATIONS - SHEET 2

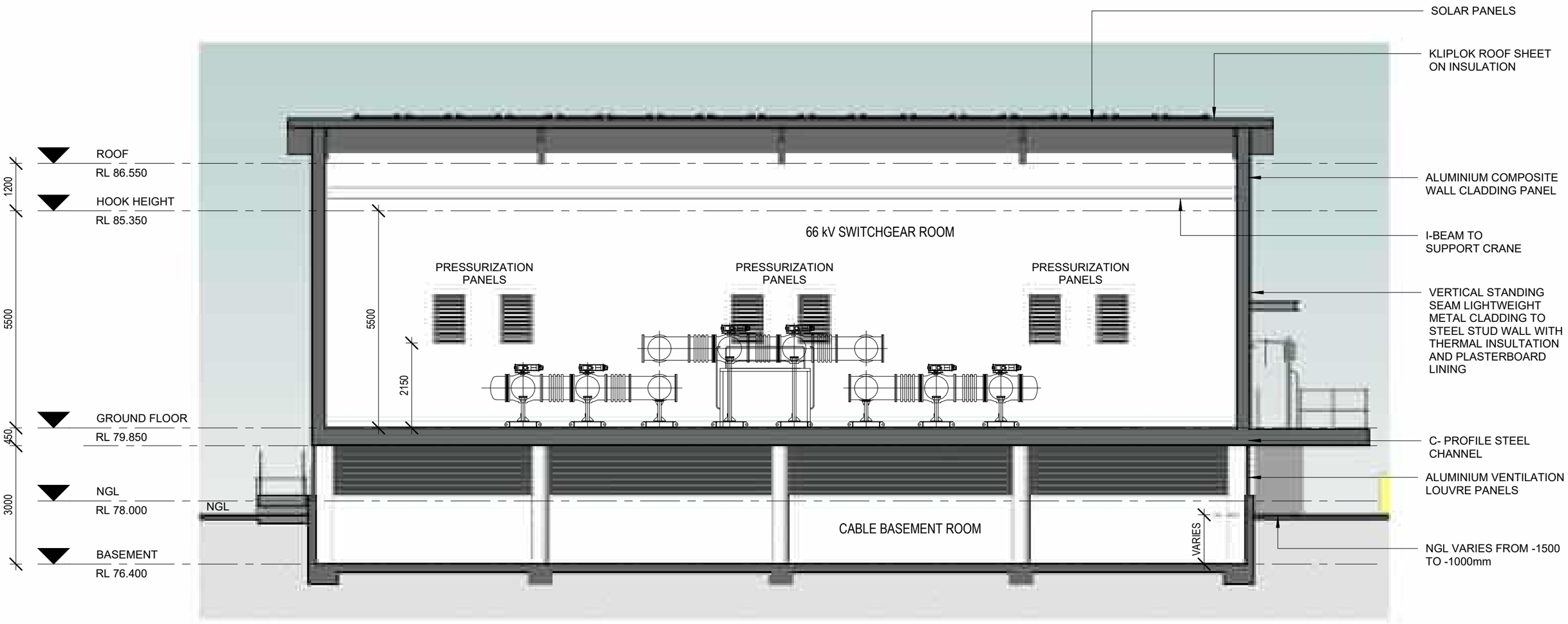
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1 | SECTION 1

SCALE 1 : 100

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3	26.07.24	PLANS UPDATED

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MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

BUILDING SECTION 1

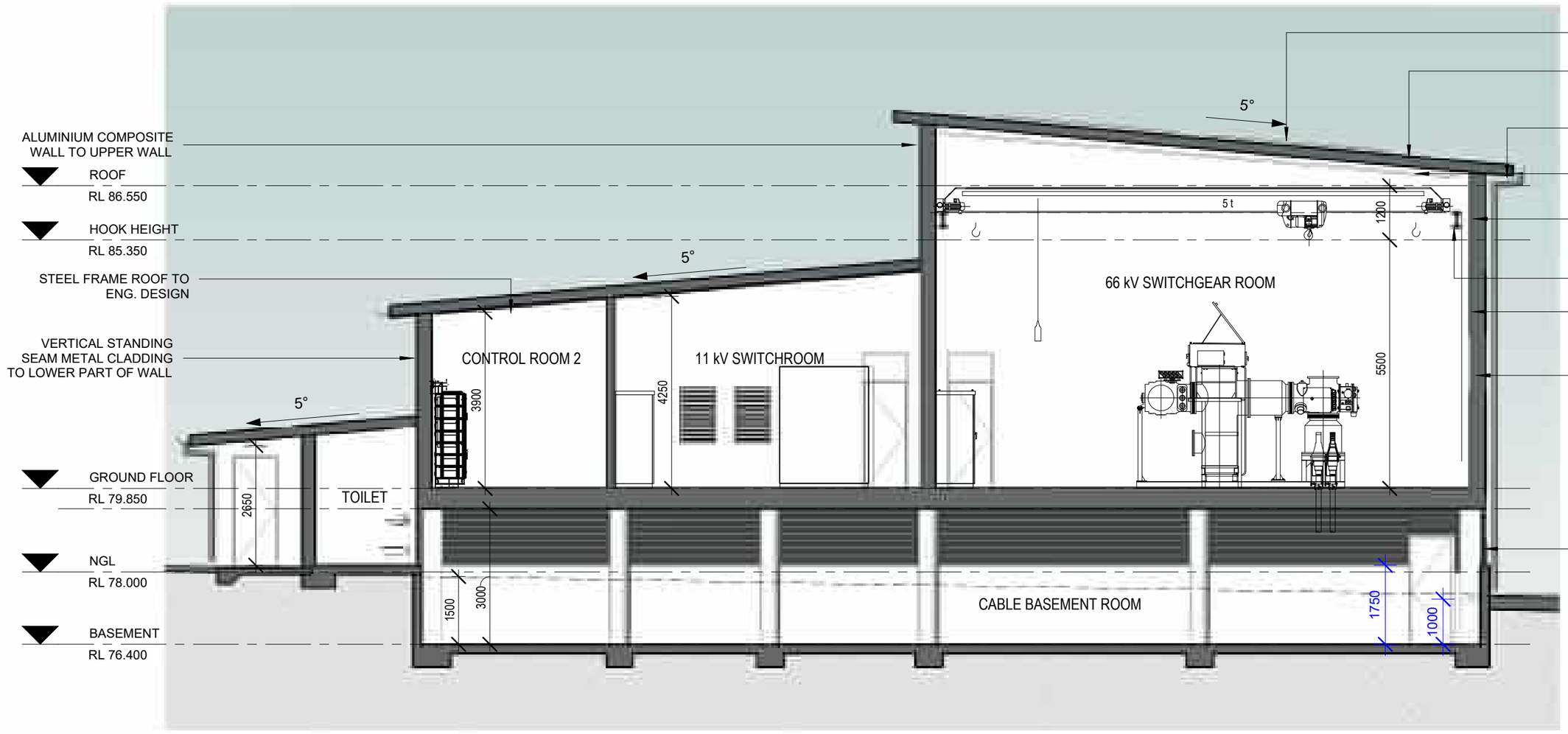
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1 | SECTION 2

SCALE 1 : 100

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Client

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Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

BUILDING SECTION 2

North

Scale

1 : 100@A3

Date

July 2024

Job No.

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Drawing No.

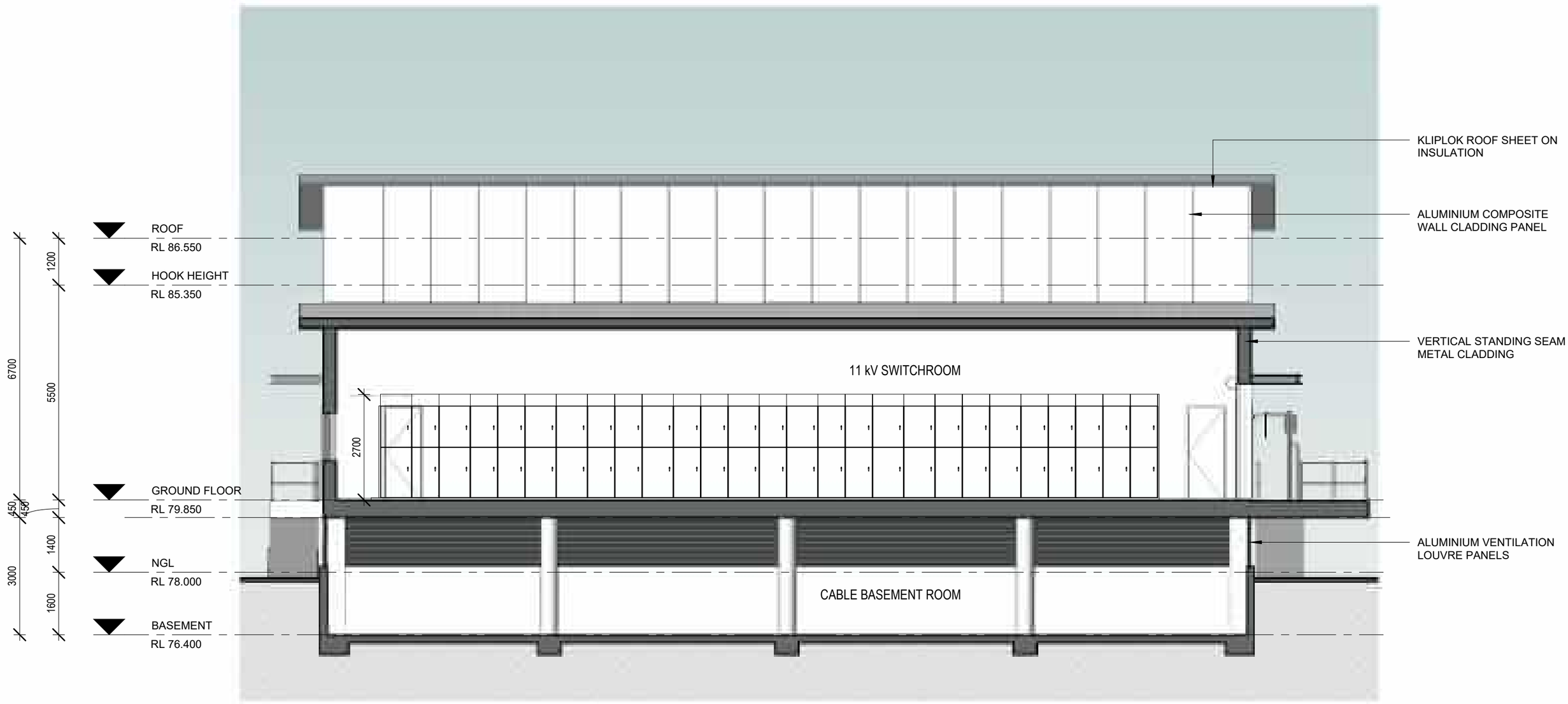
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1 | SECTION 3

SCALE 1 : 100

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Consultants

Client

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Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

BUILDING SECTION 3

North

Scale

1 : 100@A3

Date

July 2024

Job No.

24_6614

Drawing No.

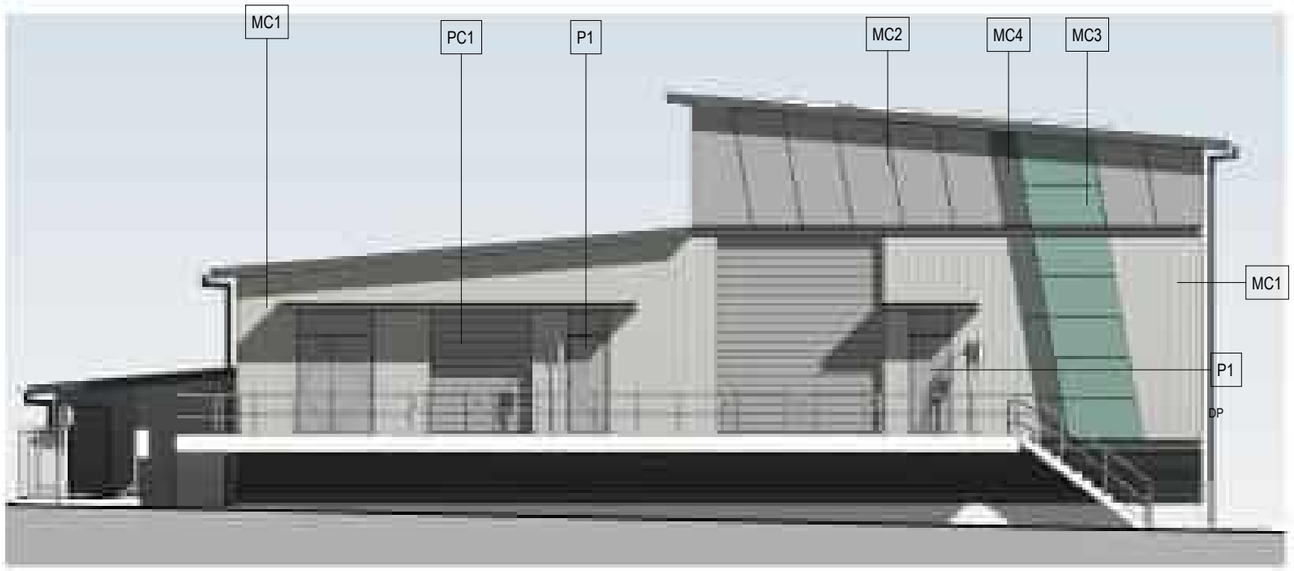
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MATERIALS FINISHES

MC1 MD1		COLORBOND 'SOUTHERLY'
MS1		COLORBOND 'BLUEGUM' ROLLER SHUTTER
MC2		ALPOLIC 'DARK GRAY METALLIC'
MC3		ALPOLIC 'GREEN METALLIC'
MC4		ALPOLIC 'MANGANESE METALLIC'
MC5		COLORBOND 'BLUEGUM'
GALV		GALVANISED STEEL
C1		NATURAL CONCRETE FINISH
P1		DULUX 'ENDLESS DUSK'
PC1		POWDER COATED PAINT FINISH TO MATCH COLOURBOND 'BLUEGUM"
PC2		POWDER COATED PAINT FINISH TO MATCH COLOURBOND 'WOODLAND GREY'

1 | ELEVATION 3 - SOUTH EAST FINISHES

SCALE1 : 150

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Client: Endeavour Energy

Project: MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing: FINISHES SCHEDULE

North

Scale: As indicated@A3

Date: July 2024

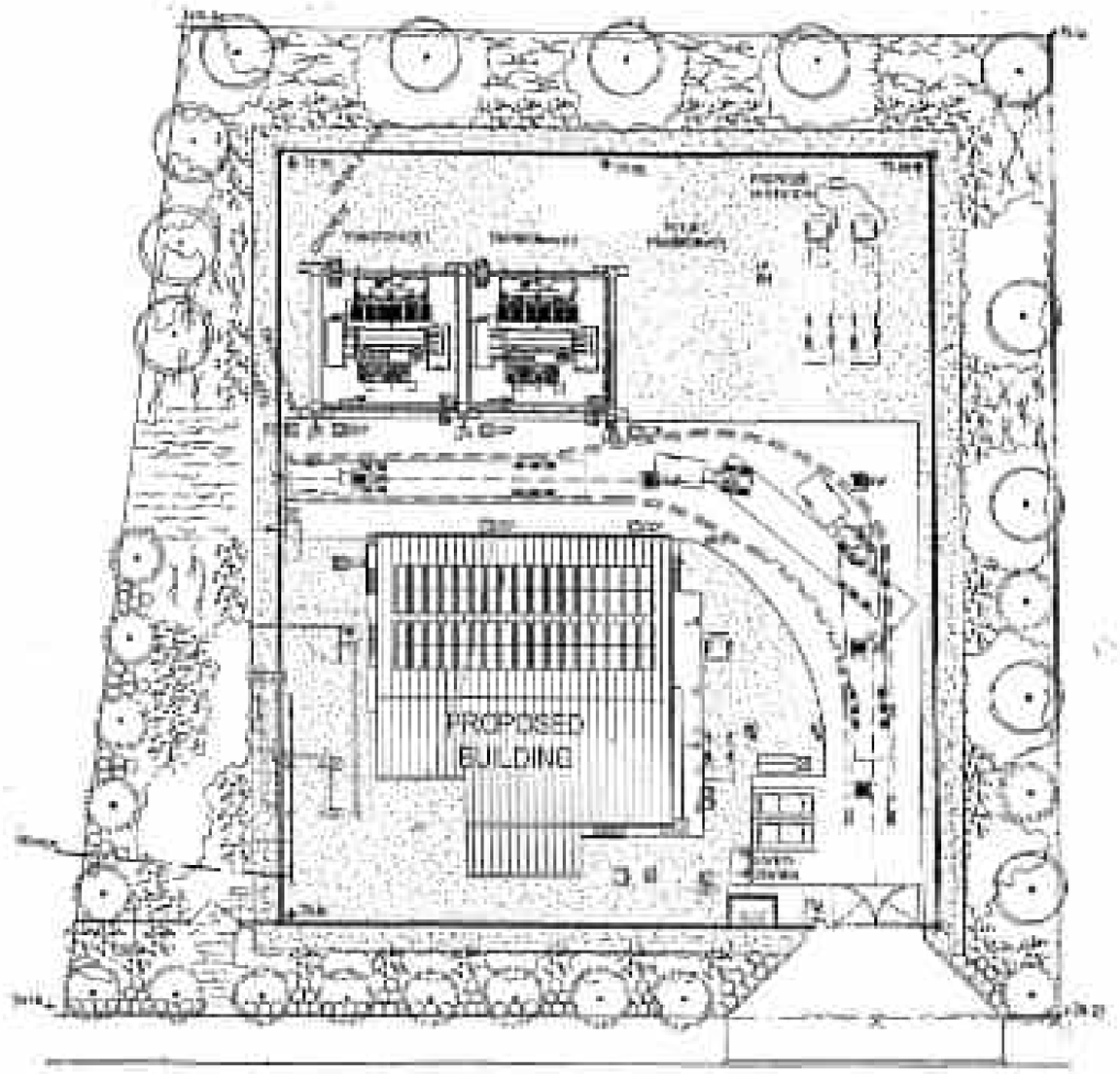
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1	16.07.24	ISSUED FRO APPROVAL

Consultants

Client

Endeavour Energy

Project

MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

LANDSCAPE PLAN

North

Scale

1 : 500@A3

Date

July 2024

Job No.

24_6614

Drawing No.

LA-01 / 1

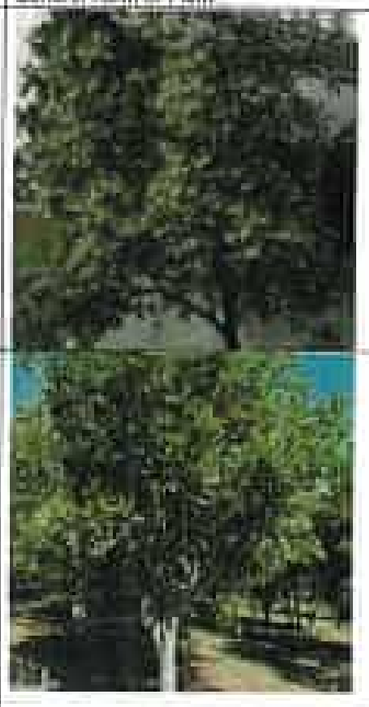
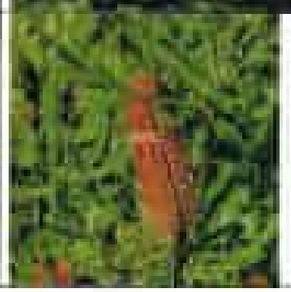
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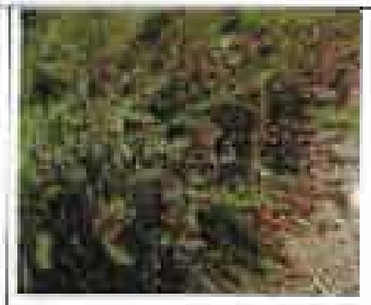
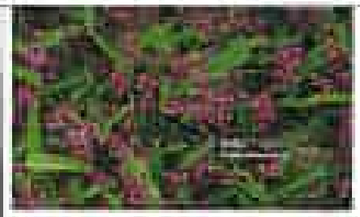
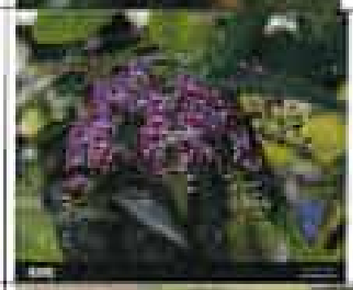
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MENANGLE PARK SUBSTATION PRELIMINARY PLANT SCHEDULE

Tall trees (Eucalyptus, Angophora spp) not selected or proposed as their canopies within a 28 metre wide planting zone are likely to extend over the substation compound, and present maintenance risk

	General Form of Plant	Detail of foliage
Elaeocarpus reticulatus Blueberry Ash Tree to 8m x 5m		
Elaeocarpus eumundianus Tuckeroo Select as single stem specimens Tree to 8m x 5m		
Leptospermum polygalifolium Screening shrub to 3.0m CH		
Banksia ericifolia Heath Banksia Screening hedge shrub to 4m		

Elaeocarpus reticulatus Blueberry Ash Tree to 8m x 5m		
Correa alba Correa Groundcover to 0.5m x 1.0m		
Chrysocephalum apiculatum Yellow Buttons Groundcover/ ground cover GR		
Grevillea speciosa Native Fuchsia Screening/ groundcover up to 2 m x 2 m per plant. Bushy leaves with fine resistant spikes.		

Brewster Murray

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MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

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PLANTING SCHEDULE - SHEET 1

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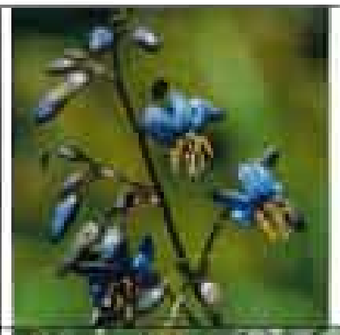
Dianella Caerulea

Blue Flax Lily

Rush form to 600mm

Use in combination with





Lomandra longifolia

Mat rush

Rush form to 500mm

Both plants have good resistance to grass and bush fires





Casuarina glauca "Tamba"

Tamba

Bush form to 750mm







NOTES

Existing plants have been selected on the basis of their suitability to the area, their availability, and their resistance to bush fires and grass fires. Plant selection is all low maintenance native material.

The area has been noted as being subject to bushfires and fire exposure is to the north and eastern margins of the site. For this reason, planting to the north and east includes a predominance of ground cover material, with trees spaced well apart to avoid overlapping of canopies.

Scramblers and rushes as ground cover have been recommended in place of indigenous native grasses which are noted for grass fire risk.

It is noted that the development is of an fill and this material should be placed to allow for cultivation and integration with suitable topsoil, to allow for development of planting.

brewster murray

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MENANGLE PARK ZONE SUBSTATION

FITZPATRICK STREET, MENANGLE PARK

Drawing

PLANTING SCHEDULE - SHEET 2

North

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Appendix B Consideration of State and Commonwealth environmental factors

EP&A Regulation section 171(2) factors

The following factors, listed in section 171(2) of the EP&A Regulation, have been considered to assess the likely impacts of the proposal on the natural and built environment. This consideration is required to comply with sections 5.5 and 5.7 of the EP&A Act.

Table A1: Consideration of section 171 of the EP&A Regulation factors

Factor	Impact
Environmental impact on the community.	Construction of the proposal would result in some short-term negative impacts due to visual amenity impacts, traffic disruptions and predicted noise impacts. This would be short-term negative (minor) impacts. During operation, there would be minor impacts from noise and visual factors, however, there is an existing mobile substation at the ZS location, therefore the visual impacts would be minimal. Noise impacts would be managed and mitigated through safeguards in **Table 5-20**. The proposal would overall have a positive long-term impact as it will support future communities with access to electrical power.
The transformation of the locality.	The construction of the proposal would result in temporary impacts for the existing locality, predominantly through negative visual impacts as identified above. As there is an existing mobile substation at the proposed ZS location, there is no long-term transformational impacts and the impacts would be minimised through the implementation of safeguards (**Table 6-1**).
Any environmental impact on the ecosystems of the locality.	The proposal would likely result in some short-term negative impacts due to the possible noise, dust and light disturbance to the surrounding environment during both construction and operation. As the ToS concluded (**Appendix D**), there will be no significant environment impact of the proposal on the vegetation. Mitigation measures outlined in **Table 6-1** would help to reduce any potential long-term environment impacts on the ecosystems of the locality.
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality.	The proposal would lead to some temporary negative aesthetic impacts due to visual amenity and heavy vehicle movement. Operation visual impacts would be minor negative impacts due to visual amenity and changes to traffic movements. The impact of the aesthetic, recreational, scientific or other environmental quality or value of the locality is to be negligible to minor and any impacts would be managed through safeguards outlined in **Table 5-29**.
Any effect on any locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations.	Nil. There are no buildings present within the proposal site. No items or places of significance will be impacted by this proposal.
Any impact on the habitat of protected fauna (within the meaning of the *Biodiversity and Conservation Act 2016*).	The proposal would not have a significant impact on the habitat of protected fauna within the proposal site. It is likely that habitat outside of the proposal site would experience negligible indirect impacts created by noise, dust and light spill during construction. This may deem such habitats unsuitable for certain species. These will be managed through the implementation of safeguards (**Table 5-5**).
Any endangering of a species of animal, plant or other form of	The proposal is not expected to endanger any species of animal, plant or other form of life, whether living on land, in water or in the air due to the low

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Factor	Impact
life, whether living on land, in water or in the air.	significance of the ecological area within the site boundary and the implementation of safeguards outlined in **Table 5-5.**
Any long-term effects on the environment	There is no vegetation clearance as part of this proposal. In the long-term, the proposal will provide access to electricity to the community and is, therefore, positive.
Any degradation of the quality of the environment.	Given the proposal site is already cleared and levelled for the existing mobile substation, there is no vegetation clearance proposed in this scope of works and, therefore, there is no expected degradation of the quality of the environment.
Any risk to the safety of the environment.	Safety risks would be limited primarily to the decommission stage and the construction stage of the proposal. Environmental management plans and work health and safety plans would be implemented by the principal contractor to minimise any safety risk during the construction of the proposal.
Any reduction in the range of beneficial uses of the environment.	No reduction in the range of beneficial uses is predicted.
Any pollution of the environment.	The proposal would have the potential to result in some minor, negative short-term water quality impacts resulting from sediments, waste, and spilt fuels and chemicals associated with the proposal. Management of water quality impacts would be undertaken in accordance with the safeguards outlined in **Table 5-6**.
Any environmental problems associated with the disposal of waste	Waste would be managed in accordance with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act (2001)*. It is not anticipated that there would be problems encountered with the disposal of waste.
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply.	It is unlikely that required resources would be in short supply.
The cumulative environmental effect with other existing or likely future activities.	There are no anticipated cumulative impacts with other existing or likely future activities, as outlined in **Section 5.15**.
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions.	The proposal is not located within a coastal area.
Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1	The proposal, as described in **Section 2**, aligns with the local, regional and district strategic plans.
Other relevant environmental factors	In considering the potential impacts of this proposal, all relevant environmental factors have been considered (refer **Section 5**).

EPBC Act Matters of National Environmental Significance

Table A2 considers the relevant MNES under the EPBC Act, and whether the proposal should be referred to the Australian Government Department of Climate Change, Energy, the Environment and Water.

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Table A2: Matters of national environmental significance

Environmental factor	Impact
Any impact on a World Heritage property?	No world heritage properties are in proximity of the proposal. No impacts to world heritage properties are predicted
Any impact on a National Heritage place?	No national heritage places are in proximity of the proposal. No impacts to world national heritage places are predicted.
Any impact on a wetland of international importance (often called 'Ramsar' wetlands)?	No Ramsar wetlands are in proximity of the proposal. No impacts to Ramsar wetlands are predicted.
Any impact on nationally threatened species, ecological communities or migratory species?	No EPBC listed threatened species, ecological communities or migratory species were identified as occurring within the study area or as being impacted by the proposal (refer **Section 4.2**.)
Any impact on a Commonwealth marine area?	No Commonwealth marine areas are in proximity of the proposal. No impacts to Commonwealth marine areas are predicted.
Does the proposal involve a nuclear action (including uranium mining)?	The proposal does not involve a nuclear action.
Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	The proposal will not have an impact on the environment of Commonwealth land.

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Appendix C Community notification letter

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Endeavour Energy
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T 131 003
Level 40-42, 8 Parramatta Square
10 Darcy Street
Parramatta NSW 2150
PO Box 811, Seven Hills NSW 1730

17 January 2025

UPCOMING WORK IN YOUR AREA

Dear Neighbour,

Improving electricity supply in your area

Endeavour Energy is responsible for building, maintaining and operating an electricity network that connects 2.7 million people to traditional and renewable energy sources in homes and businesses across Sydney's Greater West, the Blue Mountains, Southern Highlands, the Illawarra and the South Coast.

We're focused on providing reliable electricity supply as we continue to invest in the upgrade of electricity infrastructure leveraging the latest technology to build a safer, reliable and more resilient network.

Electricity supply to the Greater Macarthur Area - Menangle Zone Substation & Feeder Upgrade

Endeavour Energy supply electricity to the Greater Macarthur Area and require upgraded feeders within existing transmission lines to meet increasing electricity demand throughout the Southern Macarthur Growth Area. To complete this, Endeavour Energy propose to construct a new zone substation at the existing Menangle substation site at 45 Fitzpatrick Street, Menangle Park NSW.

The transmission line will also be replaced with a new 66K feeder to support increased supply, following rezoning of the area to establish new homes, and local centres. The proposed feeder will traverse through several lots and will run along Glenlee Road, Menangle Park NSW.

Attached are the zone substation design and feeder route designs for your reference.

Key features of the proposal include:

- Establishing a laydown area and installing environmental controls including erosion and sediment controls and fencing;
- Removal of vegetation;
- Civil works including achieving site design levels, trenching, installation of concrete footings for infrastructure;
- A new driveway to the site;
- Construction of a new 66/11kV zone substation zone including:
  - Lightning protection (including lightning pole) and insulation;
  - Fire management system, hydrant system and deluge showers;
  - Communications systems including an antenna mounted on 15m concrete pole;
- Landscaping & onsite parking area.
- A new 66kV feeder 85U from Macarthur Bulk Supply Point to the new Menangle Park zone substation via trenching;
- Decommission existing mobile zone substation by relocating decommissioned equipment and removing facilities associated with the mobile zone substation.

Review of Environmental Factors

Endeavour Energy will conduct a thorough evaluation of the project including environmental, technical, financial, and impacts on the community. In line with the NSW Environmental Planning and Assessment Act 1979 (EP&A Act), Endeavour Energy are preparing a draft Review of Environmental Factors (REF) which will outline:

- the proposal description and justification (including benefits and objectives)
- an overview of the relevant legislative framework
- consultation completed during the assessment phase
- consideration of alternatives
- the environmental impact assessment and mitigation measures to be applied during construction and operation of the proposal.

The initial draft of the Review of Environmental Factors related to this proposal will be available online at the Endeavour Energy website once completed.

If approved, a Decision Statement, containing the development consent conditions and authorising the construction works, will be issued by Endeavour Energy for the development and will be available online.

About the work ahead – timing and construction impacts

Subject to planning approvals, we plan to start work by mid-2025 and be operational by the end of 2027. This timeline may be subject to changes due to unforeseen factors like adverse weather conditions. The expected construction work hours include standard weekday hours (7am – 6pm) and Saturdays (7am – 3pm). Works on Sundays, public holidays or out of hours are not anticipated.

The work involved should not require any power outages at your property other than for a short period of time when generators are connected. Prior notification will be given for any outages.

Road users might experience occasional disruptions while the work is in progress. To manage this, traffic control measures will be enforced as necessary. If construction activities are scheduled near your property, we will ensure you receive advanced notice via SMS and/or post. We will also put in place measures to limit disruption as much as possible.

Questions or concerns

Community input and feedback is important and encouraged throughout the course of this project. For further information, or to provide feedback, please visit our website (linked above) and do not hesitate to contact me within the next 21 days referencing “Menangle Zone Substation Feeder Upgrade”.

Michelle Butler
Environmental Specialist

131003
environment@endeavourenergy.com.au

Attachments

Attachment 1 – Zone substation design

Attachment 2 – Feeder route design

Attachment 1 – Zone substation design

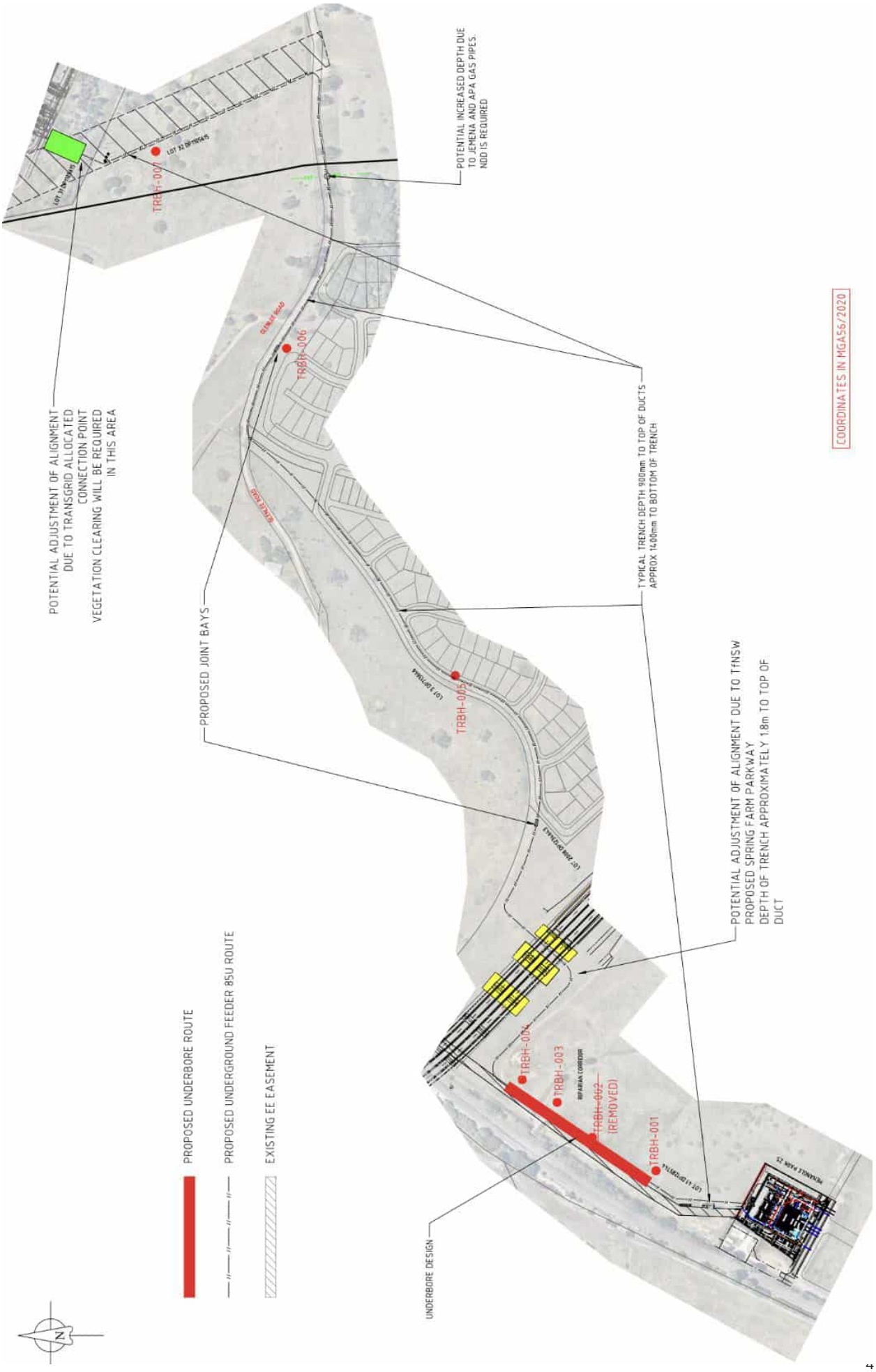
Existing view: Menangle Substation on Fitzpatrick Street:



Proposed view: Upgraded Menangle Zone Substation on Fitzpatrick Street:



Attachment 2 – Feeder route design



Appendix D Biodiversity Assessment Report

DRAFT

Biodiversity Assessment Report

Menangle Park Zone Substation

Prepared by: Jack Tatler
Draft Report: January 2025

East Coast Ecology



Document Control

Project Title: Menangle Park Zone Substation

Project Manager: Jack Tatler BSc *(Zoology & Entomology), Honours (Zoology), PhD (Ecology)*
Principal Ecologist & Accredited Assessor BAAS21006

Version	Author	Reviewer	Date
Draft v1.0	Jack Tatler (BAAS21006)	Alex Graham (BAAS19040)	24 January 2025

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East Coast Ecology Pty Ltd (ABN: 66 652 418 623)

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GLOSSARY

Abbreviation	Definition
asl	Above sea level
BAM	Biodiversity Assessment Method 2020
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BDAR	Biodiversity Development Assessment Report
BOM	Bureau of Meteorology
CEEC	Critically Endangered Ecological Community
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPE	Department of Planning and Environment
DPHI	Department of Planning, Housing and Infrastructure
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
ECE	East Coast Ecology
EP&A Act	*Environmental Planning & Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
ha	Hectares
KFH	Key Fish Habitat
km	Kilometres
LGA	Local Government Area
Locality	The same meaning when describing a local population of a species or local occurrence of an ecological community.
m	metres
mm	millimetres
MNES	Matters of National Environmental Significance
NSW	New South Wales
PCT	Plant Community Type
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
Subject Land	The land depicted in **Figure 1.**
TEC	Threatened Ecological Community

i. Details and Experience of Author/s and Contributors

Name	BAM Assessor Accreditation no.	Position/ Role	Tasks Performed	Relevant Qualifications
Jack Tatler	BAAS21006	Principal Ecologist	Project management, field surveys, report preparation	*BSc (Zoology & Entomology), Hons (Zoology), PhD (Ecology)*
Alex Graham	BAAS19040	Principal Ecologist	Document review	*BSc (Biology), Grad. Dip. (Bushfire Protection)*

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1. INTRODUCTION

1.1 The Proposed Activity

Endeavour Energy (EE) propose to establish a permanent 66/11kV 35MVA Menangle Park Zone Substation (ZS). The substation will strengthen reliability and service the large-scale infrastructure development in the Menangle Park region in line with NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) plans. The new substation will enhance the supply security and reliability of new developments by providing a diversified 33kV supply and associated fibre optic network.

The new substation will be supplied by two 66kV feeders; the existing feeder 85P and a new feeder 85U from Macarthur Bulk Supply Point (BSP). The scope also includes removing the temporary 66/11kV mobile substation from Menangle Park ZS.

East Coast Ecology Pty Ltd (ECE) was commissioned by JBS&G on behalf of EE to prepare a Biodiversity Assessment Report (BAR), including 5-Part Test and Assessment of Significance, for the proposed works associated with the development of the Menangle Park Zone Substation.

1.1.1 The Subject Land

The construction footprint assessed within this report is referred to as the 'Subject Land' and has been defined using the Site Layout provided by JBS&G. The Subject Land is approximately 2.1km in length and spans from the temporary Menangle Park Zone Substation in the south to the Macarthur Bulk Supply Point in the north. The location of the Subject Land is shown in **Figure 1**.

1.1.2 Location

The Subject Land is situated within the Campbelltown City Council Local Government Area (LGA) and is located within the suburb of Menangle Park. The Subject Land occurs within the 'Cumberland' Biogeographic Regionalisation for Australia (IBRA) Subregion, within the Sydney Basin IBRA Bioregion (**Figure 2**). The Wingecarribee LGA is located approximately 47km southwest of Sydney CBD.

1.2 Scope of Assessment

The overarching objective of this assessment was to evaluate the ecological values that occur within the Subject Land and identify how the proposal satisfies the relevant planning framework. This report discerns the likelihood of occurrence of any threatened entities (i.e. ecological communities and species) listed under the *Biodiversity Conservation Act 2016* (NSW) (BC Act) and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The full scope of the assessment included:

- Background research to determine the likelihood for NSW and/ or Commonwealth threatened biota to occur within the Subject Land during any point of their lifecycle
- Assess any potential impacts to species and/ or communities listed under the BC Act and EPBC Act
- Establishing the likelihood of occurrence and assess any potential impacts to species and/or communities listed under the BC Act, FM Act and EPBC Act
- Identifying and mapping the distribution of vegetation communities within the Subject Land

- Recording presence and the extent of any known or potential fauna habitat features such as nests, dreys, caves, crevices, culverts, pools, soaks, flowering trees, fruiting trees or hollow-bearing trees and provide recommendations for on-going management of these habitat features and any fauna present
- Determining potential ecological impacts or risks that may result due to the proposed works, and
- Recommendation of any controls or additional actions to be taken to protect or improve environmental outcomes of the proposal.

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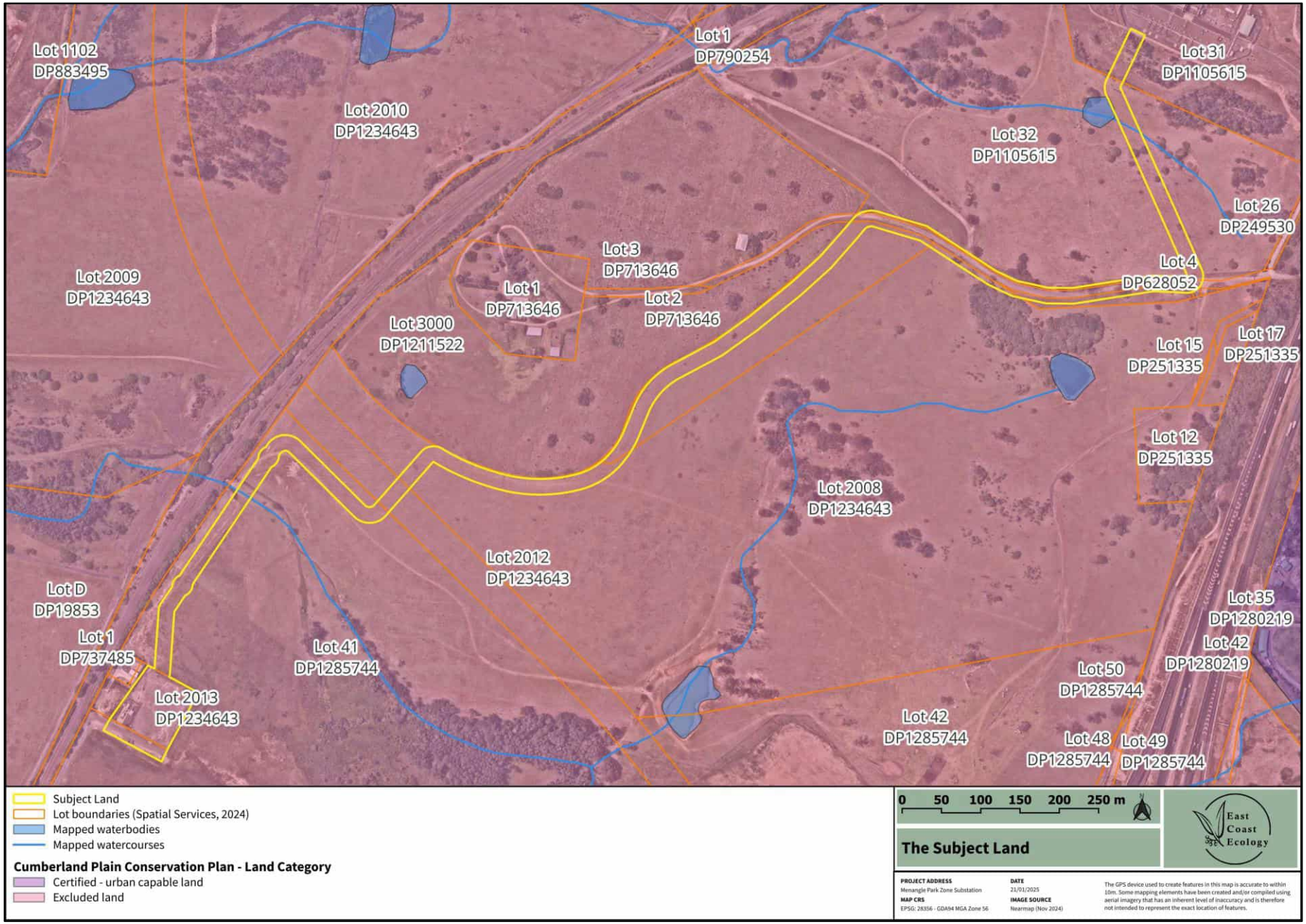


Figure 1. The location of the Subject Land.

1.3 Legislative Context

1.3.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

The Commonwealth EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places which are considered Matters of National Environmental Significance (MNES). Under the EPBC Act, approval is required for actions that have, will have, or are likely to have a significant impact on MNES.

Several EPBC listed threatened species have potential to utilise the Subject Land. The proposed activity will not result in a 'significant impact' on any MNES and a referral to the Australian Government Minister for the Environment is not required.

1.3.2 *Environmental Planning and Assessment Act 1979* (NSW)

The *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) establishes the system of environmental planning and assessment in NSW. The proposed activity is being assessed under Division 5.1 of the EP&A Act via a Review of Environment Factors (REF). This report provides input into the REF and environmental impact assessment process by providing assessment specific to matters of biodiversity.

An REF has been prepared to satisfy Endeavour Energy's duties under s.5.5 of the EP&A Act to "examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity" and s.5.5 in making decisions on the likely significance of any environmental impacts. This BAR forms part of the REF being prepared for Menangle Park Zone Substation project and assesses the biodiversity impacts of the proposed activity to meet the requirements of the EP&A Act.

1.3.3 *Biodiversity Conservation Act 2016* (NSW)

The BC Act (NSW) seeks to conserve biological diversity and promote ecologically sustainable development, to prevent extinction and promote recovery of threatened species, populations and ecological communities and to protect areas of outstanding biodiversity value.

Several BC Act listed threatened species have the potential to occur within, or utilise, the Subject Land. The BC Act requires that the significance of the impact on threatened species, populations and threatened ecological communities is assessed using the test listed in Section 7.3 of the BC Act. Where a significant impact is likely to occur, a Species Impact Statement (SIS) must be prepared in accordance with the Environment Agency Head's requirements, or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM) (DPIE, 2020a). The proposed activity will not result in a 'significant impact' on any threatened entities and therefore the Biodiversity Offset Scheme is not triggered (**Appendix C**). As such, an SIS or a BDAR is not required. The Subject Land is not located within any Areas of Outstanding Biodiversity Value.

1.3.4 Biosecurity Act 2015 (NSW)

The *Biosecurity Act 2015* (NSW) provides a framework for the prevention, elimination and minimisation of biosecurity risks posed by an activity as a matter of biosecurity. As defined in Part 3, section 23 of this Act, any non-conformance by an individual is defined as guilty of an offence.

Five (5) priority weeds for the South East region (DPI, 2025) were identified within, or adjacent to, the Subject Land:

- *Carduus nutans* subsp*. nutans* (Nodding Thistle)
- *Olea europaea* subsp*. cuspidata* (African Olive)
- *Rubus fruticosus* species aggregate (Blackberry)
- *Senecio madagascariensis* (Fireweed), and
- *Lycium ferocissimum* (African Boxthorn).

Priority weeds must be managed in accordance with the *Biosecurity Act 2015* (NSW). Suitable mitigation measures (**Section 7.2**) have been provided to appropriately manage weeds within the impact areas in accordance with the Act.

1.3.5 Water Management Act 2000 (NSW)

The main objective of the *Water Management Act 2000* (NSW) (WM Act) is to manage NSW water in a sustainable and integrated manner that will benefit today's generations without compromising future generations' ability to meet their needs. Section 91E of the Act establishes an approval regime for controlled activities within waterfront land. However, clause 41 of the Water Management (General) Regulation 2018 provides an exemption for public authorities in relation to all controlled activities on waterfront land. Therefore, approval under the WM Act is not required.

1.3.6 Fisheries Management Act 1994 (NSW)

The *Fisheries Management Act 1994* (NSW) (FM Act) aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations including conserving fish stocks and key fish habitats and promoting ecologically sustainable development.

Key Fish Habitat (KFH) occurs in the southern extent of the Subject Land (**Figure 2**). The proposed activity involves works that will be undertaken underneath KFH and does not require works within any Key Fish Habitat. Marine vegetation protected under the FM Act does not occur within the Subject Land. Given the type of construction proposed, the activity is unlikely to impact upon KFH, nor are there are any legislative requirements or notifications required under this Act.

1.3.7 State Environmental Planning Policy (Resilience and Hazards) 2021

The State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP) commenced on the 1st of March 2022 and replaces the following former SEPPs:

- State Environmental Planning Policy (Coastal Management) 2018
- State Environmental Planning Policy 33 – Hazardous and Offensive Development, and
- State Environmental Planning Policy 55 – Remediation of Land.

The Subject Land is not situated within the 'Coastal Zone' therefore this SEPP does not apply.

2. METHODOLOGY

2.1 Limitations

Not all flora and fauna species could be directly surveyed for during the site assessment. These species include nocturnal fauna and cryptic flora with flowering times outside of the survey period. The presence of nocturnal and cryptic species was assessed based on habitat constraints and historical records. The northern most section of the Subject Land could not be accessed and have been surveyed from a distance (i.e. not ground truthed) (**Figure 4**).

2.2 Permits and Licences

The biodiversity assessment was conducted under the terms of ECE's Scientific Licence issued by the NSW Department of Planning and Environment (SL102667). Fauna survey was conducted under approval RVF22/2367 from the NSW Animal Care and Ethics Committee.

2.3 Background Research

A thorough literature review of local information relevant to the Subject Land was undertaken. Searches using NSW Wildlife Atlas (BioNet) (NSW DCCEEW, 2025a) and the Commonwealth Protected Matters Search Tool (PMST) (DCCEEW, 2025) were conducted to identify all current threatened flora and fauna, as well as migratory fauna records, within a 5km radius of the Subject Land. These data were used to assist in establishing the presence or likelihood of any ecological values as occurring on or adjacent to the Subject Land and helped inform our ecologists on what to look for during the site assessment.

Soil landscape and geological mapping, as well as existing vegetation mapping, were examined to assist in determining whether any threatened flora or ecological communities could be present. The following technical resources were utilised in the preparation of this report:

- State and Commonwealth datasets:
    - EPBC Protected Matters Search Tool (DCCEEW, 2025)
    - NSW BioNet. The website of the Atlas of NSW Wildlife (NSW DCCEEW, 2025a)
    - NSW BioNet. Threatened Biodiversity Data Collection (NSW DCCEEW, 2025b)
    - NSW BioNet. Vegetation Classification System (NSW DCCEEW, 2025c)
    - NSW Government Spatial Services: Search and Discovery - Historical, Aerial and Satellite Imagery (Spatial Services, 2025a)
    - NSW Government Spatial Services: Six Maps Clip & Ship (Spatial Services, 2024b)
    - BAM Important Habitat Maps
    - Key Fish Habitat Maps – Hawkesbury-Nepean (DPI, 2025b)
- Vegetation and soil mapping:
    - The NSW State Vegetation Type Map (NSW DCCEEW, 2025d)
    - eSPADE v2.2.0 (NSW DCCEEW, 2025e)

- NSW State guidelines:
    - Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method (DPIE, 2020b)
    - Threatened Species Survey and Assessment: Guidelines for developments and activities. Working Draft (DEC, 2004b)

Species from both the BioNet and PMST online searches were combined to produce a list of threatened species, populations and communities that are likely to occur within the Subject Land (**Appendix B**).

2.4 Native Vegetation, Threatened Ecological Communities and Vegetation Integrity Methods

2.4.1 Existing Information

A review of the State Vegetation Type Map (NSW DCCEEW, 2025d) was used to assist in the identification of Plant Community Types (PCTs) within and surrounding the Subject Land. The PCT of 'best-fit' was determined based on the floristic descriptions within the Vegetation Classification System database (NSW DCCEEW, 2025c).

2.4.2 Mapping Native Vegetation Extent

The extent of native vegetation within the Subject Land was determined through a field assessment with the aid of a GPS-enabled tablet.

2.5 Threatened Flora Survey Methods

2.5.1 Review of Existing Information

Threatened flora with potential to occur within the Subject Land and immediate surrounds were identified following review of BioNet and the PMST. Soil mapping (NSW DCCEEW, 2025e) and topography (Google Earth) were also used to provide further context on habitat constraints for threatened flora.

2.5.2 Field Surveys

To determine whether any threatened flora or their habitats were present, a survey was undertaken by meandering throughout the Subject Land and in areas of native vegetation, using parallel field traverses in accordance with the 'Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method' (DPIE, 2020b).

2.6 Threatened Fauna Survey Methods

2.6.1 Review of Existing Information

Threatened fauna with potential to occur within the Subject Land and immediate surrounds were identified following review of BioNet and the PMST. Soil mapping (NSW DCCEEW, 2025e) and topography (Google Earth) were also used to provide further context on habitat constraints for threatened fauna.

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2.6.2 Habitat Constraints

A field survey was undertaken to identify any habitat constraints (e.g. waterbodies, rocky areas, tree hollows), including microhabitat, present within the Subject Land and immediate surrounds. Potential habitat constraints within the broader area (500m buffer) were assessed using Google Earth, historical aerial imagery (Spatial Services, 2025a), soil landscape mapping (NSW DCCEEW, 2025e) and recent vegetation mapping (NSW DCCEEW, 2025d).

2.6.3 Field Surveys

No targeted surveys for fauna were undertaken. To determine whether any threatened fauna species were likely to occur, targeted habitat surveys were undertaken by meandering throughout the Subject Land.

2.7 Weather Conditions

Surveys were undertaken on the 16th of December 2024 within and immediately surrounding the Subject Land. Weather conditions taken from the nearest weather station (Campbelltown (Mount Annan) (station 068257)) in the lead up and during the field survey are outlined in **Table 1**.

Table 1. Weather conditions taken from the nearest weather stations (station 068239) in the lead up and during the field survey (BOM, 2024).

Timing/activities	Date	Day	Temperature		Rainfall (mm)
			Min	Max	
Lead up to the survey	09/12/2024	Monday	17.3	24.5	0.6
	10/12/2024	Tuesday	16.3	27.9	0.2
	11/12/2024	Wednesday	16.9	27.8	0.2
	12/12/2024	Thursday	14.2	32.3	0
	13/12/2024	Friday	15.9	35.1	0
	14/12/2024	Saturday	19.9	31.1	0
	15/12/2024	Sunday	18.3	30.6	0
Vegetation mapping, flora survey and fauna habitat survey	16/12/2024	Monday	19.0	34.0	0

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3. SITE CONTEXT

3.1 Landscape Features

3.1.1 Rivers, streams, estuaries and wetlands

One unnamed mapped watercourse (4th order stream), and its riparian buffer, bifurcates the southern extent of the Subject Land (**Figure 2**). The watercourse, which runs under the train line through a box culvert, was degraded as a result of livestock activity and contained only a small amount of water at the time of the assessment (**Photo 1**). In addition, one unnamed mapped watercourse (1st order stream), and its riparian buffer, bifurcates the northern extent of the Subject Land. The northern extent of the Subject Land was not accessible on the day of the field survey and the presence of this watercourse could not be confirmed.



Photo 1. Unnamed watercourse that bifurcates the Subject Land.

3.1.2 Topography, Geology and Soils

The elevation within the Subject Land broadly grades from approximately 77m above sea level (asl) in the southern extent to approximately 115m asl in the northern extent. The Subject Land is situated across three soil landscapes: South Creek, Blacktown and Luddenham (NSW DCCEEW, 2025e).

South Creek is characterised by active floodplains of many drainage networks of the Cumberland Plain. Blacktown and Luddenham are characterised by gently undulating rises on Wianamatta Group shales, with Luddenham often associated with Minchinbury Sandstone.

3.1.3 Karst, Caves, Crevices, Cliffs, Rocks or Other of Geological Features of Significance

The Subject Land did not contain areas of geological significance (karsts, caves, cliffs and crevices). Areas of geological significance (e.g. cliffs and caves) are unlikely to be present within the locality based on a review of topographical mapping. A large box culvert occurs just west of the Subject Land (allowing the unnamed watercourse to flow into the Nepean River).

The Subject Land, or surrounding area, was not mapped as occurring on acid sulfate soils nor mapped as having risk/ probability of exhibiting occurrence of acid sulfate soils.

3.1.4 Areas of Outstanding Biodiversity Value

No Areas of Outstanding Biodiversity Value occur on the Subject Land or surrounding area.

3.1.5 NSW (Mitchell) Landscapes

Mitchell Landscapes (Mitchell, 2002) groups ecosystems into meso-ecosystems representing larger natural entities based on topography and geology. The naming of ecosystems and meso-ecosystems was standardised so that each name provided location information and a meaningful descriptive landscape term. The Subject Land occurs across the 'Cumberland' and 'Hawkesbury - Nepean Channels and Floodplains' Mitchell Landscape Ecosystem (**Figure 2**).

3.1.5.1 Cumberland

Low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline. Intruded by a small number of volcanic vents and partly covered by Tertiary river gravels and sands (Hawkesbury-Nepean Terrace Gravels landscape). Quaternary alluvium along the mains streams. General elevation 30 to 120m, local relief 50m. and sometimes affected by salt in tributary valley floors. Pedal uniform red yellow harsh texture-contrast soils in valleys. Woodlands and open forest of Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Cabbage Gum (*Eucalyptus amplifolia*) and Broad-leaved Apple (*Angophora subvelutina*). Grassy to shrubby understorey often dominated by Australian Boxthorn (*Bursaria spinosa*), poorly drained valley floors, often salt affected with Swamp Oak (*Casuarina glauca*) and paperbark (*Melaleuca* sp.).

3.1.5.2 Hawkesbury - Nepean Channels and Floodplains

Meandering channel and moderately wide floodplain of the Hawkesbury and Nepean rivers on Quaternary sand and gravel. Sand is dominant upstream of the Warragamba River junction, general elevation 0 to 20m, local relief <10m. Undifferentiated alluvial sand to poorly structured gradation profiles of sandy loam or clay loam. Forests on the river flats include Blue Box (*Eucalyptus baueriana*), Broad-leaved Apple (*Angophora subvelutina*), Manna Gum (*Eucalyptus viminalis*), River Peppermint (*Eucalyptus elata*) in upstream sectors and dominated by River Oak (*Casuarina cunninghamiana*) possibly originally with rainforest species such as white cedar (*Melia azedarach*) in the lower sectors. Common Reed (*Phragmites*

australis), Cumbungi (*Typha orientalis*) and other aquatic plants are found in the river. Deep organic loams and loamy sands on floodplain with river flat forest of Sydney Blue Gum (*Eucalyptus saligna*), Round-leaved Gum (*Eucalyptus deanei*), Forest Red Gum (*Eucalyptus tereticornis*), Cabbage Gum (*Eucalyptus amplifolia*), Broad-leaved Apple, Rough-barked Apple (*Angophora floribunda*) and River Oak. Water Gum (*Tristaniopsis laurina*) in protected channel sections. Large swamps and lagoons on the floodplain and in tributary streams below Richmond dammed by levees on the main stream support Tall Spike Rush (*Eleocharis sphacelata*), *Juncus* sp., *Melaleuca* sp., and *Lepidosperma* sp. Below Pitt Town the river is tidal and Swamp Oak (*Casuarina glauca*), Common Reed, River Mangrove (*Aegiceras corniculatum*), Grey Mangrove (*Avicennia marina*) and limited salt marsh are found on the muddy sands of the inter-tidal zone.

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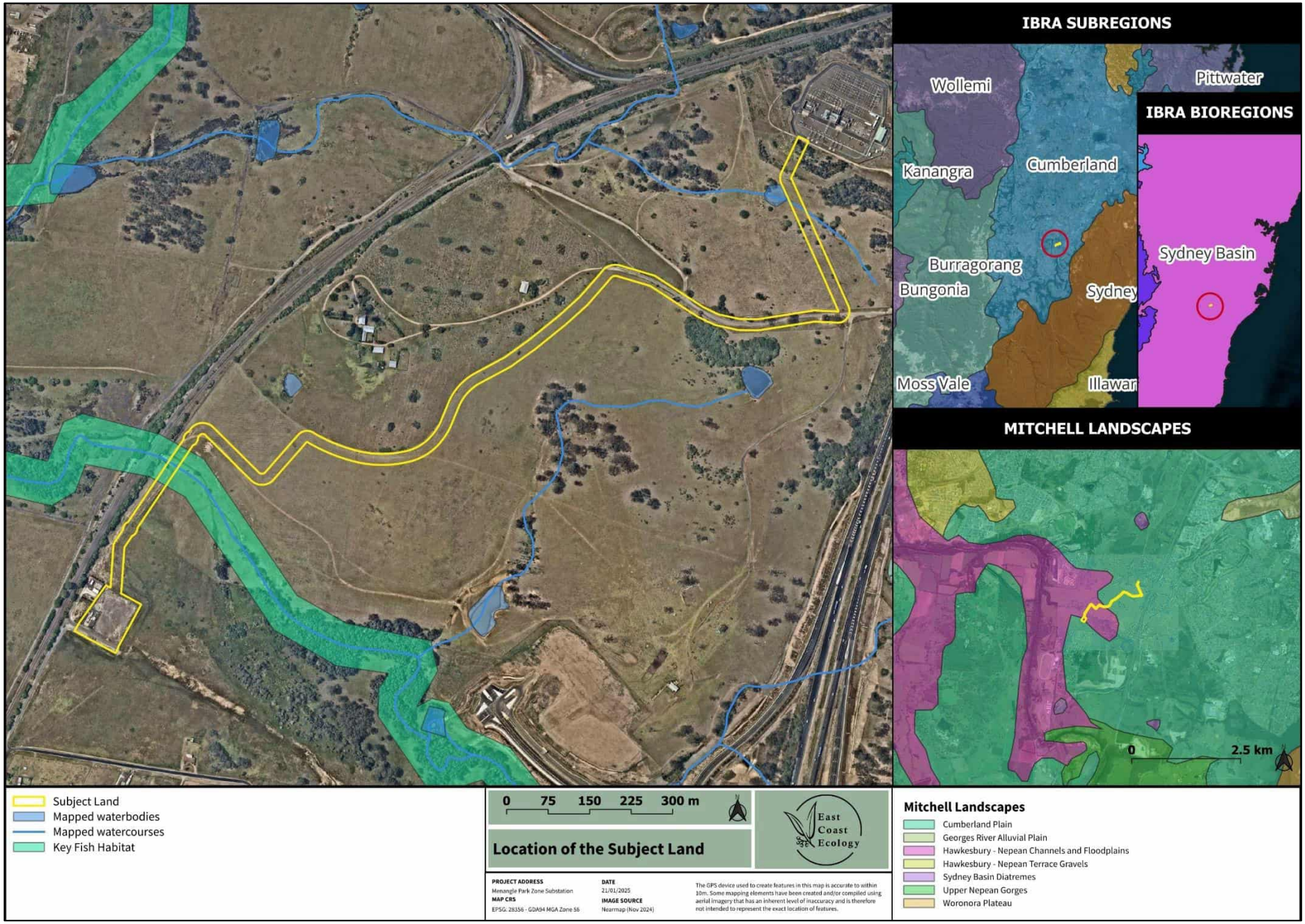


Figure 2. The location of Subject Land within the broader context.

4. RESULTS: NATIVE VEGETATION

4.1 Plant Community Types

4.1.1 Historically Mapped Vegetation

The State Vegetation Type Map (NSW DCCEEW, 2024d) indicated the presence of two Plant Community Types (PCT) in proximity to the Subject Land:

- PCT 3319: Cumberland Shale Hills Woodland, and
- PCT 3320: Cumberland Shale Plains Woodland.

The State Vegetation Type Map is presented in **Figure 3**.

4.1.2 Field-validated Vegetation

Site assessment by ECE confirmed the presence of one PCT:

- PCT 3320: Cumberland Shale Plains Woodland.

Vegetation within the Subject Land has been assessed as aligning with the BioNet Vegetation Classification PCT identified within **Table 2**. Native vegetation assigned to PCT 3320 was stratified into two vegetation zones based on varying condition classes:

- Vegetation zone 1: PCT 3320 (canopy), and
- Vegetation zone 2: PCT 3320 (poor condition grassland).

The vegetation zones within the Subject Land are detailed in **Table 3** and displayed in **Figure 4**.

Table 2. Vegetation identified within the Subject Land.

PCT ID	PCT Scientific Name	Area within the Subject Land
3320	Cumberland Shale Plains Woodland	3.93ha
	Total Area	**3.93ha**

4.1.2.1 Description of PCT 3320 in BioNet

A tall sclerophyll open forest or woodland with a sparse mid-stratum of soft-leaved shrubs and small trees with a grassy ground cover on the undulating Wianamatta Group shale plains of western Sydney. The canopy very frequently includes *Eucalyptus tereticornis* and *Eucalyptus moluccana*, with ironbarks (*Eucalyptus crebra* and *Eucalyptus fibrosa*) occasionally present and sometimes prominent in localised areas. The sparse shrub to small tree layer very frequently includes Bursaria spinosa and one or more species of Acacia, of which *Acacia parramattensis*, *Acacia decurrens* and *Acacia falcata* are the most frequent and abundant. Presence of these Acacia species helps to distinguish this PCT from the related PCT 3319 on rises of the southern Cumberland Plain which typically includes *Acacia implexa*. The mid-dense ground layer typically includes grasses, forbs, twiners and hardy small ferns. *Microlaena stipoides* is almost always present and *Themeda triandra, Dichondra repens, Brunoniella australis, Cheilanthes sieberi* subsp. *sieberi*, *Desmodium varians, Aristida vagans* and *Glycine tabacina* are very frequent. This is the most

widespread PCT on the Cumberland Plain, occupying much of the plain between Bankstown and the Hawkesbury and Nepean rivers. It typically occurs in a warm, moist climate below 120 metres asl however can occur up to 200 metres asl on the undulating terrain between Douglas Park and Campbelltown to the east of the Nepean River. A northern outlier occurs near Maroota on a small remnant on a narrow shale ridge. While widespread on the main part of the plain, this PCT primarily occurs in small, often disturbed patches within a rural or urban matrix. In the hilly country to the west of the Nepean River, this PCT is replaced by PCT 3319. On thinner shales above sandstone around the periphery of the Cumberland Plain, it grades into PCT 3321. Ironbarks are very frequent and Eucalyptus punctata is common in the canopy of PCT 3321, and Eucalyptus moluccana and Eucalyptus tereticornis are both rare.

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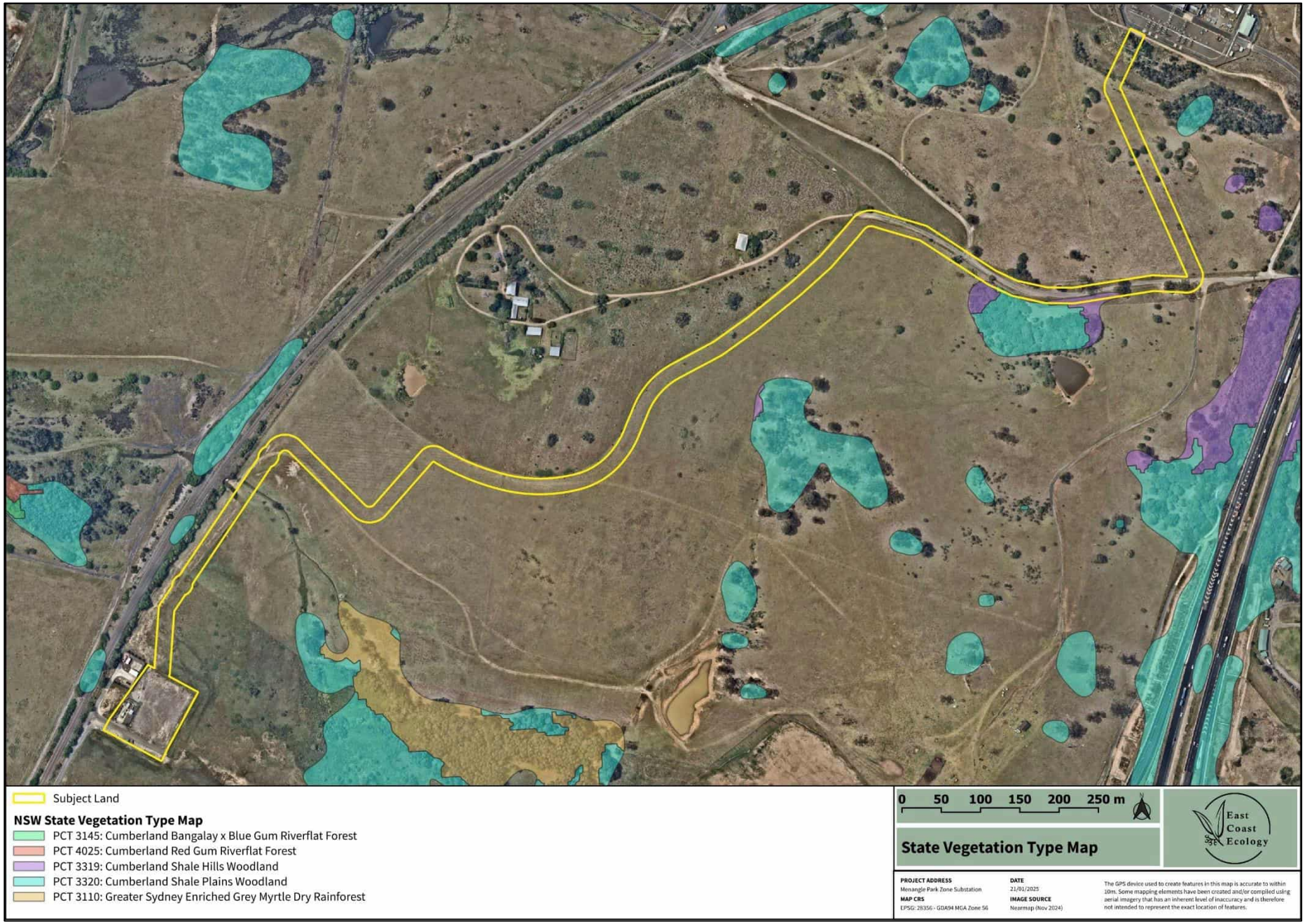


Figure 3. Vegetation communities surrounding the Subject Land.

Table 3. Description of vegetation zone 1: PCT 3320 (canopy) within the Subject Land.

PCT 3320: Cumberland Shale Plains Woodland (vegetation zone 1)	
	
Vegetation Formation	Grassy woodlands
Extent within Subject Land (approximate)	0.12ha
Description of vegetation zone 1: PCT 3320 (canopy) within the Subject Land	
The vegetation within vegetation zone 1 was in poor condition, consisting of *Eucalyptus tereticornis* and *Eucalyptus moluccana* over an exotic dominated understorey. The understorey was dominated by exotic species and environmental weeds including *Olea europaea* subsp. *cuspidata*, *Paspalum urvillei, Eragrostis curvula, Sida rhombifolia, Modiola caroliniana, Hypericum perforatum, Setaria parviflora, Senecio madagascariensis* and *Rubus fruticosus* species aggregate. Scattered occurrences of *Themeda triandra, Microlaena stipoides, Sporobolus creber*, *Dichondra repens* and *Cynodon dactylon* were recorded.	
Groundwater Dependent Ecosystems (GDE)	Assessment of the potential for the Subject Land to support groundwater dependent ecosystems was carried out using the Commonwealth's Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (BOM, 2025a). No terrestrial groundwater dependent ecosystems are mapped within the Subject Land.
BC Act 2016 Status	Cumberland Plain Woodland in the Sydney Basin Bioregion – Critically Endangered Ecological Community (CEEC)
EPBC Act 1999 Status	Does not conform (see **section 4.2.2**)

Table 4. Description of vegetation zone 2: PCT 3320 (poor condition grassland) within the Subject Land.

PCT 3320: Cumberland Shale Plains Woodland (vegetation zone 2)	
	
Vegetation Formation	Grassy woodlands
Extent within Subject Land (approximate)	3.81ha
Description of vegetation zone 2: PCT 3320 (poor condition grassland) within the Subject Land	
The vegetation within this zone was severely degraded consisting primarily of environmental and priority weeds. This zone was dominated by species including *Paspalum urvillei, Eragrostis curvula, Sida rhombifolia, Modiola caroliniana, Hypericum perforatum, Setaria parviflora, Senecio madagascariensis, Rubus fruticosus* species aggregate, *Plantago lanceolata* and *Bromus catharticus*. Scattered occurrences of *Themeda triandra, Microlaena stipoides, Sporobolus creber*, *Dichondra repens, Einadia hastata, Juncus* spp. and *Cynodon dactylon* were recorded.	
Groundwater Dependent Ecosystems (GDE)	Assessment of the potential for the Subject Land to support groundwater dependent ecosystems was carried out using the Commonwealth's Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (BOM, 2025a). No terrestrial groundwater dependent ecosystems are mapped within the Subject Land.
BC Act 2016 Status	Cumberland Plain Woodland in the Sydney Basin Bioregion – CEEC
EPBC Act 1999 Status	Does not conform (see **section 4.2.2**)

4.2 Threatened Ecological Communities

4.2.1 *Biodiversity Conservation Act 2016* - Cumberland Plain Woodland in the Sydney Basin Bioregion

PCT 3320: Cumberland Shale Plains Woodland is associated with the BC Act listed CEEC, Cumberland Plain Woodland in the Sydney Basin Bioregion. The Final Determination for this community outlines that it is associated with clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain and typically occurs on flat to undulating or hilly terrain up to about 350m elevation but may also occur on locally steep sites and at slightly higher elevations (Scientific Committee, 2009). Vegetation within zones 1 and 2 occur on Wianamatta shale and occur at an elevation between 75m and 115m asl. The mean annual rainfall of this area is typically in the range of 700-900mm, and is generally lower than that received on more elevated terrain that partially surrounds the Plain (Scientific Committee, 2009). The mean annual rainfall at Campbelltown (Station 068081) is 829mm. Characteristic canopy species detailed in the Final Determination were recorded within vegetation zone 1. The community also includes 'derived' native grasslands which result from removal of the woody strata from the woodlands and forests. Vegetation zone 2 consisted primarily of exotic species, including improved pasture, although scattered occurrences of characteristic CPW species were recorded. Although vegetation zone 2 had no canopy or shrubs species, and only scattered occurrences of characteristic CPW groundlayer species, it has been classified as the CEEC with an abundance of caution.

4.2.2 *Environmental Protection and Biodiversity Conservation Act 1999* - Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

PCT 3320: Cumberland Shale Plains Woodland is associated with the EPBC Act listed CEEC, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. The Approved Conservation Advice for this community lists key diagnostic attributes and condition thresholds to determine whether the federal listing applies to an ecological community, both of which must be met for listing under the EPBC Act. Vegetation within zones 1 and 2 do not meet the key diagnostics and minimum condition thresholds. Less than 30% of the understorey cover was made up of native species.

4.3 Wildlife Connectivity Corridors

The Subject Land occurs within a rural landscape which provides minimal wildlife connectivity (**Figure 2**). Vegetation within and surrounding the Subject Land exists primarily as exotic species and is highly degraded and fragmented.

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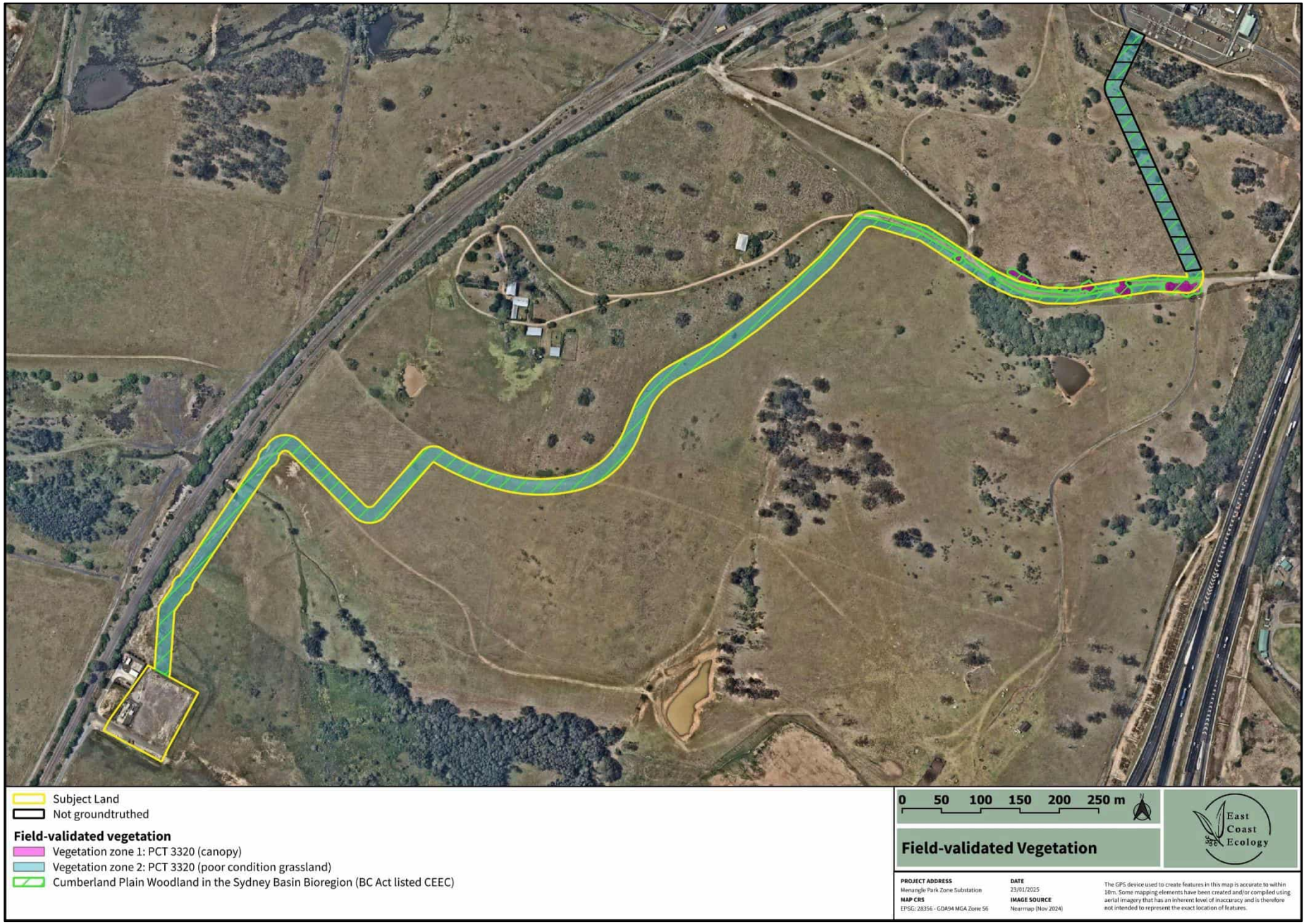


Figure 4. Field-validated vegetation communities.

5. RESULTS: THREATENED SPECIES

5.1 Threatened Flora

Database searches revealed 11 threatened flora have been recorded within a ~5km radius of the Subject Land (**Table 5**).

Table 5. Threatened flora records within ~5km of the Subject Land.

Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
Eucalyptus benthamii	Camden White Gum	CE	CE	2
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	7
Hibbertia puberula	-	E	-	16
Isotoma fluviatilis subsp. *fluviatilis*	-	CE	CE	1
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	EP	-	8
Persoonia hirsuta	Hairy Geebung	E	E	1
Pimelea spicata	Spiked Rice-flower	E	E	854
Pomaderris brunnea	Brown Pomaderris	E	V	36
Prostanthera marifolia	Seaforth Mintbush	CE	CE	1
Pterostylis saxicola	Sydney Plains Greenhood	E	E	34
Thesium australe	Austral Toadflax	V	V	1

V – Vulnerable; E – Endangered; EP – Endangered Population; CE – Critically Endangered

Based on habitat constraints or following the field survey (**Appendix B**), no threatened flora species were considered likely to occur within the Subject Land. In the event that any of these species existed on the Subject Land, it is not expected that the activity would pose a significant impact to a viable local population, on the basis that impacts will be minor, similar habitat will continue to exist in the locality and mitigation measures proposed in this report are adhered to (**Section 7.2**). Further assessment is provided in **Appendix B** of this report.

5.2 Threatened Fauna

Database searches revealed 40 threatened fauna have been recorded within a ~5km radius of the Subject Land (**Table 6**).

Table 6. Threatened fauna records within ~5km of the Subject Land.

Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
Anthochaera phrygia	Regent Honeyeater	CE	CE	3
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	114
Calidris canutus	Red Knot	-	E	8
Callocephalon fimbriatum	Gang-gang Cockatoo	E	E	14
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V	V	2
Cercartetus nanus	Eastern Pygmy-possum	V	-	1
Chalinolobus dwyeri	Large-eared Pied Bat	E	E	7
Circus assimilis	Spotted Harrier	V	-	1
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	V	2
Daphoenositta chrysoptera	Varied Sittella	V	-	50
Dasyurus maculatus	Spotted-tailed Quoll	V	E	1
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	1
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	8
Gallinago hardwickii	Latham's Snipe	V	V	17
Glossopsitta pusilla	Little Lorikeet	V	-	26
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	12
Hieraaetus morphnoides	Little Eagle	V	-	13
Hirundapus caudacutus	White-throated Needletail	V	-	1
Lathamus discolor	Swift Parrot	E	CE	178
Litoria aurea	Green and Golden Bell Frog	E	V	3
Lophoictinia isura	Square-tailed Kite	V	-	9
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	129
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	23
Miniopterus australis	Little Bent-winged Bat	V	-	11
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	17
Myotis macropus	Southern Myotis	V	-	15

Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
Neophema pulchella	Turquoise Parrot	V	-	1
Ninox connivens	Barking Owl	V	-	1
Ninox strenua	Powerful Owl	V	-	12
Petauroides volans	Southern Greater Glider	E	E	1
Petaurus norfolcensis	Squirrel Glider	V	-	1
Petroica boodang	Scarlet Robin	V	-	10
Phascolarctos cinereus	Koala	E	E	524
Pommerhelix duralensis	Dural Land Snail	E	E	1
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	158
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	4
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	8
Stagonopleura guttata	Diamond Firetail	V	V	2
Stictonetta naevosa	Freckled Duck	V	-	1
Tyto novaehollandiae	Masked Owl	V	-	2

V – Vulnerable; E – Endangered; EP – Endangered Population; CE – Critically Endangered

Based on a lack of habitat and/ or historical records, no threatened fauna were considered likely to be impacted by the activity. Further assessment is provided in **Appendix B** of this report. Details of the threatened fauna habitat recorded within the Subject Land are included in **Table 7**.

5.2.1 Threatened Fauna Habitat

Details of the threatened fauna habitat recorded within the Subject Land are included in **Table 7**. Potential breeding habitat, or other important habitat, identified within the Subject Land is discussed below.

5.2.1.1 Watercourses and Waterbodies

Two mapped watercourses occur within the Subject Land, one of which was identified during field surveys and the other was not groundtruthed. The groundtruthed watercourse was chocked with exotic vegetation however some native ground covers were scattered throughout (**Photo 1**). The watercourse is unlikely to provide habitat for threatened fauna species owing to its level of degradation and constant presence of livestock.

5.2.1.2 Hollow-bearing Stags

Two hollow-bearing stags were identified within the Subject Land (**Photo 2**). These hollow-bearing stags contained a range of hollows including 1 x small, 3 x medium, 1 x large and 1 x extra large hollows. It is possible that some of these hollows could provide potential breeding habitat for threatened birds and

mammals, although no signs of breeding were detected during the field survey. The small and medium hollows may be occasionally used for roosting by threatened microbats (e.g. Southern Myotis).



Photo 2. Example of a hollow-bearing stag within the Subject Land.

Table 7. Fauna habitat values identified within the Subject Land.

Habitat component	Subject Land
Coarse woody debris	Minor occurrence.
Rock outcrops and bush rock	Minor occurrence.
Caves, crevices and overhangs	Absent.
Culverts, bridges, mine shafts, or abandoned structures	Absent. One large box culvert was located outside of the Subject Land.
Nectar/lerp-bearing Trees	Minor occurrence – *Eucalyptus* spp.
Nectar-bearing shrubs	Absent.
Koala Use Trees	Minor occurrence – *Eucalyptus* spp.
Large stick nests	Absent.
Sap and gum sources	Minor occurrence – *Eucalyptus* spp.
She-oak fruit	Absent – *Casuarina* spp. present outside of the Subject Land.
Seed-bearing trees and shrubs	Minor occurrence – *Eucalyptus* spp.

Habitat component	Subject Land
Soft-fruit-bearing trees/shrubs	Present. African Olive and Blackberry
Dense shrubbery and leaf litter	Absent.
Tree hollows	Present – 2 stags with 1 x small, 3 x medium, 1 x large and 1 x extra large hollows
Decorticating bark	Absent.
Wetlands, soaks, and streams	Present – two streams. *Gambusia holbrooki* were observed in the stream in the southern extent of the Subject Land.
Open water bodies	Absent.
Estuarine, beach, mudflats, and rocky foreshores	Absent.

5.3 Migratory Species

Database searches revealed three migratory terrestrial species, or their habitat, are known to occur within the Subject Land (**Table 8**). These species do not breed in Australia.

Table 8. Migratory terrestrial species with potential to occur in the Subject Land.

Species	EPBC Act Status
Cuculus optatus (Oriental Cuckoo)	Migratory, CAMBA, JAMBA, ROKAMBA
Hirundapus caudacutus (White-throated Needletail)	Vulnerable, Migratory, CAMBA, JAMBA, ROKAMBA
Motacilla flava (Yellow Wagtail)	Migratory, CAMBA, JAMBA, ROKAMBA

CAMBA = China-Australia Migratory Bird Agreement, JAMBA = Japan-Australia Migratory Bird Agreement, ROKAMBA = Republic of Korea-Australia Migratory Bird Agreement and Bonn = Convention on the Conservation of Migratory Species of Wild Animals.

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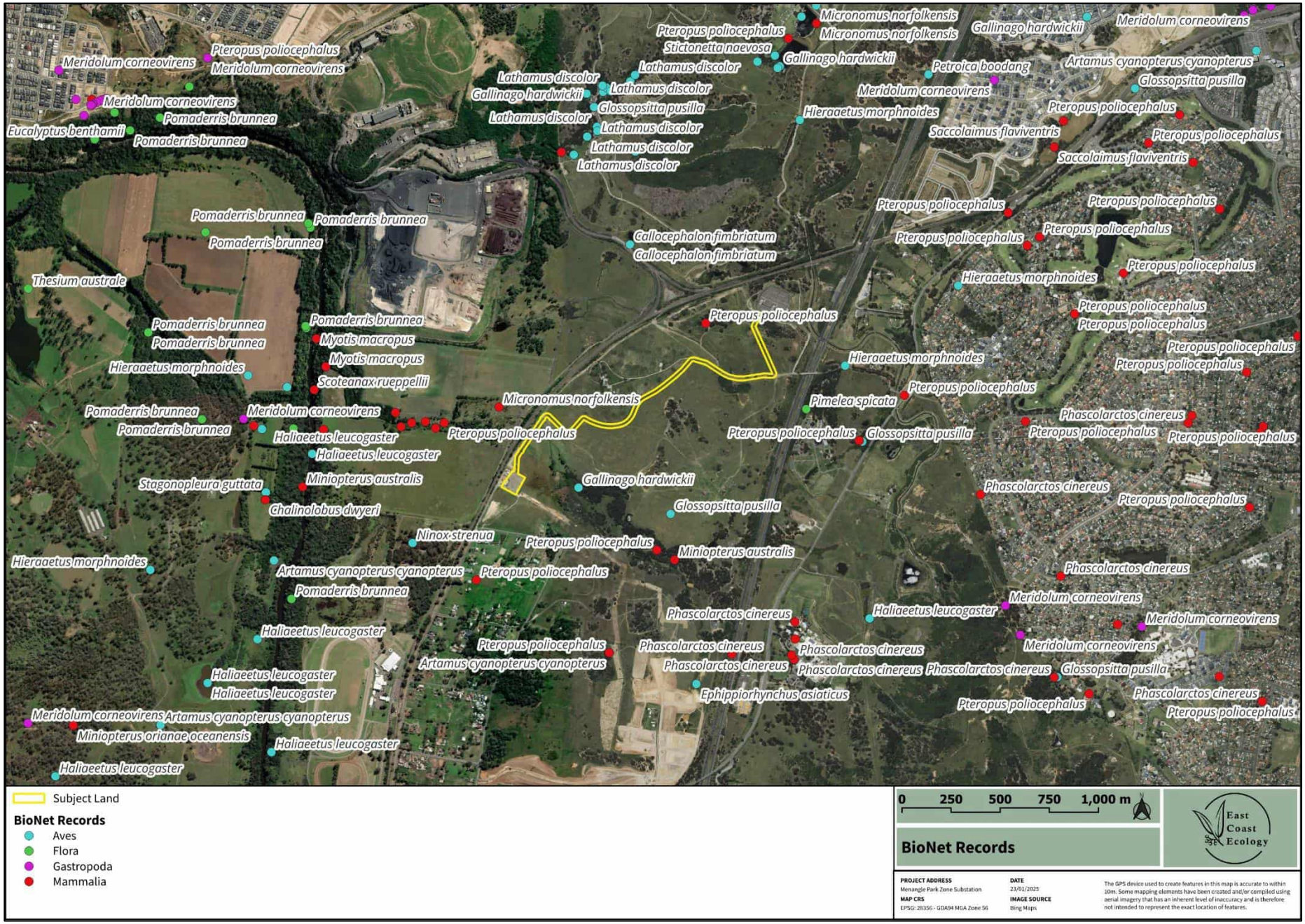


Figure 5. Threatened species records (historical) within proximity to the Subject Land.

6. IMPACT SUMMARY

6.1 Impacts to Plant Community Types

The primary direct ecological impact of the activity is clearing of native vegetation. The proposed activity will result in the removal of 3.93ha of degraded PCT 3320: Cumberland Shale Plains Woodland. Vegetation within the Subject Land was in poor condition due to historical clearing and invasion of environmental and priority weeds. Native tree removal will be avoided where possible.

6.2 Impacts to Fauna Habitat

All vegetation proposed for removal provides minor foraging habitat for a suite of protected fauna species. Sensitive and/ or specialist fauna habitats are unlikely to be directly impacted by the proposed activity. Impacts to hollow-bearing stags will be avoided wherever possible.

6.3 Impacts to Threatened Species and Communities

No threatened species were identified within the Subject Land during the field survey, nor were considered likely to occur or be impacted by the proposed activity.

One BC Act listed TEC was identified within the Subject Land:

- Cumberland Plain Woodland in the Sydney Basin Bioregion.

This TEC is listed as an CEEC under the BC Act, as detailed within **section 4.2.1**.

The proposed activity will result in the removal of approximately 3.93ha of the BC Act listed community. The result of a Test of Significance (5-Part Test) under the BC Act was that the proposed activity will not have a significant impact on this ecological community (**Appendix C**).

6.3.1 Wildlife Connectivity and Habitat Fragmentation

The Subject Land consists of agricultural land that has already fragmented the landscape. Historical clearing already presents a barrier to the movement for terrestrial and arboreal mammals, reptiles and amphibians.

The proposed activity is unlikely to cause further habitat fragmentation.

6.3.2 Fauna Injury and Mortality

The removal of 3.93ha of degraded understorey vegetation is unlikely to result in fauna injury and mortality. Targeted measures to mitigate potential impacts are discussed in **Section 7.2**.

6.4 Matters of National Environmental Significance

Under the EPBC Act, a proponent must not take an action if that action will have, or is likely to have a significant impact on MNES under the EPBC Act. The EPBC Act identifies eight (8) MNES:

1. World Heritage properties

2. National Heritage places
3. Wetlands of international importance (those listed under the Ramsar Convention)
4. Listed threatened species and communities
5. Migratory species listed under international agreements
6. Great Barrier Reef Marine Park
7. Commonwealth marine areas, and
8. Nuclear actions.

The Protected Matters Search Tool identified the following as potentially occurring within the Subject Land (or within the area):

- 10 Threatened Ecological Communities
- 67 threatened species, and
- 12 Migratory species.

No EPBC Act listed species are considered likely to occur or be impacted by the proposed activity. Therefore, a referral to the Australian Government Minister for the Environment will not be required.

6.5 Indirect and Operation Impacts

Indirect impacts occur when the proposal or activities relating to the construction or operation of the proposal affect native vegetation, threatened ecological communities and threatened species habitat beyond the Subject Land. Impacts may also result from changes to land-use patterns, such as an increase in vehicular access and human activity on native vegetation, threatened ecological communities and threatened species habitat. The indirect impacts of this proposed activity are outlined in **Table 9**.

Table 9. Indirect impacts associated with the proposal.

Potential Indirect Impact	Nature, extent and duration
Inadvertent impacts on adjacent habitat or vegetation	Impacts to adjacent vegetation can be prevented or minimised through appropriate exclusion fencing, implementation of a site-specific Construction Environmental Management Plan detailing best practice environmental protection measures, strict water quality practices and stormwater controls, and by ensuring any lighting is directed towards the developed area, rather than towards the adjacent vegetation.
Reduced viability of adjacent habitat due to edge effects	Adjacent habitats are currently subject to a degree of edge effects due to prior clearing and surrounding land use, as such an increase to edge effects is not expected to occur to the surrounding vegetation as a result of the proposed activity. The site assessment recorded environmental and priority weeds both within and adjacent to the Subject Land.

Potential Indirect Impact	Nature, extent and duration
Reduced viability of adjacent habitat due to noise, dust or light spill	It is predicted that adjacent habitat outside the Subject Land is likely to experience a negligible increase to indirect impacts created by noise, dust and light spill, during construction and operation of the future development of the Subject Land. Site lighting will be designed to minimise glare and light spillage into adjoining vegetation and be consistent with the requirements of Australian Standards and Guidelines 4282-2019 Control of the obtrusive effects of outdoor lighting. Additional control measures are to be installed to minimise glare and light spillage into adjoining vegetation to minimise potential impacts to fauna species and lighting is to be installed in a direction oriented away from the vegetation. These indirect impacts will be managed via best practices outlined in an approved Construction Environmental Management Plan. These impacts are not likely to substantially increase due to the proposed future development. Any potential impacts are not considered significant as it is highly unlikely that species abundance would be diminished.
Transport of weeds and pathogens from the site to adjacent vegetation	Weeds occurring within the Subject Land are common with those occurring within adjacent vegetation to be retained. Increased transport of pathogens and weeds is unlikely to occur, however this would be managed by biosecurity measures outlined in the Construction Environmental Management Plan.
Increased risk of starvation, exposure and loss of shade or shelter	It is highly unlikely that any threatened fauna would be exposed to increased risks from starvation, exposure, and loss of shade and shelter beyond the Subject Land as a result of the proposed activity. No habitat is to be removed beyond the Subject Land, although disturbances from noise during construction and utilisation may deem such habitats temporarily unsuitable for certain species.
Loss of breeding habitats	One large box culvert was identified immediately adjacent to the Subject Land however, it is unlikely that construction or operation would decrease its suitability as potential breeding habitat.
Trampling of threatened flora species	No impacts are expected to occur outside of the Subject Land.

Potential Indirect Impact	Nature, extent and duration
Increase in predatory species populations	It is likely that predatory species, such as foxes and cats, already inhabit areas surrounding the Subject Land. The vegetation clearance proposed by the activity is unlikely to increase predatory species populations.
Increase in pest animal populations	The Subject Land occurs in an area that likely has pest animal populations (e.g. feral cats, foxes, rabbits). The proposed activity would not result in an increase in available habitat for these species and is unlikely to lead to an increase in pest animal populations. Suitable waste disposal implemented during and post construction would further reduce the resources available for pest species.
Disturbance to specialist breeding and foraging habitat, e.g., beach nesting for shorebirds.	No specialist breeding and foraging habitat was identified adjacent to the Subject Land.

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7. AVOIDANCE, MINIMISATION & MITIGATION

7.1 Avoidance and Minimisation

When assessing the biodiversity impacts of a proposed activity there are three key considerations. These three approaches are listed in a descending order of best biodiversity outcomes:

- Avoid: measures taken by a proponent such as careful site selection, or actions taken through the design, planning, construction and operational phases of the development to completely prevent impacts on biodiversity values, or certain areas of biodiversity
- Minimise: a process applied throughout the development planning and design life cycle that seeks to reduce the residual impacts of development on biodiversity values
- Compensate: measures in a proposed activity to compensate for the biodiversity values lost. This can be achieved through offsets (financial or not).

The proposed activity has been sited in a historically cleared area, containing very low quality vegetation, to avoid impacting areas of higher biodiversity value. Tunnelling will be used under the 4th order watercourse to avoid impacting the riparian corridor. Laydown and storage areas will be positioned outside of native vegetation to avoid any additional impacts to native vegetation beyond the unavoidable impacts associated with the proposed activity. Tree or hollow removal has been avoided as part of detailed design.

7.2 Impact Mitigation and Minimisation Recommendations

This section of the report details recommended efforts to avoid and minimise impacts on biodiversity values associated with the proposed activity. Measures to be implemented before, during, and post construction are detailed in **Table 10**.

Table 10. Measures to be implemented before, during, and after construction to avoid and minimise the impacts of the proposed activity.

ID	Impact	Mitigation measure	Timing and duration	Responsibility
B01	Removal of native vegetation	Native vegetation removal will be minimised through detailed design.	Detailed design During construction	Endeavour Energy/ Contractor
B02		Field surveys to be conducted over the area not groundtruthed in December 2024. Field surveys should confirm vegetation mapping, identify whether any threatened species are present and mark any fauna habitat features.	Prior to construction	Endeavour Energy/ Contractor
B03		Pre-clearing surveys and final pre-clearing checks will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	Prior to construction	Endeavour Energy/ Contractor
B04		Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	During construction	Endeavour Energy/ Contractor
B05		An unexpected threatened species finds procedure is to be developed as part of the CEMP using the template in *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a). The procedure is to be followed if unexpected threatened	During construction	Endeavour Energy/ Contractor

ID	Impact	Mitigation measure	Timing and duration	Responsibility
		species or ecological communities not assessed in the biodiversity assessment, are identified within the Subject Land.		
B06		The following should be implemented as part of the CEMP: ▪ Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas ▪ Pre-clearing survey requirements ▪ Procedures for unexpected threatened species finds and fauna handling. ▪ Procedures addressing relevant matters specified in the DPI Policy and guidelines for fish habitat conservation and management (2013). ▪ Protocols to manage weeds, pathogens and pest species	During construction	Endeavour Energy/ Contractor
B07	Direct impacts to threatened species	Threatened fauna habitat removal will be minimised through detailed design.	Detailed design	Endeavour Energy/ Contractor
B08		Fauna encountered on-site during construction will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	During construction	Endeavour Energy/ Contractor

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ID	Impact	Mitigation measure	Timing and duration	Responsibility
B09		Habitat removal will be undertaken by staged clearing in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	During construction	Endeavour Energy/ Contractor
B10		Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Artificial hollows* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	During construction	Endeavour Energy/ Contractor
B11	Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	During construction	Endeavour Energy/ Contractor
B12	Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	During construction	Endeavour Energy/ Contractor
B13	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 7: Pathogen management* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport 2024a).	During construction	Endeavour Energy/ Contractor

8. CONCLUSION

The proposed activity will impact approximately 3.93ha of poor condition PCT 3320: Cumberland Shale Plains Woodland associated with BC Act listed EEC, Cumberland Plain Woodland in the Sydney Basin Bioregion. The removal of native trees and hollow-bearing stags will be avoided. No threatened species were considered likely to occur or be impacted by the proposed activity.

This assessment demonstrates that the relevant provisions of the *Environmental Planning and Assessment Act 1979, Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999* have been satisfied. If the appropriate recommendations in this report are followed, the proposed activity will have a non-significant impact to protected biodiversity and is unlikely to significantly impact any threatened ecological community or species.

9. REFERENCES

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APPENDICES

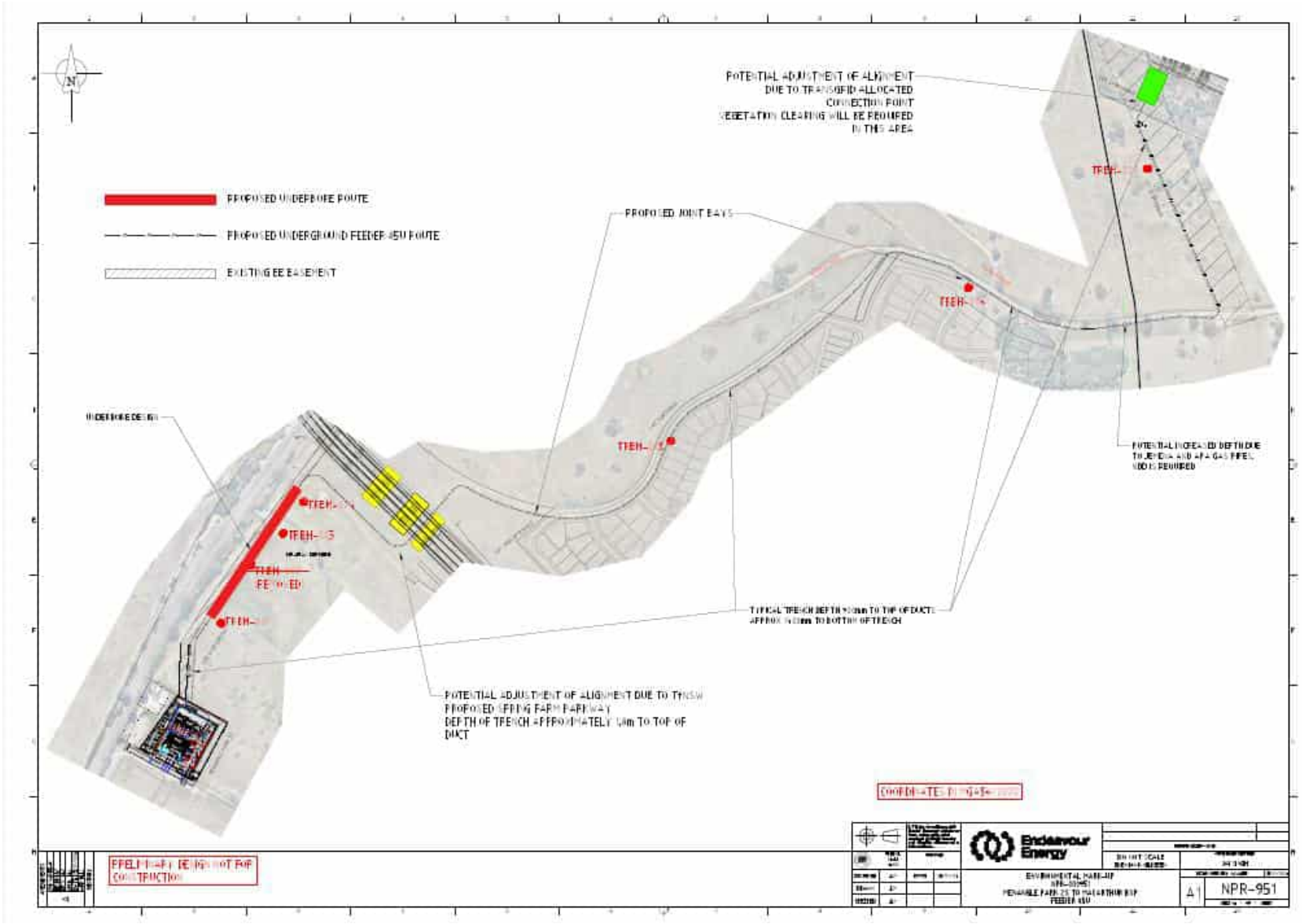
Appendix A. Menangle Park Zone Substation (Endeavour Energy, 2024).

Appendix B. Assessment of likely occurrence of threatened species within the Subject Land.

Appendix C. 5 Part Test of Significance under the BC Act.

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Appendix A. Menangle Park Zone Substation (Endeavour Energy, 2024).



Appendix B. Assessment of likely occurrence of threatened species within the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
Eucalyptus benthamii	CE	CE	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. Several trees are scattered along the Nepean River around Camden and Cobbitty. At least five trees occur on the Nattai River in Nattai National Park. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest.	2	Unlikely. This species was not detected during the field survey.
Grevillea parviflora subsp. *parviflora*	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	7	Low. There are no nearby records and this species was not detected during the field survey.
Hibbertia puberula	E	-	Occurs on sandy soil often associated with sandstone. Flowering time is October to November.	16	Low. There are no nearby records and this species was not detected during the field survey.
Isotoma fluviatilis subsp. *fluviatilis*	CE	CE	Known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks. Grows in damp places, on the Cumberland Plain, including freshwater wetland,	1	Low. There are no nearby records and this species was not detected during the field survey.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) and related vegetation types/. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as Cyndon dactylon.		
Marsdenia viridiflora subsp. *viridiflora*	EP	-	Grows in vine thickets and open shale woodland.	8	Low. There are no nearby records and this species was not detected during the field survey.
Persoonia hirsuta	E	E	Distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. A large area of occurrence, but occurs in small populations, increasing the species' fragmentation in the landscape. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. Usually present as isolated individuals or very small populations. Probably killed by fire (as other Persoonia spp. are) but will regenerate from seed.	1	Low. There are no nearby records and this species was not detected during the field survey.
Pimelea spicata	E	E	Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas; the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this	854	Low. Habitat for this species is substantially degraded and it was not detected during the field survey.

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Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			species is found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with grey box and Ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey.		
Pomaderris brunnea	E	V	The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years. Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England Tableland and in far eastern Gippsland in Victoria.	36	Low. Habitat for this species is substantially degraded and it was not detected during the field survey.
Prostanthera marifolia	CE	CE	Occurs in localised patches in or in close proximity to the endangered Duffys forest ecological community. Located on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses, a soil type which only occurs on ridge tops and has been extensively urbanised.	1	Low. There is no suitable habitat within the Subject Land. The only record on BioNet is >2km from the Subject Land and it was not detected during the field survey.
Pterostylis saxicola	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. 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	34	Low. Habitat for this species is substantially degraded and the nearest record is >4km from the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			woodland on shale-sandstone transition soils or shale soils.		
Thesium australe	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass.	1	Low. Habitat for this species is substantially degraded and it has not been recorded within the locality since 1803.
Anthochaera phrygia	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The distribution of the species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	3	Low. Potential foraging habitat within the Subject Land is highly degraded. The Subject Land is not mapped as Important habitat for this species.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
Artamus cyanopterus cyanopterus	V	-	The Dusky Woodswallow is widespread in eastern, southern and southwestern Australia. In New South Wales it is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath. The ground cover may consist of grasses, sedges or open ground, often with coarse woody debris (Higgins and Peter 2002). Birds are also often observed in farm land, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber.	114	Moderate. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Calidris canutus	-	E	The Red Knot is common in all the main suitable habitats around the coast of Australia. Very large numbers are regularly recorded in north-west Australia, with 80 Mile Beach and Roebuck Bay being particular strongholds. The only places it is not found in	8	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			significant numbers are the northern part of the Great Australian Bight in South Australia and Western Australia, and along much of the NSW coast, where wader habitat is rather scarce (excluding the Hunter Estuary). It is widespread along the coast south of Townsville and along the coasts of NSW and Victoria. In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.		
Callocephalon fimbriatum	E	E	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	14	Low. There is potential breeding habitat within the Subject Land although no signs of breeding were identified during the field survey. The nearest records are >15 years old.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
Calyptorhynchus lathami lathami	V	V	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	2	Low. There is potential breeding habitat within the Subject Land although no signs of breeding were identified during the field survey. There are no nearby records on BioNet.
Cercartetus nanus	V	-	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest . Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period .	1	Low. There is no potential habitat for this species within the Subject Land.
Chalinolobus dwyeri	E	E	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	7	Low. Potential foraging habitat within the Subject Land is of low quality. No breeding habitat was identified within the Subject Land.
Circus assimilis	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densly forested or wooded habitats	1	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality,

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.		meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Climacteris picumnus victoriae	V	V	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 forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	2	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records on BioNet.
Daphoenositta chrysoptera	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of	50	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records on BioNet.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.		
Dasyurus maculatus	V	E	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	1	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records on BioNet.
Ephippiorhynchus asiaticus	E	-	Mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.	1	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Falsistrellus tasmaniensis	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this	8	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e.,

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12km between roosting and foraging sites.		for breeding or important life cycle periods) on habitats in the Subject Land.
Gallinago hardwickii	V	V	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. 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.	17	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Glossopsitta pusilla	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	26	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
Haliaeetus leucogaster	V	-	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	12	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Hieraaetus morphnoides	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	13	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Hirundapus caudacutus	V	-	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.	1	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Lathamus discolor	E	CE	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects . The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW . This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	178	Low. Potential foraging habitat within the Subject Land is highly degraded. The Subject Land is not mapped as Important habitat for this species.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
Litoria aurea	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.	3	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records on BioNet.
Lophoictinia isura	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata or E. smithii. Individuals appear to occupy large hunting ranges of more than 100km2. They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	9	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Meridolum corneovirens	E	-	Primarily inhabits Cumberland Plain woodland (an EEC). This community is a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	129	Low. There is no suitable habitat for this species within the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
Micronomus norfolkensis	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	23	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Miniopterus australis	V	-	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	11	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Miniopterus orianae oceanensis	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	17	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Myotis macropus	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups	15	Low. There is no suitable habitat for this species within the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.		
Neophema pulchella	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	1	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Ninox connivens	V	-	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.	1	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records on BioNet.
Ninox strenua	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large	12	Low. There is no suitable habitat for this species within the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.		
Petauroides volans	E	E	The Greater Glider occurs in eucalypt forests and woodlands. Utilise tree hollows	1	Low. There is no suitable habitat for this species within the Subject Land.
Petaurus norfolcensis	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range . Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias . There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.	1	Low. There is no suitable habitat for this species within the Subject Land.
Petroica boodang	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	10	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
Phascolarctos cinereus	E	E	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall .	524	Low. Potential habitat (native trees) is severely limited within the Subject Land. No trees are proposed to removed and therefore no impacts to Koala habitat are likely to occur.
Pommerhelix duralensis	E	E	Endemic to NSW and confined to northwest fringes of the Cumberland Plain. Distribution extends as far north as St. Albans; southwest to Mulgoa, and southeast to Parrammatta. Occurs in low densities in Hawkesbury Sandstone Vegetation and Shale/Sandstone Transition Forest. Found under rocks, logs, bark and in leaf litter. Has a strong preference for shale-influenced transitional landscapes and has not been confirmed outside such habitats.	1	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records on BioNet.
Pteropus poliocephalus	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	158	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Saccolaimus flaviventris	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its	4	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			very wide range, with and without trees; appears to defend an aerial territory.		
Scoteanax rueppellii	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	8	Low. This highly mobile species may be an occasional visitor, but habitat similar to the Subject Land is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods) on habitats in the Subject Land.
Stagonopleura guttata	V	V	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities.	2	Low. Potential habitat for this species is highly degraded within the Subject Land. The nearest record of this species is >20 years old.
Stictonetta naevosa	V	-	The freckled duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits.	1	Low. There is no suitable habitat for this species within the Subject Land.
Tyto novaehollandiae	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in	2	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records in BioNet.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.		

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Appendix C. 5 Part Test of Significance under the BC Act.

Biodiversity Conservation Act 2016 (NSW)– Test of Significance (5-part Test) for Cumberland Plain Woodland – Critically Endangered

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

N/A

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

The proposed activity is not likely to have an adverse effect on the extent of CPW such that its local occurrence is at risk of extinction. Approximately 3.93ha of a severely degraded example of this community may be impacted. Occurrences of CPW in equal, or higher, quality will continue to exist adjacent to the proposed works area and in the wider locality.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The proposed activity is not likely to substantially and adversely modify the composition of CPW such that its local occurrence is a risk of extinction. Approximately 3.93ha of this community may be impacted. The extent of CPW to be impacted by the proposed activity is severely degraded (which is typical of the location) and subject to ongoing degradation from livestock activity. Occurrences of CPW in equal, or higher, quality will continue to exist adjacent to the proposed works area and in the wider locality.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

While all habitat is important, the extent of CPW within the proposed works area is severely degraded and is characterised by several scattered native species that are subject to ongoing impacts from livestock activity.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

The local occurrence of CPW is already heavily fragmented by roads and residential development. No increased fragmentation will occur as a result of the proposed activity. Occurrences of CPW in equal, or higher, quality will continue to exist adjacent to the proposed works area and in the wider locality.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The habitat to be impacted is unlikely to be of high importance to this community given its level of degradation and location within a farming property. Occurrences of CPW in equal, or higher, quality will continue to exist adjacent to the proposed works area and in the wider locality.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The activity proposed is not likely to have an adverse effect on any declared area of critical habitat, directly or indirectly.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following Key Threatening Processes (KTPs) are documented to impact upon the survival of the ecological community:

- Clearing of native vegetation

The area of CPW that may be impacted by the proposed activity is severely degraded and located within a rural farming property. No native trees will be removed. Equally suitable habitat will remain adjacent to the proposed works area and in the broader locality.

Conclusion

There will be no significant impact on the ecological community and therefore, the proposed activity should not warrant the preparation of a Species Impact Statement (SIS) or Biodiversity Development Assessment Report (BDAR).



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Appendix E Geotechnical Investigation

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Report

Geotechnical Investigation
Proposed Menangle Zone Substation
Part Lot 2 in DP 737485, Fitzpatrick Street
Menangle Park NSW

Prepared for
Endeavour Energy
C/-Brewster Murray Pty Ltd
90 York Street
SYDNEY NSW 2000

Ref: JC17313A-r1
January 2018

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30th January 2018

Our Ref: JC17313A-r1

Endeavour Energy
C/-Brewster Murray Pty Ltd
90 York Street
SYDNEY NSW 2000

Attention: Mr Michael Bullen

Dear Sir,

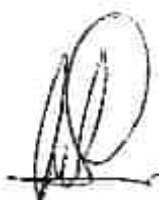
Re Geotechnical Investigation Report
Proposed Menangle Zone Substation
Part Lot 2 in DP 737485, Fitzpatrick Street, Menangle Park

We are pleased to submit our Geotechnical Investigation report for the Proposed Menangle Zone Substation to be located to the north of Fitzpatrick Street within Lot 2 DP 737485, Menangle Park as shown on Drawing No 1.

This report contains information on sub-surface conditions and our comments and recommendations on geotechnical issues for the proposed development.

Should you have any queries, please contact the undersigned.

Yours faithfully
GeoEnviro Consultancy Pty Ltd



Solern Liew CPEng NER
Director

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1. INTRODUCTION

This report presents the results of our geotechnical investigation for the Proposed Menangle Zone Substation to be constructed on Lot 2 in DP 737485 located to the north of Fitzpatrick Street and east of the Main Southern Railway Line in Menangle Park, as shown on the attached Drawing No 1. The investigation was commissioned by Mr Michael Bullen of Brewster Murray Pty Ltd and the scope of the investigation which includes a contamination assessment/waste classification was in carried out in general accordance with our fee proposal referenced PC17328A dated 25th August 2017.

We understand the Proposed Zone Substation development is to include the following;

- Construction of a new control room with basement cables.
- Construction of three new transformers including transformer bunds and fire walls.
- Construction of a driveway within the compound.

The purpose of this investigation was to assess the subsurface ground conditions including fill and groundwater conditions and based on the information provided, to provide comments and recommendations on the following;

- Site preparation and basement construction.
- Soil reactivity to AS2870.
- Retaining walls/shoring and batter slope design parameters
- Suitable footing type including allowable bearing capacity.
- Pavement subgrade characteristics and design.
- Soil salinity and aggressiveness to buried structures.

The Contamination and Waste Classification of the site is documented separately in our report referenced JC17313A-r2 dated January 2018.

2. SITE INFORMATION

2.1 Site Location and Description

The site is situated off the northern side of Fitzpatrick Street and to the east of the Main Southern Railway Line, within Lot 2 in DP 737485 as shown on the attached Drawing No 1. To the immediate west is a newly constructed Sydney Water pump station compound. The proposed substation site will occupy an area of about 6800m^2 covering and area roughly rectangular in shape with approximate dimensions of about 80m and 85m.

At the time of our investigation; the proposed substation site consisted of a vacant land cleared of trees with patchy grass cover. A spread of surface fill was evident on the western portion of the site. The substation site boundaries were surveyed and marked with survey pegs.

The site is located within a rural area with the surrounding properties consisting of predominantly of agricultural land and residential properties to the south along Fitzpatrick Street.

2.2 Site Topography

The site is situated on very gently undulating terrain to low lying terrain approximately 350m south of an un-named tributary which flows west to the Nepean River. Ground surface within the site slopes down gently to the north at angles of less than 2 degrees.

Based on Google Earth, the southern portion of the site is situated at about 82m above sea level with the northern portion of the site at about 79m above sea level.

2.3 Geological Setting

Based on the 1:100,000 Soil Landscape Map of Wollongong/Port Hacking (Reference 1) prepared by Soil Conservation Service of NSW, the northern portion of the site is underlain by Fluvial Soil belonging to the Theresa Park Landscape Group and the southern portion of the site is underlain by residual soil belonging to the Blacktown soil landscape group. Theresa Park soil typically consists of variable and poorly structured silty and sandy loams. Blacktown soil is typically shallow to moderately deep hard setting mottled texture contrast soils, moderately reactive and highly plastic.

Based on the 1:100,000 Geological Map of Wollongong/Port Hacking (Reference 2) prepared by the Department of Minerals and Energy, Sydney, the underlying geological unit consists of high-level alluvium (Tal) of the Cainozoic Era and this alluvium generally consists of clayey sands. It is generally underlain by Clays and weathered sandstones of the Wianamatta Group.

2.4 Hydrogeology

Groundwater is expected to flow north-west into the Nepean River which is situated about 1km west of the site. Infiltration of surface water through subsurface ground is expected to be moderate due to the porous nature of Fluvial Soils.

Our search of the NSW Department of Primary Industries groundwater database for the region indicates three groundwater bores within 1km from the site; the following is a summary of the bores;

Bore ID	Depth (m)	SWL (m)	Northing (mAMG)	Easting (mAMG)	Recorded Use	Water Bearing Zone (m)
GW101106	280	14	6225747	293207	Test Bore	18, 80, 160
GW111977	21	-	6226026	232309	Monitor Bore	-
GW112477	2619	-	6225067	291760	Industrial	-

Based on the above information, the groundwater may be considered a resource in the immediate area of the site.

The recent borehole investigation indicated groundwater seepage to be present between 2.8m and 5.5m below existing ground surface and groundwater to be present in the monitoring wells at about 1.2m and 1.5m below existing ground surface within 3 hours after drilling.

2.5 Site Salinity Potential Map

Based on the DIPNR Salinity Hazard map and information from adjacent sites, the site was classed as having a "moderate salinity potential".

Evidence of salt concentration on the surface in the form salt scalding, vegetation distress or bare patches associated with a saline prone environment were not evident during our site inspection undertaken during our site investigations.

2.6 Acid Sulphate Soil Risk Map

A review of the Acid Sulphate Soil Risk Maps was carried out for the site and though there were no available maps for the subject site, the surrounding maps indicate sites with similar landscapes, topography and geology with "No known occurrence of acid sulphate soil".

3. INVESTIGATION METHODOLOGY

3.1 Fieldwork

The field work for the borehole investigation was carried out on the 1st December 2017 and consisted of drilling seven boreholes. The works were carried out under the full-time supervision of our geotechnical and environmental engineers.

A total of 7 boreholes (BH 1 to BH 7) were drilled in the following locations (Refer to Drawing No 3);

- Proposed Control Room Building – BH 1, 5, 6 and 7
- Proposed Transformers and Blast walls – BH 2, 3 and 4

The boreholes were drilled using a track mounted Hanjin 8D drill rig equipped with spiral augers attached to a V-bit. The boreholes were drilled through topsoil and into natural soil and in BH 1 into siltstone/sandstone to depths varying from 7.0m to 14.6m below existing ground surface.

A test pit investigation was also undertaken and included excavation of thirty-two test pits (TP 1 to TP 32) across the site on the 1st December 2017 using a rubber tracked excavator as shown on the attached Drawing No 3. The backhoe test pits were excavated to depths varying from 0.5m to 2.1m below existing ground surface. The test pits were observed for groundwater during and upon completion of the excavation. The field results together with details of the strata encountered are presented in Table 1.

To assess the strength of the subsurface soil, Standard Penetration Tests (SPT) were carried out in the boreholes. The SPT tests involved driving a split tube steel spoon into the ground using a standard weight (ie 63.5kg) hammer and measuring the penetration resistance in number of blow counts per 150mm penetration. Hand Penetrometer tests were carried out on the SPT split-tube clayey samples.

Prior to the site investigation, underground services checks were carried out using available drawing provided by Dial-Before-You-Dig. An underground services locator equipped with an electromagnetic device was engaged as an extra precautionary measure to reduce risk of damage to underground services caused by boreholes drilling.

The boreholes were observed for groundwater during drilling and shortly after completion of the site investigation. Upon completion of the site investigation, all boreholes except BH 4 and BH 7 were backfilled with excavation spoil.

Groundwater monitoring wells were installed in BH 4 (MW 1) and BH 7 (MW 2) and this involved;

- Assembling of 50mm Class 18 PVC pipes with the bottom 3m of the standpipes consisting of machine slotted PVC screen.
- Fitting of a filter sock on the screen.
- Placement of the PVC standpipe into the boreholes for the full depth.
- Filling the voids between the standpipe and the borehole with 2mm graded sand filter to a depth of about 1m below existing ground level.
- Plugging the voids with a minimum 0.5m thick of bentonite seal
- Purging of drill water from the boreholes
- Fitting the top of the standpipe with PVC cap to prevent rain and runoffs from entering the standpipe.

The site investigation was monitored on a full-time basis by our geotechnical engineer who was responsible for locating the boreholes, carrying out insitu field testing and recording the subsurface profiles encountered. Upon completion of the investigation, the boreholes were backfilled with drilling spoil. Details of the subsurface profiles are summarised on the Borehole Reports in Appendix A of this report.

The site investigation works were carried out in general accordance with our Safe Work Method Statement (Ref JC17313A-L1 dated 28th September 2017). Details of the subsurface profile and field tests are summarised Borehole and Test Pit Reports in Appendix A and B. Explanatory notes defining the terms and symbols used in the preparation of the borehole reports are attached in Appendix E.

3.2 Laboratory Testing

3.2.1 Geotechnical Analysis

Two subgrade samples were taken from the site and were tested for 4-days soaked California Bearing Ratio (CBR) in our NATA accredited laboratory to assess the pavement subgrade characteristics.

Two "Undisturbed" U_{50} soil samples were taken from the site to our NATA accredited laboratory for Shrink-Swell Index testing to aid assessment of soil reactivity to moisture variation. Due to the sandy nature of the subsurface profile, Atterberg Limit analysis was carried out on the material.

The laboratory test results are presented in Appendix C of this report.

3.2.2 Soil Aggressiveness

To assess the likely impact of soil salinity to the proposed development, the following laboratory analysis was carried out;

- pH
- Electrical Conductivity (EC)
- Chloride (Cl)
- Sulphate ($S0_4$)
- Resistivity

The soil analysis was performed by Envirolab Services Pty Ltd, a laboratory accredited by the National Association of Testing Authorities (NATA). The analytical results and methods employed are presented in the Laboratory Test Report in Appendix D.

3.3 Groundwater Monitoring

Groundwater monitoring and sampling was carried out in BH 4 (MW1) and BH 7 (MW2) on the 4th (Day 3), 6th (Day 5) and 15th (Day 14) December 2017 and involved the following;

- Measuring the groundwater encountered
- Purging the monitoring wells up to 3 times the total volume of groundwater in the boreholes to ensure stable water samples were obtained.
- Sampling of groundwater using a low flow pump.
- The samples were then stored in an amber glass receptacle and stored in a chilled esky and transported to Envirolab Services Pty Ltd, a NATA accredited laboratory, within 24 hours for laboratory analysis.

The groundwater samples were analysed for the following;

- Soil pH
- Electrical Conductivity (EC)
- Sulphate (SO_4)
- Chlorides (CL^-)
- Resistivity
- Total Dissolve Solids (TDS)

4. RESULTS OF THE INVESTIGATION

4.1 Subsurface Conditions

Reference should be made to the attached Borehole Reports in Appendix A and Summary of Test Pit Profile in Appendix B for subsurface profiles encountered during the site investigation. The following is a summary of the subsurface profiles encountered;

Topsoil

Topsoil was encountered on the surface of all boreholes and test pits except TP 1, 10, 11, 19, 30, 31 and 32 consisting predominantly of Silty Sand and Sandy Silt of low liquid limit. The thickness of the topsoil was found to between 200mm to 400mm.

Fill

Fill was encountered on the surface of TP 1, 10, 11, 19, 30, 31 and 32 comprised of Silty Sand and Sandy Silt with thickness of between 500mm and 1500mm. The fill in TP 1, 11, 19 and 30 to 32 was found to contain traces of foreign inclusions including concrete and tile pieces and gravel.

Natural Soil

Natural soil was encountered in all boreholes and test pits consisting predominantly of Silty Sand, Sand and Clayey Sand at the upper 0.8m to 2.4m profiles and based on the SPT results, the upper profile was assessed to be loose (for cohesionless soil) and stiff (for cohesive soil).

The natural soil becomes more clayey at lower depths comprising of medium plasticity Sandy Clay and Sandy Silty Clay and fine to medium grained Clayey Sand. These clayey soils were assessed to generally of very stiff to hard consistency.

In all boreholes except BH 5, medium to high plasticity Silty Clay was encountered at depths ranging from 2.2m to 4.8m below existing ground surface and this clayey soil was assessed to be very stiff to hard.

The natural soil was generally found to be dry in the upper profile and moist in the lower profiles.

Bedrock

Bedrock consisting of Sandstone/Siltstone was encountered in BH 1 at depths of 14.0m below existing ground surface. The Sandstone/Siltstone was subjectively assessed to be extremely weathered and generally have low strength.

Groundwater

Groundwater seepage was encountered in all boreholes except BH 6 and 7 during drilling at depths ranging from 2.8m to 5.6m below existing ground surface. Groundwater was encountered at depths ranging from 1.2m to 3.0m in BH 1 to 4 shortly after borehole drilling and the groundwater in BH 2 rose from 3m to 1.2m after 3 hours of completion of the drilling.

The groundwater monitoring wells (MW 1 – BH 4 and MW2 – BH 7) encountered groundwater at 1.2m and 1.5m below existing ground surface respectively, on subsequent inspections of 4th (Day 3), 6th (Day 5) and 15th (Day 14) December 2017

Groundwater was not encountered in any of the test pits (ie maximum depth 2.1m) during or shortly after completion of the site investigation.

4.2 Laboratory Test Results

4.2.1 Geotechnical

For details of the laboratory test results, refer to the laboratory test reports in Appendix C of this report. The following is a summary of the laboratory test results;

California Bearing Ratio

Sample	Maximum Dry Density (t/m^3)	Optimum Moisture Content (%)	Field Moisture Content (%)	CBR (%)
TP 14 (0.4-0.7m)	1.79	12.0	5.5	35.0
TP 21 (0.4-0.7m)	1.81	13.5	6.0	20.0

The CBR test results indicate the insitu soil to generally have high CBR values.

Atterberg Limits

Sample	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH 1 (1.0-1.45m)	ND	ND	ND
BH 3 (1.0-1.45m)	18.0	6.0	4.0

The Atterberg Limit test results indicate the natural soil to have low to moderate reactivity to moisture variation.

4.2.2 Soil and Groundwater Aggressiveness

The following is a summary of the laboratory test results. For details refer to the laboratory test reports in Appendix D;

BH	Depth (m)	pH	EC	Factor	ECe	Cl^-	SO_4	Resistivity
BH 1	2.5-3.0	4.9	0.056	8	0.448	88	<10	18000
BH 2	1.0-1.45	5.3	0.047	9	0.423	74	<10	21000
BH 5	0.0-0.1	5.9	0.014	10	0.140	22	<10	72000

Note: EC – Electrical Conductivity (dS/m)
EC_e-Electrical Conductivity (dS/m)
SO4- Sulphate (mg/kg)
Resistivity – ohm/cm
CL – Chloride (mg/kg)

The following is a summary of the laboratory test results for salinity in groundwater;

Sample	pH	TDS	CL	SO4	EC	Resistivity
MW1	6.3	630	270	5	1000	1000
MW2	6.2	620	270	4	1000	1000

Note: TDS – Total Dissolved Solids mg/L
CL – Chloride mg/L
SO4 – Sulphate mg/L
EC – Electrical Conductivity uS/cm
Resistivity – ohm cm

5. ASSESSMENT AND RECOMMENDATIONS

5.1 Site Preparation and Basement Excavation

We understand that earthworks will be required to prepare the substation platform to design level and this may involve cut and fill. At this stage, the design platform level of the proposed substation is not available. Construction for the proposed control room basement will typically require excavation up to 3.0m deep below substation platform level.

Based on the boreholes, the site was found to be generally underlain by topsoil overlying natural Silty Sand, Sandy Clay and Silty Clay. Bedrock was encountered in BH 1 at a depth of about 14.0m below existing ground surface with groundwater at depths ranging from 1.2m to 1.5m below existing ground surface.

In view of the high groundwater encountered, consideration may be given in the design process to elevate the basement level to above groundwater level to avoid extensive dewatering by spear-points. As groundwater is subject to seasonal fluctuation, provision for some dewatering by sump and pump will still be required in order to keep a dry working area despite raising of the basement excavation.

Excavation into natural Sand and Clay may be carried out using a hydraulic excavator and we do not expect significant vibration generation adversely impacting on surrounding structures or infrastructures (eg Sydney Water).

Site regrading by cutting and filling should be carried out in controlled manner and all fill beneath permanent structures including buildings and pavements should be engineered to ensure adequate compaction is achieved. Typical earthworks should include the following;

- Stripping and removal of all topsoil and organic material.
- Excavation of all uncontrolled fill (if encountered) to expose natural soil.
- Proof rolling of the exposed surface with a minimum 10 tonne vibrating roller to identify soft and heaving areas. If soft and heaving areas are encountered, excavation of soft material should be carried out and replaced with good quality granular fill such as ripped sandstone having a maximum particle size of 75mm.

- All fill should be placed in layers not exceeding 250mm loose thickness and compacted to a minimum 98% of Standard Maximum Dry Density at ±2% of Optimum Moisture Content.

- Earthworks should be closely monitored by a geotechnical consultant and must include field density testing at an appropriate frequency and level of supervision as detailed in AS 3798-2007.

We are of the opinion that the insitu Sandy and Clayey materials are suitable for reuse as structural fill beneath buildings and pavements. Depending on the time of construction and seasonal weather conditions, some moisture conditioning by drying or wetting may be required prior to reuse as fill.

5.2 Basement Construction and Retaining Walls/Shoring

The boreholes indicate the site was found to be generally underlain by topsoil overlying natural Silty Sand, Sandy Clay and Silty Clay. Groundwater was generally encountered at depths of between 1.2m to 1.5m below existing ground surface in BH 1, 2, 4 and 7.

Based on the foregoing, basement construction should consider the following issues;

- The need for shoring and support of the excavation faces to prevent undermining of adjacent ground and to control groundwater inflow into the excavation.
- Construction of a "water-proof" retaining wall/shoring system to reduce water inflow into the site. The shoring system also acts as a cut-off wall to reduce groundwater seepage entering into the base of the excavation during construction. Some dewatering by spear points and/or sump and pump will be required to keep a dry base during construction and the method of dewatering will depend on the depth of excavation required and the groundwater level at the time of construction.
- Tanking of basement and provision of a sub-floor drainage layer and a permanent sump and pump within the basement floor will be required to reduce risk of flooding.

To control groundwater inflow into the basement excavation, the shoring system using a secant pile wall or contiguous pile wall system may be adopted. This shoring system should be constructed prior to excavation works.

Common construction method for secant pile wall includes installation of 'soft' primary piles using bentonite-cement at appropriate spacing followed by construction of 'hard' secondary concrete piles in between the primary piles. To provide an effective watertight wall, the concrete piles would need to overlap the 'soft' primary piles by cutting into the primary piles and these piles should be socketed a minimum 0.5m into bedrock or taken to sufficient depths to form an effective cut-off wall.

Contiguous pile walls may be adopted and this system consists of a continuous row of concrete piles drilled immediately adjacent to each other to form a wall of concrete. There is some risk of erosion and flow of soil through the voids between the piles as they are exposed during excavation. Adoption of this wall system will require some waterproofing and sealing of the voids by grouting particularly near the base of the excavation where groundwater may be expected.

Suitable piers may consist of grout injected piles or continuous flight auger piles (CFA). Bored piles are not considered suitable due to the sandy nature of the subsurface soil and the presence of groundwater.

The basement should be constructed as a "Tanked" system if the basement is taken to below groundwater level (ie about 1.2m below existing ground surface). Should the basement level be raised above the permanent groundwater level, the basements should be adequately water-proofed and a permanent sump and pump system be installed to keep the basement dry.

Retaining walls will be required for the basement excavation. The walls would need to the designed as a rigid or 'propped' wall (eg supported by floor slab), therefore an "at-rest" lateral earth pressure coefficient (K_o) should be adopted in the design. For toe restraints, a passive lateral earth pressure coefficient (K_p) should be adopted. For landscaping walls or walls designed as cantilever, an "active" lateral earth pressure coefficient (K_a) may be used.

The following lateral earth pressure coefficients are recommended;

Material	K_a	K_o	K_p	Bulk Density (kN/m^3)
Compacted Fill	0.33	0.55	-	18.0
Natural Sandy/Clayey Soil	0.3	0.50	3.0	19.0

Permanent subsurface drains should be provided at the back of the retaining wall, or half hydrostatic ground water pressures should be taken into account in the design.

For basement construction above groundwater table, shoring may not be required if the excavation is temporarily battered to allow for retaining wall construction. Appropriate batter slopes for the excavations will depend on the material exposed in the excavation and the length of time for which the excavation will be left unsupported. Under good drainage conditions, the following batter slopes may be adopted;

Material	Permanent Batter	Temporary Batter
Compacted Fill	2.5 Horizontal : 1 Vertical	1.5 Horizontal : 1 Vertical
Natural Sand	2.5 Horizontal : 1 Vertical	1.5 Horizontal : 1 Vertical
Very Stiff Natural Clay	2 Horizontal : 1 Vertical	1 Horizontal : 1 Vertical

The above recommended batter slopes assume that surcharge loads will be kept well clear of the crest of the batters. Some localised sloughing of the fill batters could occur during wet weather, particularly where localised groundwater is encountered.

5.3 Control Room Building Footings

The site is found to be underlain by deep sandy and clay soil profiles up to 14m deep with the upper 2.4m of the soil profile consisting relatively weak (ie loose sand or stiff clay) soil and the natural soil at lower depths was assessed to be more clayey and of very stiff to hard consistency.

As the upper 2.4m of the soil profile was found to be relatively weak and variable, we recommend the proposed control room building be supported on piers taken to the very stiff to hard natural Sandy Clay or Silty Clay at below 2.4m depth.

Due to the presence of groundwater, bored piers are not considered suitable. Suitable piers may consist of grout-injected piles or Continuous Flight Auger (CFA) piles.

For piers taken to a minimum depth of 4.5m below existing ground surface and founded on natural very stiff to hard clay, an allowable end bearing capacity of 350kPa may be adopted. For deeper piers founded at a minimum depth of 6.0m below existing ground surface, an allowable end bearing capacity of 450kPa may be adopted. If pier footings taken to bedrock (ie about 14m deep) are considered the preferred option, an end allowable bearing capacity of 1000kPa may be adopted in the footing design.

An allowable shaft adhesion of 20kPa may be adopted for the section of piers in clayey soil and the shaft adhesion of the upper 1m of the piers or the section of piers in sand should be ignored.

Footings proportioned to the above allowable loads may expect settlement to be within acceptable limits of 1% or less of the width/diameter of footings. All footings should be founded on similar geological stratum to ensure even bearing, otherwise adequate articulation should be provided to accommodate some differential settlements.

For other light weight structures and ancillary buildings, shallow footings founded on compacted fill prepared in accordance with the procedure recommended in Section 5.1 of this report or on natural very stiff Sandy Clay may be adopted. An allowable bearing capacity of 100kPa may be adopted in the footing design. We recommend that the footings and concrete slabs be adequately designed to accommodate shrink-swell movements proportioned to a Class ‘H1’ (AS2870) site.

5.4 Masonry Blast Walls and Transformer Pad Footings

We recommend the proposed masonry blast walls and transformer pads be supported on pier and slab footings with piers taken into very stiff to hard clays. The pier footing design and recommendations as outlined in above Section 5.3 may be adopted.

For uplift capacity design, the allowable uplift shaft adhesion of half that of the allowable shaft adhesion may be adopted. The allowable shaft adhesion of siltstone/sandstone of 100kPa may be adopted.

The piers for the masonry blast walls should be design to resist lateral forces using a lateral passive earth pressure coefficient (K_p) of 3.0.

5.5 Internal Pavement and Access Driveway

We understand that the pavement will consist of reinforced concrete pavements. Pavement subgrade for the proposed access road and switchyard gravel surface should be prepared and treated by the following process.

- Boxing down of the pavement subgrade to design level.
- Excavation of all topsoil material and fill if exist to expose natural clay.
- Proof rolling of the exposed surface with a minimum 10 tonne vibrating roller to identify soft and heaving areas. If soft and heaving areas are encountered, excavation of soft material should be carried out and replaced with good quality granular fill such as ripped sandstone having a maximum particle size of 75mm.
- All fill should be placed in layers not exceeding 250mm loose thickness and compacted to a minimum 98% of Standard Maximum Dry Density at ±2% of Optimum Moisture Content
- The upper 300mm of fill forming the subgrade of pavements should be compacted to a minimum 100% of Standard Maximum Dry Density at ±2% of Optimum Moisture Content.

Earthworks should be closely monitored by a geotechnical consultant and must include field density testing at an appropriate frequency and level of supervision as detailed in AS 3798-2007.

The laboratory CBR test results indicate the natural clay subgrade to have high CBR values of 20% and 35%. A design CBR value of 7% for the internal pavements and access driveways may be adopted.

Based on the Cement and Concrete Associates of Australia guidelines “Concrete, Street, and Parking Area Pavement Design”, the following pavement thickness should be adequate for traffic loading of 30 trucks or greater per day.

Material	**Thickness**
Concrete (32MPa) with F82 Steel	200mm
Subbase	100mm
Total	**300mm**

Slab on ground construction for external areas should have regularly spaced doweled or keyed movement joints and be underlain by compacted granular sub-base layer of DGB20 or equivalent good quality crushed rock. This sub-base layer also acts as a drainage layer and reduces pumping action. The sub-base layer should be compacted to not less than 100% of Standard Maximum Dry Density.

5.6 Soil and Groundwater Aggressiveness

The fundamental criteria for assessing soil salinity are based on Electrical Conductivity (Reference 4).

Class	**EC_e (ds/m)**
Non-Saline	<2
Slightly Saline	2-4
Moderately Saline	4-8
Very Saline	8-16
Highly Saline	>16

The presence of Sulphate and Chloride in the soil has the potential to cause high soil aggressivity to concrete and steel structures, in particular if the structures are in direct contact with the soil. The following is a measure of soil aggressivity for concrete based on the Australian Standard (Reference 6).

Sulphate expressed as SO_3		**PH**	**Chloride in water (ppm)**	**Soil conditions A***	**Soil conditions B#**
In Soil (ppm)	**In Groundwater (ppm)**				
<5000	<1000	>5.5	<6000	Non-aggressive	Non-aggressive
5000-1000	1000-3000	4.5-5.5	6000-12000	Mild	Mild
10000-20000	3000-10000	4-4.5	12000-30000	Severe	Moderate
>20000	>10000	<4	>30000	Very Severe	Severe

Approximate 100ppm of SO_4=80ppm of SO_3
* Soil condition A = High permeability soils (eg sands and gravels) which is below groundwater
Soil conditions B = Low permeability soils (eg silts and clays) and all soils above groundwater

The following is a measure of soil aggressivity to steel piles based on the Australian Standard (Reference 6).

pH	Chlorides (Cl)		Resistivity Ohm.cm	Soil conditions A*	Soil conditions B#
	In Soil Ppm	In water ppm			
>5	<5000	<1000	>5000	Non-aggressive	Non-aggressive
4-5	5000-20000	1000-10000	2000-5000	Mild	Non-aggressive
3-4	20000-50000	10000-20000	1000-2000	Moderate	Mild
<3	>50000	>20000	<1000	Severe	Moderate

* Soil condition A = High permeability soils (eg sands and gravels) which is below groundwater
Soil conditions B = Low permeability soils (eg silts and clays) and all soils above groundwater

The laboratory test results indicate the insitu soil to have low concentrations of Sulphate and in an environment with the lowest pH value of 4.9, the insitu soil may be classified as Mildly Aggressive to buried concrete structures. The laboratory test results indicate the insitu soil to have low concentrations of Chloride and in an environment with the lowest resistivity of 18000 ohm/cm, the insitu soil may be classified as Non Aggressive to buried steel structures.

Our comments and assessments on groundwater salinity are as follows;

- The groundwater was assessed to be moderately saline with an EC value of 1000uS/cm, within the ANZECC criteria of 2200uS/cm. This correlates with the moderate TDS values of 630 and 620 mg/L.
- The groundwater was found to have Chloride concentration of 270mg/L, Sulphate concentration of 5 and 4 mg/L and pH of 6.3 and 6.2 in MW 1 and MW 2 respectively, and is therefore Non aggressive to buried concrete structures.
- The groundwater was found to have low Resistivity of 1000 ohm cm, and is therefore Moderately aggressive to buried steel structures.

Refer to AS2159:2007 “Piling – Design and installation” and AS 3600 -2009 “Concrete Structures” for further recommendations on concrete and steel durability. As a minimum, we recommend the following;

- Concrete slabs to comprise of Class 32MPa concrete
- The minimum cover to reinforcement of 30mm from a membrane in contact with the ground be adopted.

- The minimum cover to reinforcement of 50mm for strip footings and ground beams be adopted.
- Admixtures for waterproofing and /or corrosion prevention may be used.
- Use of salt tolerant masonry and mortar below the damp proof course
- Earth straps and steel structures maybe designed to take into account a uniform corrosion allowance of 0.01 to 0.02mm/year.

5.7 Acid Sulphate Soil

Acid sulphate soils are the common name given to sediments and soils containing iron sulphides which when exposed to oxygen generate sulfuric acid. Formation conditions which normally exist in mangroves, salt marsh vegetation or tidal areas and at the bottom of coastal rivers and lakes, require a number of elements such as;

- the presence of iron-rich sediments,
- the presence of sulphate,
- removal of reaction products (ie bicarbonate),
- the presence of sulphate reducing bacterial and
- a plentiful supply of organic matter.

The relatively specific conditions under which acid sulphate soils are formed usually limit their occurrence to low lying areas with soil horizon less than RL 5m AHD (Reference 9). The site is located on gently undulating terrain with ground surface about 79m to 82m above sea level. From our investigation, the site is known to be underlain by Silty Sands, Clayey Sands and Silty Clays and there were no obvious signs of acid sulphate which is normally characterised by pungent odour being released into the air, discolouration of soil (eg green and blue tinge) and leaching of iron from the soil. Notwithstanding the above, we recommend the proposed development be monitored for the presence of Acid Sulphate soil during construction and appropriate remedial works should be carried out in the event where acid sulphate soil is encountered during construction.

In the event where acid sulphate soils are identified during construction, the soil should be properly managed as follows;

- The excavated stockpile material may either be treated on site using 3% by weight of lime or removed off-site to a landfill for treatment and disposal.
- The excavated acid sulphate soils should be treated immediately otherwise the excavated soil should be capped with non-porous clay soils greater than 0.5m thick.
- All material to be removed from the site should be carried out by a licensed contractor. This material should be sealed and contained on the truck during haulage using appropriate lining and capping material.
- Avoid as much as possible from disturbing acid sulphate soils by minimising excavation works.

6. LIMITATIONS

The interpretation and recommendations submitted in this report are based on a limited number of boreholes. There is no investigation which is thorough enough to determine all site conditions and anomalies, no matter how comprehensive the investigation program is as site data is derived from extrapolation of limited test locations. The nature and extent of variations between test locations may not become evident until construction.

Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

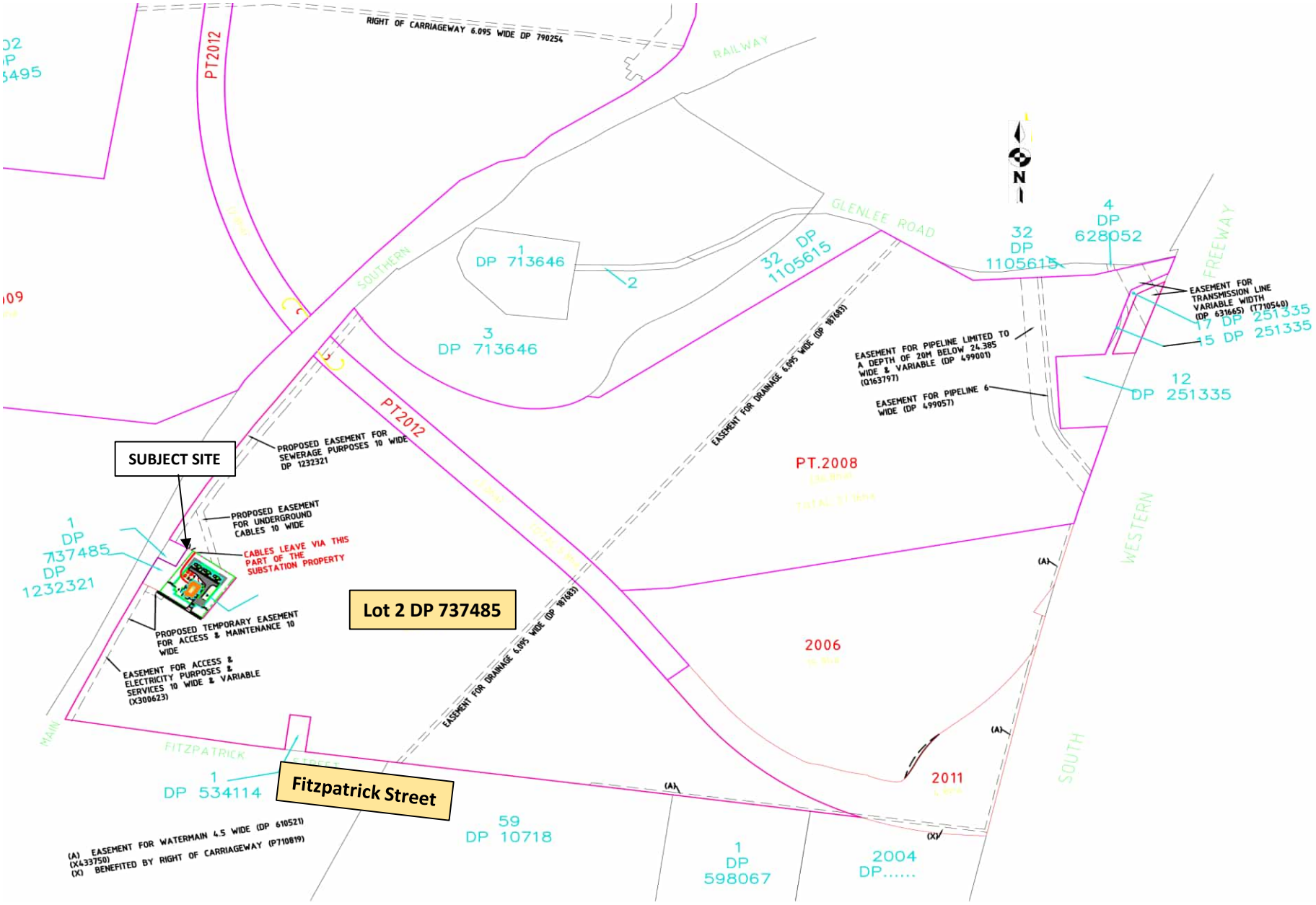
In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

The statements presented in these documents are intended to advise you of what should be your realistic expectations of this report, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. Attached in Appendix E are documents entitled "Important Information about Your Environmental Site Assessment" and Explanatory Notes in conjunction with which this report must be read, as it details important limitations regarding the investigation undertaken and this report.

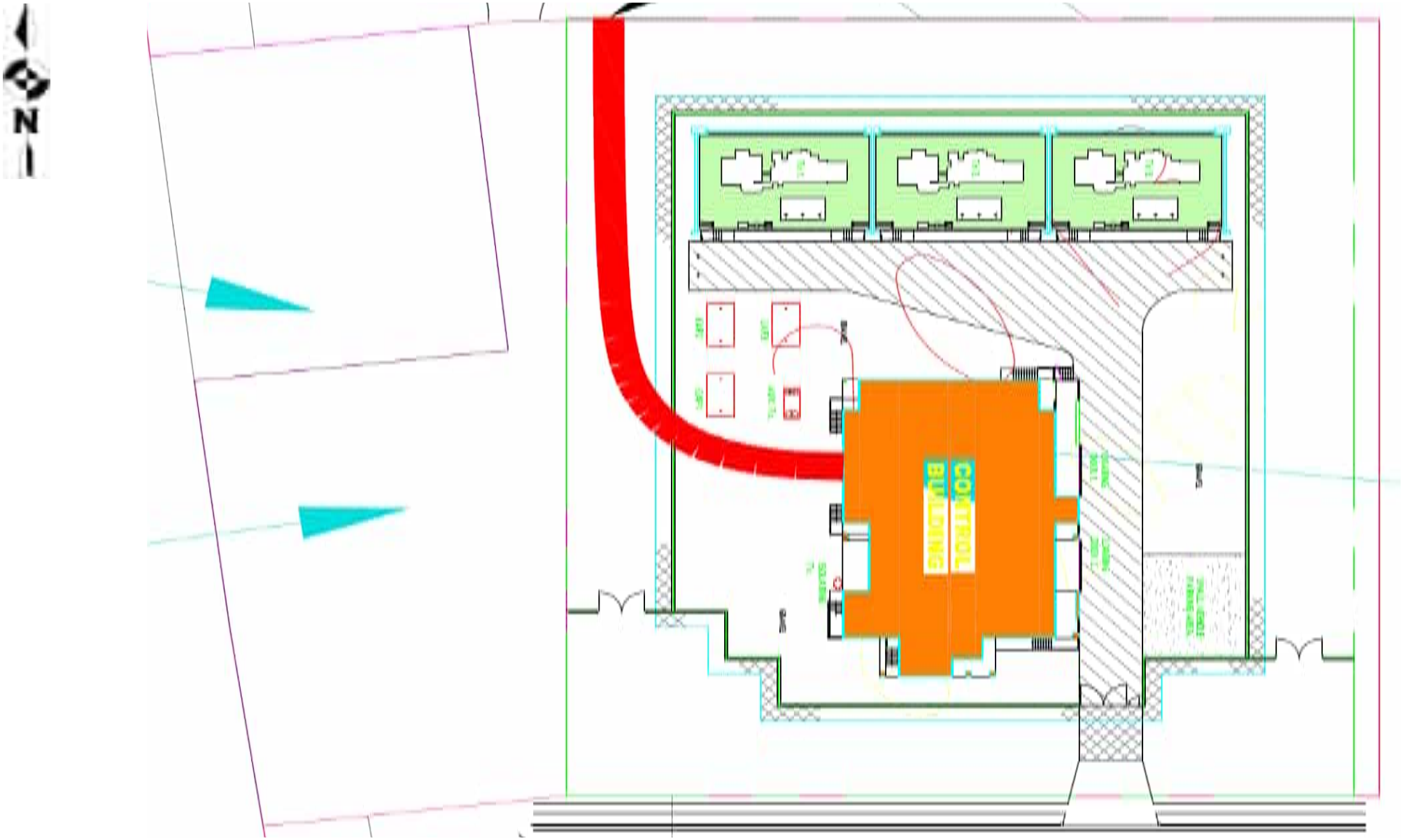
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REFERENCES

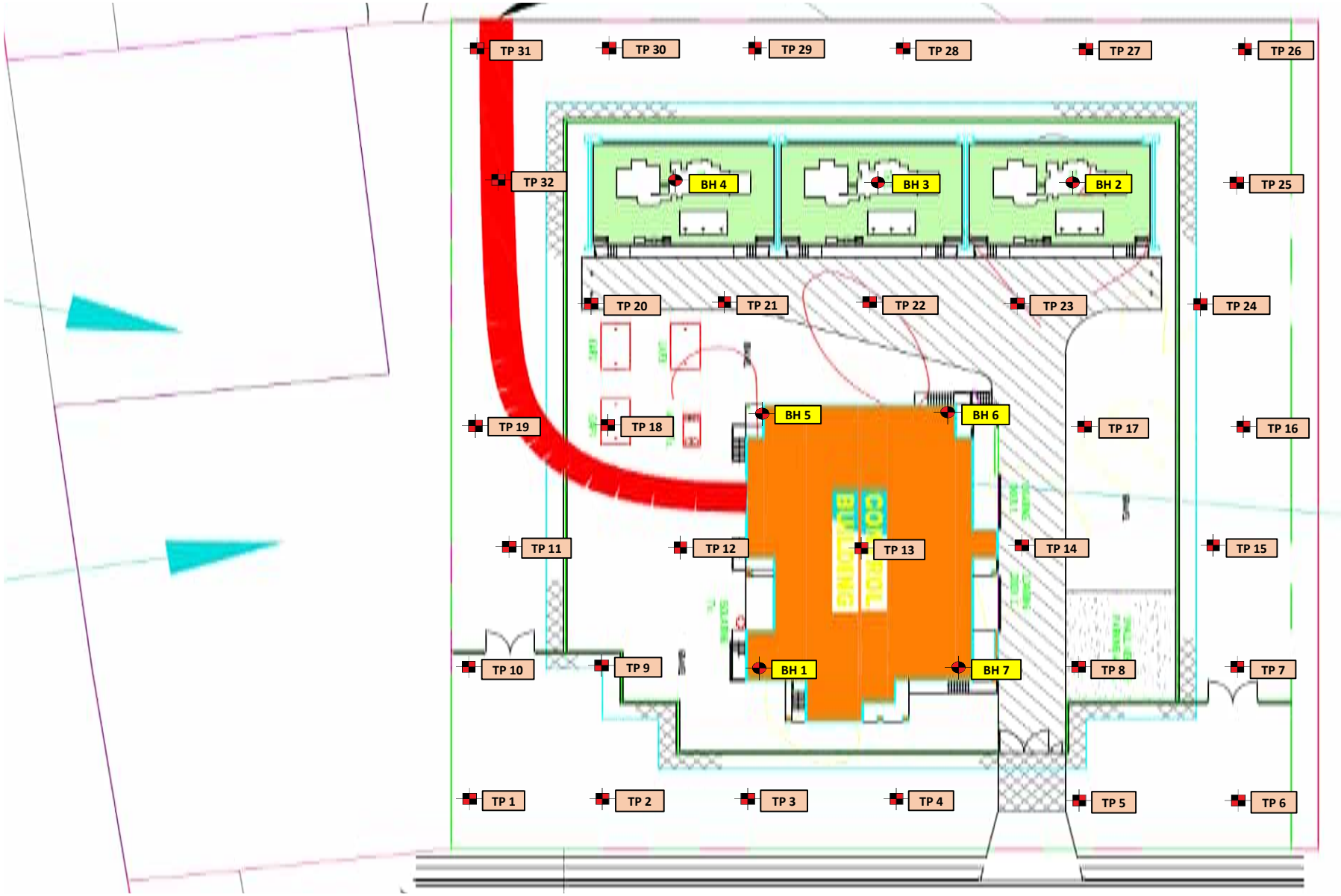
1. *1:100,000 Soil Landscape Map of Wollongong/Port Hacking – Soil Conservation Service of NSW; Sheet 9029-9129*
2. *1:100,000 Geological Map of Wollongong/Port Hacking– Geological Series Sheet 9029-9129 (Edition 1) 1985*
3. *Salinity Code of Practice – Western Sydney Regional Organisation of Councils Ltd – 2002*
4. *Department of Land and Water Conservation – "Site Investigation for Urban Salinity".2002*
5. *What do all the numbers mean? A guide for the interpretation of soil test results. – Department of Conservation and Land Management, 1992*
6. *Australian Standard, AS 2159-2009 "Piling – Design and Installation"*
7. *Australian Standard, AS 3600 -2009 "Concrete Structures"*
8. *Australian Standard, AS 3798 - 2007"Bulk Earthworks for Commercial and Residential Site"*
9. *Acid Sulphate Soil Manual – NSW Acid Sulphate Soil Management Advisory Committee August 1998*
10. *Integral Energy's guidelines "Access roads and Driveways" Document No SDI 514 Amendment No 2 2007*



GeoEnviro Consultancy Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia Tel: (02) 96798733 Fax: (02) 96798744	Drawn By: SG	Date: 08/01/2017	**Brewster Murray Pty Ltd** **Proposed Menangle Zone Substation** **Site Locality Plan**
	Checked By: SL	Date: 08/01/2017	
	Revision By:	Date:	
	Scale: Proportional	A3	**Project No: JC17313A** / **Drawing No: 1**



GeoEnviro Consultancy Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia Tel: (02) 96798733 Fax: (02) 96798744	Drawn By: SG	Date: 08/01/2017	**Brewster Murray Pty Ltd** **Proposed Menangle Zone Substation** **Proposed Site Layout**
	Checked By: SL	Date: 08/01/2017	
	Revision By:	Date:	
	Scale: Proportional	A3	Project No: JC17313A / Drawing No: 2



Legend

- Test Pit
- Borehole

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Drawn By: SG	Date: 08/01/2017	**Brewster Murray Pty Ltd**	
Checked By: SL	Date: 08/01/2017	**Proposed Menangle Zone Substation**	
Revision By:	Date:	**Test Pit and Borehole Location Plan**	
Scale: Proportional	A3	**Project No: JC17313A**	**Drawing No: 3**

APPENDIX A

Borehole Reports

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96798733 Fax: (02) 96798744

Borehole Report

Borehole no: 1 (page 1 of 2)

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:

Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
		▼	N=6 2,3,3			SC	Sandy Clay: Low to medium plasticity, brown and grey	M	VSt	200	Groundwater encountered at 1.2m 3 hours after completion
				2.0		SC	Clayey Sand: Fine to medium grained, grey brown	M	MD		
						SC	Sandy Clay: Low to medium plasticity, brown and grey	M			
			N=18 3,8,10	3.0				D-M	H	>600	
				4.0			Sandy Silty Clay: Medium plastiucity, grey and brown	M-W			
		▼	N=22 6,11,11						H	600	Seepage encountered at 4.0m
				5.0		CI-CH	Silty Clay: Medium to high plasticity, grey	MC= PL (M)			
			N=24 4,10,14	6.0					H	600	
						CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands	M-W			
				7.0							
			N=13 5,7,5						VSt-H	350-420	
				8.0							

Continued next page

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Tel: (02) 96798733 Fax: (02) 96798744

Borehole Report

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:
Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL			9.0 10.0		CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands	M	Vst -H		
TC-BIT				11.0 12.0 13.0 14.0		CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands, trace Siltstone bands	M	Vst -H		
							Siltstone/Sandstone: Brown, extremely to distinctly weathered, low strength				
				15.0 16.0			End BH 1 at 14.6m				

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Borehole Report

Borehole no: 2 (page 1 of 2)

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:
Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
		▼	N=7 1,2,5			SC	Sandy Clay: Low plasticity, grey	M	St	150-200	Groundwater encountered at 1.2m 3 hours after completion
				2.0		SC	Clayey Sand: Fine to medium grained, grey and brown	M			
			N=18 5,8,10	3.0			Silty Sandy Clay: Medium plasticity, grey and brown	M	H	400-500	
		▼				CI-CH	Silty Clay: Medium to high plasticity, grey and brown, with fine grained ironstone gravel	MC= PL (D-M)			Groundwater encountered at 3.0m upon completion
			N=19 5,8,11	4.0					H	450-550	
				5.0							
		▶	N=13 3,5,8						St-VSt	180-250	Seepage encountered at 5.6m
				6.0							
				7.0							
			N=18 4,6,12			CI-CH	Silty Clay: Medium to high plasticity, grey and brown, with fine to coarse grained ironstone gravel bands	MC< =PL (D-M)	H	>600	
				8.0							

Continued next page

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Borehole Report

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:
Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL			9.0 10.0 11.0 12.0 13.0		CI-CH	Silty Clay: Medium to high plasticity, grey and brown, with fine to coarse grained ironstone gravel bands	MC =PL (D-M)	Vst -H		
				14.0 15.0 16.0			End BH 2 at 13.0m				

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Borehole Report

Borehole no: 3

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:

Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
							Sand: Fine to medium grained, grey white	D-M	L		
				1.0							
			N=23 4,9,14			SC	Clayey Sand: Fine to medium grained, grey brown	M	VSt-H (MD)	250-400	
				2.0							
			N=11 4,5,6						VSt	300	
		▼		3.0			Silty Sandy Clay: Medium plasticity, grey brown	M	H	400	Groundwater at 3.0m after drilling
		▶									Slow infiltration Seepage encountered at 3.6m
				4.0		CI	Silty Clay: Medium plasticity, grey and brown, with fine to coarse grained ironstone gravel	M			
			N=19 5,8,11						H	500-600	
				5.0							
				6.0							
				7.0							
							End BH 3 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 4 (MW1)

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:
Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
							Sand: Fine to medium grained, grey white	D-M	L		
			3 1,1,1	1.0		SC	Sandy Clay: Medium plasticity, grey and brown, with ironstone gravel	M	St	150	Groundwater encountered at 1.2m on Day 3, 5 and 14 after investigation
				2.0							
			N=21 9,10,11	3.0			Sandy Silty Clay: Medium plasticity, brown and grey, with fine to coarse grained ironstone gravel	M	H	>600	Groundwater at 2.4m after 2hrs of drilling Seepage encountered at 2.8m
			N=22 5,11,11	4.0							
				5.0							
				6.0							
				7.0							
							End BH 4 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 5

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:

Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
			N=9 1,2,7			SC	Sandy Clay/Clayey Sand: Fine to medium grained, grey brown	M	St	150-200	
				2.0							
			N=18 5,8,10			CI	Silty Clay: Medium plasticity, grey brown, with fine to medium grained ironstone gravel bands	D-M	H	520	Seepage encountered at 2.8m
				3.0							
				4.0							
			N=20 4,9,11						H	550-600	
				5.0							
			N=23 6,11,12						H	500-600	
				6.0							
				7.0							
							End BH 5 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 6

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:

Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL	DRY ON COMPLETION					Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
			N=8 3,3,5	2.0		SC	Sandy Clay: Low to medium plasticity, grey brown	M	VSt	210	
			N=17 3,8,9	3.0		CI	Silty Clay: Medium plasticity, brown and grey, with fine to medium grained ironstone gravel	M	H	500	
			N=24 3,12,12	4.0					H	520-550	
			N=24 8,12,12	5.0					H	>600	
				6.0							
				7.0							
							End BH 7 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 7 (MW2)

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:
Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL	DRY ON COMPLETION					Sandy Silt/Silty Sand: Low liquid limit, brown	D			
							Sand: Fine to medium grained, grey white	D-M	L		
			N=6 2,2,4	1.0				M-W			
				2.0		SC	Clayey Sand: Fine to medium grained, grey and brown	M			Groundwater encountered at 1.5m on Day 3, 5 and 14 after investigation
			N=19 4,9,10	3.0		SC	Sandy Clay: Medium plasticity, grey and brown, trace of ironstone gravel	M	H	420-500	
						CI	Silty Clay: Medium plasticity, grey brown, with fine to medium grained ironstone gravel	M			
			N=22 5,9,13	4.0					H	500	
				5.0							
			N=24 7,12,12	6.0					H	550	
				7.0							
				8.0			End BH 7 at 7.0m				

APPENDIX B

Table A Summary of Test Pit Profiles

Test Pit Number	Depth (m)	Profile Type	Description
1	0.00-0.20	Fill	Sandy Silt/Silty Sand: Low liquid limit, light brown, with gravel, dry
	0.20-0.50	Fill	Silty Sand: Fine to medium grained, brown, with gravel, 1 tile fragment, 1 piece plastic rubbish, moist
	0.50-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
2	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
3	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.50	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
4	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
5	0.00-0.35	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
6	0.00-0.40	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.40-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
7	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
8	0.00-0.40	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.40-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
9	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
10	0.00-0.20	Fill	Sandy Silt: Low liquid limit, brown, with clay and gravel inclusions, dry
	0.20-0.50	FIll	Silty Sand: Fine to medium grained, dark brown, dry to moist
	0.50-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
11	0.00-0.60	Fill	Sandy Silt: Low liquid limit, brown, with clay and gravel inclusions, 1 piece of fibre cement pipe, trace timber fragments, dry
	0.60-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist

Note:
PP = Pocket Penetrometer
MC = Moisture Content
PL = Plastic Limit

GeoEnviro Consultancy

TABLE 1 (Page 1 of 3)
SUMMARY OF SOIL PROFILE

Brewster Murray Pty Ltd
Proposed Menangle Zone Substation
Fitzpatrick Street, Menangle Park

Test Pit Number	Depth (m)	Profile Type	Description
12	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
13	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
14	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-1.30	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
15	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
16	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
17	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
18	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
19	0.00-1.00	Fill	Sandy Silt/Silty Sand: Low liquid limit, brown, with gravel, clay, trace of concrete fragments, dry
	1.00-1.40	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
20	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
21	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-1.50	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
22	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
23	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry

Note:

PP = Pocket Penetrometer

MC = Moisture Content

PL = Plastic Limit

GeoEnviro Consultancy

TABLE 1 (Page 2 of 3)

SUMMARY OF SOIL PROFILE

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Test Pit Number	Depth (m)	Profile Type	Description
24	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
25	0.00-0.25	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.25-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
26	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
27	0.00-0.40	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.40-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
28	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
29	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
30	0.00-0.80	Fill	Silty Clay: Low plasticity, brown, with gravel and trace of concrete gravel, dry
	0.80-1.30	Natrual	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
31	0.00-0.40	Fill	Silty Clay: Low plasticity, brown, with gravel and trace of concrete gravel, dry
	0.40-1.50	Fill	Silty Clay: Low plasticity, brown, with sand and gravel, dry to moist
	1.50-2.00	Natural	(CL-CI) Silty Sandy Clay: Low to medium plasticity, light brown, dry to moist
32	0.00-0.30	Fill	Silty Clay: Low plasticity, brown, with gravel and trace of concrete gravel, dry
	0.30-1.50	Fill	Silty Clay: Low plasticity, brown, with sand and gravel, dry to moist
	1.50-1.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, moist
	1.70-2.10	Natural	(SC) Clayey Sand: Fine to medium grained, light brown grey, dry to moist

Note:

PP = Pocket Penetrometer

MC = Moisture Content

PL = Plastic Limit

GeoEnviro Consultancy

TABLE 1 (Page 3 of 3)

SUMMARY OF SOIL PROFILE

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

APPENDIX C

Laboratory Test Certificates – Geotechnical

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96798733 Fax: (02) 96798744

Test Results - Atterberg Limits

Client / Address: Brewster Murray Pty Ltd / SYDNEY — Job No: JC17313A

Project: Proposed Menangle Zone Substation — Date: 21/12/2017

Location: Fitzpatrick Street, Menangle — Report No: R01A

Sample Identification	BH 1 (1.0-1.45m)	BH 3 (1.0-1.45m)		
Sample Register No	SR 11762	SR 11763		
Sample Date	1-Dec-17	1-Dec-17		
Test Date	15-Dec-17	14-Dec-17		
Sample Procedure	AS 1289 1.1, 1.2.1 (6.5.3)	AS 1289 1.1, 1.2.1 (6.5.3)		
Test Results				
Test Procedure:	AS 1289 3.1.2	AS 1289 3.1.2		
Liquid Limit (%)	Not Determined	18		
Test Procedure:	AS 1289 3.2.1	AS 1289 3.2.1		
Plasitc Limit (%)	10	12		
Test Procedure:	AS 1289 3.3.1	AS 1289 3.3.1		
Plasticity Index (%)	Not Determined	6		
Test Procedure:	AS 1289 3.4.1	AS 1289 3.4.1		
Linear Shrinkage (%)	Not Determined	4.0		
Test Procedure:	AS 1289 2.1.1	AS 1289 2.1.1		
Natural Moisture Content %	14.6	17.4		
Material Description	Sandy Clay: Brown and grey	Clayey Sand: Grey and brown		

Remarks

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Accredited for compliance with ISO/IEC 17025.

NATA Accredited Laboratory Number: 14208.

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Authorised Signatory _____ So Lern Liew Date 21/12/2017

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96798733 Fax: (02) 96798744

Test Results - California Bearing Ratio

Client / Address: Brewster Murray Pty Ltd / SYDNEY — Job No: JC17313A

Project: Proposed Menangle Zone Substation — Date: 21/12/2017

Location: Fitzpatrick Street, Menangle — Report No: R02A

SAMPLE INFORMATION Test Methods	AS 1289 1.1, 1.2.1 (6.5.4)				
Lab Reference No.	SR 11764	SR 11765			
Date Sampled	01-Dec-17	01-Dec-17			
Date Tested	13-Dec-17	13-Dec-17			
Sample Identification	TP 14 (0.4-0.7m)	TP 21 (0.4-0.7m)			
Laboratory Specimen Description	Silty Sand: Brown grey	Silty Sand: Brown grey			

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 Mould A and AS1289 2.1.1

Maximum Dry Density t/m3			1.79	1.81			
Optimum Moisture Content %			12.0	13.5			
Field Moisture Content %			5.5	6.0			
% Of Oversize	19mm		Nil	Nil			
Replacement of Oversize (See note B)			NA	NA			

California Bearing Ratio - Test Method AS1289 6.1.1

CBR TEST	Dry Density t/m3	Before Soaking	1.78	1.79			
		After Soaking	1.78	1.80			
	Density Ratio %	Before Soaking	99.5	99.0			
		After Soaking	99.5	99.5			
	Moisture Content %	Before Soaking	20.0	13.0			
		After Soaking	13.5	13.5			
	Number of Days Soaked		4	4			
	Surcharge kg		4.5	4.5			
	Moisture Content After Test %	Top 30mm	13.5	13.5			
		Whole Sample	13.5	13.5			
	Swell After Soaking %		0.0	0.0			
	Penetration mm		2.5	5.0			
	CBR Value %		35.0	20.0			

Notes: (A) Test specimen was compacted to a target dry density of 100 percent standard (AS 1289 5.1.1)

(B) If specified the percentage of oversize retained on the 19mm may be replaced by an equal portion of –19mm to +4.75mm

Remarks

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Authorised Signatory _____ So Lern Liew Date 21/12/2017

APPENDIX D

Laboratory Test Certificates – Salinity

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 181300

Client Details

Client	Geoenviro Consultancy Pty Ltd
Attention	Solern Liew
Address	PO Box 1543, Macquarie Centre, North Ryde, NSW, 2113

Sample Details

Your Reference	**JC17313A**
Number of Samples	17 Soil, 1 Material
Date samples received	04/12/2017
Date completed instructions received	04/12/2017

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	11/12/2017
Date of Issue	11/12/2017

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Asbestos Approved By
Analysed by Asbestos Approved Identifier: Lulu Scott, Lucy Zhu
Authorised by Asbestos Approved Signatory: Lulu Scott

Results Approved By
Dragana Tomas, Senior Chemist
Long Pham, Team Leader, Metals
Lulu Scott, Asbestos Supervisor
Nick Sarlamis, Inorganics Supervisor
Steven Luong, Senior Chemist

Authorised By



David Springer, General Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	117	124	117	123	116

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	118	115	121	125	115

vTRH(C6-C10)/BTEXN in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
TRH C_6 - C_9	mg/kg	<25
TRH C_6 - C_{10}	mg/kg	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
naphthalene	mg/kg	<1
Total +ve Xylenes	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	117

svTRH (C10-C40) in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	85	87	87	83	79

svTRH (C10-C40) in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	82	79	79	81	79

svTRH (C10-C40) in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
TRH C_{10} - C_{14}	mg/kg	<50
TRH C_{15} - C_{28}	mg/kg	<100
TRH C_{29} - C_{36}	mg/kg	<100
TRH >C_{10} -C_{16}	mg/kg	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50
TRH >C_{16} -C_{34}	mg/kg	<100
TRH >C_{34} -C_{40}	mg/kg	<100
Total +ve TRH (>C10-C40)	mg/kg	<50
Surrogate o-Terphenyl	%	82

PAHs in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	95	91	92	90	91

PAHs in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	0.08	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	0.54	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	89	90	93	92	93

PAHs in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	<0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	<0.1
Pyrene	mg/kg	<0.1
Benzo(a)anthracene	mg/kg	<0.1
Chrysene	mg/kg	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2
Benzo(a)pyrene	mg/kg	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1
Total +ve PAH's	mg/kg	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5
Surrogate p-Terphenyl-d14	%	93

Organochlorine Pesticides in soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	85	85	88	87	84

Organochlorine Pesticides in soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	86	91	91	86	87

Organochlorine Pesticides in soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1
Surrogate TCMX	%	86

PCBs in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	85	85	88	87	84

PCBs in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	86	91	91	86	87

PCBs in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
Aroclor 1016	mg/kg	<0.1
Aroclor 1221	mg/kg	<0.1
Aroclor 1232	mg/kg	<0.1
Aroclor 1242	mg/kg	<0.1
Aroclor 1248	mg/kg	<0.1
Aroclor 1254	mg/kg	<0.1
Aroclor 1260	mg/kg	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1
Surrogate TCLMX	%	86

Acid Extractable metals in soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Arsenic	mg/kg	<4	<4	<4	<4	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	9	<1	6	7	12
Copper	mg/kg	14	2	11	12	25
Lead	mg/kg	9	4	8	10	14
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	<1	4	5	13
Zinc	mg/kg	14	4	18	20	44

Acid Extractable metals in soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Arsenic	mg/kg	<4	<4	6	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	2	<1	10	7	8
Copper	mg/kg	5	1	26	47	13
Lead	mg/kg	6	4	13	10	9
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	<1	12	7	3
Zinc	mg/kg	14	2	46	34	10

Acid Extractable metals in soil			
Our Reference		181300-18	181300-19
Your Reference	UNITS	Duplicate A	TP1 - [TRIPLICATE]
Depth		-	0.2-0.3
Date Sampled		01/12/2017	01/12/2017
Type of sample		Soil	Soil
Date prepared	-	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017
Arsenic	mg/kg	<4	<4
Cadmium	mg/kg	<0.4	<0.4
Chromium	mg/kg	<1	9
Copper	mg/kg	2	11
Lead	mg/kg	4	8
Mercury	mg/kg	<0.1	<0.1
Nickel	mg/kg	<1	2
Zinc	mg/kg	4	10

Misc Inorg - Soil				
Our Reference		181300-1	181300-2	181300-3
Your Reference	UNITS	BH1	BH2	BH5
Depth		2.5-3.0	1.0-1.45	0.0-0.1
Date Sampled		01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017
pH 1:5 soil:water	pH Units	4.9	5.3	5.9
Electrical Conductivity 1:5 soil:water	µS/cm	56	47	14
Chloride, Cl 1:5 soil:water	mg/kg	88	74	22
Sulphate, SO4 1:5 soil:water	mg/kg	<10	<10	<10
Resistivity in soil*	ohm m	180	210	720

sPOCAS field test					
Our Reference		181300-3	181300-4	181300-5	181300-6
Your Reference	UNITS	BH5	BH1	BH1	BH5
Depth		0.0-0.1	0.5-0.6	1.0-1.45	2.5-3.0
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017
pH_F (field pH test)*	pH Units	6.2	6.2	6.1	4.9
pH_{FOX} (field peroxide test)*	pH Units	5.0	3.9	5.2	3.9
Reaction Rate*	-	Slight	Moderate	Slight	Slight

Moisture						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Moisture	%	10	1.8	7.5	3.5	12

Moisture						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Moisture	%	2.8	7.3	7.6	5.1	10

Moisture		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date prepared	-	05/12/2017
Date analysed	-	06/12/2017
Moisture	%	1.8

Asbestos ID - soils						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
Sample mass tested	g	Approx. 40g	Approx. 50g	Approx. 60g	Approx. 50g	Approx. 35g
Sample Description	-	Brown sandy soil	Brown sandy soil	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
Sample mass tested	g	Approx. 40g	Approx. 40g	Approx. 45g	Approx. 65g	Approx. 45g
Sample Description	-	Brown sandy soil	Brown sandy soil	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - materials		
Our Reference		181300-11
Your Reference	UNITS	TP11 - Fibro
Depth		-
Date Sampled		01/12/2017
Type of sample		Material
Date analysed	-	08/12/2017
Mass / Dimension of Sample	-	150x70x25mm
Sample Description	-	Brown compressed fibre cement material
Asbestos ID in materials	-	No asbestos detected Organic fibre detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.

Method ID	Methodology Summary
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
TRH C_6 - C_9	mg/kg	25	Org-016	<25	7	<25	<25	0	115	115
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	7	<25	<25	0	115	115
Benzene	mg/kg	0.2	Org-016	<0.2	7	<0.2	<0.2	0	114	115
Toluene	mg/kg	0.5	Org-016	<0.5	7	<0.5	<0.5	0	109	110
Ethylbenzene	mg/kg	1	Org-016	<1	7	<1	<1	0	125	123
m+p-xylene	mg/kg	2	Org-016	<2	7	<2	<2	0	114	113
o-Xylene	mg/kg	1	Org-016	<1	7	<1	<1	0	109	108
naphthalene	mg/kg	1	Org-014	<1	7	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	120	7	117	117	0	117	115

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	[NT]	18	<25	<25	0	[NT]	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	[NT]	18	<25	<25	0	[NT]	[NT]
Benzene	mg/kg	0.2	Org-016	[NT]	18	<0.2	<0.2	0	[NT]	[NT]
Toluene	mg/kg	0.5	Org-016	[NT]	18	<0.5	<0.5	0	[NT]	[NT]
Ethylbenzene	mg/kg	1	Org-016	[NT]	18	<1	<1	0	[NT]	[NT]
m+p-xylene	mg/kg	2	Org-016	[NT]	18	<2	<2	0	[NT]	[NT]
o-Xylene	mg/kg	1	Org-016	[NT]	18	<1	<1	0	[NT]	[NT]
naphthalene	mg/kg	1	Org-014	[NT]	18	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	[NT]	18	117	128	9	[NT]	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	7	<50	<50	0	97	102
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	7	<100	<100	0	97	107
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	7	<100	<100	0	94	80
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	7	<50	<50	0	97	102
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	7	<100	<100	0	97	107
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	7	<100	<100	0	94	80
Surrogate o-Terphenyl	%		Org-003	82	7	85	80	6	88	87

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	[NT]	18	<50	<50	0	[NT]	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	[NT]	18	<50	<50	0	[NT]	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
Surrogate o-Terphenyl	%		Org-003	[NT]	18	82	83	1	[NT]	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Naphthalene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	90	89
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	91	90
Phenanthrene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	90	87
Anthracene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	80	79
Pyrene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	88	86
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	101	96
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	7	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	7	<0.05	<0.05	0	106	96
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	90	7	95	94	1	108	101

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Naphthalene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Phenanthrene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Anthracene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Pyrene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	[NT]	18	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	[NT]	18	<0.05	<0.05	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	[NT]	18	93	92	1	[NT]	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
HCB	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	92	95
gamma-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	99	102
Heptachlor	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	89	93
delta-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	86	89
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	90	93
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	105	109
Dieldrin	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	96	99
Endrin	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	87	90
pp-DDD	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	101	105
Endosulfan II	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	93	94
Methoxychlor	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	82	7	85	86	1	98	98

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
HCB	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
gamma-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
delta-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Dieldrin	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endrin	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endosulfan II	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Methoxychlor	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	[NT]	18	86	86	0	[NT]	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	101	100
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	82	7	85	86	1	84	82

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	[NT]	18	86	86	0	[NT]	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date prepared	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Arsenic	mg/kg	4	Metals-020	<4	7	<4	<4	0	109	103
Cadmium	mg/kg	0.4	Metals-020	<0.4	7	<0.4	<0.4	0	102	107
Chromium	mg/kg	1	Metals-020	<1	7	9	9	0	107	106
Copper	mg/kg	1	Metals-020	<1	7	14	12	15	106	108
Lead	mg/kg	1	Metals-020	<1	7	9	7	25	105	107
Mercury	mg/kg	0.1	Metals-021	<0.1	7	<0.1	<0.1	0	104	99
Nickel	mg/kg	1	Metals-020	<1	7	3	2	40	102	106
Zinc	mg/kg	1	Metals-020	<1	7	14	7	67	104	107

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	18	<4	<4	0	[NT]	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	18	<0.4	<0.4	0	[NT]	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	18	<1	<1	0	[NT]	[NT]
Copper	mg/kg	1	Metals-020	[NT]	18	2	2	0	[NT]	[NT]
Lead	mg/kg	1	Metals-020	[NT]	18	4	5	22	[NT]	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	18	<1	<1	0	[NT]	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	18	4	6	40	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	05/12/2017	[NT]
Date analysed	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	05/12/2017	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	111	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	112	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Date analysed	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 181300-7 for Zn. Therefore a triplicate result has been issued as laboratory sample number 181300-19.

Asbestos: A portion of the supplied sample was sub-sampled for asbestos analysis according to Envirolab procedures. We cannot guarantee that this sub-sample is indicative of the entire sample. Envirolab recommends supplying 40-50g of sample in its own container.
Note: Samples 181300-7 to 10, 12 to 17 were sub-sampled from jars provided by the client.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details

Client	Geoenviro Consultancy Pty Ltd
Attention	Solern Liew

Sample Login Details

Your reference	JC17313A
Envirolab Reference	181300
Date Sample Received	04/12/2017
Date Instructions Received	04/12/2017
Date Results Expected to be Reported	11/12/2017

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	17 Soil, 1 Material
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	12.7
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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Sample ID	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticidesin soil	PCBsin Soil	Acid Extractable metalsin soil	pH1:5 soil:water	Electrical Conductivity1:5 soil:water	Chloride, Cl1:5 soil:water	Sulphate, SO41:5 soil:water	Resistivity in soil*	sPOCAS field test	Asbestos ID - soils	Asbestos ID - materials
BH1-2.5-3.0							✓	✓	✓	✓	✓			
BH2-1.0-1.45							✓	✓	✓	✓	✓			
BH5-0.0-0.1							✓	✓	✓	✓	✓	✓		
BH1-0.5-0.6												✓		
BH1-1.0-1.45												✓		
BH5-2.5-3.0												✓		
TP1-0.2-0.3	✓	✓	✓	✓	✓	✓							✓	
TP4-0.0-0.1	✓	✓	✓	✓	✓	✓							✓	
TP10-0.1-0.2	✓	✓	✓	✓	✓	✓							✓	
TP11-0.2-0.3	✓	✓	✓	✓	✓	✓							✓	
TP11 - Fibro														✓
TP19-0.4-0.5	✓	✓	✓	✓	✓	✓							✓	
TP20-0.1-0.2	✓	✓	✓	✓	✓	✓							✓	
TP24-0.0-0.1	✓	✓	✓	✓	✓	✓							✓	
TP30-0.3-0.4	✓	✓	✓	✓	✓	✓							✓	
TP31-0.4-0.5	✓	✓	✓	✓	✓	✓							✓	
TP32-0.6-0.7	✓	✓	✓	✓	✓	✓							✓	
Duplicate A	✓	✓	✓	✓	✓	✓								

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

GeoEnviro Consultancy Pty Ltd
Unit 5, 36-41 North Avenue, Blacktown NSW 2148, Australia
Tel: (02) 9676 9770 Fax: (02) 9676 9744

Laboratory Test Request/Chain of Custody Record

Job Details
Job Number: JC171134
Client:
Project: Proposed Residential Subdivision Development
Location: Fitzpatrick Street, Marsden Park (Marsden Zib)

Sample Date: 01/12/2017
Sampled By: SG
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: Envirolab Services Pty Ltd
Address: 12 Ashley Street
Chatswood
Contact: Tania Notaro

Sampling Details				Sample Type		Test Required (√)												Test Performed (√)										
Location		Depth (m)		Soil	Water																							Retain Samples
		From	To																									
1	BH1	2.50	3.00	☒								✓	✓	✓	✓	✓												
2	BH2	1.00	1.45	☒								✓	✓	✓	✓	✓												
3	BH5	0.00	0.10	☒								✓	✓	✓	✓	✓												
4	BH1	0.50	0.80	☒							✓	✓																
5	BH1	1.00	1.45	☒							✓	✓																
6	BH5	0.00	0.10	☒							✓	✓																
7	BH5	2.50	3.00	☒							✓	✓																

Relinquished by				Received by				
Laboratory	Name	Signature	Date	Laboratory	Name	Signature	Date
Geoenviro Consultancy	Steven Goss		4/12/2017				

Legend
XB: Unpreserved Plastic (500 mL Plastic Bag)
XE: Unpreserved Jar (Small, Plastic Pot)
XG: Preserved Bottle (Glass Jar)
XPT: Standard Preservative Tub Solution
UEG: Unpreserved Bottle (Glass Jar)
UPT: Unpreserved Bottle (Tub) Tube
WG: Water Sample (Filled Glass Jar)
WP: Water Bottle (Plastic Bottle)
F: Field Sample
R: Rinsate Sample

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96766170 Fax: (02) 96766144

Laboratory Test Request/Chain of Custody Record

Job Details
Job Number: JC171318
Client:
Project: Proposed Residential Subdivision Development
Location: Fitzpatrick Street, Menangle (Menangle ZS)

Sample Date: 01/12/2017
Sampled By: SG
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: Envirolab Services Pty Ltd
Address: 12 Ashley Street
Chatswood
Contact: Tania Notaras

Sampling Details				Sample Type		Test Required (√)																						Test Performed(X)
Location		Depth (m)		Soil	Water																							
		From	To																									Keep Sample
1	TP 1	0.20	0.30	DG					✓																			
2	TP 4	0.00	0.10	DG					✓																			
3	TP 10	0.10	0.20	DG					✓																			
4	TP 11	0.20	0.30	DG					✓																			
5	TP 11 - Fibro			DG						✓																		
6	TP 16	0.40	0.50	DG					✓																			
7	TP 20	0.10	0.20	DG					✓																			
8	TP 24	0.00	0.10	DG					✓																			
9	TP 30	0.30	0.40	DG					✓																			
10	TP 31	0.40	0.50	DG					✓																			
11	TP 32	0.60	0.70	DG					✓																			
12	Duplicate A			DG						✓																		

Relinquished By				Received By			
Laboratory	Name	Signature	Date	Laboratory	Name	Signature	Date
GeoEnviro Consultancy	Steven Gass		4/12/2017				

Legend:

APPENDIX E

Explanatory Notes

EXPLANATORY NOTES

Introduction

These notes have been provided to amplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments sections. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods
The methods the description and classification of soils and rocks used in this report are based on Australian standard 1726, the SSA Site investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, qualified by the grading or other particles present (eg sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	Less than 0.002mm
Silt	0.002 to 0.6mm
Sand	0.6 to 2.00mm
Gravel	2.00m to 60.00mm

Soil Classification	Particle size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2.00mm
Gravel	2.00mm to 60.00mm

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very Soft	Less than 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer test (CPT), as below:

Relative Dense	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c-Mpa)
Very Loose	Less than 5	Less than 2
Loose	5 - 10	2 - 5
Medium Dense	10 - 30	5 - 15
Dense	30 - 50	15 - 25
Very Dense	> 50	> 25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering strength, defects and other minor components. Where relevant, further information regarding rock classification, is given on the following sheet.

Sampling
Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provided information on plasticity, grained size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally know as U_{50}) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such Samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods
The following is a brief summary of investigation methods currently carried out by this company and comments on their use and application.

Hand Auger Drilling
The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits
These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure or accommodate the poorly compacted backfill.

Large Diameter Auger (eg Pengo)
The hole is advanced by a rotating plate or short spiral auger generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 05m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

Continuous Spiral Flight Augers
The hole is advanced by using 90mm - 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the augers flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively low reliability due to remoulding, mixing or softening of samples by ground water, resulting in uncertainties of the original sample depth.

Continuous Spiral Flight Augers (continued)
The spiral augers are usually advanced by using a V - bit through the soil profile refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of the recovered rock fragments and through observation of the drilling penetration resistance.

Non - core Rotary Drilling (Wash Boring)
The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus, carrying the cuttings, together with some information from the "feel" and rate of penetration.

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg SPT and U_{50} samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rock and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks an NMLC triple tube core barrel which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of testing Soils for Engineering Purpose"- Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63Kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the "N" value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rocks, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blows counts for each 150mm of, say 4, 6, and 7 blows.

  as 4, 6, 7
  N = 13

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm.

  as 15,30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test methods is used to obtain samples in 50mm diameter thin walled samples tubes in clays. In these circumstances, the best results are shown on the bore logs in brackets.

Dynamic Cone Penetration Test
A modification to the SPT test is where the same driving system is used with a solid 60^0 tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N_c' on the bore logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 test F5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducer in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in Mpa.
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percentage.

There are two scales available for measurement of cone resistance. The lower "A" scale (0-5Mpa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main "B" scale (0-50Mpa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative frictions in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (Mpa)} = (0.4 \text{ to } 0.6)\ N \text{ (blows per 300mm)}$$

In clays the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c = (12 \text{ to} 18)\ C_u$$

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.

Cone Penetrometer Testing and Interpretation continued
This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (AS1289)
Portable dynamic cone penetrometer tests are carried out by driving a rod in to the ground with a falling weight hammer and measuring the blows per successive 100mm increments of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS 1289 Test F3.2).

Laboratory Testing
Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

Engineering Logs
The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

Ground water
Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all, during the investigation period.
- A localised perched water table may lead to a erroneous indication of the true water table.
- Water table levels will vary from time to time, due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if any water observations are to be made.

More reliable measurements can be made by installing stand pipes, which are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be interference from a perched water table or surface water.

Engineering Reports
Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal is changed, say to a twenty storey building. If this occurs, the company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company request immediate notification. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes
Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information trader Documents”, published by the Institute of Engineers Australia. Where information obtained for this investigation is provided for tender purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purpose, at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspect of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site

Review of Design
Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.

Graphic Symbols For Soil and Rock

SOIL


Fill


Topsoil


Gravel (GW , GP)


Sand (SP, SW)


Silt (ML, MH)


Clay (CL, CH)


Clayey Gravel (GC)


Silty Sand (SM)


Clayey Sand (SC)


Sandy Silt (ML)


Gravelly Clay (CL, CH)


Silty Clay (CL, CH)


Sandy Clay (CL, CH)


Peat or Organic Soil

ROCK


Shale


Sandstone


Siltstone,Mudstone,Claystone


Granite, Gabbro


Dolerite, Diorite


Basalt, Andesite

Other Materials


Concrete


Bitumen, Asphaltic Concrete, Coal


Ironstone Gravel


Organic Material

Appendix F Additional Geotechnical Investigation

DRAFT

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Unit 5, 39-41 Fourth Avenue, Blacktown, NSW 2148, Australia
PO Box 1543, Macquarie Centre. North Ryde, NSW 2113
ABN 62 084 294 762
Tel: (02) 9679 8733
Fax: (02) 9679 8744

Report

Additional Geotechnical Investigation – Groundwater and Pavement Subgrade Proposed Menangle Park Zone Substation Fitzpatrick Street, Menangle Park , NSW

Prepared for
Endeavour Energy
43 Glendenning Road
GLENDENNING NSW 3011

Ref: JC17313B-r1
August 2024

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown, NSW 2148, Australia
PO Box 1543, Macquarie Centre. North Ryde, NSW 2113

ABN 62 084 294 762
Tel: (02) 9679 8733
Fax: (02) 9679 8744

29th August 2024

Our Ref: JC17313B-r1

Endeavour Energy
43 Glendenning Road
GLENDENNING NSW 3011

Attention: Ms Rachel Alex

Dear Madam

Re Additional Geotechnical Investigation - Groundwater and Pavement
Proposed Menangle Park Zone Substation
Fitzpatrick Street

We are pleased to submit our additional geotechnical Investigation report for the Proposed Menangle Park Zone Substation to be located at Fitzpatrick Street, Menangle Park.

This report provides additional assessment of the existing groundwater conditions and pavement subgrade material and our commends and recommendations on control room basement and pavement construction.

Should you have any queries, please contact the undersigned.

Yours faithfully
GeoEnviro Consultancy Pty Ltd



Solern Liew BE MIEAust CPEng NER
Director

D:\22JOB\301\JC17313B-r1.DOC

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Document Control

Document Details	
Job No	JC17313B
Revision	r1
Title	Additional Geotechnical Investigation – Groundwater and Pavement Proposed Menangle Park Zone Substation Fitzpatrick Street Menangle Park
Address	Fitzpatrick Street, Menangle Park
Client	Endeavour Energy

Document Status				
Issue/Revision	**Status**	**Prepared By**	**Reviewed By**	**Date**
r1	Final	A Tejada	S Liew	29th August 2024

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Appendix B Explanatory Notes

1. INTRODUCTION

This report presents the results of our additional geotechnical investigation for the Proposed Menangle Park Zone Substation located at Fitzpatrick Street in Menangle Park as shown on the attached Drawing No 1. The investigation was commissioned by Ms Rachel Alex of Endeavour Energy following our fee proposal referenced JC17313A-L2 dated 18th July 2024.

We understand the Proposed Zone Substation development is to include construction of a new control room with basement cables, three new transformers including transformer bunds and fire walls, and driveway and hardstand areas within the compound.

A geotechnical investigation was undertaken by GeoEnviro Consultancy Pty Ltd (report referenced JC17313A-r1 dated January 2018) and a temporary substation was constructed and some earthworks by filling was undertaken on the site.

The purpose of this additional investigation was to further assess the subsurface ground conditions and groundwater levels and provide comments and recommendations on the following;

- The groundwater conditions for the control room basement design levels.
- Earthworks and fill construction procedures for building platform
- Subgrade conditions and recommendations for subgrade preparation and pavement design .

2. BACKGROUND INFORMATION

2.1 Site Location and Description

The site is situated off the northern side of Fitzpatrick Street and to the east of the Main Southern Railway Line, within Lot 2 in DP 737485. To the immediate west is a Sydney Water pump station compound.

The proposed substation site will occupy an area of about 6500m^2. At the time of our investigation, the site boundaries were formed with a temporary substation constructed at the south-western corner of the site. The site consisted of a hardstand area constructed in conjunction with the temporary substation with site fencing also installed.

2.2 Site Topography

The site is situated on very gently undulating terrain to low lying terrain approximately 350m south of an un-named tributary which flows west to the Nepean River. Ground surface within the site slopes down gently to the north at angles of less than 2 degrees.

Based on survey drawing provided, the southern portion of the site is situated at about reduced level 76m to 78m above the Australian Height Datum.

2.3 Geological Setting

Based on the 1:100,000 Soil Landscape Map of Wollongong/Port Hacking prepared by Soil Conservation Service of NSW, the northern portion of the site is underlain by Fluvial Soil belonging to the Theresa Park Landscape Group typically consisting of variable and poorly structured silty and sandy loams.

Based on the 1:100,000 Geological Map of Wollongong/Port Hacking prepared by the Department of Minerals and Energy, Sydney, the underlying geological unit consists of high-level alluvium (Tal) of the Cainozoic Era and this alluvium generally consists of clayey sands. It is generally underlain by Clays and weathered sandstones of the Wianamatta Group.

2.4 Hydrogeology

Groundwater is expected to flow north-west into the Nepean River which is situated about 1km west of the site. Infiltration of surface water through subsurface ground is expected to be moderate due to the porous nature of Fluvial Soils.

Based on the results of our previous geotechnical investigation, subsurface groundwater seepage was encountered at between 2.8m to 5.6m depth and this groundwater appears to have hydrostatic pressure of between 1 and 4m with standing water encountered at depths ranging from 1.2m to 3m.

2.5 Site Salinity Potential Map

Based on the Department of Infrastructure, Planning and Natural Resources 'Salinity Potential in Western Sydney 2002' Map, the site is situated in an area of "moderate" salinity potential.

2.6 Acid Sulfate Soil Risk Map

A review of the Acid Sulfate Soil Risk Maps was carried out for the site and though there were no available maps for the subject site, the surrounding maps indicate sites with similar landscapes, topography and geology to have "No known occurrence of acid sulfate soil".

3. PREVIOUS GEOTECHNICAL INVESTIGATION

Our previous investigation (Ref JC17313A-r1 dated January 2018) which involved drilling of seven boreholes to depths varying from 7.0m to 14.6m revealed the following;

- The site was found to be underlain by deep sandy and clay soil profiles overlying siltstone/sandstone at 14m below existing ground surface based on one borehole.
- The upper 1 to 2m of the profile consists of sand and the profile becomes sandy clayey at lower depths. The sandy profile was found to be loose.
- Over-consolidated alluvial Silty Clay and possibly residual clay occurs at lower depths of 2 to 5m depth. The upper 2.4m of the clay profile was found to have variable strength characteristics of Stiff to Very Stiff and at lower depths, the clayey soil was found to have of hard consistency.
- Groundwater seepage was encountered in all boreholes except one at varying depths. Groundwater rises to 1 to 3m after the site investigation.

4. ADDITIONAL INVESTIGATION

Fieldwork for the additional investigation was carried out on the 25th July 2024 and consisted of drilling three boreholes (BH 101 to BH 103) at locations compliant to Endeavour Energy's WHS requirements as shown on Drawing No 1. BH 101 and 102 were drilled in the proposed control room building location and BH 103 were drilled at the north eastern corner of the site.

The boreholes were drilled using a ute mounted GT10 drill rig equipped with spiral augers attached to a TC-bit. The boreholes were drilled to a maximum depth of 6.0m below existing ground surface. Prior to the site investigation, underground services checks were carried out using available drawing provided by Dial-Before-You-Dig and Endeavour Energy. An underground services locator equipped with an electromagnetic device was engaged as an extra precautionary measure to prevent damage to underground services caused by boreholes drilling.

To assess the strength of the subsurface soil, Standard Penetration Tests (SPT) were carried out in the boreholes. The SPT tests involved driving a split tube steel spoon into the ground using a standard weight (ie 63.5kg) hammer and measuring the penetration resistance in number of blow counts per 150mm penetration. Hand Penetrometer tests were carried out on the SPT split-tube clayey samples.

The boreholes were observed for groundwater during drilling and shortly after completion of the site investigation. Groundwater monitoring wells were installed in all boreholes and this involved;

- Assembling of 50mm Class 18 PVC pipes with the bottom 3m of the standpipes consisting of machine slotted PVC screen.
- Placement of the PVC standpipe into the boreholes for the full depth.
- Filling the voids between the standpipe and the borehole with 2mm graded sand filter to a depth of about 1m below existing ground level.
- Plugging the voids with a minimum 0.5m thick of bentonite seal
- Fitting the top of the standpipe with PVC cap and cast iron gatic cover to prevent rain and runoffs from entering the standpipe.

The site investigation was monitored on a full-time basis by our geotechnical engineer who was responsible for locating the boreholes, carrying out insitu field testing and recording the subsurface profiles encountered. Details of the subsurface profiles are summarised on the Borehole Reports in Appendix A of this report. The borehole reduced levels were obtained from interpolation of the survey contour plans prepared by Burton and Fields (Ref 34574/85228/1 dated 26/6/24);

Borehole	**Reduced Level**
BH 101	77.82m AHD
BH 102	77.35m AHD
BH 103	76.38m AHD

Explanatory notes defining the terms and symbols used in the preparation of the borehole reports are attached in Appendix B.

5. SUBSURFACE CONDITIONS

Reference should be made to the attached Borehole Reports in Appendix A for subsurface profiles encountered during the site investigation. The borehole investigation encountered fill about 1.6m to 3.0m thick overlying sand and clay with groundwater seepage encountered at depths between 1.6m and 4.2m.

The following is summary of the subsurface profiles encountered included reduced levels (RLs) referenced to Australian Height Datum (AHD);

Borehole	**BH 101 (RL 77.82m)**	**BH 102 (RL 77.35m)**	**BH 103 (RL 76.38m)**
Fill	77.82m	77.35m	76.38m
Sand (Natural)	Not Encountered	75.75m	Not Encountered
Sandy Clay (Natural)	76.22m	74.35m	Not Encountered
Silty Clay (Natural)	75.02m	73.55m	73.38m
Groundwater Seepage	72.62m	74.75m	72.18m
Standing Water	76.22m	75.95m	Not Measured

The following is a summary of the subsurface profiles encountered;

- The fill was encountered on the surface of all boreholes comprising of Gravelly Silty Clay, Silty Clay and Ripped Shale with varying amounts of gravel. The fill was generally assessed to be dry to moist.
- Natural soil consisting of predominantly Sand and Sandy Clay in the upper profiles and Silty Clay at lower depths.
- The sand in BH 102 was assessed to be loose. The sand was found to be dry to moist and wet below RL 74.75m AHD (ie 2.6m depth), noting seepage was encountered at this depth.
- The natural clayey soil was generally assessed to be very stiff to hard and dry to moist (ie moisture content equal to or less than the plastic limit). In BH 102, some moist to wet and weak (ie soft and loose) clay and sand was encountered in the upper profiles between RL 75.75m AHD (ie 1.6m depth) and RL 73.55m AHD (ie 3.8m depth).

- Bedrock was not encountered in any of the boreholes which were taken a maximum depth of 6.0m below existing ground level. Siltstone and Sandstone was encountered in previous investigation at 14m depth.

- Significant seepage was encountered in BH 101 and 102 at RL 71.62m AHD (ie 6.2m depth) and RL 74.75m AHD (ie 2.6m depth) respectively. The groundwater level in BH 101 was measured at RL 76.22m AHD (ie 1.6m depth) after one hour of completion of the borehole. The groundwater in BH 102 was measured at RL 75.95m AHD (ie 1.4m depth) shortly after borehole drilling. Minor seepage was encountered in BH 103 at RL 72.18n AHD (ie 4.2m depth) during borehole drilling and the groundwater was not measured after borehole drilling.

6. ASSESSMENT AND RECOMMENDATIONS

6.1 Groundwater and Basement Design

We understand that the proposed control room building will have a cable basement and service trenchs/stormwater pipes under the building slab. The basement will be designed as a drained basement with surface drains and collection pits to divert flows to the downstream outlets.

Based on the borehole investigation, groundwater seepage was encountered at depths of 2.6m to 5.1m and similar groundwater seepage was encountered in our 2017 investigation at between 2.8m and 5.8m depth. The groundwater rises to about 1.4m (ie RL 75.95m AHD) to 1.6m (ie RL 76.22m AHD) below ground surface in this investigation and 1.2m to 1.5m in 2017 investigation, suggesting that the site is subject to artesian flows likely in the north and north west direction.

For the proposed basement design, we recommend an RL of 76.22m AHD be adopted as the design groundwater level. Our comments and recommendations on groundwater issues and basement design are as follows;

- The proposed basement level should be elevated above the design groundwater level, otherwise the basement should be tanked to above the groundwater level.

- The service trenches/stormwater under the building should be elevated above the design ground water level, otherwise the services trenches should be cast into the slab to prevent hydrostatic groundwater pressure forcing water through the pipe junctions and slabs.

- Continuous Flight Auger (CFA) piles or injection piles should be adopted for the proposed building and structures to avoid alteration of existing groundwater level. This piling system involve pumping of concrete or grout into the pier hole to displace the groundwater during withdrawal of the auger.

- For construction below design groundwater level, dewatering by spearpoints and use of temporary shoring should be allowed for in the construction methodology

6.2 Platform Preparation and Earthworks

We understand that the substation platform is proposed to be raised about 1 to 2m from existing ground level in order to elevate the substation above the design flood level. Raising of the platform will resolve most of the groundwater issues discussed in above Section 6.1 and will assist in formation of suitable subgrade for pavement and hard stand area.

The site investigation generally revealed the site to consist of fill overlying natural sandy and clayey soils. It is understood the fill within the compound was placed during the construction of the temporary zone substation and based on the SPT results, the fill appeared to have been compacted during placement. Some moist to wet and weak (ie soft and loose) clay and sand was encountered beneath the fill in BH 102 between 1.6m and 3.8m below existing ground level.

Building platform preparation to elevate the site above the design flood level should be carried out in a controlled manner in order to avoid surface ground subsidence. Typical earthworks should include the following;

- Proof rolling of the existing surface with a minimum 7 passes of a 10 tonne vibrating roller. All soft and heaving areas where encountered should be excavated and replaced with good quality granular fill such as ripped sandstone having a maximum particle size of 75mm.

- Should deep weak ground conditions be encountered during earthworks, the depth of excavation may be reduced by construction of a bridging layer comprising of crushed rock. Geosynthetic material such as geogrids and geofabric may be used to improve site stability.
- All fill should be placed in layers not exceeding 250mm loose thickness and compacted to a minimum 98% of Standard Maximum Dry Density at ±2% of Optimum Moisture Content.
- Field density testing during fill placement by a NATA accredited laboratory. Earthworks should be closely monitored by a geotechnical consultant and must include field density testing at an appropriate frequency and level of supervision as detailed in AS 3798-2007.

6.3 Internal Pavement and Access Driveway

We understand pavements for the substation will include a gravel/switchyard pavement, flexible pavement and rigid pavements for the transformer loading bays.

Pavement subgrade should be prepared as follows;

- Proof rolling of the existing surface with a minimum 10 tonne vibrating roller to identify soft and heaving areas. If soft and heaving areas are encountered, excavation of soft material should be carried out and replaced with good quality granular fill such as ripped sandstone having a maximum particle size of 75mm.
- All fill should be placed in layers not exceeding 250mm loose thickness and compacted to a minimum 98% of Standard Maximum Dry Density at ±2% of Optimum Moisture Content.
- The upper 300mm of fill forming the subgrade of pavements should be compacted to a minimum 100% of Standard Maximum Dry Density at ±2% of Optimum Moisture Content.
- Pavement testing should be closely monitored by a geotechnical consultant and must include field density testing at an appropriate frequency and level of supervision as detailed in AS 3798-2007.

Based on the Austroad 2017 guidelines "Pavement Structural Design", the following pavement thickness should be adequate for following traffic loading;

- Flexible pavement – 2 x 10^5 ESA (Equivalent Standard Axles)
- Rigid pavement – 3 x 10^5 CVAGs (Commercial Vehicle Axle Groups)

Flexible Pavement - Adopted Traffic Loading= 2 x 10^5 Equivalent Standard Axles (ESA)

Material	Thickness
Asphaltic Concrete (AC14)	50mm
DGB20 Base Course	150mm
DGS40 Subbase	300mm
Total	**500mm**

Gravel/Switchyard Pavement - Adopted Traffic Loading= 2 x 10^5 Equivalent Standard Axles (ESA)

Material	Thickness
20mm Blue Metal Aggregate	100mm
DGB20 Base Course	150mm
DGS40 Subbase	300mm
Total	**550mm**

Rigid Pavement – Adopted Traffic Loading = 3 x 10^5 Commercial Vehicle Axle Group (CVAGs)

Material	Thickness
Concrete (Flexural Strength 4MPa)	175mm
DGB20 Subbase	150mm
Total	**325mm**

The following is our recommend pavement design for Heavy duty rigid pavement for the transformer loading bays;

Material	Thickness
Concrete (Flexural Strength 4MPa)	220mm
DGB20 Subbase	150mm
Total	**370mm**

Slab on ground construction for external areas should have regularly spaced doweled or keyed movement joints and be underlain by compacted granular sub-base layer of DGB20 or equivalent good quality crushed rock. This sub-base layer also acts as a drainage layer and reduces pumping action.

The pavement subgrade and pavement materials should be compacted to the following.

Material	Compaction Level	Compaction Type
Base Course	98%	Modified
Sub-Base Course	98%	Modified
Subgrade	100%	Standard

Adequate surface and sub-surface drainage should be provided for the pavement and adjacent areas.

7. LIMITATIONS

The interpretation and recommendations submitted in this report are based on a limited number of boreholes. There is no investigation which is thorough enough to determine all site conditions and anomalies, no matter how comprehensive the investigation program is as site data is derived from extrapolation of limited test locations. The nature and extent of variations between test locations may not become evident until construction.

Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site. Additional groundwater monitoring may be carried out to further assess the groundwater level.

In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

This report has been prepared solely for the use of the client to whom it is addressed and no other party is entitled to rely on its findings. Assessment and recommendations presented herein apply to the site as it existed at the time of the site inspection and cannot apply to changes of which GeoEnviro Consultancy is not aware and has not had the opportunity to evaluate. As regulatory evaluation criteria are constantly updated, concentrations of contaminants presently considered low, may in the future fall short of regulatory standards that require further investigation/redemption.

The statements presented in these documents are intended to advise you of what should be your realistic expectations of this report, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. Attached in Appendix B are documents entitled "Explanatory Notes" in conjunction with which this report must be read, as it details important limitations regarding the investigation undertaken and this report.

REFERENCES

1. *Salinity Code of Practice – Western Sydney Regional Organisation of Councils Ltd – 2002*
2. *Department of Land and Water Conservation – "Site Investigation for Urban Salinity".2002*
3. *What do all the numbers mean? A guide for the interpretation of soil test results. – Department of Conservation and Land Management, 1992*
4. *Australian Standard, AS 2159-2009 "Piling – Design and Installation"*
5. *Australian Standard, AS 3600 -2009 "Concrete Structures"*
6. *Australian Standard, AS 3798 - 2007"Bulk Earthworks for Commercial and Residential Site"*
7. *Acid Sulfate Soil Manual – NSW Acid Sulfate Soil Management Advisory Committee August 1998*



Legend

Borehole

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 9679 8733 Fax: (02) 9679 8744

Drawn By: AT	Date: 26/7/24	Endeavour Energy Menangle Park Zone Substation Borehole Location Plan	
Checked By: SL	Date: 26/7/24		
Revision By:	Date:		
Scale: Not to Scale	A3	Project No: JC17313B	Drawing No: 1

APPENDIX A

Borehole Reports

GeoEnviro Consultancy Pty Ltd

Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 9679 8733 Fax: (02) 9679 8744

Borehole Report

Borehole no: 101

Client: Endeavour Energy

Job no: JC17313B

Project: Proposed menangle Park Zone Substation

Date: 25/7/24

Location: Fitzpatrick Street Menangle Park

Logged by: AT

Drill Model and Mounting: GT10 | Slope: 90° | R.L. Surface: 77.82m (Approx)

Hole Diameter: 100mm | Bearing: Vertical | Datum: AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
TC	NIL						FILL: Gravelly Silty Clay: low plasticity, brown with some sand	D			
			4,8,9 N=17	1.0			FILL: Silty Clay: low to medium plasticity, light brown grey with gravel and sand	D-M			
		▼									Groundwater encountered
						CL	Sandy Clay: low plasticity, grey brown	M			at 1.6m 1hr after completion of drilling.
			9,8,19 N=27	2.0			orange with ironstone gravel bands		VSt	300	
				3.0		CI	Silty Clay: medium plasticity, grey mottled brown with trace of sand and ironstaining		VSt -H	350 560	
			6,7,10 N=17	4.0				M			
				5.0							
		▶	6,8,10 N=18	6.0				D-M	H	500 550	Minor seepage at gravel band
				7.0			End of BH at 6.0m				Groundwater monitoring well installed 3m screen 3m casing sand and bentonite
				8.0							

GeoEnviro Consultancy Pty Ltd

Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 9679 8733 Fax: (02) 9679 8744

Borehole Report

Borehole no: 102

Client: Endeavour Energy

Job no: JC17313B

Project: Proposed menangle Park Zone Substation

Date: 25/7/24

Location: Fitzpatrick Street Menangle Park

Logged by: AT

Drill Model and Mounting: GT10 | Slope: 90° | R.L. Surface: 77.35m (Approx)

Hole Diameter: 100mm | Bearing: Vertical | Datum: AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
TC	NIL						FILL: Ripped Shale	D			
			5,11,10 N=21	1.0			FILL: Gravelly Silty Clay: low plasticity, brown with sand				Groundwater encountered at 1.4m immediately after completion.
				2.0		SP	Sand: medium grained, grey brown	D-M			
							grey	M			
			3,2,3 N=5	3.0				W	L		Seepage
				4.0		CL	Sandy Clay: low plasticity, grey	M-W	(S)		
			5,11,11 N=22	5.0		CI	Silty Clay: medium plasticity, grey mottled brown with ironstone gravel bands	D-M	VSt -H (H)	350 460	
				6.0							
				7.0			End of BH at 6.0m				Groundwater monitoring well installed 3m screen 3m casing sand and bentonite
				8.0							

GeoEnviro Consultancy Pty Ltd

Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 9679 8733 Fax: (02) 9679 8744

Borehole Report

Borehole no: 103

Client: Endeavour Energy

Job no: JC17313B

Project: Proposed menangle Park Zone Substation

Date: 25/7/24

Location: Fitzpatrick Street Menangle Park

Logged by: AT

Drill Model and Mounting: GT10 | Slope: 90° | R.L. Surface: 76.38m (Approc)

Hole Diameter: 100mm | Bearing: Vertical | Datum: AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
TC	NIL						FILL: Ripped Shale	D			
			5,6,7 N=13	1.0			FILL: Gravelly Silty Clay: low to medium plasticity, grey brown with sand	D-M			
				2.0			dark brown with sand and some coal				
			15/75mm N>15	3.0		CL	Silty Clay: low plasticity, grey mottled yellow with some sand	D-M			SPT bouncing on gravel?
			6,9,13 N=22	4.0			with ironstone gravel bands		H	550 600	Very minor seepage at 2.2m
				5.0				M			
				6.0			End of BH at 6.0m				Groundwater monitoring well installed 3m screen 3m casing sand and bentonite
				7.0							
				8.0							

APPENDIX B

Explanatory Notes

EXPLANATORY NOTES

Introduction

These notes have been provided to amplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments sections. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods
The methods the description and classification of soils and rocks used in this report are based on Australian standard 1726, the SSA Site investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, qualified by the grading or other particles present (eg sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	Less than 0.002mm
Silt	0.002 to 0.6mm
Sand	0.6 to 2.00mm
Gravel	2.00m to 60.00mm

Soil Classification	Particle size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2.00mm
Gravel	2.00mm to 60.00mm

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very Soft	Less than 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer test (CPT), as below:

Relative Dense	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c-Mpa)
Very Loose	Less than 5	Less than 2
Loose	5 - 10	2 - 5
Medium Dense	10 - 30	5 - 15
Dense	30 - 50	15 - 25
Very Dense	> 50	> 25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering strength, defects and other minor components. Where relevant, further information regarding rock classification, is given on the following sheet.

Sampling
Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provided information on plasticity, grained size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally know as U_{50}) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such Samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods
The following is a brief summary of investigation methods currently carried out by this company and comments on their use and application.

Hand Auger Drilling
The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits
These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure or accommodate the poorly compacted backfill.

Large Diameter Auger (eg Pengo)
The hole is advanced by a rotating plate or short spiral auger generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 05m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

Continuous Spiral Flight Augers
The hole is advanced by using 90mm - 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the augers flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively low reliability due to remoulding, mixing or softening of samples by ground water, resulting in uncertainties of the original sample depth.

Continuous Spiral Flight Augers (continued)
The spiral augers are usually advanced by using a V - bit through the soil profile refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of the recovered rock fragments and through observation of the drilling penetration resistance.

Non - core Rotary Drilling (Wash Boring)
The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus, carrying the cuttings, together with some information from the "feel" and rate of penetration.

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg SPT and U_{50} samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rock and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks an NMLC triple tube core barrel which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of testing Soils for Engineering Purpose"- Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63Kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the "N" value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rocks, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blows counts for each 150mm of, say 4, 6, and 7 blows.

  as 4, 6, 7
  N = 13

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm.

  as 15,30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test methods is used to obtain samples in 50mm diameter thin walled samples tubes in clays. In these circumstances, the best results are shown on the bore logs in brackets.

Dynamic Cone Penetration Test
A modification to the SPT test is where the same driving system is used with a solid 60^0 tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N_c' on the bore logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 test F5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducer in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in Mpa.
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percentage.

There are two scales available for measurement of cone resistance. The lower "A" scale (0-5Mpa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main "B" scale (0-50Mpa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative frictions in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (Mpa)} = (0.4 \text{ to } 0.6)\ N \text{ (blows per 300mm)}$$

In clays the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c = (12 \text{ to} 18)\ C_u$$

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.

Cone Penetrometer Testing and Interpretation continued
This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (AS1289)
Portable dynamic cone penetrometer tests are carried out by driving a rod in to the ground with a falling weight hammer and measuring the blows per successive 100mm increments of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS 1289 Test F3.2).

Laboratory Testing
Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

Engineering Logs
The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

Ground water
Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all, during the investigation period.
- A localised perched water table may lead to a erroneous indication of the true water table.
- Water table levels will vary from time to time, due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if any water observations are to be made.

More reliable measurements can be made by installing stand pipes, which are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be interference from a perched water table or surface water.

Engineering Reports
Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal is changed, say to a twenty storey building. If this occurs, the company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company request immediate notification. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes
Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information trader Documents”, published by the Institute of Engineers Australia. Where information obtained for this investigation is provided for tender purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purpose, at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspect of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site

Review of Design
Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.

Graphic Symbols For Soil and Rock

SOIL


Fill


Topsoil


Gravel (GW , GP)


Sand (SP, SW)


Silt (ML, MH)


Clay (CL, CH)


Clayey Gravel (GC)


Silty Sand (SM)


Clayey Sand (SC)


Sandy Silt (ML)


Gravelly Clay (CL, CH)


Silty Clay (CL, CH)


Sandy Clay (CL, CH)


Peat or Organic Soil

ROCK


Shale


Sandstone


Siltstone,Mudstone,Claystone


Granite, Gabbro


Dolerite, Diorite


Basalt, Andesite

Other Materials


Concrete


Bitumen, Asphaltic Concrete, Coal


Ironstone Gravel


Organic Material

Appendix G Contamination and Waste Classification Assessment

DRAFT

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Report

Contamination and Waste Classification Assessment
Proposed Menangle Zone Substation
Part Lot 2 in DP 737485, Fitzpatrick Street
Menangle Park NSW

Prepared for
Endeavour Energy
C/-Brewster Murray Pty Ltd
90 York Street
SYDNEY NSW 2000

Ref: JC17313A-r2(rev)
February 2018

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown, NSW 2148, Australia
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20th February 2018

Our Ref: JC17313A-r2(rev)

Endeavour Energy
C/-Brewster Murray Pty Ltd
90 York Street
SYDNEY NSW 2000

Attention: Mr Michael Bullen

Dear Sir,

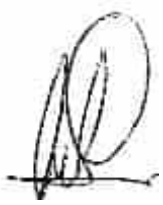
Re Contamination and Waste Classification Report
Proposed Menangle Zone Substation
Part Lot 2 in DP 737485, Fitzpatrick Street, Menangle Park

We are pleased to submit our Contamination and Waste Classification report for the Proposed Menangle Zone Substation located to the north of Fitzpatrick Street within existing Lot 2 DP 737485, Menangle Park as shown on Drawing No 1.

This report contains information on sub-surface conditions and our comments and recommendations on contamination issues for the proposed development.

Should you have any queries, please contact the undersigned.

Yours faithfully
GeoEnviro Consultancy Pty Ltd



Solern Liew CPEng NER
Director

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1. INTRODUCTION

This report presents the results of our contamination investigation for the Proposed Menangle Zone Substation referred to as part Lot 2 in DP 737485 which is located to the north of Fitzpatrick Street and to the east of the Main Southern Railway Line in Menangle Park, as shown on the attached Drawing No 1. The investigation was commissioned by Mr Michael Bullen of Brewster Murray Pty Ltd following our fee proposal referenced PC17328A dated 25th August 2017.

We understand the Proposed Zone Substation is to include the following;

- Construction of a new control room with basement cables.
- Construction of three new transformers including transformer bunds and fire walls.
- Construction of a driveway within the compound.

The objective of this study was to assess the subsurface ground conditions and based on the findings, to provide the following;

- Assessment on the contamination of the site to ensure suitability of the site for the proposed development.
- Waste classification of the fill and natural soil for off-site disposal to a landfill.
- Comments and recommendations on the likely environmental issues associated with the proposed development.

This additional study was carried out in conjunction with our geotechnical investigation and this is reported separately in our report referenced JC17313A–r1 dated January 2018 (Reference 1).

2. SCOPE OF WORK

This assessment was performed in general conformance with our understanding of the guidelines by the Australian and New Zealand Conservation Council (ANZECC) and the Office of Environment and Heritage (OE&H). The scope of this contamination and waste classification assessment was conducted in accordance the Endeavour Energies brief for geotechnical and environmental assessment investigation T-1771.

The scope of work conducted consisted of:

- Review of available information on the site history and information obtained from Department of Lands and aerial photographs,
- A search on the NSW EPAs contaminated land register and licensing register including groundwater bore from Department of Primary Industry Office of Water
- A review of Campbelltown City Councils Section 149(2) Certificate for the site in question,
- A review of published information on the subsurface conditions in the area,
- An inspection of the site and surrounding land to identify apparent or suspected areas of contamination.
- A site investigation to assess subsurface ground conditions
- Collection of subsurface soil and groundwater samples.
- Laboratory analysis of soil and water samples to detect the presence or otherwise of the contaminants of concern,
- An assessment of the laboratory test results with relevant OE&H guidelines.
- Provide a waste classification in accordance with NSW EPA Guidelines (Reference 10)

3. SITE INFORMATION

3.1 Site Location

The site is situated off the northern side of Fitzpatrick Street and to the east of the Main Southern Railway Line, within Lot 2 in DP 737485 as shown on the attached Drawing No 1. To the immediate west is a newly constructed Sydney Water pump station compound. The proposed substation site will occupy an area of about 6800m^2 covering and area roughly rectangular in shape with approximate dimensions of about 80m and 85m.

The site is located within a rural area with the surrounding properties consisting of predominantly of agricultural land and residential properties to the south along Fitzpatrick Street.

3.2 Soil Landscape and Site Topography

The site is situated on very gently undulating terrain to low lying terrain approximately 350m south of an un-named tributary which flows west to the Nepean River. Ground surface within the site slopes down gently to the north at angles of less than 2 degrees.

Based on Google Earth, the southern portion of the site is situated at about 82m above sea level with the northern portion of the site at about 79m above sea level.

Based on the 1:100,000 Soil Landscape Map of Wollongong/Port Hacking (Reference 1) prepared by Soil Conservation Service of NSW, the northern portion of the site is underlain by Fluvial Soil belonging to the Theresa Park Landscape Group and the southern portion of the site is underlain by residual soil belonging to the Blacktown soil landscape group. Theresa Park soil typically consists of variable and poorly structured silty and sandy loams. Blacktown soil is typically shallow to moderately deep hard setting mottled texture contrast soils, moderately reactive and highly plastic.

3.3 Regional Geology and Hydrogeology

Based on the 1:100,000 Geological Map of Wollongong/Port Hacking (Reference 3) prepared by the Department of Minerals and Energy, Sydney, the underlying geological unit consists of high-level alluvium (Tal) of the Cainozoic Era. This alluvium generally consists of clayey sands with thicknesses of on average 13m. It is generally underlain by Clays and weathered sandstones of the Wianamatta Group.

Groundwater is expected to flow north-west into the Nepean River which is situated about 1km west of the site. Infiltration of surface water through subsurface ground is expected to moderate due to the porous nature of Fluvial Soils.

Our search of the NSW Department of Primary Industries groundwater database for the region indicates three groundwater bores within 1km from the site; the following is a summary of the bores;

Bore ID	Depth (m)	SWL (m)	Northing (mAMG)	Easting (mAMG)	Recorded Use	Water Bearing Zone (m)
GW101106	280	14	6225747	293207	Test Bore	18, 80, 160
GW111977	21	-	6226026	232309	Monitor Bore	-
GW112477	2619	-	6225067	291760	Industrial	-

Based on the above information, the groundwater may be considered a resource in the immediate area of the site.

The recent borehole investigation indicated seepage to be present between 2.8m and 5.6m below existing ground surface and groundwater to be present in the monitoring wells at about 1.2m and 1.5m below existing ground surface within 3 hours after drilling had finished.

3.4 Acid Sulphate Soil Risk Map

A review of the Acid Sulphate Soil Risk Maps was carried out for the site and though there were no available maps for the subject site, the surrounding maps indicate sites with similar landscapes, topography and geology it indicates "No known occurrence of acid sulphate soil".

3.5 Site Inspection and Description

A site visit was carried out on the 1st December 2017 by an environmental scientist to observe existing site features and identify obvious or suspected areas of potential contamination.

At the time of our investigation; the proposed substation site consisted of a vacant land cleared of trees with patchy grass cover. A spread of surface fill was evident on the western portion of the site. The substation site boundaries were surveyed and marked with survey pegs.

4. SITE HISTORY

4.1 Aerial Photographs

A review of aerial photographs taken in 1956 to 2016 was carried out. The following is a summary of the observations made from the review;

Year	Description
1956	The site was part of a larger parcel of land with no obvious land use. The site was predominantly cleared of trees with grass cover and some dirt tracks visible. The railway line to the west of the site was constructed with Fitzpatrick Street further south a dirt road. The site was situated within a rural area with the surrounding properties cleared of most tress with grass cover and no apparent land use.
1965	The subject site and surrounding areas appeared similar to the 1960s.
1978	The previous dirt tracks visible within the site had disappeared with no obvious land use still present.
1983	The subject site and surrounding areas appeared similar to the 1970s.
1994	The subject site and surrounding areas appeared similar to the 1980s.
2016	The Sydney Water pump station to the west of the site was under construction with the construction site and earthworks encroaching over the western portion of the subject site. The remaining eastern portion of the subject site was similar to the 1990s with grass cover and no evident land use. There was no change within the surrounding properties since the 1990s.

4.2 Historical Land Titles

Description of historical information on the previous owners of the site was obtained from NSW Land & Property Information (LPI). The information can often be linked to possible land uses and provides an indication of potential contamination on the site. The following is a summary of information obtained of current and previous proprietors;

Description: Lot 2 D.P. 737485

Date of Acquisition and term held	Registered Proprietor(s) & Occupations where available	Reference to Title at Acquisition and sale
02.05.1910 (1910 to 1939)	Perpetual Trustee Company Limited	Vol 2053 Fol 122
21.03.1939 (1939 to 1942)	James Glenlee Fitzpatrick (Gentleman) Bryan Glenlee Fitzpatrick (Gentleman)	Vol 2053 Fol 122 Now Vol 5083 Fol's 230 & 231
09.10.1942 (1942 to 1954)	Kathleen Fitzpatrick (Widow)	Vol 5083 Fol's 230 & 231 Now Vol 5384 Fol 166
02.04.1954 (1954 to 1962)	Bryan Glenlee Fitzpatrick (Grazier)	Vol 5384 Fol 166 Now Vol 8004 Fol 212
11.04.1962 (1962 to 1969)	Helen Anne Patricia Fitzpatrick (Widow) (Section 94 Application not investigated)	Vol 8004 Fol 212 Now Vol 8395 Fol 50
02.10.1969 (1969 to 1977)	The State Planning Authority of New South Wales	Vol 8395 Fol 50
14.03.1977 (1977 to 1985)	New South Wales Planning and Environment Commission Now Minister Administering the Environmental Planning and Assessment Act, 1979	Vol 7403 Fol 150 & Vol 8395 Fol 50 Now Vol 1500 Fol 223
19.08.1985 (1985 to Date	# Director, Macarthur Growth Area Intervening Name Changes, Now # Landcom	Vol 1500 Fol 223 Now 2/737485

Denotes Current Registered Proprietor

Easements: -

- 28.10.1937 (C599360) – Easement for Drainage
- 26.02.1988 (X300623) – Easement for Access and Electricity Purposes and Services 10 metre(s) wide and variable

Leases: -

- 21.10.1969 (L629818) – Helen Ann Patricia Fitzpatrick (Widow) – surrendered 18.06.1970

4.3 NSW EPA Records

A search of NSW EPA contaminated land register and licensing register indicate the site to have no records kept under the Contaminated Land Management Act 1997 and Environmentally Hazardous Chemical Act 1985. Refer to Appendix C for details of the NSW EPA search.

4.4 Section 149 (2) Zoning Certificate

Copies of the Section 149 (2) zoning certificates were obtained from the Campbelltown City Council to determine conditions applicable to the site in relation to the Contaminated Land Management Act. Reference may be made to the certificates attached in Appendix D.

The certificates indicated the following;

- The sites are not within land declared to be an investigation area or remediation site under Part 3 of that Act.
- The sites are not subject to an investigation order or a remediation order within the meaning of the Act
- The sites are not the subject of a voluntary investigation proposal (or voluntary remediation proposal) the subject of the Environmental Protection Authority's agreement under Section 19 or 26 of that Act.
- The sites are not the subject of a site audit statement within the meaning of Part 4 of that Act.

5. POTENTIAL FOR CONTAMINATION

From our review of the site history records and search carried out, the site consisted of semi-rural land with no known contaminating activities or previous landuse with high risk of contamination such as service station sites, heavy industrial premises or factories, therefore, the risk of gross ground contaminants from previous landuse is considered low

However, some fill up to 1.5m thick was encountered in our recent site investigation as revealed by our test pit Nos 1, 10, 11, 19, 30, 31 and 32 and the fill was found to have minor foreign inclusions including concrete and tile pieces. As the source of the fill is unknown, there is a potential for the fill to be contaminated with heavy metals, pesticides and hydrocarbons. Though asbestos were not detected in this investigation, it is still possible for the fill to be impacted by asbestos as it was commonly used as building material in the past.

6. INVESTIGATION METHODOLOGY

6.1 Fieldwork

The field work for the borehole investigation was carried out on the 1st December 2017. The works were carried out under the full-time supervision of our geotechnical and environmental engineers. A total of 7 boreholes (BH 1 to BH 7) were drilled in the following locations (Refer to Drawing No 2);

- Proposed Control Room Building – BH 1, 5, 6 and 7
- Proposed Transformers and Blast walls – BH 2, 3 and 4

The boreholes were drilled using a track mounted Hanjin 8D drill rig equipped with spiral augers attached to a V-bit. The boreholes were drilled through topsoil and into natural soil to depths varying from 7.0m to 14.6m below existing ground surface.

A test pit investigation was also undertaken and included excavation of thirty-two test pits (TP 1 to TP 32) across the site on the 1st December 2017 using a rubber tracked excavator as shown on the attached Drawing No 3. The backhoe test pits were excavated to depths varying from 0.5m to 2.1m below existing ground surface. The test pits were observed for groundwater during and upon completion of the excavation. The field results together with details of the strata encountered are presented in Table 1.

To assess the strength of the subsurface soil, Standard Penetration Tests (SPT) were carried out in the boreholes. The SPT tests involved driving a split tube steel spoon into the ground using a standard weight (ie 63.5kg) hammer and measuring the penetration resistance in number of blow counts per 150mm penetration. Hand Penetrometer tests were carried out on the SPT split-tube clayey samples.

Prior to the site investigation, underground services checks were carried out using available drawing provided by Dial-Before-You-Dig. An underground services locator equipped with an electromagnetic device was engaged as an extra precautionary measure to reduce risk of damage to underground services caused by boreholes drilling.

The boreholes were observed for groundwater during drilling and shortly after completion of the site investigation. Upon completion of the site investigation, all boreholes except BH 4 and BH 7 were backfilled with excavation spoil.

A groundwater monitoring well was installed in BH 4 (MW 1) and BH 7 (MW 2) and this involved;

- Assembling of 50mm Class 18 PVC pipes with the bottom 3m of the standpipes consisting of machine slotted PVC screen.
- Fitting of a filter sock on the screen.
- Placement of the PVC standpipe into the boreholes for the full depth.
- Filling the voids between the standpipe and the borehole with 2mm graded sand filter to a depth of about 1m below existing ground level.
- Plugging the voids with a minimum 0.5m thick of bentonite seal
- Purging of drill water from the boreholes
- Fitting the top of the standpipe with PVC cap to prevent rain and runoffs from entering the standpipe.

The site investigation was monitored on a full-time basis by our geotechnical engineer who was responsible for locating the boreholes, carrying out insitu field testing and recording the subsurface profiles encountered. Upon completion of the investigation, the boreholes were backfilled with drilling spoil. Details of the subsurface profiles are summarised on the Borehole Reports in Appendix A of this report.

The site investigation works were carried out in general accordance with our Safe Work Method Statement (Ref JC17313A-L1 dated 28th September 2017). Details of the subsurface profile and field tests are summarised Borehole and Test Pit Reports in Appendix A and Table 1. Explanatory notes defining the terms and symbols used in the preparation of the borehole reports are attached in Appendix G.

6.2 Groundwater Monitoring

Groundwater monitoring and sampling was carried out in BH 4 (MW1) and BH 7 (MW2) on the 4th (Day 3), 6th (Day 5) and 15th (Day 14) December 2017 and involved the following;

- Measuring the groundwater encountered
- Purging the monitoring wells up to 3 times the total volume of groundwater in the boreholes to ensure stable water samples were obtained.
- Sampling of groundwater using a low flow pump
- The samples were then stored in an amber glass receptacle and stored in a chilled esky and transported to Envirolab Services Pty Ltd, a NATA accredited laboratory, within 24 hours for laboratory analysis.

6.3 Laboratory Testing

Soil Testing – Contamination

Ten soil samples were taken from the site for laboratory analysis by Envirolab Services Pty Ltd, a NATA accredited laboratory to aid assessment of soil contamination and waste classification. The soil samples were analysed for Specific Contamination Concentration (SCC) of the following contaminations of concern concern consisting of;

- Heavy Metals - Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Lead (Pb), Nickel (Ni) and Zinc (Zn)
- Organochlorine Pesticides (OCP).
- Polychlorinated Biphenyls (PCB)
- Total Recoverable Hydrocarbons (TRH)
- Benzene, Toluene, Ethyl Benzene and Xylene (BTEX)
- Polycyclic Aromatic Hydrocarbon (PAH)
- TCLP – heavy metals and PAH
- pH.

In addition to the above, a fibre cement sample from a broken pipe was taken from TP 11 and was analysed for the presence of Asbestos.

The laboratory results for SCC are summarised in Tables 3 to 8. The laboratory test results are detailed on the attached Laboratory Test Report in Appendix E.

Groundwater Testing

In addition, groundwater samples (MW 1 and MW2) were analysed for the above contaminants of concern and other indicator parameters as follows;

- Heavy metals - Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Lead (Pb), Nickel (Ni) and Zinc (Zn).
- Organochlorine Pesticides (OCP).
- Total Recoverable Hydrocarbons (TRH)
- Benzene, Toluene, Ethyl Benzene and Total Xylene (BTEX)
- Polycyclic Aromatic Hydrocarbons (PAH
- Electrical Conductivity (Ec)
- pH
- Sulphate (SO_4)
- Chloride (Cl)
- Total Dissolved Solids.

The laboratory results are summarised in Tables 11 to 13. The laboratory test results are detailed on the attached Laboratory Test Reports in Appendix E.

7. GUIDELINE CRITERIA

The investigation criteria for the site are the environmental criteria (or unrestricted land use criteria) from the Australian and New Zealand Environment and Conservation Council & National Health and Medical Research Council (ANZECC & NHMRC) (Reference 4) and the Office of Environment and Heritage (OEH) Guidelines for Assessing Service Station (Reference 8).

For the purpose of assessing if the site requires remediation prior to development, the DEC requires consideration for National Environmental Health Forum (NEHF) (Reference 6), which are health-based soil investigation levels (HILs) for different exposure settings. The HILs are conservative criteria set specifically to protect human health. The human health levels are based on typical exposure scenarios for various landuse types and derived rigorously following national and international protocols. The NEHF criteria which was updated by the National Environment Protection Council Service Corporation (NEPC) (Reference 7) are health-based soil investigation levels (HILs) for different exposure settings.

For the purpose of assessing the contamination status of the site, the criteria for Commercial or Industrial (HILs D) are adopted as the Site Criteria. The criteria for a standard residential setting with garden/accessible soil (HILs 'A') are also included in this report for comparison. The Site Criteria for assessing TRH and BTEX is based on the NSW EPA Guideline for Assessing Service Station Sites (Reference 8).

For off-site disposal of fill, contaminated material and surplus soil excavated as part of the proposed development works are regulated by the provision of the Protection of the Environment Operations Act (POEO Act 1997) and associated regulations and guidelines including the OEH guideline on Classifying Waste (Reference 10).
There are two types of chemical contaminants concentrations used to classify waste as follows;

- Specific contaminant concentration (SCC)
- Leachable concentration of any chemical contaminant using the toxicity characteristics leaching procedure (TCLP).

Classifying waste based on SCC alone is based on the following thresholds (ie CT1 & CT2);

Analytes	**Maximum values of specific contaminant concentration (SCC) for classification without TCLP**	
	General Solid Waste	Restricted Solid Waste
	CT1 (mg/kg)	CT2 (mg/kg)
Pb	100	400
Cd	20	80
Cr (IV)	100	400
Ni	40	160
As	100	400
Hg	4	16
OCP	NA	NA
PCB	NA	NA
Benzo(a)pyrene	0.8	3.2
PAH	NA	NA
TRH C_6-C_9[(a)]	NA	NA
TRH C_{10}-C_{36}[(a)]	NA	NA
Benzene	10	40
Toluene	288	1152
Xylenes	1000	4000

Note: TCLP – Leachable Concentration CT – Total Concentration Criteria
ND – Not Detected NA – Not Available

Classifying waste based on both SCC and TCLP is based on the following thresholds (ie TCLP1/TCLP2 and SCC1/SCC2);

Analytes	**Waste Classification**			
	General Solid Waste		**Restricted Solid Waste**	
	TCLP1	**SCC1**	**TCLP2**	**SCC2**
Pb	5	1500	20	6000
Cd	1	100	4	400
Cr	5	1900	20	7600
Ni	2	1050	8	4200
As	5	500	20	2000
Hg	0.2	50	20	200
OCP	NA	NA	NA	NA
PCB	NA	<50	NA	<50
Benzo(a)pyrene	0.04	10	0.16	23
PAH	NA	200	NA	800
TRH C_6-C_9[(a)]	NA	650	NA	2600
TRH C_{10}-C_{36}[(a)]	NA	10000	NA	40000
Benzene	0.5	18	2	72
Ethyl Benzene	30	1080	120	4320
Toluene	14.4	518	57.6	2073
Xylenes	50	1800	200	7200

Note: TC – Total Concentration (mg/kg) LP – Leachable Concentration (mg/L)
TCLP – Leachable Concentration Criteria SCC – Total Concentration Criteria
ND – Not Detected NA – Not Available

In this study, the waste was classified based on both SCC alone.

8. RESULTS OF THE INVESIGATION

8.1 Subsurface Conditions

Reference should be made to the attached Borehole Reports in Appendix A and Summary of Test Pit Profile in Appendix B for subsurface profiles encountered during the site investigation. The following is a summary of the subsurface profiles encountered;

Topsoil

Topsoil was encountered on the surface of all boreholes and test pits except TP 1, 10, 11, 19, 30, 31 and 32 consisting predominantly of Silty Sand and Sandy Silt of low liquid limit. The thickness of the topsoil was found to between 200mm to 400mm.

Fill

Fill was encountered on the surface of TP 1, 10, 11, 19, 30, 31 and 32 comprised of Silty Sands and Sandy Silts with thickness of between 500mm and 1500mm. The fill in TP 1, 11, 19 and 30 to 32 was found to contain traces of foreign inclusions including concrete and tile pieces and gravel. A fibre cement pipe was encountered in the fill in TP 11.

Natural Soil

Natural soil was encountered in all boreholes and test pits consisting predominantly of Silty Sand, Sand and Clayey Sand at the upper 0.8m to 2.4m profiles and based on the SPT results, the upper profile was assessed to be loose (for cohesionless soil) and stiff (for cohesive soil).

The natural soil becomes more clayey at lower depths comprising of medium plasticity Sandy Clay and Sandy Silty Clay and fine to medium grained Clayey Sand. These clayey soils were assessed to generally of very stiff to hard consistency.

In all boreholes except BH 5, medium to high plasticity Silty Clay was encountered at depths ranging from 2.2m to 4.8m below existing ground surface and this clayey soil was assessed to be very stiff to hard.

The natural soil was generally found to be dry in the upper profile and moist in the lower profiles.

Bedrock

Bedrock consisting of Sandstone/Siltstone was encountered in BH 1 at depths of 14.0m below existing ground surface. The Sandstone Siltstone was subjectively assessed to be extremely weathered and generally have low strength.

Groundwater

Groundwater seepage was encountered in all boreholes except BH 6 and 7 during drilling at depths ranging from 2.8m to 5.6m below existing ground surface. Groundwater was encountered at depths ranging from 1.2m to 3.0m in BH 1 to 4 shortly after borehole drilling and the groundwater in BH 2 rose from 3m to 1.2m after 3 hours of completion of the drilling.

The groundwater monitoring wells (MW 1 – BH 4 and MW2 – BH 7) encountered groundwater at 1.2m and 1.5m below existing ground surface respectively, on subsequent inspections of 4th (Day 3), 6th (Day 5) and 15th (Day 14) December 2017

Groundwater was not encountered in any of the test pits (ie maximum depth 2.1m) during or shortly after completion of the site investigation.

8.2 Laboratory Results

8.2.1 Soil Samples – Contamination

Reference should be made to Table 2 for sampling schedule and Drawing No 3 for sampling location plan. The following is a summary of the laboratory test results and our assessment;

Heavy Metals

A total of ten individual samples (TP 1 (0.2-0.3m), TP 4 (0.0-0.1m), TP 10 (0.1-0.2m), TP 11 (0.2-0.3m), TP 19 (0.4-0.5m), TP 20 (0.1-0.2m), TP 24 (0.0-0.1m), TP 30 (0.3-0.4m), TP 31 (0.4-0.5m) and TP 32 (0.6-0.7m)) were analysed for a range of heavy metals consisting of As, Cd, Cr, Cu, Pb, Hg, Ni and Zn.

All individual samples analysed were found to have concentrations of heavy metals of concern to be within the Site Criteria. The results are summarised in Table 3.

Organochlorine Pesticides (OCP)

(TP 1 (0.2-0.3m), TP 4 (0.0-0.1m), TP 10 (0.1-0.2m), TP 11 (0.2-0.3m), TP 19 (0.4-0.5m), TP 20 (0.1-0.2m), TP 24 (0.0-0.1m), TP 30 (0.3-0.4m), TP 31 (0.4-0.5m) and TP 32 (0.6-0.7m)) were analysed for a range of organochlorine pesticides.

All concentrations of OCP were found to be below detection limits and therefore within the Site Criteria. The results are summarised in Table 4.

Polychlorinated Biphenyls (PCB)

(TP 1 (0.2-0.3m), TP 4 (0.0-0.1m), TP 10 (0.1-0.2m), TP 11 (0.2-0.3m), TP 19 (0.4-0.5m), TP 20 (0.1-0.2m), TP 24 (0.0-0.1m), TP 30 (0.3-0.4m), TP 31 (0.4-0.5m) and TP 32 (0.6-0.7m)) were analysed for a range of Polychlorinated Biphenyls

All concentrations of PCB were found to be below detection limits and therefore within the Site Criteria. The results are summarised in Table 5.

Total Recoverable Hydrocarbons (TRH)

(TP 1 (0.2-0.3m), TP 4 (0.0-0.1m), TP 10 (0.1-0.2m), TP 11 (0.2-0.3m), TP 19 (0.4-0.5m), TP 20 (0.1-0.2m), TP 24 (0.0-0.1m), TP 30 (0.3-0.4m), TP 31 (0.4-0.5m) and TP 32 (0.6-0.7m)) were analysed for TRH.

All concentrations of TRH were found to be below detection limits and therefore within the Site Criteria. The results are summarised in Table 6.

Polycyclic Aromatic Hydrocarbons (PAH)

(TP 1 (0.2-0.3m), TP 4 (0.0-0.1m), TP 10 (0.1-0.2m), TP 11 (0.2-0.3m), TP 19 (0.4-0.5m), TP 20 (0.1-0.2m), TP 24 (0.0-0.1m), TP 30 (0.3-0.4m), TP 31 (0.4-0.5m) and TP 32 (0.6-0.7m)) were analysed for PAH.

All concentrations of PAH were found to be negligible or below detection limits and therefore within the Site Criteria. The results are summarised in Table 7.

Asbestos

A total of ten soil samples and one fibre cement sample taken from a broken pipe from TP 11 were analysed for the presence of Asbestos. All soil samples analysed did not detect Asbestos Fibres or Fibrous Asbestos (AF/FA). The fibre cement sample taken from the broken pipe was not found to be Asbestos Containing Material (ACM). The results are summarised Table 8.

8.2.2 Laboratory Test Results – Groundwater

The groundwater samples were compared with the ANZECC 2000 criteria for protection of 95% of species in slightly to moderately disturbed freshwater ecosystems.

The groundwater samples were found to have to have slightly elevated concentrations of Cadmium (ie 0.7µg/L and 0.6µg/L in MW 1 and MW 2 respectively) above the ANZECC criteria for protection of 95% of species of 0.2µg/L. The groundwater samples were also found to have elevated concentrations of Zinc (ie 69µg/L and 67µg/L in MW 1 and MW 2 respectively) above the ANZECC criteria for protection of 95% of species of 8µg/L. All other heavy metals were found to be within the ANZECC Criteria. All results for OCP, PCB, TRH, BTEX and PAH were found to be below laboratory detection limits and therefore are within the Criteria

The following is a summary of the laboratory test results for salinity in groundwater;

Sample	pH	TDS	CL	SO4	EC	Resistivity
MW1	6.3	630	270	5	1000	1000
MW2	6.2	620	270	4	1000	1000

Note: TDS – Total Dissolved Solids mg/L
CL – Chloride mg/L
SO4 – Sulphate mg/L
EC – Electrical Conductivity uS/cm
Resistivity – ohm cm

The groundwater was assessed to be moderately saline with an EC value of 1000uS/m, within the ANZECC criteria of 2200uS/cm. This correlates with the moderate TDS values of 630 and 620 mg/L.

8.2.3 Quality Assurance/ Quality Control (QA/QC)

Chain of Custody Forms and Preservation

The fieldwork was carried out in accordance with standard written procedures which included collection of samples in new glass jars, preservation of samples in ice chests and transportation of samples to the contract laboratory under chain of custody documentation.

Field Duplicates

A duplicate sample (Duplicate A) was prepared from the primary sample TP 4 (0.0-0.1m) and analysed. Refer to Table 9 for details.

The Relative Percentage Difference (RPD) values between primary and the duplicate sample was calculated to assess the results. A zero RPD means perfect agreement of results between the primary and duplicate sample whilst an RPD above 200% indicates total disagreement in results.

The maximum RPD value obtained was 0.0%. The RPD values for OCP, PCB, TRH, BTEX and PAH could not be calculated because the results were below laboratory detection limits in both primary and duplicate samples.

The internal laboratory QA/QC results which are presented in the laboratory certificates in Appendix E are considered acceptable based on the duplicate and control samples analysed. The overall results suggest that the laboratory analysis carried out is reliable for this assessment.

Laboratory QA

Envirolab Services carried out internal QA/QC procedures which normally includes one or more of the following;

- Preparation and analysis of duplicate and triplicate samples to assess precision of laboratory results,
- A spike and duplicate spike is prepared for each sample batch. This involves spiking a sample with a known concentration of contaminant to verify the absence of matrix effects and to assess precision,
- Analysis of sample batch as reagent blanks to monitor reagent purity and as an over-all procedural blank. Reagent blank will also be run after samples with a high concentration to prevent carry over.
- A surrogate is added to all samples to monitor sample matrix effects throughout all analytical stages by calculating the % recovery at the completion of the analysis.

The laboratory control results are included in the laboratory test reports in Appendix E.

QA/QC Assessment

The QA/QC indicators either all complied with the required standards or showed variations that would have no significant effect on the quality or interpretation of the data. It is therefore assessed that for the purposes of this analysis, the QA/QC results are adequate and the quality of the data is acceptable for use in this contamination assessment.

9. ASSESSMENT AND RECOMMENDATIONS

9.1 Contamination Issues

This contamination study of the Proposed Menangle Zone Substation to the north of Fitzpatrick Street in Menangle Park was performed by GeoEnviro Consultancy in order to investigate the likelihood of ground contamination. The scope of the investigation included a review of site history/records, a site inspection, soil sampling and laboratory analysis and this was conducted in accordance the Endeavour Energy's brief T-1771.

The site investigation revealed the site to be generally underlain by topsoil overlying natural Sandy and Clayey soils to depths of 14m or more. Some fill consisting of Silty Sand and Sandy Silt was encountered mainly along the western and north western portions of the site and minor foreign inclusions such as concrete and tile fragments were encountered in the fill as encountered in TP 1, 10, 11, 19, 30, 31 and 32. A fibre cement pipe was encountered in the fill in TP 11.

Selected soil samples and two groundwater samples (MW1 and MW2) were analysed for a range of potential contaminants of concern including Heavy metals (As, Cd, Cr, Cu, Hg, Pb, Ni and Zn), Organochlorine pesticides, Organophosphorus pesticides, Polychlorinated Biphenyls, Total Recoverable Hydrocarbons, Benzene, Toluene, Ethyl Benzene and Xylene and Polycyclic Aromatic Hydrocarbons. A broken piece of fibre cement pipe from TP 11 was analysed for asbestos. The soil laboratory results were interpreted by comparison with guideline criteria recommended by the NSW EPA and the groundwater results were compacted with the ANZECC 2000 criteria for protection of 95% of species..

The laboratory test results indicated all concentrations of contaminants of concern to be within the Site Criteria and the fibre cement sample from TP 11 did not encounter asbestos. The groundwater samples were generally found to have low or negligible concentrations of contaminants with the ANZECC criteria and the slightly elevated concentrations of Cadmium and Zinc encountered are likely to be background levels from surrounding disturbed terrain, therefore not considered significant.

Within the context of the scope of work carried out, we are of the opinion that the site has a low risk of gross ground chemical contamination and therefore site is suitable for the proposed substation development.

We note that the site was found to be impacted by some fill with a trace (ie <5%) of foreign matter (eg building debris) along the western site boundary (ie TP 1, 10, 11, 19, 30, 31 and 32). The NEPM 2013 guidelines (Reference 7) permit the presence of foreign matter within the fill to be retained within the site subject to compliant of the fill material to the Site Criteria and aesthetically acceptable (eg malodorous soils, discoloured chemical deposits, stained soil, large monolithic deposits/large inert foreign matter, putrescible refuse and animal remains). Though the guidelines do not outline specific trigger values, we consider fill containing greater than 5% by weight of foreign matter to be aesthetically unacceptable, therefore the insitu fill is within acceptable limits.

The following issues relating to site contamination which need to be considered are as follows;

- All site works should be carried out under the supervision of an environmental scientist/engineer and this may include soil sampling and validation sampling to ensure
- Should insitu fill material be found to have foreign matter great than 5% by weight, the fill should be excavated and disposed off-site to an OEH approved landfill or treated by screening and removal of foreign matter.
- Our site investigation did not encounter asbestos however should asbestos be detected during construction, all works should cease and an "Unexpected Asbestos Finds Protocol" as outlined in Appendix F should be initiated. The NEPM 2013 (Reference 7) provides guidelines on treatment and health screening levels for asbestos in soil which may be classified in three types of asbestos; Bonded asbestos-containing-material (ACM), Fibrous asbestos (FA) and Asbestos fines (AF). A hygienist should be engaged to supervise asbestos clean-up works.

9.2 Construction Issues

Construction works for the substation may include excavation for the cable basement and importation of fill to raise the site to above flood level. Our geotechnical report (Reference 1) has provided recommendations for basement excavation and earthworks construction. The proposed development would need to consider the following;

- All topsoil, fill and natural soil to be excavated are to be disposed to an appropriately licensed landfill should be classified in accordance with OE&H guidelines Part 1 – Classifying Waste, NSW EPA November 2014 (Reference 10).

- All screened and clean insitu fill intended to be reused on-site should be validated by laboratory analysis to ensure suitability of the material for reuse.
- All imported fill required for bulk earthworks should be validated as clean compactable fill (VENM) free of organics, non-saline and not affected by acid sulphate soil.

9.3 Waste Classification

For off-site disposal of surplus fill to a landfill, the material to be excavated from sites is regulated by the provision of the Protection of the Environment Operations Act (POEO Act 1997) and associated regulations and guidelines including the DEC guideline on classifying waste (Reference 10). Based on the foregoing, our waste classifications for the on-site material are as follows;

- Silty Sand and Sandy Silt with organics (Topsoil) – "General Solid Waste (Non putrescibles)".
- Silty Sand and Sandy Silt with foreign inclusions (Fill) – "General Solid Waste (Non putrescibles)".
- Natural Silty Sand, Clayey Sand, Sandy Clay, Silty Clay, Sandstone/Siltstone – "Virgin Natural Excavated Material (VENM)"

In the event where more buried fill material other than those encountered in the investigation is exposed during earthworks, this material should be appropriately excavated, isolated and classified. All fill containing asbestos is to be classified as "Special Waste – Asbestos".

The natural soils should be monitored for presence of acid sulphate soil during site excavation which is normally characterised by pungent odour being released into the air, discolouration of soil (eg green and blue tinge) and leaching of iron from the soil. All natural soil containing sulphidic ore (Reference 18) and should be classified as "General Solid Waste".

10. LIMITATIONS

The interpretation and recommendations submitted in this report are based on a limited number of boreholes. There is no investigation which is thorough enough to determine all site conditions and anomalies, no matter how comprehensive the investigation program is as site data is derived from extrapolation of limited test locations. The nature and extent of variations between test locations may not become evident until construction.

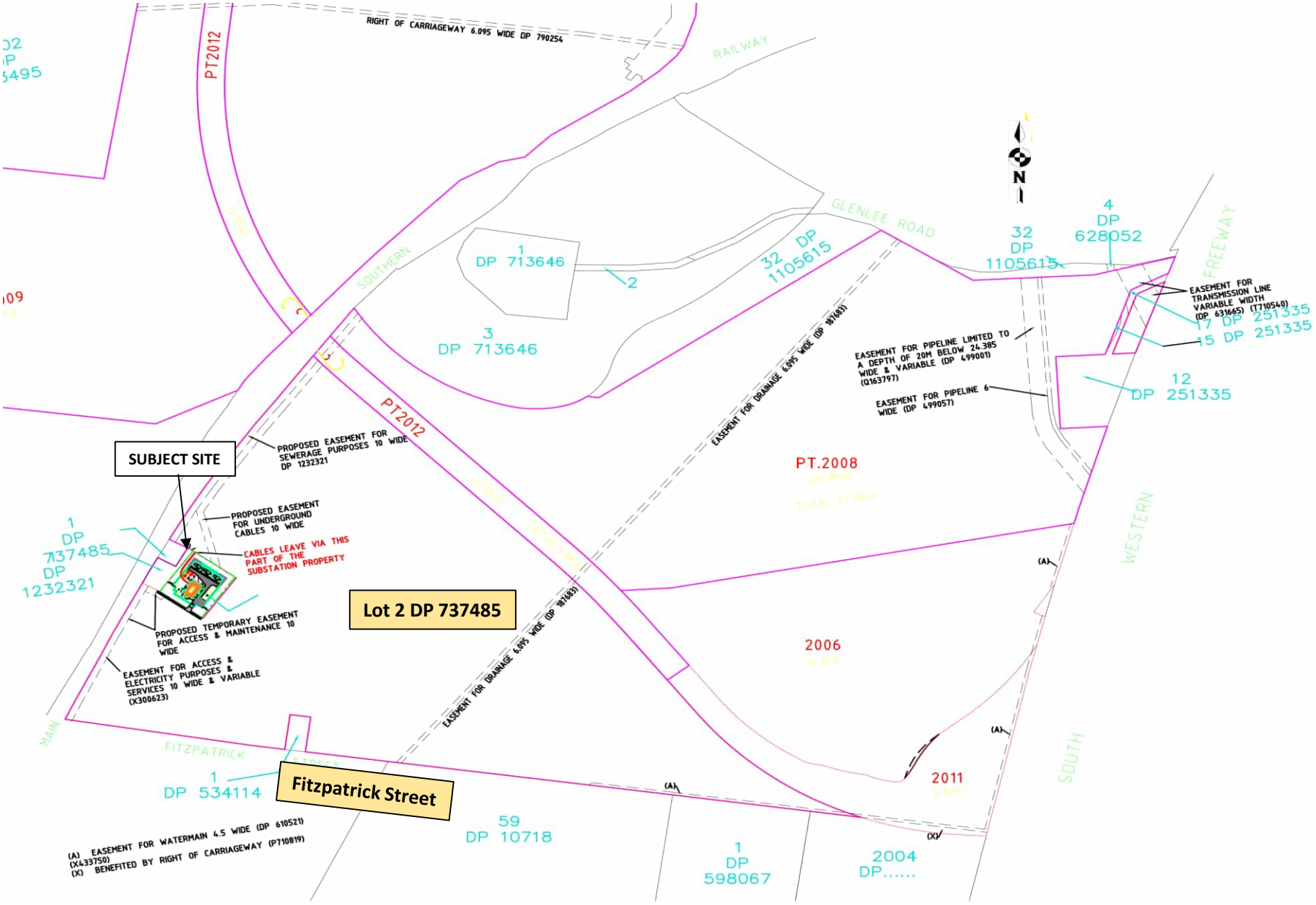
Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

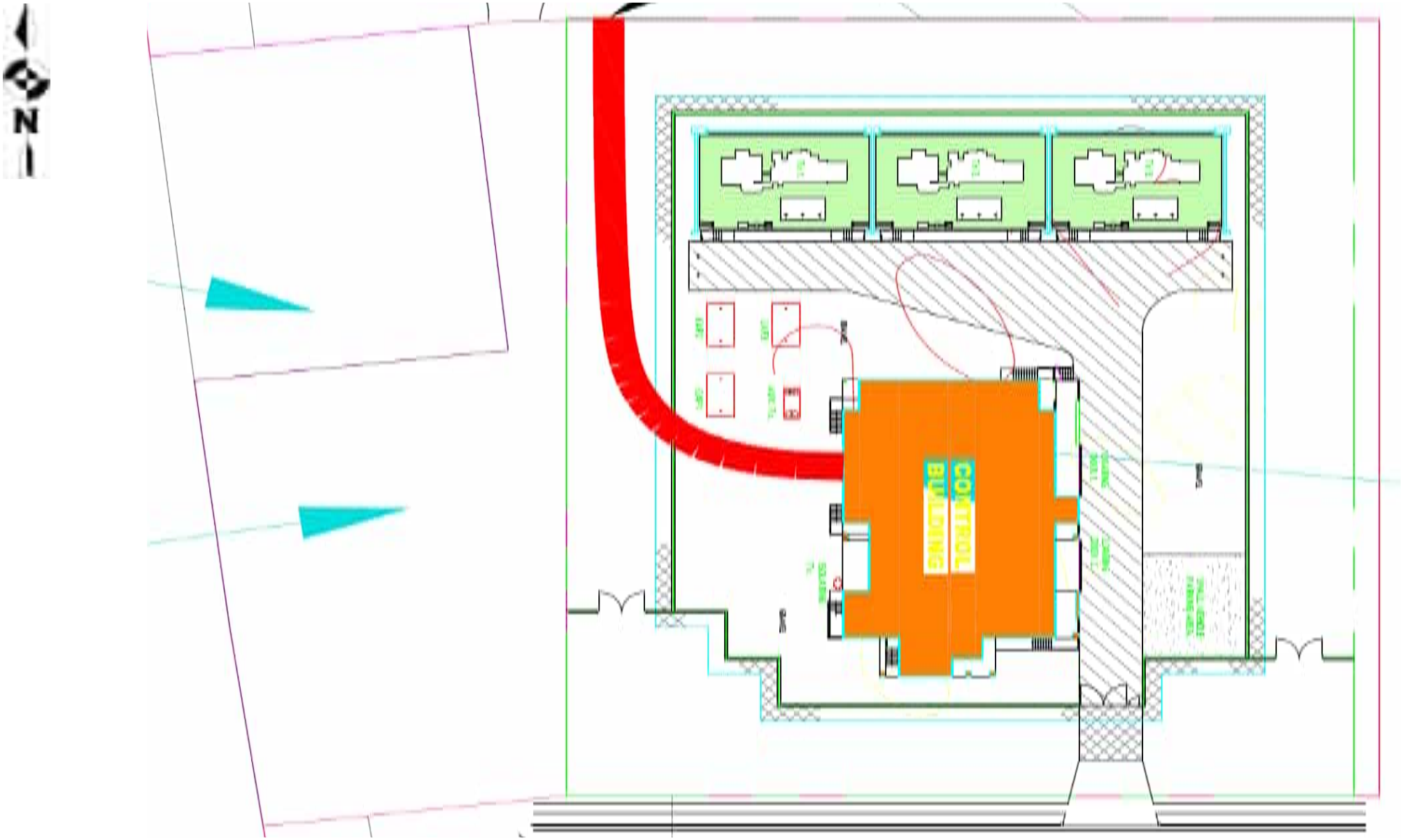
The statements presented in these documents are intended to advise you of what should be your realistic expectations of this report, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. Attached in Appendix G are documents entitled "Important Information about Your Environmental Site Assessment" and Explanatory Notes in conjunction with which this report must be read, as it details important limitations regarding the investigation undertaken and this report.

REFERENCES

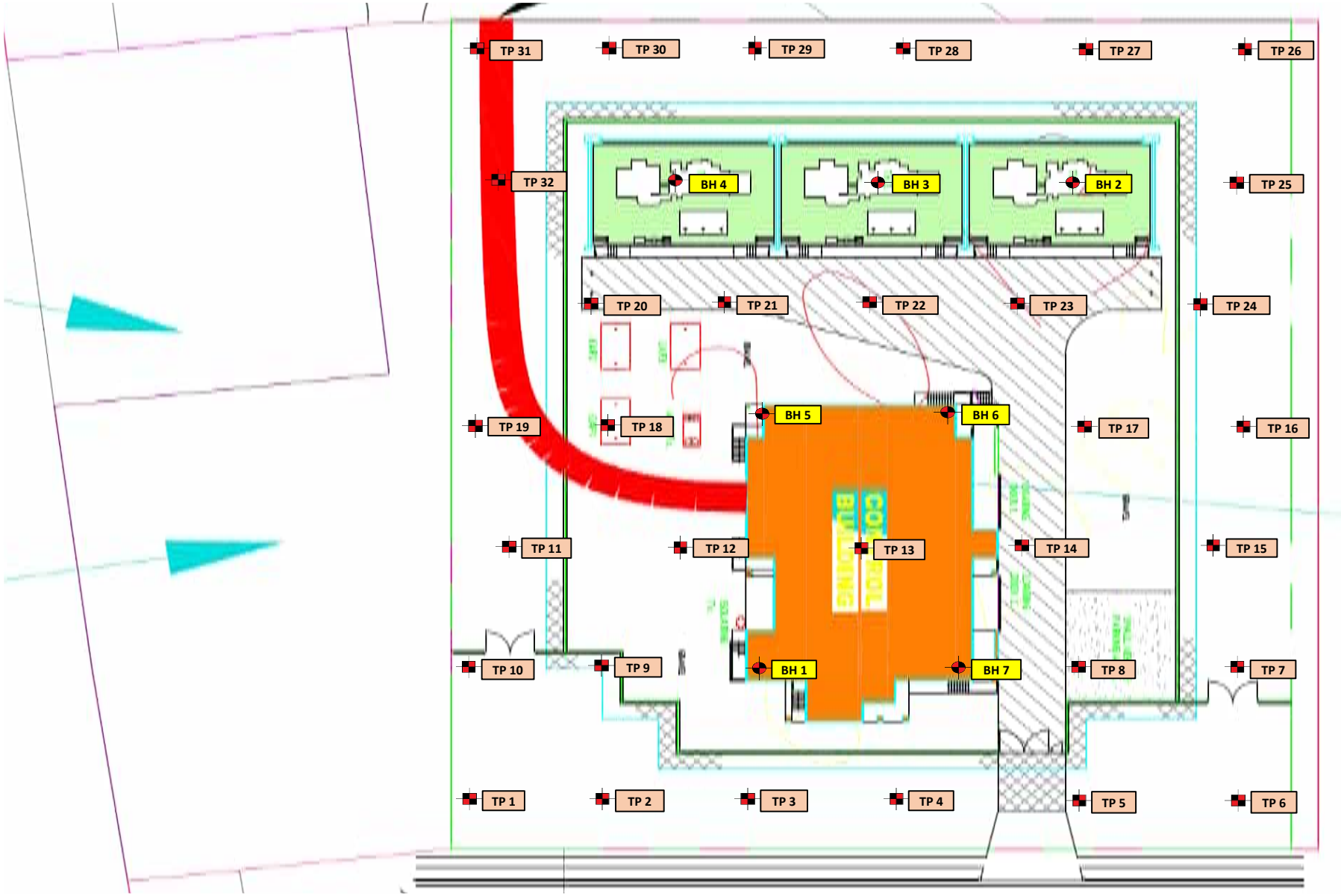
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2. *1:100,000 Soil Landscape Map of Wollongong/Port Hacking – Soil Conservation Service of NSW; Sheet 9029-9129*
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14. *What do all the numbers mean? A guide for the interpretation of soil test results. – Department of Conservation and Land Management, 1992*
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GeoEnviro Consultancy Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia Tel: (02) 96798733 Fax: (02) 96798744	Drawn By: SG	Date: 08/01/2017	**Brewster Murray Pty Ltd** **Proposed Menangle Zone Substation** **Site Locality Plan**
	Checked By: SL	Date: 08/01/2017	
	Revision By:	Date:	
	Scale: Proportional	A3	**Project No: JC17313A** / **Drawing No: 1**



GeoEnviro Consultancy Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia Tel: (02) 96798733 Fax: (02) 96798744	Drawn By: SG	Date: 08/01/2017	**Brewster Murray Pty Ltd** **Proposed Menangle Zone Substation** **Proposed Site Layout**
	Checked By: SL	Date: 08/01/2017	
	Revision By:	Date:	
	Scale: Proportional	A3	Project No: JC17313A / Drawing No: 2



Legend

- Test Pit
- Borehole

GeoEnviro Consultancy

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Drawn By: SG	Date: 08/01/2017	**Brewster Murray Pty Ltd**	
Checked By: SL	Date: 08/01/2017	**Proposed Menangle Zone Substation**	
Revision By:	Date:	**Test Pit and Borehole Location Plan**	
Scale: Proportional	A3	**Project No: JC17313A**	**Drawing No: 3**

Test Pit Number	Depth (m)	Profile Type	Description
1	0.00-0.20	Fill	Sandy Silt/Silty Sand: Low liquid limit, light brown, with gravel, dry
	0.20-0.50	Fill	Silty Sand: Fine to medium grained, brown, with gravel, 1 tile fragment, 1 piece plastic rubbish, moist
	0.50-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
2	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
3	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.50	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
4	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
5	0.00-0.35	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
6	0.00-0.40	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.40-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
7	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
8	0.00-0.40	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.40-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
9	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
10	0.00-0.20	Fill	Sandy Silt: Low liquid limit, brown, with clay and gravel inclusions, dry
	0.20-0.50	FIll	Silty Sand: Fine to medium grained, dark brown, dry to moist
	0.50-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist
11	0.00-0.60	Fill	Sandy Silt: Low liquid limit, brown, with clay and gravel inclusions, 1 piece of fibre cement pipe, trace timber fragments, dry
	0.60-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry to moist

Note:
PP = Pocket Penetrometer
MC = Moisture Content
PL = Plastic Limit

GeoEnviro Consultancy

TABLE 1 (Page 1 of 3)
SUMMARY OF SOIL PROFILE

Brewster Murray Pty Ltd
Proposed Menangle Zone Substation
Fitzpatrick Street, Menangle Park

Test Pit Number	Depth (m)	Profile Type	Description
12	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
13	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
14	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-1.30	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
15	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
16	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
17	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
18	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
19	0.00-1.00	Fill	Sandy Silt/Silty Sand: Low liquid limit, brown, with gravel, clay, trace of concrete fragments, dry
	1.00-1.40	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
20	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
21	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-1.50	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
22	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
23	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.60	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry

Note:

PP = Pocket Penetrometer

MC = Moisture Content

PL = Plastic Limit

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TABLE 1 (Page 2 of 3)

SUMMARY OF SOIL PROFILE

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Test Pit Number	Depth (m)	Profile Type	Description
24	0.00-0.30	Topsoil	Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
25	0.00-0.25	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.25-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
26	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
27	0.00-0.40	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.40-0.90	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
28	0.00-0.35	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.35-0.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
29	0.00-0.30	Topsoil	Sandy Silt/Silty Sand: Fine to medium grained, light brown grey, dry
	0.30-0.80	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
30	0.00-0.80	Fill	Silty Clay: Low plasticity, brown, with gravel and trace of concrete gravel, dry
	0.80-1.30	Natrual	(SM) Silty Sand: Fine to medium grained, light grey brown, dry
31	0.00-0.40	Fill	Silty Clay: Low plasticity, brown, with gravel and trace of concrete gravel, dry
	0.40-1.50	Fill	Silty Clay: Low plasticity, brown, with sand and gravel, dry to moist
	1.50-2.00	Natural	(CL-CI) Silty Sandy Clay: Low to medium plasticity, light brown, dry to moist
32	0.00-0.30	Fill	Silty Clay: Low plasticity, brown, with gravel and trace of concrete gravel, dry
	0.30-1.50	Fill	Silty Clay: Low plasticity, brown, with sand and gravel, dry to moist
	1.50-1.70	Natural	(SM) Silty Sand: Fine to medium grained, light grey brown, moist
	1.70-2.10	Natural	(SC) Clayey Sand: Fine to medium grained, light brown grey, dry to moist

Note:

PP = Pocket Penetrometer

MC = Moisture Content

PL = Plastic Limit

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TABLE 1 (Page 3 of 3)

SUMMARY OF SOIL PROFILE

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Sample	Depths (m)	Sample Date	Sample Type	Analysis														
				Heavy Metals								OCP	PCB	TRH	BTEX	PAH	Asbestos	Indicator Parameters
				As	Cd	Cr	Cu	Pb	Hg	Ni	Zn							
TP1	0.2-0.3	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP4	0.0-0.1	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP10	0.1-0.2	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP11	0.2-0.3	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP11 - Fibro	-	1/12/2017	Material														o	
TP19	0.4-0.5	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP20	0.1-0.2	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP24	0.0-0.1	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP30	0.3-0.4	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP31	0.4-0.5	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
TP32	0.6-0.7	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
Duplicate A	-	1/12/2017	Soil	o	o	o	o	o	o	o	o	o	o	o	o	o		
MW1	-	17/01/2018	Water	o	o	o	o	o	o	o	o	o	o	o	o	o		o
MW2	-	17/01/2018	Water	o	o	o	o	o	o	o	o	o	o	o	o	o		o

Note: O denotes tested

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TABLE 2

Analytical Program

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Sample	Depths (m)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
TP1	0.2-0.3	<4	<0.4	9	14	9	<0.1	3	14
TP4	0.0-0.1	<4	<0.4	<1	2	4	<0.1	<1	4
TP10	0.1-0.2	<4	<0.4	6	11	8	<0.1	4	18
TP11	0.2-0.3	<4	<0.4	7	12	10	<0.1	5	20
TP19	0.4-0.5	6	<0.4	12	25	14	<0.1	13	44
TP20	0.1-0.2	<4	<0.4	2	5	6	<0.1	2	14
TP24	0.0-0.1	<4	<0.4	<1	1	4	<0.1	<1	2
TP30	0.3-0.4	6	<0.4	10	26	13	<0.1	12	46
TP31	0.4-0.5	<4	<0.4	7	47	10	<0.1	7	34
TP32	0.6-0.7	<4	<0.4	8	13	9	<0.1	3	10
Duplicate A	-	<4	<0.4	<1	2	4	<0.1	<1	4
HBILs 'A' Criteria		**100**	**20**	**100 (VI)**	**600**	**300**	**40**	**400**	**7400**
HBILs 'D' Criteria		**3000**	**900**	**3600 (VI)**	**240000**	**1500**	**730**	**6000**	**400000**

Notes

1) All results are expressed as mg/kg and pH (units).

2) Figures in bold italics and underlined exceed the HBIL 'D' Criteria

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TABLE 3
Summary of Analytical Results - Heavy Metals

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Sample	Depths (m)	HCB	alpha-BHC	gamma-BHC	beta-BHC	Heptachlor	delta-BHC	Aldrin	Heptachlor Epoxide	gamma-Chlordane	alpha-chlordane	Endosulfan I	pp-DDE	Dieldrin	Endrin	pp-DDD	Endosulfan II	pp-DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor	Total OCP
TP1	0.2-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP4	0.0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP10	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP11	0.2-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP19	0.4-0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP20	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP24	0.0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP30	0.3-0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP31	0.4-0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP32	0.6-0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
Duplicate A	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
HBILs 'A' Criteria		**10**			**6**		**6**		**50**	**270**	**240**	**6**	**10**	**240**		**240**		**300**	
HBILs 'D' Criteria		**80**			**50**		**45**		**530**	**2000**	**3600**	**45**	**100**	**3600**		**3600**		**2500**	

Notes

1) All results are expressed as mg/kg and pH (units).

2) Figures in bold italics exceed the HBILs 'D' Criteria

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TABLE 4
Summary of Analytical Results - OCP

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Sample	Depths (m)	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Total PCB
TP1	0.2-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP4	0.0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP10	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP11	0.2-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP19	0.4-0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP20	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP24	0.0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP30	0.3-0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP31	0.4-0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
TP32	0.6-0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
Duplicate A	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
HBILs 'A' Criteria									**1**
HBILs 'D' Criteria									**7**

Notes

1) All results are expressed as mg/kg and pH (units).

2) Figures in bold italics exceed the HBILs 'D' Criteria

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TABLE 5
Summary of Analytical Results - PCB

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Sample	Depths (m)	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	C_{10}-C_{36}	F1 [4] C_6-C_{10}	F2 [5] $>C_{10}$-C_{16}	F3 C_{16}-C_{34}	F4 C_{34}-C_{40}	Volatile Organic Compounds (VOC)					
											Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene
TP1	0.2-0.3	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP4	0.0-0.1	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP10	0.1-0.2	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP11	0.2-0.3	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP19	0.4-0.5	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP20	0.1-0.2	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP24	0.0-0.1	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP30	0.3-0.4	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP31	0.4-0.5	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
TP32	0.6-0.7	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
Duplicate A	-	<25	<50	<100	<100	<250	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<1
NSW DEC (1994)		**65**				**1000**					**1**	**1.4**	**3.1**	**14**		
HSLs 'A and B' Criteria																
(SAND)	**0m to <1m**						**45**	**110**			**0.5**	**160**	**55**	**40**		**3**
	1m to <2m						**70**	**240**			**0.5**	**220**		**60**		
	2m to < 4m						**110**	**440**			**0.5**	**310**		**95**		
	4m+						**200**				**0.5**	**540**		**170**		
HSLs 'D' Criteria																
(SAND)	**0m to <1m**						**260**				**3**			**230**		
	1m to <2m						**370**				**3**					
	2m to < 4m						**630**				**3**					
	4m+										**3**					

Notes

1) All results are expressed as mg/kg unless otherwise specified

2) Figures in bold exceed the NSW DEC criteria

3) ND Not detected

4) F1 is C_6-C_{10} minus the sum of the BTEX concentrations

5) F2 is $>C_{10}$-C_{16} Minus Napthalene

6) Figures in bold italics that have been underlined exceed the HSLs 'A and B' Criteria

7) Figures in bold italics exceed the HSLs 'D' Criteria

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TABLE 6

Summary of Analytical Results - TRH and VOC

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Prepared by SL Date : 2/02/2018
Checked By:__SG___Date:2/02/2018

Sample	Depths (m)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	Benzo(a)pyrene TEQ	Total PAHs
TP1	0.2-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP4	0.0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP10	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP11	0.2-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP19	0.4-0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP20	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP24	0.0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP30	0.3-0.4	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.2	0.08	<0.1	<0.1	<0.1	<0.05	0.54
TP31	0.4-0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
TP32	0.6-0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
Duplicate A	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1	<0.05	ND
HBILs 'A' Criteria		**3**															**3***	**300**
HBILs 'D' Criteria																	**40***	**4000**

Notes

1) All results are expressed as mg/kg

2) Figures in bold italics exceed the HBIL 'A' Criteria

3) Figures in bold italics that have been underlined exceed the HBIL 'D' Criteria

* B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products

PAH Species	TEF
Benzo(a)anthracene	0.1
Benzo(a)pyrene	1
Benzo(b+j)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Benzo(g,h,i)perylene	0.01
Chrysene	0.01
Dibenzo(a,h)anthracene	1
Indeno(1,2,3-c,d)pyrene	0.1

GeoEnviro Consultancy

TABLE 7
Summary of Analytical Results - PAH

Brewster Murray Pty Ltd
Proposed Menangle Zone Substation
Fitzpatrick Street, Menangle Park

Prepared By: SL Date: 2/02/2018
Checked By:__SG___Date:2/02/2018

Sample	Depths (m)	Asbestos
TP1	0.2-0.3	<0.1g/kg
TP4	0.0-0.1	<0.1g/kg
TP10	0.1-0.2	<0.1g/kg
TP11	0.2-0.3	<0.1g/kg
TP19	0.4-0.5	<0.1g/kg
TP20	0.1-0.2	<0.1g/kg
TP24	0.0-0.1	<0.1g/kg
TP30	0.3-0.4	<0.1g/kg
TP31	0.4-0.5	<0.1g/kg
TP32	0.6-0.7	<0.1g/kg
TP11 - Fibro	-	ND
HBILs 'A' Criteria		**0.01% / 0.001%** [1]
HBILs 'D' Criteria		**0.05% / 0.001%** [1]

Note: ND = Not detected

Measured in %w/w

1) Bonded Asbestos Contaminaint Material / Fiberous Asbestos and Asbestos Fines

2) Figures in bold italics exceed the HBILs 'D' Criteria

GeoEnviro Consultancy

TABLE 8

Summary of Analytical Results - Asbestos

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Sample	Depths (m)	Metals							
		Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
TP 4	0.00-0.10	<4	<0.4	<1	2	4	<0.1	<1	4
Duplicate A	-	<4	<0.4	<1	2	4	<0.1	<1	4
Relative Percentage Difference (RPD)		NA	NA	NA	0.0	0.0	NA	NA	0.0

Sample	Depths (m)	OCP	PCB	TRH	BTEX	PAH
TP 4	0.00-0.10	ND	ND	ND	ND	ND
Duplicate A	-	ND	ND	ND	ND	ND
Relative Percentage Difference (RPD)		NA	NA	NA	NA	NA

Notes

1) All results are expressed as mg/kg .

2) ND - Not Detected

3) NA - Not Applicable

GeoEnviro Consultancy

TABLE 9
Summary of Analytical Results - Quality Assurance

Brewster Murray Pty Ltd

Proposed Menangle Zone Substation

Fitzpatrick Street, Menangle Park

Sample	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
MW1	<1	**0.7**	<1	<1	<1	<0.05	8	**69**
MW2	<1	**0.6**	<1	<1	<1	<0.05	8	**67**
ANZECC Water Quality Guidelines-2000	24/13[3]	0.2	1[4]		3.4	0.6	11	8

Notes

1) All results are expressed as µg/L.

2) Figures in bold exceeds ANZECC Guidelines for Water Quality 2000 for protection of 95% of species

3) As III/As V

4) Cr VI

GeoEnviro Consultancy

TABLE 10

Summary of Analytical Results (Dam water) - Heavy Metals

Brewster Murray Pty Ltd
Proposed Menangle Zone Substation
Fitzpatrick Street, Menangle Park

Sample	OCP						PCB
	Heptachlor	Endrin	gamma-Chlordane	alpha-Chlordane	DDT	Others	
MW1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2
MW2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2
ANZECC Water Quality Guidelines-2000	0.09	0.02	0.08		0.01	ID	0.6/0.03[3]

Notes

1) All results are expressed as µg/L.

2) Figures in bold exceeds ANZECC Guidelines for Water Quality 2000 for protection of 95% of species

3) Aroclor 1242/Aroclor 1254

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TABLE 11

Summary of Analytical Results (Dam water) - OCI

Brewster Murray Pty Ltd
Proposed Menangle Zone Substation
Fitzpatrick Street, Menangle Park

Sample	BTEX									PAH
	Benzene	Toluene	EthylBenzene	m+p-Xylene	o-Xylene	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	
MW1	<1	<1	<1	<2	<1	<10	<50	<100	<100	ND
MW2	<1	<1	<1	<2	<1	<10	<50	<100	<100	ND
ANZECC Water Quality Guidelines-2000	950	ID	ID	350	200					16[3]

Notes

1) All results are expressed as µg/L.

2) Figures in bold exceeds ANZECC Guidelines for Water Quality 2000 for protection of 95% of species

3) Naphathelene

GeoEnviro Consultancy

TABLE 12

Summary of Analytical Results (Dam water) - BTEX/ TRH/ PAH

Brewster Murray Pty Ltd
Proposed Menangle Zone Substation
Fitzpatrick Street, Menangle Park

Sample	Total Dissolve Solids (mg/L)	pH	Chloride (mg/L)	Sulphate (mg/L)	Resistivity ohm cm	Salinity (uS/cm)
MW1	630	6.3	270	5	1000	1000
MW2	620	6.2	270	4	1000	1000
ANZECC Water Quality Guidelines-2000		6.5-8.0				125-2200

Notes

1) All results are expressed as µg/L.

2) Figures in bold exceeds ANZECC Guidelines for Water Quality 2000 for protection of 95% of species

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TABLE 14

Summary of Analytical Results (Groundwater) - Indicator Parameters

Murray Brewster Pty Ltd
Marayong Zone Substation Renewal
Charles Street and Frederick Street Lalor Park

APPENDIX A

Borehole Reports

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96798733 Fax: (02) 96798744

Borehole Report

Borehole no: 1 (page 1 of 2)

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:

Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
		▼	N=6 2,3,3			SC	Sandy Clay: Low to medium plasticity, brown and grey	M	VSt	200	Groundwater encountered at 1.2m 3 hours after completion
				2.0		SC	Clayey Sand: Fine to medium grained, grey brown	M	MD		
						SC	Sandy Clay: Low to medium plasticity, brown and grey	M			
			N=18 3,8,10	3.0				D-M	H	>600	
				4.0			Sandy Silty Clay: Medium plastiucity, grey and brown	M-W			
		▼	N=22 6,11,11						H	600	Seepage encountered at 4.0m
				5.0		CI-CH	Silty Clay: Medium to high plasticity, grey	MC= PL (M)			
			N=24 4,10,14	6.0					H	600	
						CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands	M-W			
				7.0							
			N=13 5,7,5						VSt-H	350-420	
				8.0							

Continued next page

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Tel: (02) 96798733 Fax: (02) 96798744

Borehole Report

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:
Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL			9.0 10.0		CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands	M	Vst -H		
TC-BIT				11.0 12.0 13.0 14.0		CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands, trace Siltstone bands	M	Vst -H		
							Siltstone/Sandstone: Brown, extremely to distinctly weathered, low strength				
				15.0 16.0			End BH 1 at 14.6m				

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Borehole Report

Borehole no: 2 (page 1 of 2)

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:
Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
		▼	N=7 1,2,5			SC	Sandy Clay: Low plasticity, grey	M	St	150-200	Groundwater encountered at 1.2m 3 hours after completion
				2.0		SC	Clayey Sand: Fine to medium grained, grey and brown	M			
			N=18 5,8,10	3.0			Silty Sandy Clay: Medium plasticity, grey and brown	M	H	400-500	
		▼				CI-CH	Silty Clay: Medium to high plasticity, grey and brown, with fine grained ironstone gravel	MC= PL (D-M)			Groundwater encountered at 3.0m upon completion
			N=19 5,8,11	4.0					H	450-550	
				5.0							
		▶	N=13 3,5,8						St-VSt	180-250	Seepage encountered at 5.6m
				6.0							
				7.0							
			N=18 4,6,12			CI-CH	Silty Clay: Medium to high plasticity, grey and brown, with fine to coarse grained ironstone gravel bands	MC< =PL (D-M)	H	>600	
				8.0							

Continued next page

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Borehole Report

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:
Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL			9.0 10.0 11.0 12.0 13.0		CI-CH	Silty Clay: Medium to high plasticity, grey and brown, with fine to coarse grained ironstone gravel bands	MC =PL (D-M)	Vst -H		
				14.0 15.0 16.0			End BH 2 at 13.0m				

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Borehole Report

Borehole no: 3

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:

Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
							Sand: Fine to medium grained, grey white	D-M	L		
				1.0							
			N=23 4,9,14			SC	Clayey Sand: Fine to medium grained, grey brown	M	VSt-H (MD)	250-400	
				2.0							
			N=11 4,5,6						VSt	300	
		▼		3.0			Silty Sandy Clay: Medium plasticity, grey brown	M	H	400	Groundwater at 3.0m after drilling
		▶									Slow infiltration Seepage encountered at 3.6m
				4.0		CI	Silty Clay: Medium plasticity, grey and brown, with fine to coarse grained ironstone gravel	M			
			N=19 5,8,11						H	500-600	
				5.0							
				6.0							
				7.0							
							End BH 3 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 4 (MW1)

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Slope: 90 deg
R.L. Surface:
Hole Diameter: 100 mm
Bearing: -
Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
							Sand: Fine to medium grained, grey white	D-M	L		
			3 1,1,1	1.0		SC	Sandy Clay: Medium plasticity, grey and brown, with ironstone gravel	M	St	150	Groundwater encountered at 1.2m on Day 3, 5 and 14 after investigation
				2.0							
			N=21 9,10,11	3.0			Sandy Silty Clay: Medium plasticity, brown and grey, with fine to coarse grained ironstone gravel	M	H	>600	Groundwater at 2.4m after 2hrs of drilling Seepage encountered at 2.8m
			N=22 5,11,11	4.0							
				5.0							
				6.0							
				7.0							
							End BH 4 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 5

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:

Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL						Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
			N=9 1,2,7			SC	Sandy Clay/Clayey Sand: Fine to medium grained, grey brown	M	St	150-200	
				2.0							
			N=18 5,8,10			CI	Silty Clay: Medium plasticity, grey brown, with fine to medium grained ironstone gravel bands	D-M	H	520	Seepage encountered at 2.8m
				3.0							
				4.0							
			N=20 4,9,11						H	550-600	
				5.0							
			N=23 6,11,12						H	500-600	
				6.0							
				7.0							
							End BH 5 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 6

Client: Brewster Murray Pty Ltd
Job no: JC17313A

Project: Proposed Menangle Zone Substation
Date: 1/12/17

Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:

Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL	DRY ON COMPLETION					Sandy Silt/Silty Sand: Low liquid limit, brown	D			
				1.0			Sand: Fine to medium grained, grey white	D-M	L		
			N=8 3,3,5	2.0		SC	Sandy Clay: Low to medium plasticity, grey brown	M	VSt	210	
			N=17 3,8,9	3.0		CI	Silty Clay: Medium plasticity, brown and grey, with fine to medium grained ironstone gravel	M	H	500	
			N=24 3,12,12	4.0					H	520-550	
			N=24 8,12,12	5.0					H	>600	
				6.0							
				7.0							
							End BH 7 at 7.0m				
				8.0							

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Borehole Report

Borehole no: 7 (MW2)

Client: Brewster Murray Pty Ltd
Job no: JC17313A
Project: Proposed Menangle Zone Substation
Date: 1/12/17
Location: Fitzpatrick Street, Menangle
Logged by: SG

Drill Model and Mounting: Hanjn 8D | Slope: 90 deg | R.L. Surface:
Hole Diameter: 100 mm | Bearing: - | Datum:

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description (Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component)	Moisture Content	Consistency/Density Index	Hand Penetrometer kPa	Structure and Additional Observations
V-BIT	NIL	DRY ON COMPLETION					Sandy Silt/Silty Sand: Low liquid limit, brown	D			
							Sand: Fine to medium grained, grey white	D-M	L		
			N=6 2,2,4	1.0				M-W			
				2.0		SC	Clayey Sand: Fine to medium grained, grey and brown	M			Groundwater encountered at 1.5m on Day 3, 5 and 14 after investigation
			N=19 4,9,10	3.0		SC	Sandy Clay: Medium plasticity, grey and brown, trace of ironstone gravel	M	H	420-500	
						CI	Silty Clay: Medium plasticity, grey brown, with fine to medium grained ironstone gravel	M			
			N=22 5,9,13	4.0					H	500	
				5.0							
			N=24 7,12,12	6.0					H	550	
				7.0							
				8.0			End BH 7 at 7.0m				

APPENDIX B

Sampling Quality Assurance Plan

SAMPLING LOCATION AND RECORDING

The position of all sampling points shall be approximated with reference to site features and boundaries and recorded on a site plan. All sampling locations shall be labelled with a unique number with prefix as follows;

- BH - Boreholes including hand auger boreholes
- TP – Test pit excavation

Soil types shall be recorded in accordance with the geotechnical classifications detailed in AS1726-1993 Geotechnical Site Investigations. A field log shall record the following but not limited to the following information;

- Profile type – fill, natural, bedrock etc
- Depths of profile type
- Soil classification including composition, properties and characteristics.
- Groundwater conditions.
- Depths of samples collected.
- Unusual or unexpected conditions including odour, colour etc.

SOIL SAMPLING

Sampling equipment used shall be in sound working order and free of oil leaks. Soil samples recovered from the testpits were collected directly from an undisturbed lump of soil from the backhoe bucket. Care was taken to ensure that cross contamination between samples do not occur

Immediately after collection, samples were placed in new jars and stored in cooled conditions while in the field and in transit to the laboratory.

Field personnel will be responsible for the labelling of all sample containers. Labelling shall be completed using permanent markers. Each sample shall be labelled with the following information;

- Project Number
- Sample Identification Number.
- Sampling depth.

SAMPLE CUSTODY

A Laboratory Test Request & Chain of Custody (COC) form shall be completed for each sample set collected. The form is maintained as a record of sample collection, transfer, shipment and receipt by the laboratory. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving them shall sign, date and record the time on the COC.

Any samples damage shall be reported to the field personnel so that resampling could take place.

APPENDIX C

EPA Searches and Groundwater Bores

Search results

Your search for: Name (site, occupier, owner, recipient):
Environmentally Hazardous Chemicals
LGA: Campbelltown City Council

Search Again
Refine Search

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the planning process.

Search TIP

To search for a specific site, search by LGA (local government area) and carefully review all sites listed.

... more search tips

More information about particular sites may be available from:

- The POEO public register
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.
This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register.POEO public register

22 January 2018

For business and industry ()

For local government ()

Contact us

131 555 (tel:131555)

Online (http://www.epa.nsw.gov.au/about-us/contact-us/feedback/feedback-form)

info@epa.nsw.gov.au (mailto:info@epa.nsw.gov.au)

EPA Office Locations (http://www.epa.nsw.gov.au/about-us/contact-us/locations)

Accessibility (http://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/help-index)
Disclaimer (http://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/disclaimer)
Privacy (http://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/privacy)
Copyright (http://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/copyright)

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Search results

Your search for: Name (site, occupier, owner, recipient):
Contaminated Land Management
LGA: Campbelltown City Council

Search Again
Refine Search

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the planning process.

Search TIP

To search for a specific site, search by LGA (local government area) and carefully review all sites listed.

... more search tips

More information about particular sites may be available from:

- The POEO public register
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.
This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register.POEO public register

22 January 2018

For business and industry ()

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Contact us

131 555 (tel:131555)

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info@epa.nsw.gov.au (mailto:info@epa.nsw.gov.au)

EPA Office Locations (http://www.epa.nsw.gov.au/about-us/contact-us/locations)

Accessibility (http://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/help-index)
Disclaimer (http://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/disclaimer)
Privacy (http://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/privacy)
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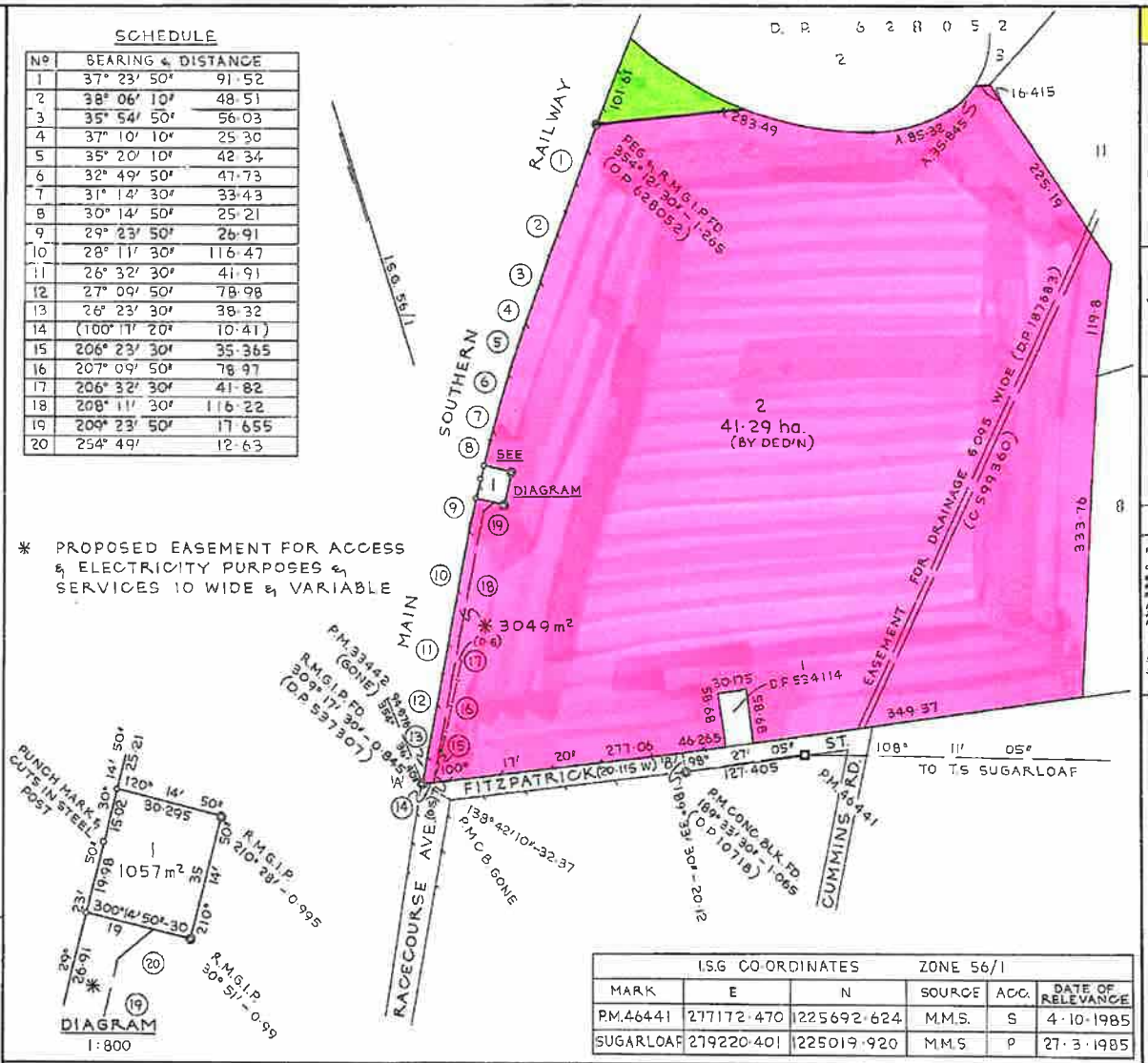
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PLAN FORM 2 — Plan Drawing only to appear in this space — *OFFICE USE ONLY

Signatures and seals only.

SCHEDULE

No	BEARING & DISTANCE	
1	37° 23′ 50″	91·52
2	38° 06′ 10″	48·51
3	35° 54′ 50″	56·03
4	37° 10′ 10″	25·30
5	35° 20′ 10″	42·34
6	32° 49′ 50″	47·73
7	31° 14′ 30″	33·43
8	30° 14′ 50″	25·21
9	29° 23′ 50″	26·91
10	28° 11′ 30″	116·47
11	26° 32′ 30″	41·91
12	27° 09′ 50″	78·98
13	26° 23′ 30″	38·32
14	(100° 11′ 20″	10·41)
15	206° 23′ 30″	35·365
16	207° 09′ 50″	78·97
17	206° 32′ 30″	41·82
18	208° 11′ 30″	116·22
19	209° 23′ 50″	17·655
20	254° 49′	12·63



I.S.G. CO-ORDINATES		ZONE 56/1			
MARK	E	N	SOURCE	ACC.	DATE OF RELEVANCE
P.M.46441	277172·470	1225692·624	M.M.S.	S	4·10·1985
SUGARLOAF	279220·401	1225019·920	M.M.S	P	27·3·1985

LOT 1 SHOWN HEREON PROPOSED TO BE ACQUIRED BY THE M.W.S.&D.B.

D.P. 737485

Registered: 24·10·1986

C.A.:

Title System: TORRENS

Purpose: AQUISITION - NOTA CURRENT PLAN AT REG'N S 327AA L.G.A.

Ref. Map: U7322-5 #

Last Plan: D.P. 628052

PLAN OF LAND & EASEMENT PROPOSED TO BE ACQUIRED WITHIN LOT 1 D.P. 628052

Reduction Ratio 1: 3000
Lengths are in metres

Mun./Shire: CAMPBELLTOWN
City
Locality: MENANGLE PARK
Parish: MENANGLE
County: CUMBERLAND

This is sheet 1 of my plan in ____ sheets. (Delete if inapplicable).

I, ALAN WILLIAM SIMPSON of M.W.S.&D.B. (LTO DEL BOX 9897) a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that the survey represented in this plan is accurate and has been made *(1) by me (2) under my immediate supervision, in accordance with the Survey Practice Regulations, 1933, and was completed on 22·9·1986

Signature: A. W. Simpson

Surveyor registered under Surveyors Act, 1929, as amended. Datum Line of Azimuth: A – B. *Strike out either (1) or (2). †Insert date of survey.

Panel for use only for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements or restrictions as to user.

Council Clerk's Certificate

I hereby certify that:—

(a) the requirements of the Local Government Act, 1919 (other than the requirements for the registration of plans), and

*(b) the requirements of section 345 of the (Metropolitan Water, Sewerage and Drainage Act, 1924, as amended, (Hunter District Water, Sewerage, and Drainage Act, 1938, as amended

have been complied with by the applicant in relation to the proposed ____ (Insert "new road", "subdivision" or "consolidated lot") set out herein

Subdivision No. ____

Date ____

(Signature) ____ Council Clerk

*This part of certificate to be deleted where the application is only for a consolidated lot or the opening of a new road or where the land to be subdivided is wholly outside the area of operations of the Metropolitan Water Sewerage and Drainage Board and the Hunter District Water Board.
†Delete if inapplicable.

A.F.D.

LOT 1 SHOWN HEREON PROPOSED TO BE ACQUIRED BY THE M.W.S.&D.B.

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

SURVEYOR'S REFERENCE 224807 86/592

This negative is a photograph made as a permanent record of a document in the custody of the Registrar General this day.

27th October, 1986

D B 1 133482

123/25492 F.B. 6769 R.E.

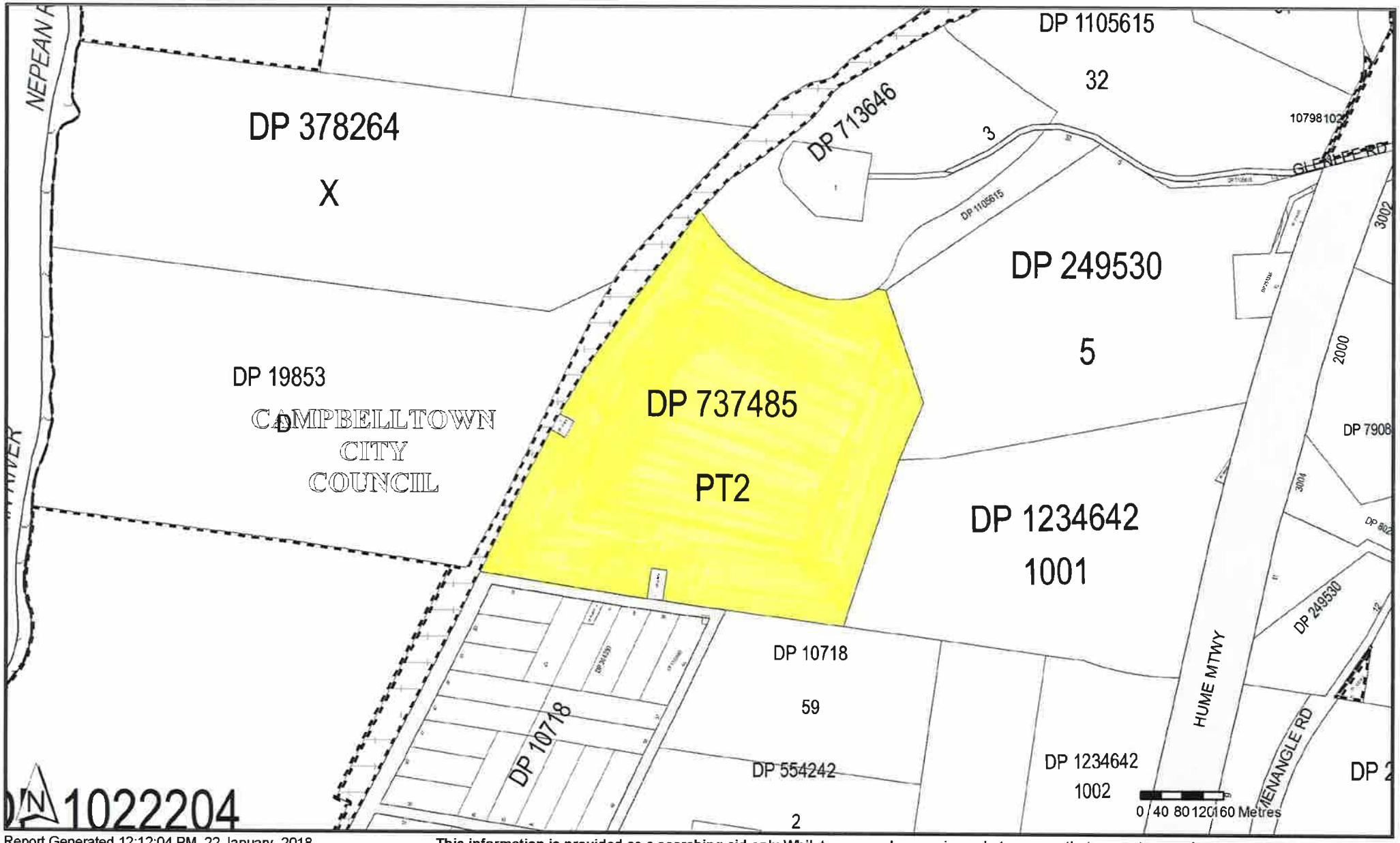
Req:R986598 /Doc:DP 0737485 P /Rev:25-Jun-1992 /Sts:OK.OK /Pgs:ALL /Prt:22-Jan-2018 11:13 /Seq:1 of 1
Ref:PSH-GROLLY-JC17313A /Src:H

LAND REGISTRY SERVICES

Cadastral Records Enquiry Report : Lot 2 DP 737485

Ref : NOUSER

Locality : MENANGLE PARK
Parish : MENANGLE
LGA : CAMPBELLTOWN
County : CUMBERLAND



Report Generated 12:12:04 PM, 22 January, 2018

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This information is provided as a searching aid only.Whilst every endeavour is made to ensure that current map, plan and titling information is accurately reflected, the Registrar General cannot guarantee the information provided. For ALL ACTIVITY PRIOR TO SEPTEMBER 2002 you must refer to the RGs Charting and Reference Maps

Req:R986598 /Doc:DP 0737485 P /Rev:25-Jun-1992 /Sts:OK.OK /Pgs:ALL /Prt:22-Jan-2018 11:13 /Seq:1 of 1
Ref:PSH-GROLLY-JC17313A /Src:H

123/25492 FB 6769 R.E.

D P 737485

PLAN FORM 2

Signatures and seals only.

Plan Drawing only to appear in this space

*OFFICE USE ONLY

D.P. 737485

Registered: 24-10-1986

C.A.: —

Title System: TORRENS

Purpose: ACQUISITION - NOTA CURRENT PLAN AT REGN'S 9271AA L.G.A.

Ref. Map: U7922-5 *

Last Plan: D.P. 628052

N O O 2 E I A

PLAN OF LAND & EASEMENT PROPOSED TO BE ACQUIRED WITHIN LOT 1 D.P. 628052

Reduction Ratio 1 : 2000 — Lengths are in metres

Land District: CAMPBELLTOWN

Locality: MENANGLE PARK

Parish: MENANGLE

County: CUMBERLAND

This is sheet 1 of my plan/s dated 22-9-1986

I, (ALAN WILLIAM SIMPSON) of M.W.S.&D.B. (LTO DEL BOX 8897) a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that this survey represented in this plan is accurate and has been made * (a) by me (the surveyor) personally (b) by a person under my direct supervision and control who was competent to do so * and that the said survey was completed on the 22-9-1986

Surveyor: [signature]

* Delete words not applicable

Purpose for use only for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements or restrictions as to use.

SURVEYORS REFERENCE 1224807 86/592

SCHEDULE

No	BEARING & DISTANCE
1	37° 23' 50" 91.52
2	38° 06' 10" 48.51
3	35° 54' 50" 56.03
4	37° 10' 10" 25.30
5	35° 20' 10" 42.34
6	32° 49' 50" 47.73
7	31° 14' 30" 33.43
8	30° 14' 50" 25.21
9	29° 23' 50" 26.91
10	28° 11' 30" 116.47
11	26° 32' 30" 41.91
12	27° 09' 50" 78.98
13	26° 23' 30" 38.32
14	(100° 11' 20" 10.41)
15	206° 23' 30" 35.365
16	207° 09' 50" 78.97
17	206° 32' 30" 41.82
18	208° 11' 30" 116.22
19	209° 23' 50" 17.655
20	254° 49' 12.63

* PROPOSED EASEMENT FOR ACCESS & ELECTRICITY PURPOSES & SERVICES 10 WIDE & VARIABLE

RACECOURSE AVE

MAIN

SOUTHERN

RAILWAY

FITZPATRICK (20115 W.B.)

CUMMINS RD.

EASEMENT FOR DRAINAGE 6.095 WIDE (D.P. 187683) (C 599360)

TO TS SUGARLOAF

SEE DIAGRAM (1)

* 3049 m²

2 41.29 ha. (BY DEDN.)

1057 m²

DIAGRAM 1:800

ISG COORDINATES			ZONE 56/1		
MARK	E	N	SOURCE	ACC.	DATE OF RELEVANCE
P.M.46441	277172.470	6225692.624	M.M.S.	S	4-10-1985
SUGARLOAF	279220.401	6225019.920	M.M.S.	P	27-3-1985

LOT 1 SHOWN HEREON PROPOSED TO BE ACQUIRED BY THE M.W.S.&D.B.

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

This negative is a photograph made as a permanent record of a document in the custody of the Registrar General this day.

27th October, 1986

D P 737485

All Groundwater

find a site

- All Groundwater Map
  - North Coast Region
  - Hunter Region
  - **Greater Sydney Region**
  - South Coast Region
  - Northwest Region
  - Central West Region
  - Southwest Region
  - Far West Region
  - Great Artesian Basin
  - Coal Basins

bandwidth ◉ high ○ low

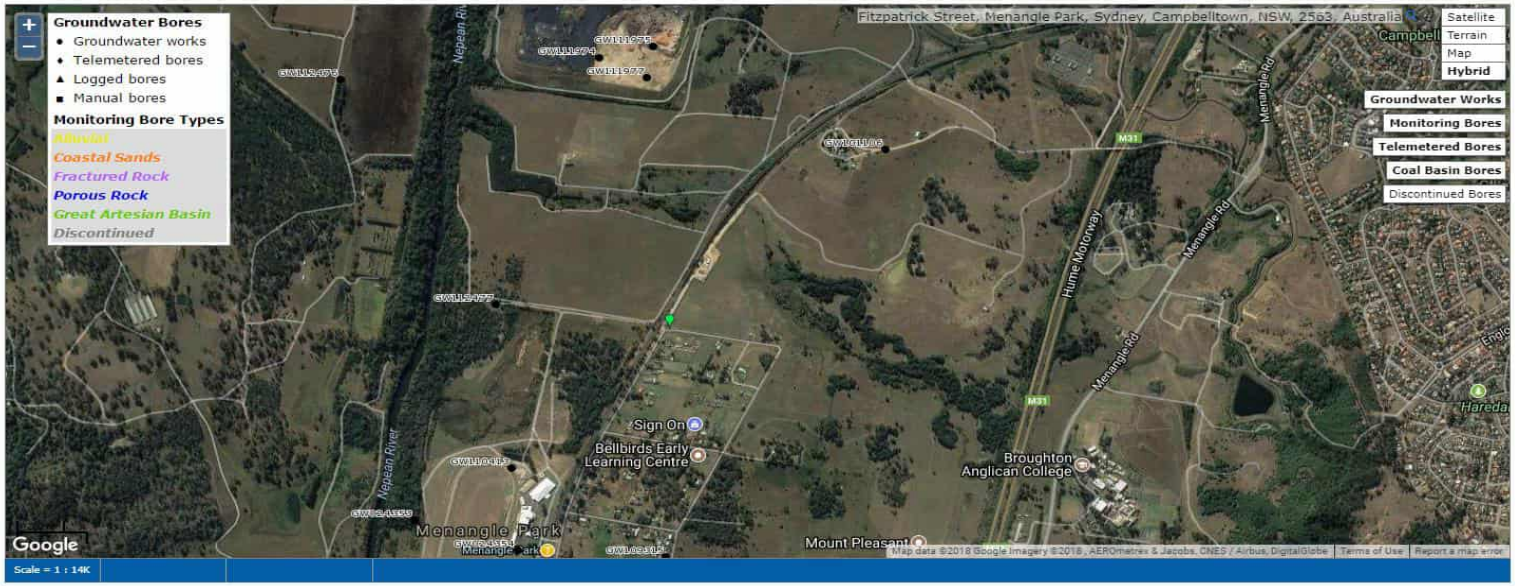
glossary and metadata

Greater Sydney Region

bookmark this page

All data times are Eastern Standard Time

Map



NSW Office of Water
Work Summary

GW112477

Licence: 10BL603964 **Licence Status:** CONVERTED

Authorised Purpose(s): INDUSTRIAL
Intended Purpose(s): INDUSTRIAL

Work Type: Bore
Work Status: Equipped
Construct.Method:
Owner Type: Mines

Commenced Date: **Final Depth:** 2619.30 m
Completion Date: 18/12/2007 **Drilled Depth:** 2619.30 m

Contractor Name: McDermott Drilling
Driller: Unkown Unknown
Assistant Driller:

Property: MENANGLE PARK 30 RACECOURSE AVE MENANGLE PARK 2563 NSW **Standing Water Level:**
GWMA: **Salinity:**
GW Zone: **Yield:**

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	CUMBE	CUMBE.28	10//1022204
Licensed:			

Region: 10 - Sydney South Coast **CMA Map:**
River Basin: - Unknown **Grid Zone:** **Scale:**
Area/District:

Elevation: 0.00 m (A.H.D.) **Northing:** 6225067.0 **Latitude:** 34°05'40.2"S
Elevation Source: Unknown **Easting:** 291760.0 **Longitude:** 150°44'34.0"E

GS Map: - **MGA Zone:** 0 **Coordinate Source:** Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	2619.30	177			(Unknown)
1	1	Casing	Steel	0.00	0.00	177			

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

15/07/2013: Type of casing:Steel

Diameter: 177.8mm
22/07/2014: Nat Carling, 22-July-2014; Added construction components, owner type, work name, status & drill depth.

***** End of GW112477 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water
Work Summary

GW111977

Licence: 10BL605155 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method: Auger - Solid Flight
Owner Type: Private

Commenced Date:
Completion Date: 22/05/2012
Final Depth: 21.00 m
Drilled Depth: 21.00 m

Contractor Name: DOUGLAS PARTNERS PTY LTD
Driller: Lloyd Cooper
Assistant Driller:

Property: J & W TRIPODI HOLDINGS LOT 1102 GLENLEE ROAD MENANGLE PARK 2563 NSW
Standing Water Level:
GWMA:
GW Zone:
Salinity:
Yield:

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	CUMBE	CUMBE.36	1102//883495
Licensed:			

Region: 10 - Sydney South Coast
CMA Map:
River Basin: - Unknown
Area/District:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6226026.0
Easting: 292309.0
Latitude: 34°05'09.4"S
Longitude: 150°44'56.2"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.50	150			Auger - Solid Flight
1		Hole	Hole	5.50	21.00	150			Rotary - Water
1		Annulus	Bentonite/Grout	4.50	5.50				
1		Annulus	Waterworn/Rounded	5.50	21.00				Graded
1	1	Casing	Pvc Class 9	0.00	6.00	50	46		Seated on Bottom, Screwed
1	1	Opening	Slots	6.00	21.00	50		1	Casing - Machine Slotted, PVC Class 9, Screwed

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

0.00	20.70	20.70	FILLING,GREY BLACK GRAVELLY SAND,CLAY AND SILT	Fill	
20.70	21.00	0.30	CLAY,ORANGE LIGHT GREY BROWN CLAY	Clay	

Remarks

17/07/2014: Nat Carling, 17-July-2014; Updated status.

***** End of GW111977 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water
Work Summary

GW101106

Licence: 10BL158151 **Licence Status:** CANCELLED

Authorised Purpose(s): TEST BORE
Intended Purpose(s): TEST BORE

Work Type: Bore
Work Status: Test Hole
Construct.Method: Rotary Air
Owner Type: Private

Commenced Date:
Completion Date: 07/03/1997
Final Depth: 280.00 m
Drilled Depth: 280.00 m

Contractor Name: SOUTHERN TABLELANDS DRILLING
Driller: Roger Charles Ritchie
Assistant Driller:

Property: N/A
GWMA: -
GW Zone: -
Standing Water Level: 17.000
Salinity:
Yield: 1.310

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	CUMBE	CUMBE.28	2//713646
Licensed:	CUMBERLAND	MENANGLE	Whole Lot 2//713646

Region: 10 - Sydney South Coast
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6225747.0
Easting: 293207.0
Latitude: 34°05'19.1"S
Longitude: 150°45'31.0"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	96.00	200			Rotary Air
1		Hole	Hole	96.00	280.00	160			Rotary Air

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
18.00	19.00	1.00	Unknown	14.00		0.26	19.00		4000.00
80.00	84.00	4.00	Unknown	14.00		0.30	84.00		4000.00
160.00	163.00	3.00	Unknown	17.00		0.75	163.00		4000.00

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	Red Clay	Clay	
1.00	6.00	5.00	Brown clay	Clay	
6.00	80.00	74.00	Grey shale	Shale	

80.00	102.00	22.00	Grey sandstone	Sandstone	
102.00	145.00	43.00	White sandstone	Sandstone	
145.00	151.00	6.00	Sandstone/shale bands	Sandstone	
151.00	160.00	9.00	Sandstone	Sandstone	
160.00	180.00	20.00	Shale	Shale	
180.00	267.00	87.00	Sandstone	Sandstone	
267.00	280.00	13.00	Illawarra Shale	Shale	

Remarks

16/01/2013: Nat Carling, 16-Jan-2013; Added rock type codes to driller's log & added missing information (based on existing data).

***** End of GW101106 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

APPENDIX D

Section 149 Certificate

campbelltown
city council

Issue Date: 23 January 2018
Application Number: 201800221
Receipt Number: 3881080

Geoenviro Consultancy
PO Box 1543
Macquarie Centre
NORTH RYDE NSW 2113

Your Reference: JC17313A

PLANNING CERTIFICATE UNDER SECTION 149 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Section 149 Planning Certificate phone enquiries: (02) 4645 4560.

Property Address: Lot 2 Menangle Road
MENANGLE PARK NSW 2563

Property Description: Lot 2 DP 737485

As at the date of issue, the following matters apply to the land subject of this certificate:

INFORMATION PROVIDED UNDER SECTION 149(2) OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 (the Act)

PART 1 – Names of relevant planning instruments and DCPs

Planning Instrument: Campbelltown LEP 2015
Effect: RU2 Rural Landscape

Planning Instrument: Campbelltown LEP 2015
Effect: R2 Low Density Residential

Planning Instrument: Campbelltown LEP 2015
Effect: SP2 Infrastructure (Future Road Corridor)

Planning Instrument: Campbelltown LEP 2015
Effect: RE1 Public Recreation

Planning Instrument: Campbelltown LEP 2015
Effect: R5 Large Lot Residential

(1) The following environmental planning instruments apply to the carrying out of development on the land subject of this certificate:

Local environmental plans (LEPs) and deemed environmental planning instruments

Campbelltown LEP 2015

For further information about these local environmental plans and deemed environmental planning instruments, contact Council's Environmental Planning Section on (02) 4645 4601.

State environmental planning policies (SEPPs)

SEPP No.21 – Caravan Parks

SEPP No.30 – Intensive Agriculture

SEPP No.33 – Hazardous and Offensive Development

SEPP No.44 – Koala Habitat Protection

SEPP No.50 – Canal Estate Development

SEPP No.55 – Remediation of Land

SEPP No.64 – Advertising and Signage

SEPP No.65 – Design Quality of Residential Apartment Development

SEPP No.70 – Affordable Housing (Revised Schemes)

SEPP (Vegetation in Non-Rural Areas) 2017

SEPP (Housing for Seniors or People with a Disability) 2004

SEPP No.19 - Bushland in Urban Areas

SEPP (Building Sustainability Index: BASIX) 2004

SEPP (State Significant Precincts) 2005

SEPP (Mining, Petroleum Production and Extractive Industries) 2007

SEPP (Miscellaneous Consent Provisions) 2007

SEPP (Infrastructure) 2007

SEPP (Exempt and Complying Development Codes) 2008

SEPP (Affordable Rental Housing) 2009

SEPP (State and Regional Development) 2011

SEPP (Educational Establishments and Child Care Facilities) 2017

Sydney REP No.20 - Hawkesbury-Nepean River (No.2 - 1997)

For further information about these State environmental planning policies, contact the Department of Planning and Environment (www.planning.nsw.gov.au).

(2) The following proposed environmental planning instruments, which are or have been the subject of community consultation or on public exhibition under the Act (unless the Director-General has notified Council that the making of the proposed instrument has been deferred indefinately or has not been approved), will apply to the carrying out of development on the land subject of this certificate:

Draft local environmental plans (LEPs)

None

For further information about these draft local environmental plans, contact Council's Environmental Planning Section on (02) 4645 4601.

Draft State environmental planning policies (SEPPs)

None

For further information about these draft State environmental planning policies, contact the Department of Planning and Environment (www.planning.nsw.gov.au).

(3) The following development control plans (DCPs) apply to the carrying out of development on the land subject of this certificate:

Campbelltown (Sustainable City) DCP 2015

For further information about these development control plans, contact Council's Environmental Planning Section on (02) 4645 4601. Please note that the names of any draft development control plans that apply to the land subject of this certificate, that have been placed on exhibiton by Council but have not yet come into effect, are provided as advice under section 149(5) of the Act.

PART 2 – Zoning and land use under relevant LEPs

a) The following zone(s) apply to the land subject of this certificate:

RU2 Rural Landscape

R2 Low Density Residential

SP2 Infrastructure (Future Road Corridor)

RE1 Public Recreation

R5 Large Lot Residential

b) The purposes for which the plan or instrument provides that development may be carried out without the need for development consent are detailed in the land use table for each zone. Reference should be made to either Attachment 1 to this certificate or the appropriate section of the attached copy of the plan or instrument.

In addition, SEPP (Exempt and Complying Development Codes) 2008 and clause 3.1 of the Campbelltown LEP 2015 allow certain types of development to be carried out as exempt development within the Campbelltown City local government area.

c) The purposes for which the plan or instrument provides that development may not be carried out except with development consent are detailed in the land use table for each zone. Reference should be made to either Attachment 1 to this certificate or the appropriate section of the attached copy of the plan or instrument.

In addition, SEPP (Exempt and Complying Development Codes) 2008 and clause 3.2 of the Campbelltown LEP 2015 allow certain types of development to be carried out as complying development within the Campbelltown City local government area after a complying development certificate has been obtained from Council or from an accredited certifier.

Clause 2.5 of the Campbelltown LEP 2015 also allows for additional permitted uses with development consent on particular land.

d) The purposes for which the plan or instrument provides that development is prohibited are detailed in the land use table for each zone. Reference should be made to either Attachment 1 to this certificate or the appropriate section of the attached copy of the plan or instrument.

e) Any development standards applying to the land subject of this certificate that fix minimum land dimensions for the erection of a dwelling-house and, if so, the minimum land dimensions so fixed are detailed in the relevant section of the plan or instrument. Reference should be made to either Attachment 2 to this certificate or the appropriate section(s) of the attached copy of the plan or instrument. In addition, certain Council development control plans may impose minimum development standards for the creation of allotments and/or minimum site area and dimensions for the erection of a dwelling-house.

For further information about items a), b), c), d) and e) above, contact Council's Environmental Planning Section on (02) 4645 4601.

f) The land subject of this certificate does not include or comprise critical habitat.

g) The land subject of this certificate is not in a conservation area (however described).

h) No item of environmental heritage (however described) is situated on the land subject of this certificate.

PART 2A – Zoning and land use under State Environmental Planning Policy (Sydney Region Growth Centres) 2006

None

PART 3 – Complying development

(1) Complying development may be carried out on the land subject of this certificate under each of the following codes for complying development, to the extent shown, because of the provisions of clauses 1.17A(1)(c) to (e), (2), (3) and (4), 1.18(1)(c3) and 1.19 of State Environmental Planning Policy (Exempt and Complying Development Codes) 2008:

Housing Alterations Code – on all of the land

Commercial and Industrial Alterations Code – on all of the land

Subdivisions Code – on all of the land

General Development Code – on all of the land

Demolition Code – on all of the land

Fire Safety Code – on all of the land

Housing Code – on part of the land

Rural Housing Code – on part of the land

Commercial and Industrial (New Buildings and Additions) Code – on part of the land

Please note that reference should also be made to the relevant parts of this policy for the general requirements for complying development and to the relevant codes for complying

development which may also include provisions relating to zoning, lot size etc.

(2) Complying development may not be carried out on the land subject of this certificate under each of the following codes for complying development, to the extent shown and for the reason(s) stated, because of the provisions of clauses 1.17A(1)(c) to (e), (2), (3) and (4), 1.18(1)(c3) and 1.19 of State Environmental Planning Policy (Exempt and Complying Development Codes) 2008:

Housing Code – on part of the land

Rural Housing Code – on part of the land

Commercial and Industrial (New Buildings and Additions) Code – on part of the land

Because part of the land is reserved for a public purpose by an environmental planning instrument.

PART 4 – Coastal protection

The land subject of this certificate is not affected by the operation of section 38 or 39 of the Coastal Protection Act 1979, but only to the extent that Council has been notified by the Department of Finance, Services and Innovation.

Please note that Campbelltown City Council is not defined as a coastal council under the Coastal Protection Act 1979.

PART 5 – Mine subsidence

The land subject of this certificate is within a proclaimed Mine Subsidence District under the Mine Subsidence Compensation Act 1961. The approval of the Mine Subsidence Board is required for all subdivision and building, except for certain minor structures. Surface development controls are in place to prevent damage from old, current or future mining. It is strongly recommended prospective purchasers consult with the Mine Subsidence Board regarding mine subsidence and any surface development guidelines. The Board can assist with information about mine subsidence and advise whether existing structures comply with the requirements of the Mine Subsidence Compensation Act 1961. For further information, contact the local Mine Subsidence Board on (02) 4677 1967 (www.minesub.nsw.gov).

PART 6 – Road widening and road realignment

The land subject of this certificate is affected by road widening or road realignment under Division 2 of Part 3 of the Roads Act 1993, an environmental planning instrument or a resolution of Council.

PART 7 – Council and other public authority policies on hazard risk restrictions

a) Council has adopted a policy with respect to all land within the Campbelltown City local government area with unusual site conditions. This policy restricts the development of land where extensive earthworks and/or filling has been carried out. Land, the development of which is restricted by this policy, has a restriction as to user placed on the title of the land stating the details of any restriction. Building lots can be affected by excessive land gradient, filling, reactive or dispersive soils, overland flow and/or mine subsidence. Buildings, structures or site works may require specific structural design to ensure proper building

construction. Consequently, some applications may require the submission of structural design details and geotechnical reports. It is suggested that prior to lodging an application, enquiries be made to Council's Planning and Environment Division to ascertain any specific requirements.

b) Council has adopted by resolution the certified Campbelltown LGA Bush Fire Prone Land Map. This map identifies bush fire prone land within the Campbelltown City local government area as defined in section 4(1) of the Act. Where the land subject of this certificate is identified as bush fire prone land, the document entitled "Planning for Bush Fire Protection" prepared by the NSW Rural Fire Service in co-operation with the Department of Planning and dated December 2006 should be consulted with regards to possible restrictions on the development of the land because of the likelihood of bushfire.

c) The land subject of this certificate is not affected by a policy adopted by Council or adopted by any other public authority and notified to Council for reference in a planning certificate that restricts the development of the land because of the likelihood of tidal inundation.

d) The land subject of this certificate is not affected by a policy adopted by Council or adopted by any other public authority and notified to Council for reference in a planning certificate that restricts the development of the land because of the likelihood of acid sulphate soils.

e) Council has adopted by resolution a policy on contaminated land which may restrict the development of the land subject of this certificate. This policy is implemented when zoning or land use changes are proposed on lands which have previously been used for certain purposes. Council records do not have sufficient information about previous use of this land to determine whether the land is contaminated. Consideration of Council's adopted policy and the application of provisions under relevant State legislation is warranted.

PART 7A – Flood related development controls information

(1) Development on all or part of the land subject of this certificate for the purposes of dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings (not including development for the purposes of group homes or seniors housing) is subject to flood related controls.

(2) Development on all or part of the land subject of this certificate for any other purpose is subject to flood related development controls.

(3) Words and expressions in this clause have the same meanings as in the instrument set out in the Schedule to the Standard Instrument (Local Environmental Plans) Order 2006.

Please note that some additional information regarding flooding and flood related development controls may be provided as advice under section 149(5) of the Act.

PART 8 – Land reserved for acquisition

An environmental planning instrument, deemed environmental planning instrument or draft environmental planning instrument applying to the land subject of this certificate provides for the acquisition of all or part of the land by a public authority, as referred to in section 27 of the Act.

PART 9 – Contribution plans

The following contribution plan(s) apply to the land subject of this certificate:

Campbelltown City Council Section 94A Development Contributions Plan

For further information about these contribution plans, contact Council's Environmental Planning Section on (02) 4645 4601.

PART 9A – Biodiversity certified land

The land subject of this certificate is not biodiversity certified land under Part 8 of the Biodiversity Conservation Act 2016.

Please note that biodiversity certified land includes land certified under Part 7AA of the Threatened Species Conservation Act 1995 that is taken to be certified under Part 8 of the Biodiversity Conservation Act 2016.

PART 10 – Biodiversity stewardship sites

The land subject of this certificate is not a biodiversity stewardship site under a biodiversity stewardship agreement under Part 5 of the Biodiversity Conservation Act 2016 (but only in so far as Council has been notified of the existence of such an agreement by the Chief Executive of the Office of Environment and Heritage).

Please note that biodiversity stewardship agreements include biobanking agreements under Part 7A of the Threatened Species Conservation Act 1995 that are taken to be biodiversity stewardship agreements under Part 5 of the Biodiversity Conservation Act 2016.

PART 10A – Native vegetation clearing set asides

The land subject of this certificate does not contain a set aside under section 60ZC of the Local Land Services Act 2013 (but only in so far as Council has been notifed of the existance of such a set aside area by Local Land Services or it is registered in the public register under that section).

PART 11 – Bush fire prone land

Some of the land subject of this certificate has been identified as bush fire prone land on the Campbelltown City Council - Bush Fire Prone Land Map that has been certified for the purposes of section 146(2) of the Act.

Please note that in accordance with section 66 of the Rural Fires Act 1997 and relevant regulations, a Bush Fire Hazard Reduction Notice may have been issued on this land. It is recommended that advice be obtained from the Macarthur Zone Rural Fire Service.

PART 12 – Property vegetation plans

No property vegetation plan applies to the land subject of this certificate.

Please note that the whole of the Campbelltown City local government area is excluded from the operation of the Native Vegetation Act 2003.

PART 13 – Orders under Trees (Disputes Between Neighbours) Act 2006

No order has been made under the Trees (Disputes Between Neighbours) Act 2006 to carry out work in relation to a tree on the land subject of this certificate (but only to the extent that Council has been notified of any such orders).

PART 14 – Directions under Part 3A

No direction, in force under section 75P(2)(c1) of the Act, that a provision of an environmental planning instrument prohibiting or restricting the carrying out of a project or a stage of a project on the land subject of this certificate under Part 4 of the Act does not have effect, has been issued by the Minister.

PART 15 – Site compatibility certificates and conditions for seniors housing

a) No current site compatibility certificate (seniors housing), of which Council is aware, exists in respect of proposed development on the land subject of this certificate.

b) No conditions of consent to a development application, granted after 11 October 2007, of the kind referred to in clause 18(2) of State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004 have been imposed in respect of proposed development on the land subject of this certificate.

PART 16 – Site compatibility certificates for infrastructure

No valid site compatibitlity certificate (infrastructure), of which Council is aware, exists in respect of proposed development on the land subject of this certificate.

PART 17 – Site compatibility certificates and conditions for affordable rental housing

(1) No current site compatibility certificate (affordable rental housing), of which Council is aware, exists in respect of proposed development on the land subject of this certificate.

(2) No conditions of consent to a development application of the kind referred to in clause 17(1) or 37(1) of State Environmental Planning Policy (Affordable Rental Housing) 2009 have been imposed in respect of proposed development on the land subject of this certificate.

PART 18 – Paper subdivision information

(1) No adopted development plan or development plan that is proposed to be subject to a consent ballot apply to the land subject of this certificate.

(2) No subdivision order applies to the land subject of this certificate.

PART 19 – Site verification certificates

No current site verification certificate issued under Division 3 of Part 4AA of State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (of which Council is aware) applies to the land subject of this certificate.

PART 20 – Loose-fill asbestos insulation

No residential dwelling erected on the land subject of this certificate has been identified in the Loose-Fill Asbestos Insulation Register as containing loose-fill asbestos ceiling insulation.

For more information contact NSW Fair Trading (www.fairtrading.nsw.gov.au)

Matters prescribed by section 59(2) of the Contaminated Land Management Act 1997

(a) The land subject of this certificate is not significantly contaminated land within the meaning of the Contaminated Land Management Act 1997.

(b) The land subject of this certificate is not subject to a management order within the meaning of the Contaminated Land Management Act 1997.

(c) The land subject of this certificate is not the subject of an approved voluntary management proposal within the meaning of the Contaminated Land Management Act 1997.

(d) The land subject of this certificate is not subject to an ongoing maintenance order within the meaning of the Contaminated Land Management Act 1997.

(e) The land subject of this certificate is not the subject of a site audit statement within the meaning of the Contaminated Land Management Act 1997 provided to Council.

Jim Baldwin, per
Director City Development

Attachment 1

Campbelltown Local Environmental Plan 2015

Zone RU2 Rural Landscape

1 Objectives of zone

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To maintain the rural landscape character of the land.
- To provide for a range of compatible land uses, including extensive agriculture.
- To preserve and enhance bushland, wildlife corridors, natural habitat and water resources, including waterways, ground water and riparian land.
- To protect and enhance areas of scenic value, and the visual amenity of prominent ridgelines, by minimising development and providing visual contrast to nearby urban development.

2 Permitted without consent

Extensive agriculture; Home occupations

3 Permitted with consent

Agricultural produce industries; Animal boarding or training establishments; Bed and breakfast accommodation; Boat launching ramps; Building identification signs; Business identification signs; Camping grounds; Car parks; Cellar door premises; Child care centres; Community facilities; Dual occupancies (attached); Dwelling houses; Environmental facilities; Environmental protection works; Farm buildings; Farm stay accommodation; Flood mitigation works; Helipads; Home-based child care; Home businesses; Home industries; Information and education facilities; Intensive plant agriculture; Recreation areas; Recreation facilities (outdoor); Respite day care centres; Roads; Roadside stalls; Rural workers' dwellings; Veterinary hospitals

4 Prohibited

Any development not specified in item 2 or 3

NOTE: A copy of the complete written instrument for the Campbelltown Local Environmental Plan 2015 is available on the NSW Legislation website at: http://www.legislation.nsw.gov.au

Attachment 1

Campbelltown Local Environmental Plan 2015

Zone R2 Low Density Residential

1 Objectives of zone

- To provide for the housing needs of the community within a low density residential environment.
- To enable other land uses that provide facilities or services to meet the day to day needs of residents.
- To enable development for purposes other than residential only if that development is compatible with the character of the living area and is of a domestic scale.
- To minimise overshadowing and ensure a desired level of solar access to all properties.
- To facilitate diverse and sustainable means of access and movement.

2 Permitted without consent

Home occupations

3 Permitted with consent

Attached dwellings; Boarding houses; Building identification signs; Business identification signs; Child care centres; Community facilities; Dual occupancies; Dwelling houses; Emergency services facilities; Environmental facilities; Environmental protection works; Exhibition homes; Exhibition villages; Flood mitigation works; Group homes; Home-based child care; Home businesses; Home industries; Multi dwelling housing; Places of public worship; Recreation areas; Recreation facilities (outdoor); Respite day care centres; Roads; Schools; Semi-detached dwellings

4 Prohibited

Any development not specified in item 2 or 3

NOTE: A copy of the complete written instrument for the Campbelltown Local Environmental Plan 2015 is available on the NSW Legislation website at: http://www.legislation.nsw.gov.au

Attachment 1

Campbelltown Local Environmental Plan 2015

Zone SP2 Infrastructure

1 Objectives of zone

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.
- To encourage activities involving research and development.
- To optimise value-adding development opportunities, particularly those associated with research.
- To provide for the retention and creation of view corridors.
- To preserve bushland, wildlife corridors and natural habitat.
- To maintain the visual amenity of prominent ridgelines.

2 Permitted without consent

Environmental protection works

3 Permitted with consent

Flood mitigation works; Roads; The purpose shown on the Land Zoning Map, including any development that is ordinarily incidental or ancillary to development for that purpose

4 Prohibited

Any development not specified in item 2 or 3

NOTE: A copy of the complete written instrument for the Campbelltown Local Environmental Plan 2015 is available on the NSW Legislation website at: http://www.legislation.nsw.gov.au

Attachment 1

Campbelltown Local Environmental Plan 2015

Zone RE1 Public Recreation

1 Objectives of zone

- To enable land to be used for public open space or recreational purposes.
- To provide a range of recreational settings and activities and compatible land uses.
- To protect and enhance the natural environment for recreational purposes.
- To provide for land uses compatible with the ecological, scientific, cultural or aesthetic values of land in the zone.
- To facilitate the multiple use of certain open space areas.
- To facilitate development that is ancillary or incidental to the special land uses provided for in this zone.
- To provide for the sufficient and equitable distribution of public open space to meet the needs of the local community.
- To preserve and rehabilitate bushland, wildlife corridors and natural habitat, including waterways and riparian lands, and facilitate public enjoyment of these areas.
- To provide for the retention and creation of view corridors.
- To protect and enhance areas of scenic value and the visual amenity of prominent ridgelines.
- To preserve land that is required for public open space or recreational purposes.

2 Permitted without consent

Nil

3 Permitted with consent

Boat launching ramps; Camping grounds; Car parks; Community facilities; Emergency services facilities; Environmental facilities; Environmental protection works; Flood mitigation works; Heliports; Information and education facilities; Jetties; Kiosks; Markets; Recreation areas; Recreation facilities (indoor); Recreation facilities (major); Recreation facilities (outdoor); Registered clubs; Restaurants or cafes; Roads; Signage; Small bars; Water recreation structures; Water supply systems

4 Prohibited

Any development not specified in item 2 or 3

NOTE: A copy of the complete written instrument for the Campbelltown Local Environmental Plan 2015 is available on the NSW Legislation website at: http://www.legislation.nsw.gov.au

Attachment 1

Campbelltown Local Environmental Plan 2015

Zone R5 Large Lot Residential

1 Objectives of zone

- To provide residential housing in a rural setting while preserving, and minimising impacts on, environmentally sensitive locations and scenic quality.
- To ensure that large residential lots do not hinder the proper and orderly development of urban areas in the future.
- To ensure that development in the area does not unreasonably increase the demand for public services or public facilities.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To enable development for certain purposes other than residential only if that development is compatible with the character and scale of the living area.
- To minimise overshadowing and ensure a desired level of solar access to all properties.

2 Permitted without consent

Home occupations

3 Permitted with consent

Building identification signs; Business identification signs; Child care centres;
Community facilities; Dual occupancies (attached); Dwelling houses; Emergency
services facilities; Environmental facilities; Environmental protection works;

Exhibition homes; Exhibition villages; Flood mitigation works; Home-based child care; Home businesses; Home industries; Recreation areas; Recreation facilities
(outdoor); Respite day care centres; Roads

4 Prohibited

Any development not specified in item 2 or 3

NOTE: A copy of the complete written instrument for the Campbelltown Local Environmental Plan 2015 is available on the NSW Legislation website at: http://www.legislation.nsw.gov.au

Attachment 2

Campbelltown Local Environmental Plan 2015

4.1 Minimum subdivision lot size

(1) The objectives of this clause are as follows:

(a) to ensure that the density of development is compatible with the capacity of existing and proposed infrastructure,

(b) to ensure that the density of settlement will be compatible with the objectives of the zone,

(c) to limit the density of settlement in environmentally, scenically or historically sensitive areas,

(d) to ensure lot sizes are compatible with the conservation of natural systems, including waterways, riparian land and groundwater dependent ecosystems,

(e) to facilitate viable agricultural undertakings,

(f) to protect the curtilage of heritage items and heritage conservation areas,

(g) to facilitate a diversity of housing forms.

(2) This clause applies to a subdivision of any land shown on the Lot Size Map that requires development consent and that is carried out after the commencement of this Plan.

(3) The size of any lot resulting from a subdivision of land to which this clause applies is not to be less than the minimum size shown on the Lot Size Map in relation to that land.

(4) This clause does not apply in relation to the subdivision of individual lots in a strata plan or community title scheme.

(4A) If a lot is a battle-axe lot or other lot with an access handle, the area of the access handle is not to be included in calculating the lot size.

(4B) Despite subclause (3), development consent may be granted for the subdivision of land into lots that do not meet the minimum size shown on the Lot Size Map if the lots are residue lots resulting

4.1AA Minimum subdivision lot size for community title schemes

(1) The objectives of this clause are as follows:

(a) to provide for the proper and orderly development of land,

(b) to ensure that land developed under the *Community Land Development Act 1989* will achieve densities consistent with the objectives of the zone,

(c) to protect the curtilage of heritage items and heritage conservation areas.

(2) This clause applies to a subdivision (being a subdivision that requires development consent) under the *Community Land Development Act 1989* of land in any of the following zones:

(a) Zone RU2 Rural Landscape,

(b) Zone R2 Low Density Residential,

(c) Zone R3 Medium Density Residential,

(d) Zone R5 Large Lot Residential,

(e) Zone E3 Environmental Management,

(f) Zone E4 Environmental Living.

(3) The size of any lot resulting from a subdivision of land to which this clause applies (other than any lot comprising association property within the meaning of the *Community Land Development Act 1989*) is not to be less than the minimum size shown on the Lot Size Map in relation to that land.

4.1A Maximum dwelling density in certain residential areas

(1) The objectives of this clause are as follows:

(a) to restrict the dwelling yield on certain land,

(b) to ensure that infrastructure is not overburdened,

(c) to provide for a diversity of dwelling types.

(2) This clause applies to land identified as "Restricted dwelling yield" on the Restricted Dwelling Yield Map.

(3) Despite clauses 4.1, 4.1AA, 4.1B and 4.1C, the total number of dwellings that may be created by the development of land specified in Column 1 of the table to this clause must not exceed the number specified in Column 2 of the table.

Column 1	Column 2
"Area 1" on the Restricted Dwelling Yield Map, being land at Airds-Bradbury	2104
"Area 2" on the Restricted Dwelling Yield Map, being land at Claymore	1490
"Area 3"on the Restricted Dwelling Yield Map, being land at the Western Sydney University	850

4.1B Minimum subdivision lot sizes for dual occupancies in certain zones

(1) The objectives of this clause are as follows:

(a) to achieve planned residential density in certain zones,

(b) to ensure that lot sizes are consistent with the predominant subdivision pattern of the area and maintain a low density residential character in existing neighbourhoods,

(c) to facilitate development applications seeking concurrent approval for dual occupancy development and subdivision,

(d) to prevent the fragmentation of land.

(2) Despite clause 4.1, development consent may be granted to development for the purpose of a dual occupancy if the development will be on a lot that is at least the minimum size shown on the Lot Size for Dual Occupancy Development Map in relation to that land.

(3) Despite clause 4.1 and subclause (2), development consent may be granted for the subdivision of land in Zone R2 Low Density Residential into lots that are less than the minimum lot size shown on the Lot Size Map in relation to that land if:

(a) there is an existing dual occupancy on the land that was lawfully erected under an environmental planning instrument or there is a development application for the concurrent approval of a dual occupancy and its subdivision into 2 lots, and

(b) the lot size of each resulting lot will be at least 300 square metres, and

(c) the subdivision will not result in more than one principal dwelling on each resulting lot.

4.1C Minimum qualifying site area and lot size for certain residential and child care centre development in residential zones

(1) The objectives of this clause are as follows:

(a) to achieve planned residential densities in certain zones,

(b) to achieve satisfactory environmental and infrastructure outcomes,

(c) to minimise any adverse impact of development on residential amenity,

(d) to minimise land use conflicts.

(2) Development consent may be granted to development for a purpose specified in the table to this clause on land in a zone listed beside the purpose, if the area of the lot is equal to or greater than the area specified in Column 3 of the table.

(3) Development consent may be granted to the subdivision of land in a zone that is specified in the table to this clause for a purpose listed beside the zone, if the area of the lot to be created is equal to or greater than the area specified in Column 4 of the table.

Column 1	Column 2	Column 3	Column 4
Dwelling house	Zone R2 Low Density Residential	500 square metres	500 square metres
Dual occupancy	Zone R2 Low Density Residential	700 square metres	300 square metres
Semi-detached dwelling	Zone R2 Low Density Residential	700 square metres	300 square metres
Attached dwelling	Zone R2 Low	1,000 square metres	300 square metres

	Density Residential		
Multi dwelling housing	Zone R2 Low Density Residential	1,000 square metres	300 square metres
Child care centres	Zone R2 Low Density Residential or Zone R3 Medium Density Residential	800 square metres	N/A
Residential flat buildings	Zone R4 High Density Residential	1,200 square metres	1,200 square metres

4.1D Minimum lot sizes for certain land uses in certain environment protection zones

(1) The objectives of this clause are as follows:

(a) to allow for certain non-residential land uses,

(b) to minimise any adverse impact on local amenity and the natural environment,

(c) to achieve satisfactory environmental and infrastructure outcomes,

(d) to minimise land use conflicts.

(2) This clause applies to land in the following zones:

(a) Zone E3 Environmental Management,

(b) Zone E4 Environmental Living.

(3) Development consent may be granted to development for a purpose specified in the table to this clause on land in a zone listed beside the purpose, if the area of the lot is equal to or greater than the area specified in the table.

Column 1	Column 2	Column 3
Animal boarding or training establishments	Zone E3 Environmental Management	5 hectares
Educational establishments	Zone E3 Environmental Management or Zone E4 Environmental Living	10 hectares
Places of public worship	Zone E3 Environmental Management	10 hectares

4.2 Rural subdivision

(1) The objective of this clause is to provide flexibility in the application of standards for subdivision in rural zones to allow land owners a greater chance to achieve the objectives for development in the relevant zone.

(2) This clause applies to the following rural zones:

(a) Zone RU1 Primary Production,

(b) Zone RU2 Rural Landscape,

(c) Zone RU4 Primary Production Small Lots,

(d) Zone RU6 Transition.

Note. When this Plan was made it did not include all of these zones.

(3) Land in a zone to which this clause applies may, with development consent, be subdivided for the purpose of primary production to create a lot of a size that is less than the minimum size shown on the Lot Size Map in relation to that land.

(4) However, such a lot cannot be created if an existing dwelling would, as the result of the subdivision, be situated on the lot.

(5) A dwelling cannot be erected on such a lot.

Note. A dwelling includes a rural worker's dwelling (see definition of that term in the Dictionary).

4.2A Erection of dwelling houses or dual occupancies (attached) on land in certain rural and environment protection zones

(1) The objectives of this clause are as follows:

(a) to enable the replacement of lawfully erected dwelling houses and dual occupancies (attached), and the realisation of dwelling entitlements in rural and environment protection zones,

(b) to restrict the extent of residential development in rural and environment protection zones to maintain the existing character,

(c) to recognise the contribution that development density in these zones makes to the landscape and environmental character of those places.

(2) This clause applies to land in the following zones:

(a) Zone RU2 Rural Landscape,

(b) Zone E3 Environmental Management,

(c) Zone E4 Environmental Living.

(3) Development consent must not be granted for the erection of a dwelling house or a dual occupancy (attached) on land to which this clause applies unless the land:

(a) is a lot that has at least the minimum lot size shown on the Lot Size Map in relation to that land, or

(b) is a lot created under this Plan (other than clause 4.2 (3)), or

(c) is a lot created under an environmental planning instrument before this Plan commenced and on which the erection of a dwelling house or a dual occupancy (attached) was permissible immediately before that commencement, or

(d) is a lot resulting from a subdivision for which development consent (or its equivalent) was granted before this Plan commenced and on which the erection of a dwelling house or a dual occupancy (attached) would have been permissible if the

plan of subdivision had been registered before that commencement, or

(e) is an existing holding, or

(f) would have been a lot or holding referred to in paragraph (a), (b), (c), (d) or (e) had it not been affected by:

(i) a minor realignment of its boundaries that did not create an additional lot, or

(ii) a subdivision creating or widening a public road or public reserve or for another public purpose, or

(iii) a consolidation with an adjoining public road or public reserve or for another public purpose.

Note. A dwelling cannot be erected on a lot created under clause 9 of *State Environmental Planning Policy (Rural Lands) 2008* or clause 4.2.

(4) Development consent must not be granted under subclause (3) unless:

(a) no dwelling house or dual occupancy (attached) has been erected on the land, and

(b) if a development application has been made for development for the purposes of a dwelling house or dual occupancy (attached) on the land—the application has been refused or it was withdrawn before it was determined, and

(c) if development consent has been granted in relation to such an application—the consent has been surrendered or it has lapsed.

(5) Development consent may be granted for the erection of a dwelling house or a dual occupancy (attached) on land to which this clause applies if there is a lawfully erected dwelling house or dual occupancy (attached) on the land and the dwelling house or dual occupancy (attached) proposed to be erected is intended only to replace the existing dwelling house or dual occupancy (attached).

(6) Development consent may be granted to convert a dwelling house into, or to replace a dwelling house with, a dual occupancy (attached) on land to which this clause applies if no dual occupancy (attached) exists on the land and the dual occupancy (attached) is designed and will be constructed to have the appearance of a single dwelling.

(7) In this clause:

existing holding means land that:

(a) was a holding on the relevant date, and

(b) is a holding at the time the application for development consent referred to in subclause (3) is lodged,

whether or not there has been a change in the ownership of the holding since the relevant date, and includes any other land adjoining that land acquired by the owner since the relevant date.

holding means all adjoining land, even if separated by a road or railway, held by the same person or persons.

relevant date means:

(a) in the case of land to which *Campbelltown (Urban Area) Local Environmental Plan 2002* applied immediately before the commencement of this Plan:

(i) for land identified as "25 February 1977" on the Former LEP and IDO Boundaries Map—25 February 1977, or

(ii) for land identified as "15 July 1977" on the Former LEP and IDO Boundaries Map—15 July 1977, or

(iii) for land identified as "3 November 1978" on the Former LEP and IDO Boundaries Map—3 November 1978, or

(b) in the case of land to which *Campbelltown Local Environmental Plan—District 8 (Central Hills Lands)* applied immediately before the commencement of this Plan—20 September 1974, or

(c) in the case of land to which *Campbelltown Local Environmental Plan No 1* applied immediately before the commencement of this Plan—26 June 1981, or

(d) in the case of land to which *Interim Development Order No 13—City of Campbelltown* applied immediately before the commencement of this Plan—20 September 1974, or

(e) in the case of land to which *Interim Development Order No 15—City of Campbelltown* applied immediately before the commencement of this Plan—27 September 1974, or

(f) in the case of land to which *Interim Development Order No 28—City of Campbelltown* applied immediately before the commencement of this Plan—3 November 1978.

Note. The owner in whose ownership all the land is at the time the application is lodged need not be the same person as the owner in whose ownership all the land was on the stated date.

4.2B Erection of rural workers' dwellings on land in Zones RU2 and E3

(1) The objectives of this clause are as follows:

(a) to facilitate, on the same land, the provision of adequate accommodation for employees involved in existing agricultural activities, including agricultural produce industries,

(b) to maintain the non-urban landscape and development characters of certain rural and environment protection zones.

(2) This clause applies to land in the following zones:

(a) Zone RU2 Rural Landscape,

(b) Zone E3 Environmental Management.

(3) Development consent must not be granted for the erection of a rural worker's dwelling on land to which this clause applies unless the consent authority is satisfied that:

(a) the development will be on the same lot as an existing lawfully erected dwelling house or dual occupancy (attached), and

(b) the development will not impair the use of the land for agricultural activities, including agricultural produce industries, and

(c) the agricultural activity or agricultural produce industry has an economic capacity to support the ongoing employment of rural workers, and

(d) the development is necessary considering the nature of the existing or proposed agricultural activity or agricultural produce industry occurring on the land or as a result of the remote or isolated location of the land, and

(e) there will be not more than one rural worker's dwelling on the lot, and

(f) the development will be a single storey building with a maximum floor area of 120 square metres or not more than 20% of the floor area of any existing dwelling house on that land, whichever is greater.

4.2C Exceptions to minimum subdivision lot sizes for certain land in Zones RU2 and E3

(1) The objective of this clause is to allow the owners of certain land to which the following environmental planning instruments applied to excise a home-site area from an existing lot (or existing holding) by the means of a subdivision:

(a) *Campbelltown Local Environmental Plan No 1*,

(b) *Interim Development Order No 15—City of Campbelltown.*

(2) Subclause (3) applies to each lot to which *Campbelltown Local Environmental Plan No 1* applied immediately before its repeal that:

(a) was in existence on 26 June 1981, and

(b) is in Zone E3 Environmental Management, and

(c) has an area of at least 10 hectares.

(3) Development consent must not be granted to the subdivision of the land to which this subclause applies unless the proposed subdivision will result in the creation of only 2 lots, each of which must have an area of at least 2 hectares.

(4) Subclause (5) applies to each lot to which *Interim Development Order No 15—City of Campbelltown* applied immediately before its repeal that:

(a) was in existence on 18 July 1973, and

(b) is in Zone RU2 Rural Landscape.

(5) Development consent must not be granted to the subdivision of the land to which this subclause applies unless the smallest lot to be created has an area of at least 2 hectares and is required for the erection of a dwelling house for occupation by:

(a) the person who owned the land on 18 July 1973, or

(b) a relative of that owner, or

(c) a person employed or engaged by that owner in the use of land of the owner adjoining or adjacent to that lot for the purpose of agriculture.

(6) The total number of lots that may be created by the subdivision of land to which subclause (5) applies, whether by one or more subdivisions, must not exceed:

(a) if the land to be subdivided had an area of less than 10 hectares—nil, or

(b) if the land to be subdivided had an area of at least 10 hectares but less than 40 hectares—1, or

(c) if the land to be subdivided had an area of at least 40 hectares but less than 80 hectares—2, or

(d) if the land to be subdivided had an area of at least 80 hectares—3.

4.2D Exceptions to minimum subdivision lot sizes for certain land in Zone E4

(1) The objective of this clause is to permit the subdivision of certain land in the East Edge Scenic Protection Lands Area to create lots of a size that are less than the minimum lot size shown on the Lot Size Map in relation to that land.

(2) This clause applies to land identified as "1 ha" on the Lot Averaging Map.

(3) Despite clause 4.1, development consent may be granted to the subdivision of land to which this clause applies if the subdivision will not create a number of lots that is more than the number resulting from multiplying the total area of the land being subdivided by the maximum density control number specified on the Lot Averaging Map in relation to that land.

(4) Development consent must not be granted under this clause unless the consent authority is satisfied that:

(a) the pattern of lots created by the subdivision, the provision of access and services and the location of any future buildings on the land will not have a significant detrimental impact on native vegetation, and

(b) each lot to be created by the subdivision contains a suitable land area for:

(i) a dwelling house, and

(ii) an appropriate asset protection zone relating to bush fire hazard, and

(iii) if reticulated sewerage is not available to the lot—on-site sewage treatment, management and disposal, and

(iv) other services related to the use of the land for residential occupation, and

(c) if reticulated sewerage is not available to the lot—a geotechnical assessment demonstrates to the consent

authority's satisfaction that the lot can suitably accommodate the on-site treatment, management and disposal of effluent, and

(d) adequate arrangements are in place for the provision of infrastructure to service the needs of development in the locality.

NOTE: A copy of the complete written instrument for the Campbelltown Local Environmental Plan 2015 is available on the NSW Legislation website at: http://www.legislation.nsw.gov.au

APPENDIX E

Laboratory Test Certificates

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 181300

Client Details

Client	Geoenviro Consultancy Pty Ltd
Attention	Solern Liew
Address	PO Box 1543, Macquarie Centre, North Ryde, NSW, 2113

Sample Details

Your Reference	**JC17313A**
Number of Samples	17 Soil, 1 Material
Date samples received	04/12/2017
Date completed instructions received	04/12/2017

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	11/12/2017
Date of Issue	11/12/2017

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Asbestos Approved By
Analysed by Asbestos Approved Identifier: Lulu Scott, Lucy Zhu
Authorised by Asbestos Approved Signatory: Lulu Scott

Results Approved By
Dragana Tomas, Senior Chemist
Long Pham, Team Leader, Metals
Lulu Scott, Asbestos Supervisor
Nick Sarlamis, Inorganics Supervisor
Steven Luong, Senior Chemist

Authorised By



David Springer, General Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	117	124	117	123	116

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	118	115	121	125	115

vTRH(C6-C10)/BTEXN in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
TRH C_6 - C_9	mg/kg	<25
TRH C_6 - C_{10}	mg/kg	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
naphthalene	mg/kg	<1
Total +ve Xylenes	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	117

svTRH (C10-C40) in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	85	87	87	83	79

svTRH (C10-C40) in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	82	79	79	81	79

svTRH (C10-C40) in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
TRH C_{10} - C_{14}	mg/kg	<50
TRH C_{15} - C_{28}	mg/kg	<100
TRH C_{29} - C_{36}	mg/kg	<100
TRH >C_{10} -C_{16}	mg/kg	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50
TRH >C_{16} -C_{34}	mg/kg	<100
TRH >C_{34} -C_{40}	mg/kg	<100
Total +ve TRH (>C10-C40)	mg/kg	<50
Surrogate o-Terphenyl	%	82

PAHs in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	95	91	92	90	91

PAHs in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	0.08	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	0.54	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	89	90	93	92	93

PAHs in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	<0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	<0.1
Pyrene	mg/kg	<0.1
Benzo(a)anthracene	mg/kg	<0.1
Chrysene	mg/kg	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2
Benzo(a)pyrene	mg/kg	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1
Total +ve PAH's	mg/kg	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5
Surrogate p-Terphenyl-d14	%	93

Organochlorine Pesticides in soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	85	85	88	87	84

Organochlorine Pesticides in soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	86	91	91	86	87

Organochlorine Pesticides in soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1
Surrogate TCMX	%	86

PCBs in Soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	85	85	88	87	84

PCBs in Soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	86	91	91	86	87

PCBs in Soil		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date extracted	-	05/12/2017
Date analysed	-	05/12/2017
Aroclor 1016	mg/kg	<0.1
Aroclor 1221	mg/kg	<0.1
Aroclor 1232	mg/kg	<0.1
Aroclor 1242	mg/kg	<0.1
Aroclor 1248	mg/kg	<0.1
Aroclor 1254	mg/kg	<0.1
Aroclor 1260	mg/kg	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1
Surrogate TCLMX	%	86

Acid Extractable metals in soil						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Arsenic	mg/kg	<4	<4	<4	<4	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	9	<1	6	7	12
Copper	mg/kg	14	2	11	12	25
Lead	mg/kg	9	4	8	10	14
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	<1	4	5	13
Zinc	mg/kg	14	4	18	20	44

Acid Extractable metals in soil						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Arsenic	mg/kg	<4	<4	6	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	2	<1	10	7	8
Copper	mg/kg	5	1	26	47	13
Lead	mg/kg	6	4	13	10	9
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	<1	12	7	3
Zinc	mg/kg	14	2	46	34	10

Acid Extractable metals in soil			
Our Reference		181300-18	181300-19
Your Reference	UNITS	Duplicate A	TP1 - [TRIPLICATE]
Depth		-	0.2-0.3
Date Sampled		01/12/2017	01/12/2017
Type of sample		Soil	Soil
Date prepared	-	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017
Arsenic	mg/kg	<4	<4
Cadmium	mg/kg	<0.4	<0.4
Chromium	mg/kg	<1	9
Copper	mg/kg	2	11
Lead	mg/kg	4	8
Mercury	mg/kg	<0.1	<0.1
Nickel	mg/kg	<1	2
Zinc	mg/kg	4	10

Misc Inorg - Soil				
Our Reference		181300-1	181300-2	181300-3
Your Reference	UNITS	BH1	BH2	BH5
Depth		2.5-3.0	1.0-1.45	0.0-0.1
Date Sampled		01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017
pH 1:5 soil:water	pH Units	4.9	5.3	5.9
Electrical Conductivity 1:5 soil:water	µS/cm	56	47	14
Chloride, Cl 1:5 soil:water	mg/kg	88	74	22
Sulphate, SO4 1:5 soil:water	mg/kg	<10	<10	<10
Resistivity in soil*	ohm m	180	210	720

sPOCAS field test					
Our Reference		181300-3	181300-4	181300-5	181300-6
Your Reference	UNITS	BH5	BH1	BH1	BH5
Depth		0.0-0.1	0.5-0.6	1.0-1.45	2.5-3.0
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017
pH_F (field pH test)*	pH Units	6.2	6.2	6.1	4.9
pH_{FOX} (field peroxide test)*	pH Units	5.0	3.9	5.2	3.9
Reaction Rate*	-	Slight	Moderate	Slight	Slight

Moisture						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Moisture	%	10	1.8	7.5	3.5	12

Moisture						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2017	05/12/2017	05/12/2017	05/12/2017	05/12/2017
Date analysed	-	06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Moisture	%	2.8	7.3	7.6	5.1	10

Moisture		
Our Reference		181300-18
Your Reference	UNITS	Duplicate A
Depth		-
Date Sampled		01/12/2017
Type of sample		Soil
Date prepared	-	05/12/2017
Date analysed	-	06/12/2017
Moisture	%	1.8

Asbestos ID - soils						
Our Reference		181300-7	181300-8	181300-9	181300-10	181300-12
Your Reference	UNITS	TP1	TP4	TP10	TP11	TP19
Depth		0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3	0.4-0.5
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
Sample mass tested	g	Approx. 40g	Approx. 50g	Approx. 60g	Approx. 50g	Approx. 35g
Sample Description	-	Brown sandy soil	Brown sandy soil	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		181300-13	181300-14	181300-15	181300-16	181300-17
Your Reference	UNITS	TP20	TP24	TP30	TP31	TP32
Depth		0.1-0.2	0.0-0.1	0.3-0.4	0.4-0.5	0.6-0.7
Date Sampled		01/12/2017	01/12/2017	01/12/2017	01/12/2017	01/12/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
Sample mass tested	g	Approx. 40g	Approx. 40g	Approx. 45g	Approx. 65g	Approx. 45g
Sample Description	-	Brown sandy soil	Brown sandy soil	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - materials		
Our Reference		181300-11
Your Reference	UNITS	TP11 - Fibro
Depth		-
Date Sampled		01/12/2017
Type of sample		Material
Date analysed	-	08/12/2017
Mass / Dimension of Sample	-	150x70x25mm
Sample Description	-	Brown compressed fibre cement material
Asbestos ID in materials	-	No asbestos detected Organic fibre detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.

Method ID	Methodology Summary
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
TRH C_6 - C_9	mg/kg	25	Org-016	<25	7	<25	<25	0	115	115
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	7	<25	<25	0	115	115
Benzene	mg/kg	0.2	Org-016	<0.2	7	<0.2	<0.2	0	114	115
Toluene	mg/kg	0.5	Org-016	<0.5	7	<0.5	<0.5	0	109	110
Ethylbenzene	mg/kg	1	Org-016	<1	7	<1	<1	0	125	123
m+p-xylene	mg/kg	2	Org-016	<2	7	<2	<2	0	114	113
o-Xylene	mg/kg	1	Org-016	<1	7	<1	<1	0	109	108
naphthalene	mg/kg	1	Org-014	<1	7	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	120	7	117	117	0	117	115

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	[NT]	18	<25	<25	0	[NT]	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	[NT]	18	<25	<25	0	[NT]	[NT]
Benzene	mg/kg	0.2	Org-016	[NT]	18	<0.2	<0.2	0	[NT]	[NT]
Toluene	mg/kg	0.5	Org-016	[NT]	18	<0.5	<0.5	0	[NT]	[NT]
Ethylbenzene	mg/kg	1	Org-016	[NT]	18	<1	<1	0	[NT]	[NT]
m+p-xylene	mg/kg	2	Org-016	[NT]	18	<2	<2	0	[NT]	[NT]
o-Xylene	mg/kg	1	Org-016	[NT]	18	<1	<1	0	[NT]	[NT]
naphthalene	mg/kg	1	Org-014	[NT]	18	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	[NT]	18	117	128	9	[NT]	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	7	<50	<50	0	97	102
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	7	<100	<100	0	97	107
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	7	<100	<100	0	94	80
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	7	<50	<50	0	97	102
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	7	<100	<100	0	97	107
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	7	<100	<100	0	94	80
Surrogate o-Terphenyl	%		Org-003	82	7	85	80	6	88	87

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	[NT]	18	<50	<50	0	[NT]	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	[NT]	18	<50	<50	0	[NT]	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	[NT]	18	<100	<100	0	[NT]	[NT]
Surrogate o-Terphenyl	%		Org-003	[NT]	18	82	83	1	[NT]	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Naphthalene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	90	89
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	91	90
Phenanthrene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	90	87
Anthracene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	80	79
Pyrene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	88	86
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	101	96
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	7	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	7	<0.05	<0.05	0	106	96
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	90	7	95	94	1	108	101

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Naphthalene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Phenanthrene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Anthracene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Pyrene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	[NT]	18	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	[NT]	18	<0.05	<0.05	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	[NT]	18	93	92	1	[NT]	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
HCB	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	92	95
gamma-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	99	102
Heptachlor	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	89	93
delta-BHC	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	86	89
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	90	93
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	105	109
Dieldrin	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	96	99
Endrin	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	87	90
pp-DDD	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	101	105
Endosulfan II	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	93	94
Methoxychlor	mg/kg	0.1	Org-005	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	82	7	85	86	1	98	98

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
HCB	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
gamma-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
delta-BHC	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Dieldrin	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endrin	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endosulfan II	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Methoxychlor	mg/kg	0.1	Org-005	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	[NT]	18	86	86	0	[NT]	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date extracted	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	101	100
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	7	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	82	7	85	86	1	84	82

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	[NT]	18	86	86	0	[NT]	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	181300-8
Date prepared	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Date analysed	-			05/12/2017	7	05/12/2017	05/12/2017		05/12/2017	05/12/2017
Arsenic	mg/kg	4	Metals-020	<4	7	<4	<4	0	109	103
Cadmium	mg/kg	0.4	Metals-020	<0.4	7	<0.4	<0.4	0	102	107
Chromium	mg/kg	1	Metals-020	<1	7	9	9	0	107	106
Copper	mg/kg	1	Metals-020	<1	7	14	12	15	106	108
Lead	mg/kg	1	Metals-020	<1	7	9	7	25	105	107
Mercury	mg/kg	0.1	Metals-021	<0.1	7	<0.1	<0.1	0	104	99
Nickel	mg/kg	1	Metals-020	<1	7	3	2	40	102	106
Zinc	mg/kg	1	Metals-020	<1	7	14	7	67	104	107

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Date analysed	-			[NT]	18	05/12/2017	05/12/2017		[NT]	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	18	<4	<4	0	[NT]	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	18	<0.4	<0.4	0	[NT]	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	18	<1	<1	0	[NT]	[NT]
Copper	mg/kg	1	Metals-020	[NT]	18	2	2	0	[NT]	[NT]
Lead	mg/kg	1	Metals-020	[NT]	18	4	5	22	[NT]	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	18	<0.1	<0.1	0	[NT]	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	18	<1	<1	0	[NT]	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	18	4	6	40	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	05/12/2017	[NT]
Date analysed	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	05/12/2017	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	111	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	112	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Date analysed	-			05/12/2017	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 181300-7 for Zn. Therefore a triplicate result has been issued as laboratory sample number 181300-19.

Asbestos: A portion of the supplied sample was sub-sampled for asbestos analysis according to Envirolab procedures. We cannot guarantee that this sub-sample is indicative of the entire sample. Envirolab recommends supplying 40-50g of sample in its own container.
Note: Samples 181300-7 to 10, 12 to 17 were sub-sampled from jars provided by the client.

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SAMPLE RECEIPT ADVICE

Client Details

Client	Geoenviro Consultancy Pty Ltd
Attention	Solern Liew

Sample Login Details

Your reference	JC17313A
Envirolab Reference	181300
Date Sample Received	04/12/2017
Date Instructions Received	04/12/2017
Date Results Expected to be Reported	11/12/2017

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	17 Soil, 1 Material
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	12.7
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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Sample ID	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticidesin soil	PCBsin Soil	Acid Extractable metalsin soil	pH1:5 soil:water	Electrical Conductivity1:5 soil:water	Chloride, Cl1:5 soil:water	Sulphate, SO41:5 soil:water	Resistivity in soil*	sPOCAS field test	Asbestos ID - soils	Asbestos ID - materials
BH1-2.5-3.0							✓	✓	✓	✓	✓			
BH2-1.0-1.45							✓	✓	✓	✓	✓			
BH5-0.0-0.1							✓	✓	✓	✓	✓	✓		
BH1-0.5-0.6												✓		
BH1-1.0-1.45												✓		
BH5-2.5-3.0												✓		
TP1-0.2-0.3	✓	✓	✓	✓	✓	✓							✓	
TP4-0.0-0.1	✓	✓	✓	✓	✓	✓							✓	
TP10-0.1-0.2	✓	✓	✓	✓	✓	✓							✓	
TP11-0.2-0.3	✓	✓	✓	✓	✓	✓							✓	
TP11 - Fibro														✓
TP19-0.4-0.5	✓	✓	✓	✓	✓	✓							✓	
TP20-0.1-0.2	✓	✓	✓	✓	✓	✓							✓	
TP24-0.0-0.1	✓	✓	✓	✓	✓	✓							✓	
TP30-0.3-0.4	✓	✓	✓	✓	✓	✓							✓	
TP31-0.4-0.5	✓	✓	✓	✓	✓	✓							✓	
TP32-0.6-0.7	✓	✓	✓	✓	✓	✓							✓	
Duplicate A	✓	✓	✓	✓	✓	✓								

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

GeoEnviro Consultancy Pty Ltd
Unit 5, 36-41 North Avenue, Blacktown NSW 2148, Australia
Tel: (02) 9676 9770 Fax: (02) 9676 9744

Laboratory Test Request/Chain of Custody Record

Job Details
Job Number: JC171134
Client:
Project: Proposed Residential Subdivision Development
Location: Fitzpatrick Street, Marsden Park (Marsden Zib)

Sample Date: 01/12/2017
Sampled By: SG
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: Envirolab Services Pty Ltd
Address: 12 Ashley Street
Chatswood
Contact: Tania Notaro

Sampling Details				Sample Type		Test Required (√)												Test Performed (√)										
Location		Depth (m)		Soil	Water																							Retain Samples
		From	To																									
1	BH1	2.50	3.00	☒								✓	✓	✓	✓	✓												
2	BH2	1.00	1.45	☒								✓	✓	✓	✓	✓												
3	BH5	0.00	0.10	☒								✓	✓	✓	✓	✓												
4	BH1	0.50	0.80	☒							✓	✓																
5	BH1	1.00	1.45	☒							✓	✓																
6	BH5	0.00	0.10	☒							✓	✓																
7	BH5	2.50	3.00	☒							✓	✓																

Relinquished by				Received by				
Laboratory	Name	Signature	Date	Laboratory	Name	Signature	Date
Geoenviro Consultancy	Steven Goss		4/12/2017				

Legend
XB: Unpreserved Plastic (500 mL Plastic Bag)
XE: Unpreserved Jar (Small, Plastic Pot)
XG: Preserved Bottle (Glass Jar)
XPT: Standard Preservative Tub Solution
UEG: Unpreserved Bottle (Glass Jar)
UPT: Unpreserved Bottle (Tub) Tube
WG: Water Sample (Filled Glass Jar)
WP: Water Bottle (Plastic Bottle)
F: Field Sample
R: Rinsate Sample

GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96766170 Fax: (02) 96766144

Laboratory Test Request/Chain of Custody Record

Job Details
Job Number: JC171318
Client:
Project: Proposed Residential Subdivision Development
Location: Fitzpatrick Street, Menangle (Menangle ZS)

Sample Date: 01/12/2017
Sampled By: SG
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: Envirolab Services Pty Ltd
Address: 12 Ashley Street
Chatswood
Contact: Tania Notaras

Sampling Details				Sample Type		Test Required (√)																						Test Performed(X)
Location		Depth (m)		Soil	Water																							
		From	To																									Keep Sample
1	TP 1	0.20	0.30	DG					✓																			
2	TP 4	0.00	0.10	DG					✓																			
3	TP 10	0.10	0.20	DG					✓																			
4	TP 11	0.20	0.30	DG					✓																			
5	TP 11 - Fibro			DG						✓																		
6	TP 16	0.40	0.50	DG					✓																			
7	TP 20	0.10	0.20	DG					✓																			
8	TP 24	0.00	0.10	DG					✓																			
9	TP 30	0.30	0.40	DG					✓																			
10	TP 31	0.40	0.50	DG					✓																			
11	TP 32	0.60	0.70	DG					✓																			
12	Duplicate A			DG						✓																		

Relinquished By				Received By			
Laboratory	Name	Signature	Date	Laboratory	Name	Signature	Date
GeoEnviro Consultancy	Steven Gass		4/12/2017				

Legend:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 183530

Client Details

Client	Geoenviro Consultancy Pty Ltd
Attention	Solern Liew
Address	PO Box 1543, Macquarie Centre, North Ryde, NSW, 2113

Sample Details

Your Reference	**JC17313A**
Number of Samples	2 Water
Date samples received	18/01/2018
Date completed instructions received	18/01/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	25/01/2018
Date of Issue	24/01/2018

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Results Approved By
Dragana Tomas, Senior Chemist
Jaimie Loa-Kum-Cheung, Senior Chemist
Nick Sarlamis, Inorganics Supervisor
Steven Luong, Senior Chemist

Authorised By



David Springer, General Manager

vTRH(C6-C10)/BTEXN in Water			
Our Reference		183530-1	183530-2
Your Reference	UNITS	MW1	MW2
Type of sample		Water	Water
Date extracted	-	19/01/2018	19/01/2018
Date analysed	-	22/01/2018	22/01/2018
TRH C_6 - C_9	µg/L	<10	<10
TRH C_6 - C_{10}	µg/L	<10	<10
TRH C_6 - C_{10} less BTEX (F1)	µg/L	<10	<10
Benzene	µg/L	<1	<1
Toluene	µg/L	<1	<1
Ethylbenzene	µg/L	<1	<1
m+p-xylene	µg/L	<2	<2
o-xylene	µg/L	<1	<1
Naphthalene	µg/L	<1	<1
Surrogate Dibromofluoromethane	%	102	102
Surrogate toluene-d8	%	98	98
Surrogate 4-BFB	%	98	97

svTRH (C10-C40) in Water			
Our Reference		183530-1	183530-2
Your Reference	UNITS	MW1	MW2
Type of sample		Water	Water
Date extracted	-	19/01/2018	19/01/2018
Date analysed	-	19/01/2018	19/01/2018
TRH C_{10} - C_{14}	µg/L	<50	<50
TRH C_{15} - C_{28}	µg/L	<100	<100
TRH C_{29} - C_{36}	µg/L	<100	<100
TRH >C_{10} - C_{16}	µg/L	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	µg/L	<50	<50
TRH >C_{16} - C_{34}	µg/L	<100	<100
TRH >C_{34} - C_{40}	µg/L	<100	<100
Surrogate o-Terphenyl	%	106	88

PAHs in Water			
Our Reference	UNITS	183530-1	183530-2
Your Reference		MW1	MW2
Type of sample		Water	Water
Date extracted	-	19/01/2018	19/01/2018
Date analysed	-	19/01/2018	19/01/2018
Naphthalene	µg/L	<1	<1
Acenaphthylene	µg/L	<1	<1
Acenaphthene	µg/L	<1	<1
Fluorene	µg/L	<1	<1
Phenanthrene	µg/L	<1	<1
Anthracene	µg/L	<1	<1
Fluoranthene	µg/L	<1	<1
Pyrene	µg/L	<1	<1
Benzo(a)anthracene	µg/L	<1	<1
Chrysene	µg/L	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2
Benzo(a)pyrene	µg/L	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	98	96

OCP in water			
Our Reference	UNITS	183530-1	183530-2
Your Reference		MW1	MW2
Type of sample		Water	Water
Date extracted	-	19/01/2018	19/01/2018
Date analysed	-	19/01/2018	19/01/2018
HCB	µg/L	<0.2	<0.2
alpha-BHC	µg/L	<0.2	<0.2
gamma-BHC	µg/L	<0.2	<0.2
beta-BHC	µg/L	<0.2	<0.2
Heptachlor	µg/L	<0.2	<0.2
delta-BHC	µg/L	<0.2	<0.2
Aldrin	µg/L	<0.2	<0.2
Heptachlor Epoxide	µg/L	<0.2	<0.2
gamma-Chlordane	µg/L	<0.2	<0.2
alpha-Chlordane	µg/L	<0.2	<0.2
Endosulfan I	µg/L	<0.2	<0.2
pp-DDE	µg/L	<0.2	<0.2
Dieldrin	µg/L	<0.2	<0.2
Endrin	µg/L	<0.2	<0.2
pp-DDD	µg/L	<0.2	<0.2
Endosulfan II	µg/L	<0.2	<0.2
pp-DDT	µg/L	<0.2	<0.2
Endrin Aldehyde	µg/L	<0.2	<0.2
Endosulfan Sulphate	µg/L	<0.2	<0.2
Methoxychlor	µg/L	<0.2	<0.2
Surrogate TCMX	%	82	84

PCBs in Water			
Our Reference		183530-1	183530-2
Your Reference	UNITS	MW1	MW2
Type of sample		Water	Water
Date extracted	-	19/01/2018	19/01/2018
Date analysed	-	19/01/2018	19/01/2018
Aroclor 1016	µg/L	<2	<2
Aroclor 1221	µg/L	<2	<2
Aroclor 1232	µg/L	<2	<2
Aroclor 1242	µg/L	<2	<2
Aroclor 1248	µg/L	<2	<2
Aroclor 1254	µg/L	<2	<2
Aroclor 1260	µg/L	<2	<2
Surrogate TCLMX	%	82	84

HM in water - dissolved			
Our Reference		183530-1	183530-2
Your Reference	UNITS	MW1	MW2
Type of sample		Water	Water
Date prepared	-	22/01/2018	22/01/2018
Date analysed	-	22/01/2018	22/01/2018
Arsenic-Dissolved	µg/L	<1	<1
Cadmium-Dissolved	µg/L	0.7	0.6
Chromium-Dissolved	µg/L	<1	<1
Copper-Dissolved	µg/L	<1	<1
Lead-Dissolved	µg/L	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05
Nickel-Dissolved	µg/L	8	8
Zinc-Dissolved	µg/L	69	67

Miscellaneous Inorganics			
Our Reference		183530-1	183530-2
Your Reference	UNITS	MW1	MW2
Type of sample		Water	Water
Date prepared	-	18/01/2018	18/01/2018
Date analysed	-	18/01/2018	18/01/2018
pH	pH Units	6.3	6.2
Electrical Conductivity	µS/cm	1,000	1,000
Total Dissolved Solids (grav)	mg/L	630	620
Chloride, Cl	mg/L	270	270
Sulphate, SO4	mg/L	5	4
Resistivity	ohm m	10	10

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-10°C.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
Date analysed	-			22/01/2018	[NT]	[NT]	[NT]	[NT]	22/01/2018	[NT]
TRH C_6 - C_9	µg/L	10	Org-016	<10	[NT]	[NT]	[NT]	[NT]	107	[NT]
TRH C_6 - C_{10}	µg/L	10	Org-016	<10	[NT]	[NT]	[NT]	[NT]	107	[NT]
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	105	[NT]
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	107	[NT]
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	108	[NT]
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	[NT]	[NT]	108	[NT]
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	107	[NT]
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate Dibromofluoromethane	%		Org-016	102	[NT]	[NT]	[NT]	[NT]	100	[NT]
Surrogate toluene-d8	%		Org-016	99	[NT]	[NT]	[NT]	[NT]	101	[NT]
Surrogate 4-BFB	%		Org-016	97	[NT]	[NT]	[NT]	[NT]	101	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
Date analysed	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
TRH C_{10} - C_{14}	µg/L	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	83	[NT]
TRH C_{15} - C_{28}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	90	[NT]
TRH C_{29} - C_{36}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	79	[NT]
TRH >C_{10} - C_{16}	µg/L	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	83	[NT]
TRH >C_{16} - C_{34}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	90	[NT]
TRH >C_{34} - C_{40}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	79	[NT]
Surrogate o-Terphenyl	%		Org-003	73	[NT]	[NT]	[NT]	[NT]	132	[NT]

QUALITY CONTROL: PAHs in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
Date analysed	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
Naphthalene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	70	[NT]
Acenaphthylene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluorene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	88	[NT]
Phenanthrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	89	[NT]
Anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	92	[NT]
Pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	112	[NT]
Benzo(a)anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	89	[NT]
Benzo(b,j+k)fluoranthene	µg/L	2	Org-012	<2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	92	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	79	[NT]	[NT]	[NT]	[NT]	95	[NT]

QUALITY CONTROL: OCP in water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
Date analysed	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
HCB	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	86	[NT]
gamma-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	88	[NT]
Heptachlor	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	92	[NT]
delta-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	89	[NT]
Heptachlor Epoxide	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	90	[NT]
gamma-Chlordane	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-Chlordane	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	89	[NT]
Dieldrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	91	[NT]
Endrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	89	[NT]
pp-DDD	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	91	[NT]
Endosulfan II	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDT	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endrin Aldehyde	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	106	[NT]
Methoxychlor	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-005	100	[NT]	[NT]	[NT]	[NT]	124	[NT]

QUALITY CONTROL: PCBs in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
Date analysed	-			19/01/2018	[NT]	[NT]	[NT]	[NT]	19/01/2018	[NT]
Aroclor 1016	µg/L	2	Org-006	<2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1221	µg/L	2	Org-006	<2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1232	µg/L	2	Org-006	<2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1242	µg/L	2	Org-006	<2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1248	µg/L	2	Org-006	<2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1254	µg/L	2	Org-006	<2	[NT]	[NT]	[NT]	[NT]	97	[NT]
Aroclor 1260	µg/L	2	Org-006	<2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCLMX	%		Org-006	100	[NT]	[NT]	[NT]	[NT]	125	[NT]

QUALITY CONTROL: HM in water - dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			22/01/2018	[NT]	[NT]	[NT]	[NT]	22/01/2018	[NT]
Date analysed	-			22/01/2018	[NT]	[NT]	[NT]	[NT]	22/01/2018	[NT]
Arsenic-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	95	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	109	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	94	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			18/01/2018	[NT]	[NT]	[NT]	[NT]	18/01/2018	[NT]
Date analysed	-			18/01/2018	[NT]	[NT]	[NT]	[NT]	18/01/2018	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Total Dissolved Solids (grav)	mg/L	5	Inorg-018	<5	[NT]	[NT]	[NT]	[NT]	117	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Resistivity	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

vTRH(C6-C10)/BTEXN in Water - Samples were subsampled from amber bottles.

Dissolved Metals: no preserved sample was received, therefore
the unpreserved sample was filtered through 0.45 µm filter at the lab.
Note: there is a possibility some elements may be underestimated.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details

Client	Geoenviro Consultancy Pty Ltd
Attention	Solern Liew

Sample Login Details

Your reference	JC17313A
Envirolab Reference	183530
Date Sample Received	18/01/2018
Date Instructions Received	18/01/2018
Date Results Expected to be Reported	25/01/2018

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	2 Water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	16.3
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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Sample ID	vTRH(C6-C10)/BTEXN in Water	svTRH (C10-C40) in Water	PAHsin Water	OCP in water	PCBs in Water	HM in water - dissolved	pH	Electrical Conductivity	Total Dissolved Solids(grav)	Chloride, Cl	Sulphate, SO4	Resistivity
MW1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.

GeoEnviro Consultancy Pty Ltd
(Unit 3, 36-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96784733 Fax: (02) 96788144

Laboratory Test Request/Chain of Custody Record

Job Details
Job Number: JC171013A
Client:
Project: Proposed Menangle Zone Substation
Location: Pitcairnie Street, Menangle Park

Sample Date: 17/01/2018
Sampled By: SG
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: Envirolab Services Pty Ltd
Address: 12 Ashley Street
Chatswood
Contact: Tania Notara

Sampling Details			Sample Type		Tests Requested (1)															Tests Performed(2)							
Location	Depth (m)		Soil	Water	Metals (As,Cd,Cr,Cu,Ni,Pb,Zn,Hg)	OCP / PCB	Combination 1	Combination 2a	Combination 2b	Combination 3	Asbestos	pH	EC	CEC/ESP	Cl / SO4	Resistivity		Tick Required Tests							Insert Samples
	From	To																									
1 MW1	-	-		W3																							
2 MW2	-	-		W2																							

Relinquished by:

Laboratory	Name	Signature	Date
Geotechnics Consultancy	Steven Giles		18/01/2018

Received By

Laboratory	Name	Signature	Date

Legend:
(1) Enviroad Services (Ref: Peters Hwy)
(2) Enviroad Services (Email: Phone Hwy)
(W) Enviroad Services (Glass Jar)
(ST) Enviroad Environmental Soil Sample
(SS) Unpolluted Sample, Glass Tube
(ST) Unpolluted Sample, Tissue Tube
(WS) Water Sample, Amber Glass Jar
(WP) Water Sample, Plastic Bottle

* Assay Required
Discard Sample

APPENDIX F

Unexpected Asbestos Finds Protocol

Unexpected Asbestos Finds

If asbestos is detected in area not identified as containing asbestos prior to, or during, bulk excavation works the following 'Unexpected Finds Protocol' will apply:

- Upon discovery of suspected asbestos containing material, the site manager is to be notified and the affected area closed off by the use of barrier tape and warning signs. Warning signs shall be specific to Asbestos Hazards and shall comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;
- Work shall comply with WorkCover requirements including *Working with Asbestos*, *2008*;
- An OHS consultant or a hygienist is to be notified to inspect the area and confirm the presence of asbestos and determine whether the asbestos is classified as friable or bonded asbestos and determine the extent of remediation works to be undertaken. A report detailing this information will be compiled by the OHS consultant and provided to the Site Manager (SM) (or his representative);
- The impacted soil will be classified and disposed of, as a minimum, as Special Waste (Asbestos) at an appropriately licensed facility. In dry and windy conditions the stockpile will be kept lightly wetted and may be covered with plastic sheet whilst awaiting disposal;
- All work associated with asbestos in soil will be undertaken by a contractor holding a class AS-1 Licence (friable) or AS2 Licence for bonded asbestos, as appropriate. WorkCover must be notified 7 days in advance of any asbestos works;
- Monitoring for airborne asbestos fibres is to be carried out during the soil excavation in asbestos contaminated materials;
- Documentary evidence (weighbridge dockets) of correct disposal is to be provided to the Principal (or their representative);
- At the completion of the excavation, a clearance inspection is to be carried out, soil samples taken and analysed for asbestos fibres followed by written certification provided by an OHS Consultant that the area is safe to be accessed and worked (with respect to asbestos impact). If required, the filling material remaining in the inspected area can be covered/ sealed by an appropriate physical barrier layer of non-asbestos containing material prior to sign–off;
- Details are to be recorded in the site record system;
- Following clearance by an OHS Consultant or hygenist, the area may be reopened for further excavation or construction work.

APPENDIX G

Important Information about your Environmental Site Assessment
Explanatory Notes

GeoEnviro Consultancy Pty Ltd
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Fax: (02) 9679 8744
Email: geoenviro@exemail.com.au

IMPORTANT INFORMATION REGARDING YOUR ENVIRONMENTAL SITE ASSESSMENT

This Environmental Assessment Report was performed in general conformance with our understanding of the guidelines by the Australian and New Zealand Conservation Council (ANZECC), the Office of Environment and Heritage (OEH) and the National Environmental Protection (Assessment of Site Contamination) Measure 1999 (amended 2013).

These accompanying notes have been prepared by GeoEnviro Consultancy Pty Ltd, using guidelines prepared by ASFE; The Association of Engineering Firms Practising in the Geosciences. The notes are offered as an aid in the interpretation of your environmental site assessment report.

REASONS FOR AN ENVIRONMENTAL SITE ASSESSMENT

Environmental site assessments are typically, though not exclusively, performed in the following circumstances:

- As a pre- acquisition assessment on behalf of either a purchaser or a vendor, when a property is to be sold
- As a pre-development assessment, when a property or area of land is to be redeveloped, or the land use has change, eg from a factory to a residential subdivision
- As a pre-development assessment of greenfield sites, to establish baseline conditions and assess environmental, geological and hydrological constraints to the development of, eg, a landfill
- As an audit of the environmental effects of previous and present site usage

Each circumstance requires a specific approach to the assessment of soil and groundwater contamination. In all cases the objective is to identify and if possible, quantify the risks which unrecognised contamination poses to the ongoing or proposed activity. Such risk may be both financial (clean-up costs or limitations in site use) and physical (health risks to site users or the public).

ENVIRONMENTAL SITE ASSESSMENT LIMITATIONS

Although information provided by an environmental site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination within a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which did not show signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur, only the most likely contaminants are screened.

AN ENVIRONMANTAL SITE ASSESSMENT REPORT IS BASED ON A UNIQUE SET OF PROJECT SPECIFIC FACTORS

Your environmental assessment report should not be used;

- When the nature of the proposed development is changed, eg, if a residential development is proposed, rather than a commercial development
- When the size or configuration of the proposed development is altered, eg, if a basement is added
- When the location or orientation of the proposed structure is modified
- When there is a change of land ownership, or
- For application to an adjacent site

In order to avoid costly problems, you should ask your consultant to assess any changes in the project since the assessment and the implications, if any, to recommendations made in the assessment.

ENVIRONMENTAL SITE ASSESSMENT FINDINGS ARE PROFESSIONAL ESTIMATES

Site assessment identifies actual sub-surface conditions only at those points where samples are taken, when they are taken. Data obtained from the sampling and subsequent laboratory analyses are interpreted by geologists, engineers or scientist and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on any proposed development and appropriate remediation measures. Actual conditions may differ from those inferred, because no professional, no matter how qualified and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, however, steps can be taken to help minimise the impact. For this reason, site owner should retain the services of their consultants throughout the development stage of the project in order to identify variances, conduct additional tests which may be necessary and to recommend solutions to problems encountered on site.

Soil and groundwater contamination is a field in which legislation and interpretation of legislation by government departments is changing rapidly. Whilst every attempt is made by GeoEnviro Consultancy Pty Ltd to be familiar with current policy, our interpretation of the investigation findings should not be taken to be that of the relevant authority. When approval from a statutory authority is required for a project, that approval should be directly sought.

STABILITY OF SUB-SURFACE CONDITIONS

Sub-surface conditions can change by natural processes and site activities. As an environmental site assessment is based on conditions existing at the time of the investigation, project decisions should not be based on environmental site assessment data which may have been affected by time. The consultant should be requested to advise if additional tests are required.

ENVIRONMENTAL SITE ASSESSMENTS ARE PERFORMED FOR SPECIFIC PURPOSES AND CLIENTS

Environmental site assessments are prepared in response to a specific scope of work required to meet the specific needs or specific individuals. An assessment prepared for a consulting civil engineer may not be adequate to a construction contractor or another civil engineer.

An assessment should not be used by other persons for any purpose, or by the client for a different purposes. No individual, other than the client, should apply an assessment, even for its intended purposes, without first conferring with the consultant. No person should apply an assessment for any purposes other than that originally contemplated, without first conferring with the consultant.

MISINTERPRETATION OF ENVIRONMENTAL SITE ASSESSMENTS

Costly problems can occur when design professionals develop plans based on misinterpretation of an environmental site assessment. In order to minimise problems, the environmental consultant should be retained to work with appropriate design professionals, to explain relevant findings and to review the adequacy of plans and specifications relative to contamination issues.

LOGS SHOULD NOT BE SEPARATED FORM THE REPORT

Borehole and test pit logs are prepared by environmental scientists, engineers or geologist, based upon interpretation of field conditions and laboratory evaluation of field samples. Field logs normally provided in our reports and these should not be redrawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however, contractors can still misinterpret the logs during bid preparation if separated from the test of the assessment. Should this occur, delays and disputes , or unanticipated costs may result.

To reduce the likelihood of boreholes and test pit logs misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of sub-surface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations, such as contractors.

READ RESPONSIBILITY CLAUSES CLOSELY

An environmental site assessment is based extensively on judgement and opinion, therefore, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claim being lodged against consultants. In order to aid in prevention of this problem, model clauses have been developed for use in written transmittals. These are definitive clauses, designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment and you are encouraged to read them closely. Your consultant will be happy to give full and frank answers to any questions you may have.

EXPLANATORY NOTES

Introduction

These notes have been provided to amplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments sections. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods
The methods the description and classification of soils and rocks used in this report are based on Australian standard 1726, the SSA Site investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, qualified by the grading or other particles present (eg sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	Less than 0.002mm
Silt	0.002 to 0.6mm
Sand	0.6 to 2.00mm
Gravel	2.00m to 60.00mm

Soil Classification	Particle size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2.00mm
Gravel	2.00mm to 60.00mm

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very Soft	Less than 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer test (CPT), as below:

Relative Dense	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c-Mpa)
Very Loose	Less than 5	Less than 2
Loose	5 - 10	2 - 5
Medium Dense	10 - 30	5 - 15
Dense	30 - 50	15 - 25
Very Dense	> 50	> 25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering strength, defects and other minor components. Where relevant, further information regarding rock classification, is given on the following sheet.

Sampling
Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provided information on plasticity, grained size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally know as U_{50}) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such Samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods
The following is a brief summary of investigation methods currently carried out by this company and comments on their use and application.

Hand Auger Drilling
The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits
These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure or accommodate the poorly compacted backfill.

Large Diameter Auger (eg Pengo)
The hole is advanced by a rotating plate or short spiral auger generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 05m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

Continuous Spiral Flight Augers
The hole is advanced by using 90mm - 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the augers flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively low reliability due to remoulding, mixing or softening of samples by ground water, resulting in uncertainties of the original sample depth.

Continuous Spiral Flight Augers (continued)
The spiral augers are usually advanced by using a V - bit through the soil profile refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of the recovered rock fragments and through observation of the drilling penetration resistance.

Non - core Rotary Drilling (Wash Boring)
The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus, carrying the cuttings, together with some information from the "feel" and rate of penetration.

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg SPT and U_{50} samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rock and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks an NMLC triple tube core barrel which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of testing Soils for Engineering Purpose"- Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63Kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the "N" value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rocks, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blows counts for each 150mm of, say 4, 6, and 7 blows.

  as 4, 6, 7
  N = 13

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm.

  as 15,30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test methods is used to obtain samples in 50mm diameter thin walled samples tubes in clays. In these circumstances, the best results are shown on the bore logs in brackets.

Dynamic Cone Penetration Test
A modification to the SPT test is where the same driving system is used with a solid 60^0 tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N_c' on the bore logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 test F5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducer in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in Mpa.
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percentage.

There are two scales available for measurement of cone resistance. The lower "A" scale (0-5Mpa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main "B" scale (0-50Mpa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative frictions in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (Mpa)} = (0.4 \text{ to } 0.6)\ N \text{ (blows per 300mm)}$$

In clays the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c = (12 \text{ to} 18)\ C_u$$

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.

Cone Penetrometer Testing and Interpretation continued
This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (AS1289)
Portable dynamic cone penetrometer tests are carried out by driving a rod in to the ground with a falling weight hammer and measuring the blows per successive 100mm increments of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS 1289 Test F3.2).

Laboratory Testing
Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

Engineering Logs
The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

Ground water
Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all, during the investigation period.
- A localised perched water table may lead to a erroneous indication of the true water table.
- Water table levels will vary from time to time, due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if any water observations are to be made.

More reliable measurements can be made by installing stand pipes, which are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be interference from a perched water table or surface water.

Engineering Reports
Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal is changed, say to a twenty storey building. If this occurs, the company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company request immediate notification. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes
Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information trader Documents”, published by the Institute of Engineers Australia. Where information obtained for this investigation is provided for tender purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purpose, at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspect of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site

Review of Design
Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.

Graphic Symbols For Soil and Rock

SOIL


Fill


Topsoil


Gravel (GW , GP)


Sand (SP, SW)


Silt (ML, MH)


Clay (CL, CH)


Clayey Gravel (GC)


Silty Sand (SM)


Clayey Sand (SC)


Sandy Silt (ML)


Gravelly Clay (CL, CH)


Silty Clay (CL, CH)


Sandy Clay (CL, CH)


Peat or Organic Soil

ROCK


Shale


Sandstone


Siltstone,Mudstone,Claystone


Granite, Gabbro


Dolerite, Diorite


Basalt, Andesite

Other Materials


Concrete


Bitumen, Asphaltic Concrete, Coal


Ironstone Gravel


Organic Material

Appendix H Construction Noise Impact Assessment (TfNSW Noise Tool Outputs)

DRAFT

Transport for NSW

Distanced Based Assessment (Noisiest Plant)

Please pick from drop-down list in orange cells

Noise area category		R1
RBL or L_{A90} Background level (dB(A))	Day	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Mangement Level (dB(A))	Day	50
	Day (OOHW)	45
	Evening	40
	Night	35
Noisiest plant		13.5T Excavator With Hammer
Is there line of sight to receiver?		Yes

Steps for Assessment:

1. Schedule noisy works to occur in standard hours where possible or before 11pm and implement Standard Measures.
2. Select the representative noise area category. The worksheet titled 'Representative Noise Environ.' provides a number of examples to help select the noise area category.
3. Select the noisiest plant. If not found in drop-down list, refer to 'Source List' and select a representative plant with equivalent sound power level.
4. Is there line of sight to receiver? Select the appropriate scenario from the drop down list .

Identify and implement standard mitigation measures where feasible and reasonable. Include any shielding implemented as part of the standard mitigation measures by changing the selection in the 'Is there line of sightoiaw to receiver' drop-down list. Solid barriers can be in the form of road cutting, timber lapped and capped fence, shipping container, site office, etc. Substantial solid barriers are barriers greater than 5 metres in height or multiple rows of houses or a sound barrier specifically designed to mitigate construction noise. Please note that vegetation and trees are not considered to be a form of solid barrier and any gaps would compromise the acoustic integrity of the solid barrier.

5. Determine if there are any receivers (both residential and non-residential receivers) within the affected distance for each relevant time period . Consider background LA90 noise measurements to check assumption in Step #2 if:

(a) there are many affected receivers and the impact duration at any one receiver is more than 3 weeks; or

(b) there are a few affected receivers and the impact duration at any one receiver is more than 6 weeks.

Note that consideration need to be given to the construction staging plan when determining impact duration.

7. Identify if there are any receivers within the additional mitigation measures distances and identify feasible and reasonable measures at each receiver.
8. Where night works are involved, identify sleep disturbance affected distance.
9. Document the outcomes of these steps.

(Note that suitable noise management levels for other noise-sensitive businesses not identified in the Construction and Maintenance Noise Estimator should be investigated on a project-by-project basis. Please contact a Roads and Maritime noise speciliast for more information)

Abbreviation	Measure
N	Notification
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Residential receiver

			$L_{Aeq(15minute)}$ noise level above background (L_{A90})											$L_{Aeq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep disutrbance L_{Amax} 65 dB(A)
			5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)					
			Noticeable			Clearly audible			Moderately intrusive			Highly intrusive					
		Affected distance (m)	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Affected distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Day	455							N	215	60	N	105	70	N, PC, RO	60	75	
	Day (OOHW)	655				N, R1, DR	455	50	N, R1, DR	215	60	N, R1, DR, PC, SN	105	70	N, PC, RO	60	75	
	Evening	940				N, R1, DR	655	45	N, R1, DR	315	65	N, R1, DR, PC, SN	150	65	N, PC, RO	60	75	
	Night	1340	N	1340	35	N, R2, DR	940	40	N, PC, SN, R2, DR	455	50	AA, N, PC, SN, R2, DR	215	60	N, PC, RO	60	75	315
	Highly Affected	60													N, PC, RO	60	75	
Developed settlements (urban and suburban)	Day	590							N	260	60	N	110	70	N, PC, RO	70	75	
	Day (OOHW)	870				N, R1, DR	590	50	N, R1, DR	260	60	N, R1, DR, PC, SN	110	70	N, PC, RO	70	75	
	Evening	1265				N, R1, DR	870	45	N, R1, DR	390	55	N, R1, DR, PC, SN	170	65	N, PC, RO	70	75	
	Night	1790	N	1790	35	N, R2, DR	1265	40	N, PC, SN, R2, DR	590	50	AA, N, PC, SN, R2, DR	260	60	N, PC, RO	70	75	390
	Highly Affected	70													N, PC, RO	70	75	
Propagation across a valley / over water	Day	815							N	340	60	N	130	70	N, PC, RO	80	75	
	Day (OOHW)	1215				N, R1, DR	815	50	N, R1, DR	340	60	N, R1, DR, PC, SN	130	70	N, PC, RO	80	75	
	Evening	1770				N, R1, DR	1215	45	N, R1, DR	530	55	N, R1, DR, PC, SN	210	65	N, PC, RO	80	75	
	Night	2005	N	2005	35	N, R2, DR	1770	40	N, PC, SN, R2, DR	815	50	AA, N, PC, SN, R2, DR	340	60	N, PC, RO	80	75	530
	Highly Affected	80													N, PC, RO	80	75	

Non-residential receiver
Undeveloped green fields, rural areas with isolated dwellings

		Standard hours		$L_{Aeq(15minute)}$ noise level above NML					LAeq(15minute) 75 dB(A) or greater (Highly affected)		
				<10 dB(A)			10 to 20 dB(A)				
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	315				N	150	65	N, PC, RO	60	75
Hospital wards and operating theatres	Day	65	150							N, PC, RO	60	75
Place of worship	Day	55	315				N	150	65	N, PC, RO	60	75
Active recreation	Day	65	150							N, PC, RO	60	75
Passive recreation	Day	60	215				N	105	70	N, PC, RO	60	75
Industrial premise	Day	75	60							N, PC, RO	60	75
Offices, retail outlets	Day	70	105							N, PC, RO	60	75

		OOHW		$L_{Aeq(15minute)}$ noise level above NML											
				< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	150				N, R1, DR	105	70	N, R1, DR	34	80	N, R1, DR, PC, SN	11	90
	Night	65	150	N	150	65	N, R2, NR	105	70	N, PC, SN, R2, DR	34	80	AA, N, PC, SN, R2, DR	11	90
Place of worship	Evening	55	315				N, R1, DR	215	60	N, R1, DR	105	70	N, R1, DR, PC, SN	34	80
	Night	55	315	N	315	55	N, R2, NR	215	60	N, PC, SN, R2, DR	105	70	AA, N, PC, SN, R2, DR	34	80
Active recreation	Evening	65	150				N, R1, DR	105	70	N, R1, DR	34	80	N, R1, DR, PC, SN	11	90
Passive recreation	Evening	60	215				N, R1, DR	150	65	N, R1, DR	60	75	N, R1, DR, PC, SN	19	85
Industrial premise	Evening	75	60				N, R1, DR	34	80	N, R1, DR	11	90	N, R1, DR, PC, SN	3	100
	Night	75	60	N	60	75	N, R2, NR	34	80	N, PC, SN, R2, DR	11	90	AA, N, PC, SN, R2, DR	3	100
Offices, retail outlets	Evening	70	105				N, R1, DR	60	75	N, R1, DR	19	85	N, R1, DR, PC, SN	6	95
	Night	70	105	N	105	70	N, R2, NR	60	75	N, PC, SN, R2, DR	19	85	AA, N, PC, SN, R2, DR	6	95

Non-residential receiver
Developed settlements (urban and suburban)

		Standard hours		$L_{Aeq(15minute)}$ noise level above NML					LAeq(15minute) 75 dB(A) or greater (Highly affected)		
				<10 dB(A)			10 to 20 dB(A)				
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	390				N	170	65	N, PC, RO	70	75
Hospital wards and operating theatres	Day	65	170							N, PC, RO	70	75
Place of worship	Day	55	390				N	170	65	N, PC, RO	70	75
Active recreation	Day	65	170							N, PC, RO	70	75
Passive recreation	Day	60	260				N	110	70	N, PC, RO	70	75
Industrial premise	Day	75	70							N, PC, RO	70	75
Offices, retail outlets	Day	70	110							N, PC, RO	70	75

		OOHW		$L_{Aeq(15minute)}$ noise level above NML											
				< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	170				N, R1, DR	110	70	N, R1, DR	39	80	N, R1, DR, PC, SN	12	90
	Night	65	170	N	170	65	N, R2, NR	110	70	N, PC, SN, R2, DR	39	80	AA, N, PC, SN, R2, DR	12	90
Place of worship	Evening	55	390				N, R1, DR	260	60	N, R1, DR	110	70	N, R1, DR, PC, SN	39	80
	Night	55	390	N	390	55	N, R2, NR	260	60	N, PC, SN, R2, DR	110	70	AA, N, PC, SN, R2, DR	39	80
Active recreation	Evening	65	170				N, R1, DR	110	70	N, R1, DR	39	80	N, R1, DR, PC, SN	12	90
Passive recreation	Evening	60	260				N, R1, DR	170	65	N, R1, DR	70	75	N, R1, DR, PC, SN	22	85
Industrial premise	Evening	75	70				N, R1, DR	39	80	N, R1, DR	12	90	N, R1, DR, PC, SN	4	100
	Night	75	70	N	70	75	N, R2, NR	39	80	N, PC, SN, R2, DR	12	90	AA, N, PC, SN, R2, DR	4	100
Offices, retail outlets	Evening	70	110				N, R1, DR	70	75	N, R1, DR	22	85	N, R1, DR, PC, SN	7	95
	Night	70	110	N	110	70	N, R2, NR	70	75	N, PC, SN, R2, DR	22	85	AA, N, PC, SN, R2, DR	7	95

Transport for NSW

Distanced Based Assessment (Noisiest Plant)

Please pick from drop-down list in orange cells

Noise area category		R1
RBL or L_{A90} Background level (dB(A))	Day	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Mangement Level (dB(A))	Day	50
	Day (OOHW)	45
	Evening	40
	Night	35
Noisiest plant		13.5T Excavator With Hammer
Is there line of sight to receiver?		No (behind substantial solid barrier)

Steps for Assessment:

1. Schedule noisy works to occur in standard hours where possible or before 11pm and implement Standard Measures.
2. Select the representative noise area category. The worksheet titled 'Representative Noise Environ.' provides a number of examples to help select the noise area category.
3. Select the noisiest plant. If not found in drop-down list, refer to 'Source List' and select a representative plant with equivalent sound power level.
4. Is there line of sight to receiver? Select the appropriate scenario from the drop down list .

Identify and implement standard mitigation measures where feasible and reasonable. Include any shielding implemented as part of the standard mitigation measures by changing the selection in the 'Is there line of sightoiaw to receiver' drop-down list. Solid barriers can be in the form of road cutting, timber lapped and capped fence, shipping container, site office, etc. Substantial solid barriers are barriers greater than 5 metres in height or multiple rows of houses or a sound barrier specifically designed to mitigate construction noise. Please note that vegetation and trees are not considered to be a form of solid barrier and any gaps would compromise the acoustic integrity of the solid barrier.

5. Determine if there are any receivers (both residential and non-residential receivers) within the affected distance for each relevant time period . Consider background LA90 noise measurements to check assumption in Step #2 if:

(a) there are many affected receivers and the impact duration at any one receiver is more than 3 weeks; or

(b) there are a few affected receivers and the impact duration at any one receiver is more than 6 weeks.

Note that consideration need to be given to the construction staging plan when determining impact duration.

7. Identify if there are any receivers within the additional mitigation measures distances and identify feasible and reasonable measures at each receiver.
8. Where night works are involved, identify sleep disturbance affected distance.
9. Document the outcomes of these steps.

(Note that suitable noise management levels for other noise-sensitive businesses not identified in the Construction and Maintenance Noise Estimator should be investigated on a project-by-project basis. Please contact a Roads and Maritime noise speciliast for more information)

Abbreviation	Measure
N	Notification
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Residential receiver

			$L_{Aeq(15minute)}$ noise level above background (L_{A90})											$L_{Aeq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep disutrbance L_{Amax} 65 dB(A)
			5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)					
			Noticeable			Clearly audible			Moderately intrusive			Highly intrusive					
		Affected distance (m)	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Affected distance (m)
Indeveloped green fields, rural areas with isolated dwellings	Day	215							N	105	60	N	35	70	N, PC, RO	25	75	
	Day (OOHW)	315				N, R1, DR	215	50	N, R1, DR	105	60	N, R1, DR, PC, SN	35	70	N, PC, RO	25	75	
	Evening	455				N, R1, DR	315	45	N, R1, DR	155	55	N, R1, DR, PC, SN	55	65	N, PC, RO	25	75	
	Night	655	N	655	35	N, R2, DR	455	40	N, PC, SN, R2, DR	215	50	AA, N, PC, SN, R2, DR	105	60	N, PC, RO	25	75	150
	Highly Affected	25													N, PC, RO	25	75	
Developed settlements (urban and suburban)	Day	260							N	110	60	N	40	70	N, PC, RO	25	75	
	Day (OOHW)	390				N, R1, DR	260	50	N, R1, DR	110	60	N, R1, DR, PC, SN	40	70	N, PC, RO	25	75	
	Evening	590				N, R1, DR	390	45	N, R1, DR	170	55	N, R1, DR, PC, SN	70	65	N, PC, RO	25	75	
	Night	870	N	870	35	N, R2, DR	590	40	N, PC, SN, R2, DR	260	50	AA, N, PC, SN, R2, DR	110	60	N, PC, RO	25	75	170
	Highly Affected	25													N, PC, RO	25	75	
Propagation across a valley / over water	Day	340							N	130	60	N	45	70	N, PC, RO	30	75	
	Day (OOHW)	530				N, R1, DR	340	50	N, R1, DR	130	60	N, R1, DR, PC, SN	45	70	N, PC, RO	30	75	
	Evening	815				N, R1, DR	530	45	N, R1, DR	210	55	N, R1, DR, PC, SN	80	65	N, PC, RO	30	75	
	Night	1215	N	1215	35	N, R2, DR	815	40	N, PC, SN, R2, DR	340	50	AA, N, PC, SN, R2, DR	130	60	N, PC, RO	30	75	210
	Highly Affected	30													N, PC, RO	30	75	

Non-residential receiver
Undeveloped green fields, rural areas with isolated dwellings

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	150				N	60	65	N, PC, RO	25	75
Hospital wards and operating theatres	Day	65	60							N, PC, RO	25	75
Place of worship	Day	55	150				N	60	65	N, PC, RO	25	75
Active recreation	Day	65	60							N, PC, RO	25	75
Passive recreation	Day	60	105				N	35	70	N, PC, RO	25	75
Industrial premise	Day	75	25							N, PC, RO	25	75
Offices, retail outlets	Day	70	35							N, PC, RO	25	75

				$L_{Aeq(15minute)}$ noise level above NML											
	OOHW			< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	60				N, R1, DR	35	70	N, R1, DR	14	80	N, R1, DR, PC, SN	4	90
	Night	65	60	N	60	65	N, R2, NR	35	70	N, PC, SN, R2, DR	14	80	AA, N, PC, SN, R2, DR	4	90
Place of worship	Evening	55	150				N, R1, DR	105	60	N, R1, DR	35	70	N, R1, DR, PC, SN	14	80
	Night	55	150	N	150	55	N, R2, NR	105	60	N, PC, SN, R2, DR	35	70	AA, N, PC, SN, R2, DR	14	80
Active recreation	Evening	65	60				N, R1, DR	35	70	N, R1, DR	14	80	N, R1, DR, PC, SN	4	90
Passive recreation	Evening	60	105				N, R1, DR	60	65	N, R1, DR	25	75	N, R1, DR, PC, SN	8	85
Industrial premise	Evening	75	25				N, R1, DR	14	80	N, R1, DR	4	90	N, R1, DR, PC, SN	1	100
	Night	75	25	N	25	75	N, R2, NR	14	80	N, PC, SN, R2, DR	4	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	35				N, R1, DR	25	75	N, R1, DR	8	85	N, R1, DR, PC, SN	3	95
	Night	70	35	N	35	70	N, R2, NR	25	75	N, PC, SN, R2, DR	8	85	AA, N, PC, SN, R2, DR	3	95

Non-residential receiver
Developed settlements (urban and suburban)

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	170				N	70	65	N, PC, RO	25	75
Hospital wards and operating theatres	Day	65	70							N, PC, RO	25	75
Place of worship	Day	55	170				N	70	65	N, PC, RO	25	75
Active recreation	Day	65	70							N, PC, RO	25	75
Passive recreation	Day	60	110				N	40	70	N, PC, RO	25	75
Industrial premise	Day	75	25							N, PC, RO	25	75
Offices, retail outlets	Day	70	40							N, PC, RO	25	75

				$L_{Aeq(15minute)}$ noise level above NML											
	OOHW			< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	70				N, R1, DR	40	70	N, R1, DR	14	80	N, R1, DR, PC, SN	4	90
	Night	65	70	N	70	65	N, R2, NR	40	70	N, PC, SN, R2, DR	14	80	AA, N, PC, SN, R2, DR	4	90
Place of worship	Evening	55	170				N, R1, DR	110	60	N, R1, DR	40	70	N, R1, DR, PC, SN	14	80
	Night	55	170	N	170	55	N, R2, NR	110	60	N, PC, SN, R2, DR	40	70	AA, N, PC, SN, R2, DR	14	80
Active recreation	Evening	65	70				N, R1, DR	40	70	N, R1, DR	14	80	N, R1, DR, PC, SN	4	90
Passive recreation	Evening	60	110				N, R1, DR	70	65	N, R1, DR	25	75	N, R1, DR, PC, SN	8	85
Industrial premise	Evening	75	25				N, R1, DR	14	80	N, R1, DR	4	90	N, R1, DR, PC, SN	1	100
	Night	75	25	N	25	75	N, R2, NR	14	80	N, PC, SN, R2, DR	4	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	40				N, R1, DR	25	75	N, R1, DR	8	85	N, R1, DR, PC, SN	3	95
	Night	70	40	N	40	70	N, R2, NR	25	75	N, PC, SN, R2, DR	8	85	AA, N, PC, SN, R2, DR	3	95

Transport for NSW

Distanced Based Assessment (Noisiest Plant)

Please pick from drop-down list in orange cells

Noise area category		R1
RBL or L_{A90} Background level (dB(A))	Day	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Mangement Level (dB(A))	Day	50
	Day (OOHW)	45
	Evening	40
	Night	35
Noisiest plant		Bored Piling Rig
Is there line of sight to receiver?		Yes

Steps for Assessment:

1. Schedule noisy works to occur in standard hours where possible or before 11pm and implement Standard Measures.
2. Select the representative noise area category. The worksheet titled 'Representative Noise Environ.' provides a number of examples to help select the noise area category.
3. Select the noisiest plant. If not found in drop-down list, refer to 'Source List' and select a representative plant with equivalent sound power level.
4. Is there line of sight to receiver? Select the appropriate scenario from the drop down list .

Identify and implement standard mitigation measures where feasible and reasonable. Include any shielding implemented as part of the standard mitigation measures by changing the selection in the 'Is there line of sightoiaw to receiver' drop-down list. Solid barriers can be in the form of road cutting, timber lapped and capped fence, shipping container, site office, etc. Substantial solid barriers are barriers greater than 5 metres in height or multiple rows of houses or a sound barrier specifically designed to mitigate construction noise. Please note that vegetation and trees are not considered to be a form of solid barrier and any gaps would compromise the acoustic integrity of the solid barrier.

5. Determine if there are any receivers (both residential and non-residential receivers) within the affected distance for each relevant time period . Consider background LA90 noise measurements to check assumption in Step #2 if:

(a) there are many affected receivers and the impact duration at any one receiver is more than 3 weeks; or

(b) there are a few affected receivers and the impact duration at any one receiver is more than 6 weeks.

Note that consideration need to be given to the construction staging plan when determining impact duration.

7. Identify if there are any receivers within the additional mitigation measures distances and identify feasible and reasonable measures at each receiver.
8. Where night works are involved, identify sleep disturbance affected distance.
9. Document the outcomes of these steps.

(Note that suitable noise management levels for other noise-sensitive businesses not identified in the Construction and Maintenance Noise Estimator should be investigated on a project-by-project basis. Please contact a Roads and Maritime noise speciliast for more information)

Abbreviation	Measure
N	Notification
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Residential receiver

			$L_{Aeq(15minute)}$ noise level above background (L_{A90})											$L_{Aeq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep disutrbance L_{Amax} 65 dB(A)
			5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)					
			Noticeable			Clearly audible			Moderately intrusive			Highly intrusive					
		Affected distance (m)	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Affected distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Day	250							N	120	60	N	45	70	N, PC, RO	25	75	
	Day (OOHW)	365				N, R1, DR	250	50	N, R1, DR	120	60	N, R1, DR, PC, SN	45	70	N, PC, RO	25	75	
	Evening	525				N, R1, DR	365	45	N, R1, DR	175	55	N, R1, DR, PC, SN	75	65	N, PC, RO	25	75	
	Night	760	N	760	35	N, R2, DR	525	40	N, PC, SN, R2, DR	250	50	AA, N, PC, SN, R2, DR	120	60	N, PC, RO	25	75	175
	Highly Affected	25													N, PC, RO	25	75	
Developed settlements (urban and suburban)	Day	305							N	135	60	N	50	70	N, PC, RO	30	75	
	Day (OOHW)	460				N, R1, DR	305	50	N, R1, DR	135	60	N, R1, DR, PC, SN	50	70	N, PC, RO	30	75	
	Evening	690				N, R1, DR	460	45	N, R1, DR	200	55	N, R1, DR, PC, SN	85	65	N, PC, RO	30	75	
	Night	1010	N	1010	35	N, R2, DR	690	40	N, PC, SN, R2, DR	305	50	AA, N, PC, SN, R2, DR	135	60	N, PC, RO	30	75	200
	Highly Affected	30													N, PC, RO	30	75	
Propagation across a valley / over water	Day	405							N	160	60	N	60	70	N, PC, RO	35	75	
	Day (OOHW)	630				N, R1, DR	405	50	N, R1, DR	160	60	N, R1, DR, PC, SN	60	70	N, PC, RO	35	75	
	Evening	960				N, R1, DR	630	45	N, R1, DR	255	55	N, R1, DR, PC, SN	95	65	N, PC, RO	35	75	
	Night	1420	N	1420	35	N, R2, DR	960	40	N, PC, SN, R2, DR	405	50	AA, N, PC, SN, R2, DR	160	60	N, PC, RO	35	75	255
	Highly Affected	35													N, PC, RO	35	75	

Non-residential receiver
Undeveloped green fields, rural areas with isolated dwellings

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	175				N	75	65	N, PC, RO	25	75
Hospital wards and operating theatres	Day	65	75							N, PC, RO	25	75
Place of worship	Day	55	175				N	75	65	N, PC, RO	25	75
Active recreation	Day	65	75							N, PC, RO	25	75
Passive recreation	Day	60	120				N	45	70	N, PC, RO	25	75
Industrial premise	Day	75	25							N, PC, RO	25	75
Offices, retail outlets	Day	70	45							N, PC, RO	25	75

				$L_{Aeq(15minute)}$ noise level above NML											
	OOHW			< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	75				N, R1, DR	45	70	N, R1, DR	14	80	N, R1, DR, PC, SN	4	90
	Night	65	75	N	75	65	N, R2, NR	45	70	N, PC, SN, R2, DR	14	80	AA, N, PC, SN, R2, DR	4	90
Place of worship	Evening	55	175				N, R1, DR	120	60	N, R1, DR	45	70	N, R1, DR, PC, SN	14	80
	Night	55	175	N	175	55	N, R2, NR	120	60	N, PC, SN, R2, DR	45	70	AA, N, PC, SN, R2, DR	14	80
Active recreation	Evening	65	75				N, R1, DR	45	70	N, R1, DR	14	80	N, R1, DR, PC, SN	4	90
Passive recreation	Evening	60	120				N, R1, DR	75	65	N, R1, DR	25	75	N, R1, DR, PC, SN	8	85
Industrial premise	Evening	75	25				N, R1, DR	14	80	N, R1, DR	4	90	N, R1, DR, PC, SN	1	100
	Night	75	25	N	25	75	N, R2, NR	14	80	N, PC, SN, R2, DR	4	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	45				N, R1, DR	25	75	N, R1, DR	8	85	N, R1, DR, PC, SN	3	95
	Night	70	45	N	45	70	N, R2, NR	25	75	N, PC, SN, R2, DR	8	85	AA, N, PC, SN, R2, DR	3	95

Non-residential receiver
Developed settlements (urban and suburban)

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	200				N	85	65	N, PC, RO	30	75
Hospital wards and operating theatres	Day	65	85							N, PC, RO	30	75
Place of worship	Day	55	200				N	85	65	N, PC, RO	30	75
Active recreation	Day	65	85							N, PC, RO	30	75
Passive recreation	Day	60	135				N	50	70	N, PC, RO	30	75
Industrial premise	Day	75	30							N, PC, RO	30	75
Offices, retail outlets	Day	70	50							N, PC, RO	30	75

				$L_{Aeq(15minute)}$ noise level above NML											
	OOHW			< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	85				N, R1, DR	50	70	N, R1, DR	17	80	N, R1, DR, PC, SN	5	90
	Night	65	85	N	85	65	N, R2, NR	50	70	N, PC, SN, R2, DR	17	80	AA, N, PC, SN, R2, DR	5	90
Place of worship	Evening	55	200				N, R1, DR	135	60	N, R1, DR	50	70	N, R1, DR, PC, SN	17	80
	Night	55	200	N	200	55	N, R2, NR	135	60	N, PC, SN, R2, DR	50	70	AA, N, PC, SN, R2, DR	17	80
Active recreation	Evening	65	85				N, R1, DR	50	70	N, R1, DR	17	80	N, R1, DR, PC, SN	5	90
Passive recreation	Evening	60	135				N, R1, DR	85	65	N, R1, DR	30	75	N, R1, DR, PC, SN	9	85
Industrial premise	Evening	75	30				N, R1, DR	17	80	N, R1, DR	5	90	N, R1, DR, PC, SN	2	100
	Night	75	30	N	30	75	N, R2, NR	17	80	N, PC, SN, R2, DR	5	90	AA, N, PC, SN, R2, DR	2	100
Offices, retail outlets	Evening	70	50				N, R1, DR	30	75	N, R1, DR	9	85	N, R1, DR, PC, SN	3	95
	Night	70	50	N	50	70	N, R2, NR	30	75	N, PC, SN, R2, DR	9	85	AA, N, PC, SN, R2, DR	3	95

Transport for NSW

Distanced Based Assessment (Noisiest Plant)

Please pick from drop-down list in orange cells

Noise area category		R1
RBL or L_{A90} Background level (dB(A))	Day	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Mangement Level (dB(A))	Day	50
	Day (OOHW)	45
	Evening	40
	Night	35
Noisiest plant		Bored Piling Rig
Is there line of sight to receiver?		No (behind substantial solid barrier)

Steps for Assessment:

1. Schedule noisy works to occur in standard hours where possible or before 11pm and implement Standard Measures.
2. Select the representative noise area category. The worksheet titled 'Representative Noise Environ.' provides a number of examples to help select the noise area category.
3. Select the noisiest plant. If not found in drop-down list, refer to 'Source List' and select a representative plant with equivalent sound power level.
4. Is there line of sight to receiver? Select the appropriate scenario from the drop down list .

Identify and implement standard mitigation measures where feasible and reasonable. Include any shielding implemented as part of the standard mitigation measures by changing the selection in the 'Is there line of sightoiaw to receiver' drop-down list. Solid barriers can be in the form of road cutting, timber lapped and capped fence, shipping container, site office, etc. Substantial solid barriers are barriers greater than 5 metres in height or multiple rows of houses or a sound barrier specifically designed to mitigate construction noise. Please note that vegetation and trees are not considered to be a form of solid barrier and any gaps would compromise the acoustic integrity of the solid barrier.

5. Determine if there are any receivers (both residential and non-residential receivers) within the affected distance for each relevant time period . Consider background LA90 noise measurements to check assumption in Step #2 if:

(a) there are many affected receivers and the impact duration at any one receiver is more than 3 weeks; or

(b) there are a few affected receivers and the impact duration at any one receiver is more than 6 weeks.

Note that consideration need to be given to the construction staging plan when determining impact duration.

7. Identify if there are any receivers within the additional mitigation measures distances and identify feasible and reasonable measures at each receiver.
8. Where night works are involved, identify sleep disturbance affected distance.
9. Document the outcomes of these steps.

(Note that suitable noise management levels for other noise-sensitive businesses not identified in the Construction and Maintenance Noise Estimator should be investigated on a project-by-project basis. Please contact a Roads and Maritime noise speciliast for more information)

Abbreviation	Measure
N	Notification
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Residential receiver

			$L_{Aeq(15minute)}$ noise level above background (L_{A90})											$L_{Aeq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep disutrbance L_{Amax} 65 dB(A)
			5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)					
			Noticeable			Clearly audible			Moderately intrusive			Highly intrusive					
		Affected distance (m)	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Affected distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Day	120							N	45	60	N	20	70	N, PC, RO	15	75	
	Day (OOHW)	175				N, R1, DR	120	50	N, R1, DR	45	60	N, R1, DR, PC, SN	20	70	N, PC, RO	15	75	
	Evening	250				N, R1, DR	175	40	N, R1, DR	70	50	N, R1, DR, PC, SN	20	65	N, PC, RO	15	75	
	Night	365	N	365	35	N, R2, DR	250	40	N, PC, SN, R2, DR	120	50	AA, N, PC, SN, R2, DR	45	60	N, PC, RO	15	75	75
	Highly Affected	15													N, PC, RO	15	75	
Developed settlements (urban and suburban)	Day	135							N	50	60	N	20	70	N, PC, RO	15	75	
	Day (OOHW)	200				N, R1, DR	135	50	N, R1, DR	50	60	N, R1, DR, PC, SN	20	70	N, PC, RO	15	75	
	Evening	305				N, R1, DR	200	45	N, R1, DR	85	55	N, R1, DR, PC, SN	30	65	N, PC, RO	15	75	
	Night	460	N	460	35	N, R2, DR	305	40	N, PC, SN, R2, DR	135	50	AA, N, PC, SN, R2, DR	50	60	N, PC, RO	15	75	85
	Highly Affected	15													N, PC, RO	15	75	
Propagation across a valley / over water	Day	160							N	60	60	N	20	70	N, PC, RO	15	75	
	Day (OOHW)	255				N, R1, DR	160	50	N, R1, DR	60	60	N, R1, DR, PC, SN	20	70	N, PC, RO	15	75	
	Evening	405				N, R1, DR	255	45	N, R1, DR	95	55	N, R1, DR, PC, SN	35	65	N, PC, RO	15	75	
	Night	630	N	630	35	N, R2, DR	405	40	N, PC, SN, R2, DR	160	50	AA, N, PC, SN, R2, DR	60	60	N, PC, RO	15	75	95
	Highly Affected	15													N, PC, RO	15	75	

Non-residential receiver
Undeveloped green fields, rural areas with isolated dwellings

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	75				N	25	65	N, PC, RO	15	75
Hospital wards and operating theatres	Day	65	25							N, PC, RO	15	75
Place of worship	Day	55	75				N	25	65	N, PC, RO	15	75
Active recreation	Day	65	25							N, PC, RO	15	75
Passive recreation	Day	60	45				N	20	70	N, PC, RO	15	75
Industrial premise	Day	75	15							N, PC, RO	15	75
Offices, retail outlets	Day	70	20							N, PC, RO	15	75

				$L_{Aeq(15minute)}$ noise level above NML											
	OOHW			< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	25				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
	Night	65	25	N	25	65	N, R2, NR	20	70	N, PC, SN, R2, DR	8	80	AA, N, PC, SN, R2, DR	3	90
Place of worship	Evening	55	75				N, R1, DR	45	60	N, R1, DR	20	70	N, R1, DR, PC, SN	8	80
	Night	55	75	N	75	55	N, R2, NR	45	60	N, PC, SN, R2, DR	20	70	AA, N, PC, SN, R2, DR	8	80
Active recreation	Evening	65	25				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
Passive recreation	Evening	60	45				N, R1, DR	25	65	N, R1, DR	15	75	N, R1, DR, PC, SN	5	85
Industrial premise	Evening	75	15				N, R1, DR	8	80	N, R1, DR	3	90	N, R1, DR, PC, SN	1	100
	Night	75	15	N	15	75	N, R2, NR	8	80	N, PC, SN, R2, DR	3	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	20				N, R1, DR	15	75	N, R1, DR	5	85	N, R1, DR, PC, SN	2	95
	Night	70	20	N	20	70	N, R2, NR	15	75	N, PC, SN, R2, DR	5	85	AA, N, PC, SN, R2, DR	2	95

Non-residential receiver
Developed settlements (urban and suburban)

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	85				N	30	65	N, PC, RO	15	75
Hospital wards and operating theatres	Day	65	30							N, PC, RO	15	75
Place of worship	Day	55	85				N	30	65	N, PC, RO	15	75
Active recreation	Day	65	30							N, PC, RO	15	75
Passive recreation	Day	60	50				N	20	70	N, PC, RO	15	75
Industrial premise	Day	75	15							N, PC, RO	15	75
Offices, retail outlets	Day	70	20							N, PC, RO	15	75

				$L_{Aeq(15minute)}$ noise level above NML											
	OOHW			< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	30				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
	Night	65	30	N	30	65	N, R2, NR	20	70	N, PC, SN, R2, DR	8	80	AA, N, PC, SN, R2, DR	3	90
Place of worship	Evening	55	85				N, R1, DR	50	60	N, R1, DR	20	70	N, R1, DR, PC, SN	8	80
	Night	55	85	N	85	55	N, R2, NR	50	60	N, PC, SN, R2, DR	20	70	AA, N, PC, SN, R2, DR	8	80
Active recreation	Evening	65	30				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
Passive recreation	Evening	60	50				N, R1, DR	30	65	N, R1, DR	15	75	N, R1, DR, PC, SN	5	85
Industrial premise	Evening	75	15				N, R1, DR	8	80	N, R1, DR	3	90	N, R1, DR, PC, SN	1	100
	Night	75	15	N	15	75	N, R2, NR	8	80	N, PC, SN, R2, DR	3	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	20				N, R1, DR	15	75	N, R1, DR	5	85	N, R1, DR, PC, SN	2	95
	Night	70	20	N	20	70	N, R2, NR	15	75	N, PC, SN, R2, DR	5	85	AA, N, PC, SN, R2, DR	2	95

Transport for NSW

Distanced Based Assessment (Noisiest Plant)

Please pick from drop-down list in orange cells

Noise area category		R1
RBL or L_{A90} Background level (dB(A))	Day	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Mangement Level (dB(A))	Day	50
	Day (OOHW)	45
	Evening	40
	Night	35
Noisiest plant		13.5T Excavator
Is there line of sight to receiver?		Yes

Steps for Assessment:

1. Schedule noisy works to occur in standard hours where possible or before 11pm and implement Standard Measures.
2. Select the representative noise area category. The worksheet titled 'Representative Noise Environ.' provides a number of examples to help select the noise area category.
3. Select the noisiest plant. If not found in drop-down list, refer to 'Source List' and select a representative plant with equivalent sound power level.
4. Is there line of sight to receiver? Select the appropriate scenario from the drop down list .

Identify and implement standard mitigation measures where feasible and reasonable. Include any shielding implemented as part of the standard mitigation measures by changing the selection in the 'Is there line of sightoiaw to receiver' drop-down list. Solid barriers can be in the form of road cutting, timber lapped and capped fence, shipping container, site office, etc. Substantial solid barriers are barriers greater than 5 metres in height or multiple rows of houses or a sound barrier specifically designed to mitigate construction noise. Please note that vegetation and trees are not considered to be a form of solid barrier and any gaps would compromise the acoustic integrity of the solid barrier.

5. Determine if there are any receivers (both residential and non-residential receivers) within the affected distance for each relevant time period . Consider background LA90 noise measurements to check assumption in Step #2 if:

(a) there are many affected receivers and the impact duration at any one receiver is more than 3 weeks; or

(b) there are a few affected receivers and the impact duration at any one receiver is more than 6 weeks.

Note that consideration need to be given to the construction staging plan when determining impact duration.

7. Identify if there are any receivers within the additional mitigation measures distances and identify feasible and reasonable measures at each receiver.
8. Where night works are involved, identify sleep disturbance affected distance.
9. Document the outcomes of these steps.

(Note that suitable noise management levels for other noise-sensitive businesses not identified in the Construction and Maintenance Noise Estimator should be investigated on a project-by-project basis. Please contact a Roads and Maritime noise speciliast for more information)

Abbreviation	Measure
N	Notification
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Residential receiver

			$L_{Aeq(15minute)}$ noise level above background (L_{A90})											$L_{Aeq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep disutrbance L_{Amax} 65 dB(A)
			5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)					
			Noticeable			Clearly audible			Moderately intrusive			Highly intrusive					
		Affected distance (m)	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Affected distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Day	120							N	45	60	N	20	70	N, PC, RO	15	75	
	Day (OOHW)	175				N, R1, DR	120	50	N, R1, DR	45	60	N, R1, DR, PC, SN	20	70	N, PC, RO	15	75	
	Evening	250				N, R1, DR	175	45	N, R1, DR	75	55	N, R1, DR, PC, SN	25	65	N, PC, RO	15	75	
	Night	365	N	365	35	N, R2, DR	250	40	N, PC, SN, R2, DR	120	50	AA, N, PC, SN, R2, DR	45	60	N, PC, RO	15	75	75
	Highly Affected	15													N, PC, RO	15	75	
Developed settlements (urban and suburban)	Day	135							N	50	60	N	20	70	N, PC, RO	15	75	
	Day (OOHW)	200				N, R1, DR	135	50	N, R1, DR	50	60	N, R1, DR, PC, SN	20	70	N, PC, RO	15	75	
	Evening	305				N, R1, DR	200	45	N, R1, DR	85	55	N, R1, DR, PC, SN	30	65	N, PC, RO	15	75	
	Night	460	N	460	35	N, R2, DR	305	40	N, PC, SN, R2, DR	135	50	AA, N, PC, SN, R2, DR	50	60	N, PC, RO	15	75	85
	Highly Affected	15													N, PC, RO	15	75	
Propagation across a valley / over water	Day	160							N	60	60	N	20	70	N, PC, RO	15	75	
	Day (OOHW)	255				N, R1, DR	160	50	N, R1, DR	60	60	N, R1, DR, PC, SN	20	70	N, PC, RO	15	75	
	Evening	405				N, R1, DR	255	45	N, R1, DR	95	55	N, R1, DR, PC, SN	35	65	N, PC, RO	15	75	
	Night	630	N	630	35	N, R2, DR	405	40	N, PC, SN, R2, DR	160	50	AA, N, PC, SN, R2, DR	60	60	N, PC, RO	15	75	95
	Highly Affected	15													N, PC, RO	15	75	

Non-residential receiver
Undeveloped green fields, rural areas with isolated dwellings

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	75				N	25	65	N, PC, RO	15	75
Hospital wards and operating theatres	Day	65	25							N, PC, RO	15	75
Place of worship	Day	55	75				N	25	65	N, PC, RO	15	75
Active recreation	Day	65	25							N, PC, RO	15	75
Passive recreation	Day	60	45				N	20	70	N, PC, RO	15	75
Industrial premise	Day	75	15							N, PC, RO	15	75
Offices, retail outlets	Day	70	20							N, PC, RO	15	75

			$L_{Aeq(15minute)}$ noise level above NML											
	OOHW		< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	25				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
	Night	65	25	N	25	65	N, R2, NR	20	70	N, PC, SN, R2, DR	8	80	AA, N, PC, SN, R2, DR	3	90
Place of worship	Evening	55	75				N, R1, DR	45	60	N, R1, DR	20	70	N, R1, DR, PC, SN	8	80
	Night	55	75	N	75	55	N, R2, NR	45	60	N, PC, SN, R2, DR	20	70	AA, N, PC, SN, R2, DR	8	80
Active recreation	Evening	65	25				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
Passive recreation	Evening	60	45				N, R1, DR	25	65	N, R1, DR	15	75	N, R1, DR, PC, SN	5	85
Industrial premise	Evening	75	15				N, R1, DR	8	80	N, R1, DR	3	90	N, R1, DR, PC, SN	1	100
	Night	75	15	N	15	75	N, R2, NR	8	80	N, PC, SN, R2, DR	3	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	20				N, R1, DR	15	75	N, R1, DR	5	85	N, R1, DR, PC, SN	2	95
	Night	70	20	N	20	70	N, R2, NR	15	75	N, PC, SN, R2, DR	5	85	AA, N, PC, SN, R2, DR	2	95

Non-residential receiver
Developed settlements (urban and suburban)

			$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
	Standard hours		<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	85				N	30	65	N, PC, RO	15	75
Hospital wards and operating theatres	Day	65	30							N, PC, RO	15	75
Place of worship	Day	55	85				N	30	65	N, PC, RO	15	75
Active recreation	Day	65	30							N, PC, RO	15	75
Passive recreation	Day	60	50				N	20	70	N, PC, RO	15	75
Industrial premise	Day	75	15							N, PC, RO	15	75
Offices, retail outlets	Day	70	20							N, PC, RO	15	75

			$L_{Aeq(15minute)}$ noise level above NML											
	OOHW		< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	30				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
	Night	65	30	N	30	65	N, R2, NR	20	70	N, PC, SN, R2, DR	8	80	AA, N, PC, SN, R2, DR	3	90
Place of worship	Evening	55	85				N, R1, DR	50	60	N, R1, DR	20	70	N, R1, DR, PC, SN	8	80
	Night	55	85	N	85	55	N, R2, NR	50	60	N, PC, SN, R2, DR	20	70	AA, N, PC, SN, R2, DR	8	80
Active recreation	Evening	65	30				N, R1, DR	20	70	N, R1, DR	8	80	N, R1, DR, PC, SN	3	90
Passive recreation	Evening	60	50				N, R1, DR	30	65	N, R1, DR	15	75	N, R1, DR, PC, SN	5	85
Industrial premise	Evening	75	15				N, R1, DR	8	80	N, R1, DR	3	90	N, R1, DR, PC, SN	1	100
	Night	75	15	N	15	75	N, R2, NR	8	80	N, PC, SN, R2, DR	3	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	20				N, R1, DR	15	75	N, R1, DR	5	85	N, R1, DR, PC, SN	2	95
	Night	70	20	N	20	70	N, R2, NR	15	75	N, PC, SN, R2, DR	5	85	AA, N, PC, SN, R2, DR	2	95

Transport for NSW

Distanced Based Assessment (Noisiest Plant)

Steps for Assessment:

1. Schedule noisy works to occur in standard hours where possible or before 11pm and implement Standard Measures.
2. Select the representative noise area category. The worksheet titled 'Representative Noise Environ.' provides a number of examples to help select the noise area category.
3. Select the noisiest plant. If not found in drop-down list, refer to 'Source List' and select a representative plant with equivalent sound power level.
4. Is there line of sight to receiver? Select the appropriate scenario from the drop down list .

Identify and implement standard mitigation measures where feasible and reasonable. Include any shielding implemented as part of the standard mitigation measures by changing the selection in the 'Is there line of sightoiaw to receiver' drop-down list. Solid barriers can be in the form of road cutting, timber lapped and capped fence, shipping container, site office, etc. Substantial solid barriers are barriers greater than 5 metres in height or multiple rows of houses or a sound barrier specifically designed to mitigate construction noise. Please note that vegetation and trees are not considered to be a form of solid barrier and any gaps would compromise the acoustic integrity of the solid barrier.

5. Determine if there are any receivers (both residential and non-residential receivers) within the affected distance for each relevant time period . Consider background LA90 noise measurements to check assumption in Step #2 if:

(a) there are many affected receivers and the impact duration at any one receiver is more than 3 weeks; or

(b) there are a few affected receivers and the impact duration at any one receiver is more than 6 weeks.

Note that consideration need to be given to the construction staging plan when determining impact duration.

7. Identify if there are any receivers within the additional mitigation measures distances and identify feasible and reasonable measures at each receiver.
8. Where night works are involved, identify sleep disturbance affected distance.
9. Document the outcomes of these steps.

(Note that suitable noise management levels for other noise-sensitive businesses not identified in the Construction and Maintenance Noise Estimator should be investigated on a project-by-project basis. Please contact a Roads and Maritime noise speciliast for more information)

Abbreviation	Measure
N	Notification
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Please pick from drop-down list in orange cells

Noise area category		R1
RBL or L_{A90} Background level (dB(A))	Day	40
	Evening	35
	Night	30
$L_{Aeq(15minute)}$ Noise Mangement Level (dB(A))	Day	50
	Day (OOHW)	45
	Evening	40
	Night	35
Noisiest plant		Microdrilling Rig (Soilmec SM-5)
Is there line of sight to receiver?		Yes

Residential receiver

			$L_{Aeq(15minute)}$ noise level above background (L_{A90})											$L_{Aeq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep disutrbance L_{Amax} 65 dB(A)
			5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)					
			Noticeable			Clearly audible			Moderately intrusive			Highly intrusive					
		Affected distance (m)	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Affected distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Day	270							N	130	60	N	50	70	N, PC, RO	30	75	
	Day (OOHW)	390				N, R1, DR	270	50	N, R1, DR	130	60	N, R1, DR, PC, SN	50	70	N, PC, RO	30	75	
	Evening	565				N, R1, DR	390	45	N, R1, DR	185	55	N, R1, DR, PC, SN	85	65	N, PC, RO	30	75	
	Night	815	N	815	35	N, R2, DR	565	40	N, PC, SN, R2, DR	270	50	AA, N, PC, SN, R2, DR	130	60	N, PC, RO	30	75	120
	Highly Affected	30													N, PC, RO	30	75	
Developed settlements (urban and suburban)	Day	335							N	145	60	N	55	70	N, PC, RO	35	75	
	Day (OOHW)	500				N, R1, DR	335	50	N, R1, DR	145	60	N, R1, DR, PC, SN	55	70	N, PC, RO	35	75	
	Evening	745				N, R1, DR	500	45	N, R1, DR	220	55	N, R1, DR, PC, SN	95	65	N, PC, RO	35	75	
	Night	1090	N	1090	35	N, R2, DR	745	40	N, PC, SN, R2, DR	335	50	AA, N, PC, SN, R2, DR	145	60	N, PC, RO	35	75	135
	Highly Affected	35													N, PC, RO	35	75	
Propagation across a valley / over water	Day	445							N	175	60	N	65	70	N, PC, RO	40	75	
	Day (OOHW)	690				N, R1, DR	445	50	N, R1, DR	175	60	N, R1, DR, PC, SN	65	70	N, PC, RO	40	75	
	Evening	1040				N, R1, DR	690	45	N, R1, DR	280	55	N, R1, DR, PC, SN	105	65	N, PC, RO	40	75	
	Night	1530	N	1530	35	N, R2, DR	1040	40	N, PC, SN, R2, DR	445	50	AA, N, PC, SN, R2, DR	175	60	N, PC, RO	40	75	160
	Highly Affected	40													N, PC, RO	40	75	

Non-residential receiver
Undeveloped green fields, rural areas with isolated dwellings

		Standard hours		$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
				<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	185				N	85	65	N, PC, RO	30	75
Hospital wards and operating theatres	Day	65	85							N, PC, RO	30	75
Place of worship	Day	55	185				N	85	65	N, PC, RO	30	75
Active recreation	Day	65	85							N, PC, RO	30	75
Passive recreation	Day	60	130				N	50	70	N, PC, RO	30	75
Industrial premise	Day	75	30							N, PC, RO	30	75
Offices, retail outlets	Day	70	50							N, PC, RO	30	75

		OOHW		$L_{Aeq(15minute)}$ noise level above NML											
				< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	85				N, R1, DR	50	70	N, R1, DR	17	80	N, R1, DR, PC, SN	5	90
	Night	65	85	N	85	65	N, R2, NR	50	70	N, PC, SN, R2, DR	17	80	AA, N, PC, SN, R2, DR	5	90
Place of worship	Evening	55	185				N, R1, DR	130	60	N, R1, DR	50	70	N, R1, DR, PC, SN	17	80
	Night	55	185	N	185	55	N, R2, NR	130	60	N, PC, SN, R2, DR	50	70	AA, N, PC, SN, R2, DR	17	80
Active recreation	Evening	65	85				N, R1, DR	50	70	N, R1, DR	17	80	N, R1, DR, PC, SN	5	90
Passive recreation	Evening	60	130				N, R1, DR	85	65	N, R1, DR	30	75	N, R1, DR, PC, SN	9	85
Industrial premise	Evening	75	30				N, R1, DR	17	80	N, R1, DR	5	90	N, R1, DR, PC, SN	2	100
	Night	75	30	N	30	75	N, R2, NR	17	80	N, PC, SN, R2, DR	5	90	AA, N, PC, SN, R2, DR	2	100
Offices, retail outlets	Evening	70	50				N, R1, DR	30	75	N, R1, DR	9	85	N, R1, DR, PC, SN	3	95
	Night	70	50	N	50	70	N, R2, NR	30	75	N, PC, SN, R2, DR	9	85	AA, N, PC, SN, R2, DR	3	95

Non-residential receiver
Developed settlements (urban and suburban)

		Standard hours		$L_{Aeq(15minute)}$ noise level above NML						LAeq(15minute) 75 dB(A) or greater (Highly affected)		
				<10 dB(A)			10 to 20 dB(A)					
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	220				N	95	65	N, PC, RO	35	75
Hospital wards and operating theatres	Day	65	95							N, PC, RO	35	75
Place of worship	Day	55	220				N	95	65	N, PC, RO	35	75
Active recreation	Day	65	95							N, PC, RO	35	75
Passive recreation	Day	60	145				N	55	70	N, PC, RO	35	75
Industrial premise	Day	75	35							N, PC, RO	35	75
Offices, retail outlets	Day	70	55							N, PC, RO	35	75

		OOHW		$L_{Aeq(15minute)}$ noise level above NML											
				< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	95				N, R1, DR	55	70	N, R1, DR	20	80	N, R1, DR, PC, SN	6	90
	Night	65	95	N	95	65	N, R2, NR	55	70	N, PC, SN, R2, DR	20	80	AA, N, PC, SN, R2, DR	6	90
Place of worship	Evening	55	220				N, R1, DR	145	60	N, R1, DR	55	70	N, R1, DR, PC, SN	20	80
	Night	55	220	N	220	55	N, R2, NR	145	60	N, PC, SN, R2, DR	55	70	AA, N, PC, SN, R2, DR	20	80
Active recreation	Evening	65	95				N, R1, DR	55	70	N, R1, DR	20	80	N, R1, DR, PC, SN	6	90
Passive recreation	Evening	60	145				N, R1, DR	95	65	N, R1, DR	35	75	N, R1, DR, PC, SN	11	85
Industrial premise	Evening	75	35				N, R1, DR	20	80	N, R1, DR	6	90	N, R1, DR, PC, SN	2	100
	Night	75	35	N	35	75	N, R2, NR	20	80	N, PC, SN, R2, DR	6	90	AA, N, PC, SN, R2, DR	2	100
Offices, retail outlets	Evening	70	55				N, R1, DR	35	75	N, R1, DR	11	85	N, R1, DR, PC, SN	4	95
	Night	70	55	N	55	70	N, R2, NR	35	75	N, PC, SN, R2, DR	11	85	AA, N, PC, SN, R2, DR	4	95

Appendix I Operational Noise Impact Assessment

DRAFT

Appendix J Aboriginal Objects Due Diligence Assessment

DRAFT

20 January 2024

Rachel Gray
Senior Environmental Consultant
JBS&G
Level 1, 50 Margaret Street, Sydney, NSW
rgray@jbsg.com.au

Dear Rachel,

Re: Aboriginal Heritage Due Diligence Report – Menangle Park Zone Substation and Feeder 85U

Artefact Heritage and Environment Pty Ltd (Artefact Heritage) have been engaged by JBS&G to prepare an Aboriginal Heritage Due Diligence Report for the Menangle Park Zone Substation and Feeder 85U.

This report outlines the results of an Aboriginal Heritage Due Diligence which meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (Department of Environment, Climate Change and Water [DECCW] 2010a), hereafter the Due Diligence Code of Practice, and includes recommendations as to whether further archaeological investigation may be required.

This report has been prepared by Rebecca Bryant (Senior Heritage Consultant, Artefact) with contributions from Amanda Bie Wojcik (Graduate Heritage Consultant, Artefact), and management input and review provided by Jayden van Beek (Technical Specialist, Artefact).

If you have any queries regarding this due diligence, please do not hesitate to contact me.

Yours Sincerely,

Rebecca Bryant
Senior Heritage Consultant
Artefact Heritage
rebecca.bryant@artefact.net.au
0405 236 821

DRAFT

1.0 INTRODUCTION

The *National Parks & Wildlife Act 1974* (the NPW Act) provides statutory protection for all 'Aboriginal objects' and 'Aboriginal Places' in NSW whereby it is an offence to damage, deface or destroy Aboriginal objects or places. The NPW Act defines an Aboriginal 'object' as:

> *any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises New South Wales, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal European extraction, and includes Aboriginal remains.*

An 'Aboriginal place' is a place gazetted by the Minister, under the Section 84 of the NPW Act:

> *The Minister may, by order published in the Gazette, declare any place specified or described in the order, being a place that, in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture, to be an Aboriginal place for the purposes of this Act.*

Section 87(1) of the NPW Act provides that it is a defence to these provisions if the harm is authorised by an Aboriginal Heritage Impact Permit (AHIP). Section 87(2) of the NPW Act provides that:

> *It is a defence to a prosecution for an offence under section 86 (2) if the defendant shows that 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.*

Undertaking Due Diligence does not constitute consent to harm Aboriginal objects, nor are they a 'site clearance' mechanism to allow activities to occur in an area where Aboriginal objects are likely or known to be present. Consultation with the Aboriginal community is not a formal requirement of the Due Diligence process, however, consideration of undertaking some form of consultation should occur, particularly if it will assist in informing any decision-making. If an AHIP will be required, consultation must be undertaken in accordance with the requirements of Section 60 of the *National Parks and Wildlife Regulation 2019*, as described in the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010b).

The completion of Due Diligence should only occur in situations where it is appropriate and applicable to do so by following the flowchart on Page 1 of the Due Diligence Code of Practice. It has been determined that it is appropriate to undertake a Due Diligence for these proposed works, as shown in Table 1.

Table 1: Determination of the suitability of employing a Due Diligence process for this activity

Question		Answer
1.	Is the activity considered a Major Project under Part 4, Division 4.7 or Part 5, Division 5.2 of the EP&A Act?	No

Question		Answer
2.	Is the activity exempt from the National Parks and Wildlife Act 1974 or Regulation 2019?	No
3.	Will the activity involve harm that is trivial or negligible	No
4.	Is the activity in an Aboriginal Place or there are known Aboriginal objects in the project area	No
5.	Is the activity a low impact activity in accordance with the National Parks and Wildlife Regulation 2019?	No
6.	Do you want to follow an industry specific Code of Practice	No
7.	Follow the Due Diligence Code of Practice	Yes

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2.0 PROJECT INFORMATION

2.1 Project background

Artefact Heritage have been engaged by JBS&G to prepare an Aboriginal Heritage Due Diligence Report (Due Diligence Report) prior to proposed works. A Due Diligence Report was requested to determine if the proposed works will impact the registered Aboriginal sites within the footprint of proposed works and buffer zone, and whether there is potential for other Aboriginal objects to be present within this area, hereinafter referred as the study area.

2.2 Description of the study area

The study area is located within Menangle Park, Menangle, NSW. The southern portion includes the existing electricity substation wholly within the area legally defined as Lot 2013 DP1234643. The study area then extends through a corridor of undulating land in a northwest direction crossing through portions of Lot 41 DP1285744, Lot 2012 DP1234643, Lot 2008 D1234643, Lot 4 DP628052, Lot 32 DP1105615, and Lot 31 DP1105615 (Figure 1). The study area is within the City of Campbelltown Local Government Area and Tharawal Local Aboriginal Land Council (TLAC). The Nepean River is located between approximately 1 km and 2.2 km west of the study area and is feed by numerous creeks and tributaries. Two of which cross through the study area. Howes Creek crosses through a southern portion of the study area, and a minor tributary is within the northern portion of the study area.

2.3 Proposed works

The proposed works would include the removal of the temporary 66/11kV mobile substation at the Menangle Park Zone Substation within the southern section of the study area and construction of a new permanent 66/11kV 35 MVA substation. The new substation will be supplied by two 66Kv feeders; the existing feeder 85P, and a new feeder 85U from Macarthur Bulk Supply Point at the northeast end of the study area (Figure 2). Installation of the new feeder would involve a combination of mechanical trench excavation and underboring of an approximately 100m-long section underneath Howes Creek at the south end of the study area.

The new substation will enhance the supply security and reliability of new infrastructure developments in the Menangle Park region by providing a diversified 33kV supply and associated fibre optic network.

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Figure 1: Study Area

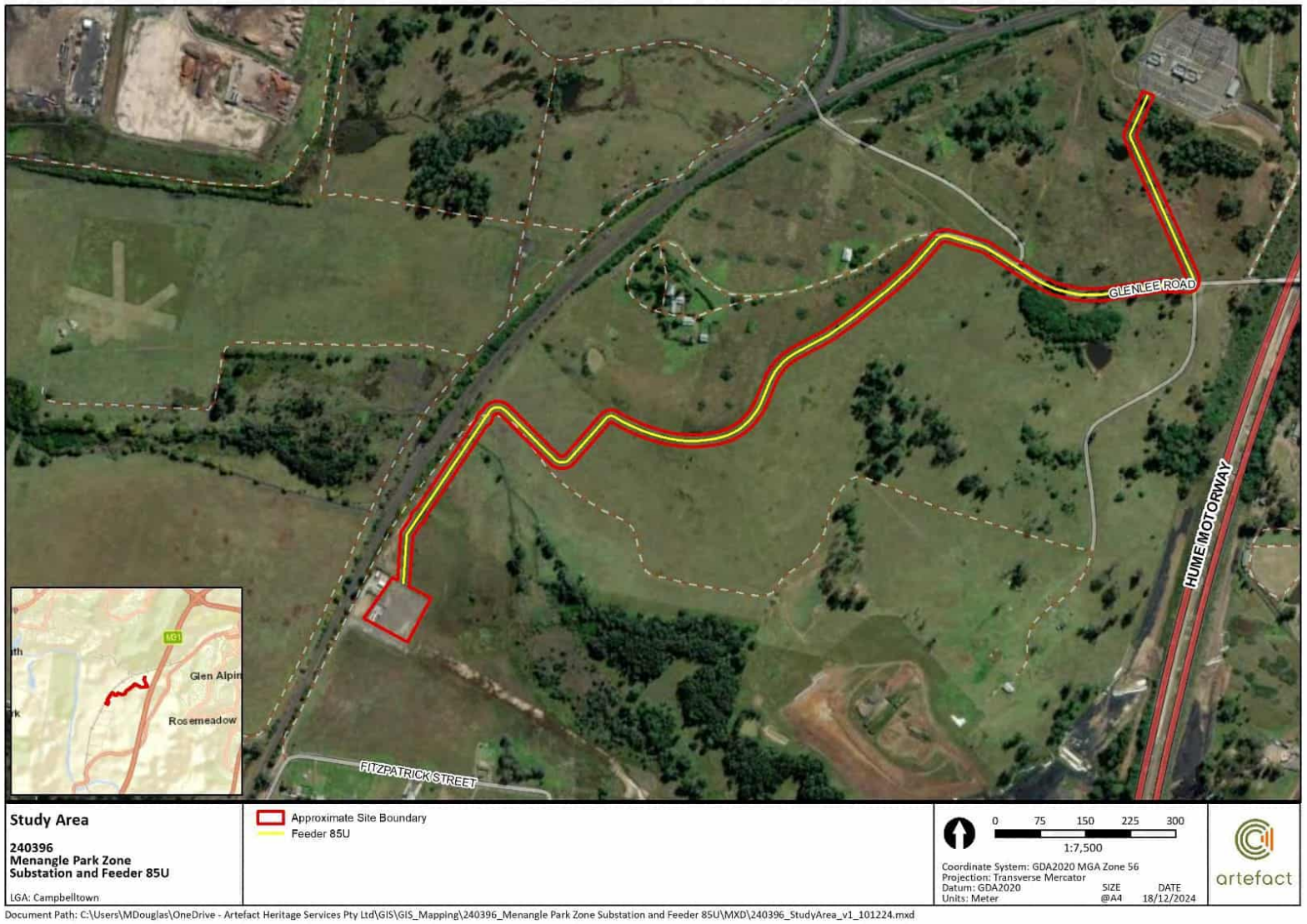
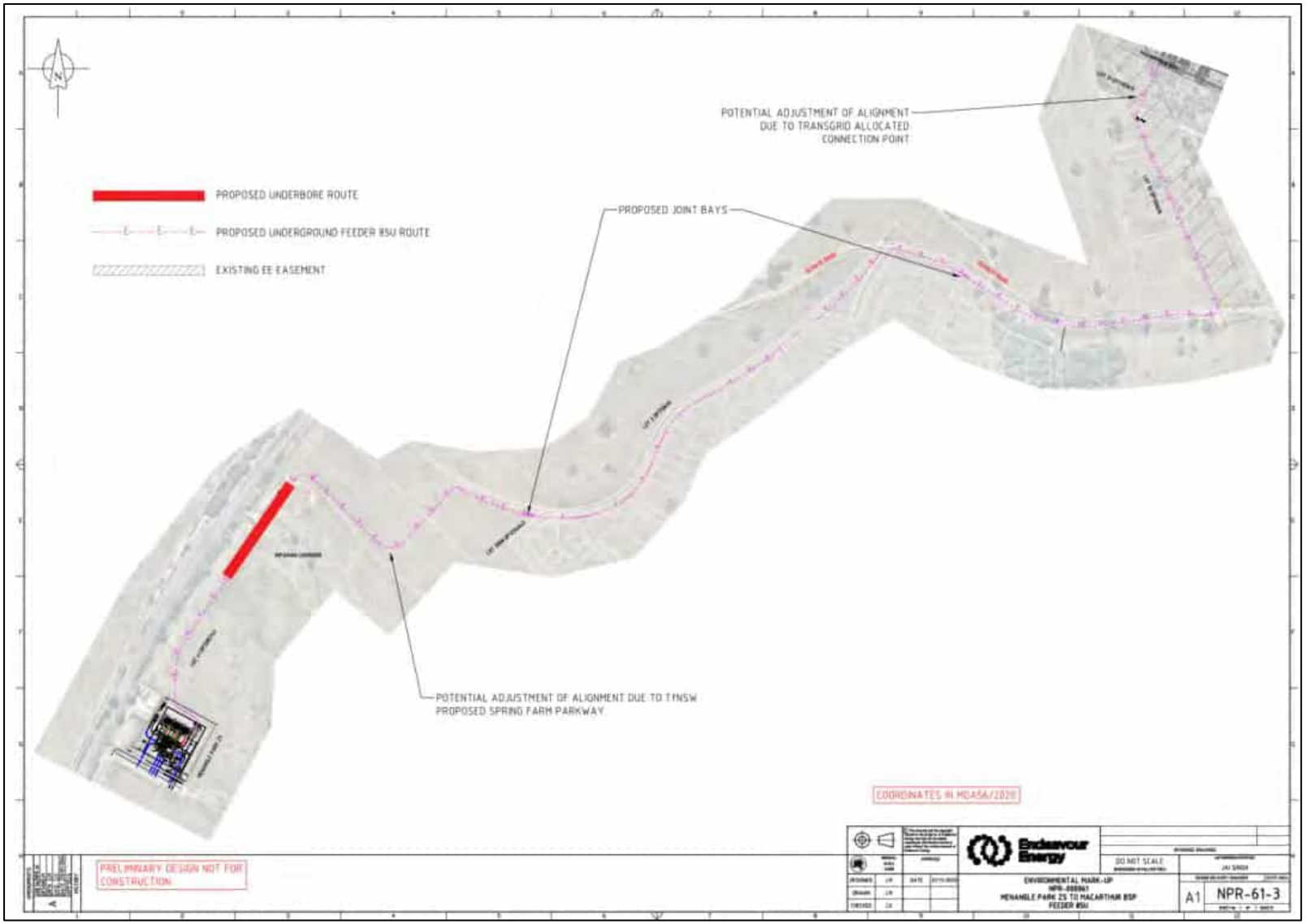


Figure 2: Preliminary design for proposed works



3.0 BACKGROUND

3.1 Aboriginal Heritage Information Management System (AHIMS) search

NOTE: The location of Aboriginal sites is considered culturally sensitive information. It is advised that this information, including the AHIMS data appearing on the heritage map for the proposal be removed from this report if it is to enter the public domain.

A search of the Aboriginal Heritage Information Management System (AHIMS) database (Client ID 955632) was completed on 29 November 2024 for a search area measuring approximately 4 km x 4 km centred on the study area (Figure 3). The parameters of this search were:

GDA 1994 MGA 56	291590 – 295590 m E 6223765 – 6227765 m N
Buffer	0 m
Number of sites	82
Client Service ID	955632

There are 82 sites recorded on AHIMs.' however two are listed as 'not a site'. The site status for the other sites listed one as 'deleted', two were listed as 'partially destroyed', twelve were listed as 'destroyed', and the remaining sixty-five as 'valid'. The AHIMS database also records sites using a list of twenty standard site features (OEH, 2012). The majority of registered sites within the search area are 'Artefact' which can be isolated stone artefacts, or stone artefact scatters. There are 77 sites with this feature which accounts for 94% of all sites. There are also three instances of 'Artefact, Potential Archaeological Deposit (PAD)', one instance of 'PAD', and one instance of 'Modified Tree', which could be culturally engraved or carved tree. These are summarised in Table 2.

There are two registered Aboriginal sites within the study area (Figure 4), AHIMS ID 52-2-4529 and AHIMS ID 52-2-4497. They are 'Artefact' sites, and are now listed as 'destroyed' on the AHIMS database, and both were impacted under a now-expired Aboriginal Heritage Impact Permits (AHIPs). There are four other registered sites within the 100 m of the study area. Two of these, AHIMS ID 52-2-4069 and AHIMS ID 52-2 45-26, are listed as 'destroyed'. The other two sites, AHIMS ID 52-2-4396 and AHIMS ID 52-2-3918, are listed as valid. AHIMS ID 52-2-4396 is approximately 5 m west of the proposed new substation and is an artefact reburial site. The other site, AHIMS ID 52-2-3918, is an artefact scatter and is mapped as being approximately 55 m to the south of the study area. A summary of sites within the study area and in close proximity is listed in Table 3.

In general, the majority of the AHIMS sites mapped within the extensive area are within close proximity to a water course (Figure 3), which would have been a necessary resource for past Aboriginal populations. The sites mapped as being within the study area, or in close proximity to it, are concentrated in the southern portion of the study area and within 100 m of the temporary substation (Figure 4). They are either isolated stone artefacts or stone artefact scatters, no PADs or modified trees are within, or in close proximity to the study area, and none were recorded with associated PAD. As mentioned in the previous paragraph, there are also a number of existing or expired AHIPS that include portions of the study area. The status of these AHIPs in relation to AHIMS sites within and near the study area are listed in Table 2 and shown in Figure 5 below.

Table 2: Frequency of site features in AHIMS search results

Site Types	Frequency	Percentage
Artefact	77	94%
Artefact, Potential Archaeological Deposit (PAD)	3	4%
Potential Archaeological Deposit (PAD)	1	1%
Modified Tree	1	1%
Total	**82**	**100%**

Table 3: Site Status of AHIMS sites within study area or in close proximity, and any known AHIPs.

AHIMS ID	Description	Distance from study area	Site Status	Existing AHIP	Expiration of AHIP
52-2-4529	Menangle Park Substation Artefact Scatter MPS AS 01. Site Status is 'destroyed'	Within study area	Destroyed	C0005561	Endeavor Energy expiration 21/01/2022
52-2-4396	MP - Reburial - 2017 (AHIMS ID 52-2-4396) Artefact reburial site comprising artefacts retrieved from test excavations adjacent to Howes Creek	5 m	Valid	None	N/A
52-2-4069	MPSW-AS1-13 (AHIMS ID 52-2-4069) comprised six silcrete and two tuff artefacts identified during test excavation related to the Sydney Water pipeline. The site was identified within an upper terrace adjacent to the south bank of Howes Creek. Artefacts were recovered over a 170 m transect.	80 m	Destroyed	C0000393	Sydney Water expiration 1/7/2029
52-2-4526	MPF AS 01. Open artefact scatter recorded on a raised, artificial embankment created by works adjacent to the Main Southern Railway. Two silcrete flakes were identified in a disturbed exposure: one proximal flake fragment and one distal flake fragment.	5 m	Destroyed	C0000393	Sydney Water expiration 1/7/2029

AHIMS ID	Description	Distance from study area	Site Status	Existing AHIP	Expiration of AHIP
52-2-4497	Menangle Park Feeder Isolated Find 01 (MPFIF 01) located on a raised artificial embankment created following works by Sydney Water. Surface visibility across the site was high due to the recent excavation works by Sydney Water. The site contains one backed medial flake fragment. The artefact comprised red silcrete and measures 19 mm long x 14 mm wide x 4 mm deep. The site is considered to be in a highly disturbed context. No further archaeological potential has been identified in association with this site.	Within study area	Destroyed	C0005561	Endeavor Energy expiration 21/01/2022
52-2-3918	Artefact scatter	55 m	Valid	TBA	KNC 2022 states an AHIP to be sought
52-2-3919	Isolated stone artefact located on edge of a small farm dam along a first order stream north of Glenlee Road. Site was disturbed by dam construction and ongoing sheet erosion Archaeological potential was considered low due to disturbance. Archaeological testing in the vicinity did not recover any further artefacts.	90 m	Valid	None	N/A

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Figure 3: AHIMS extensive search

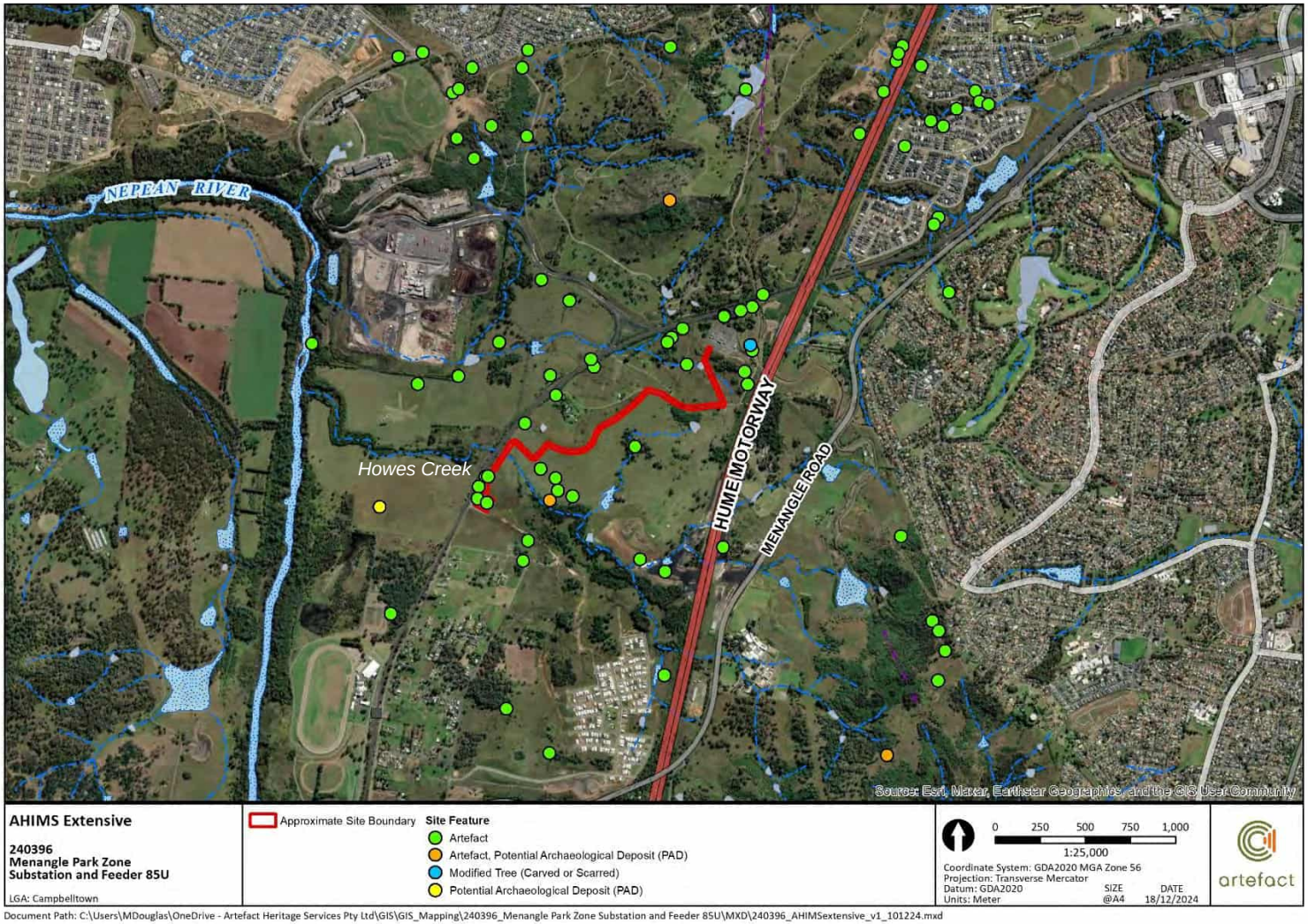


Figure 4: AHIMS detailed search

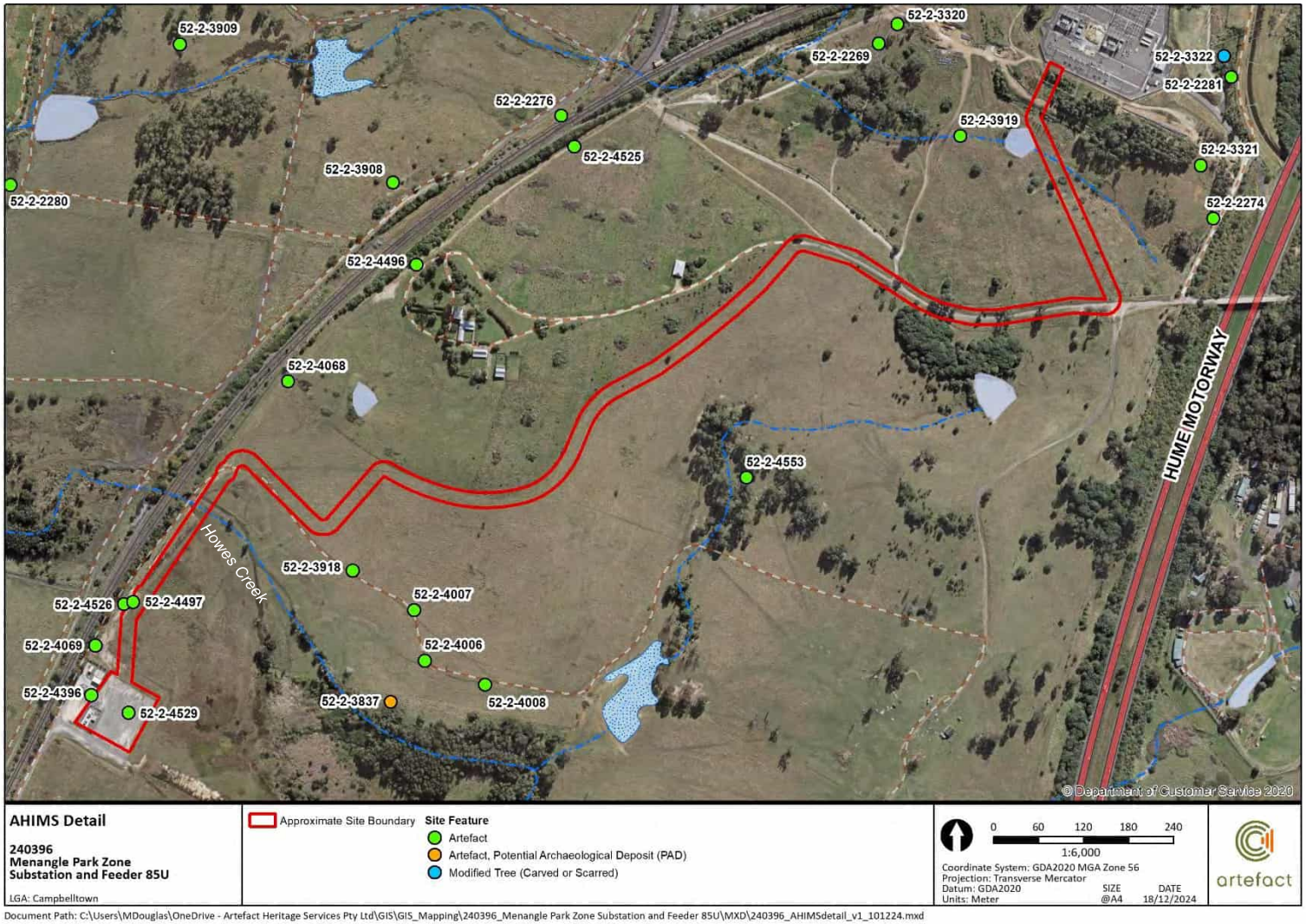
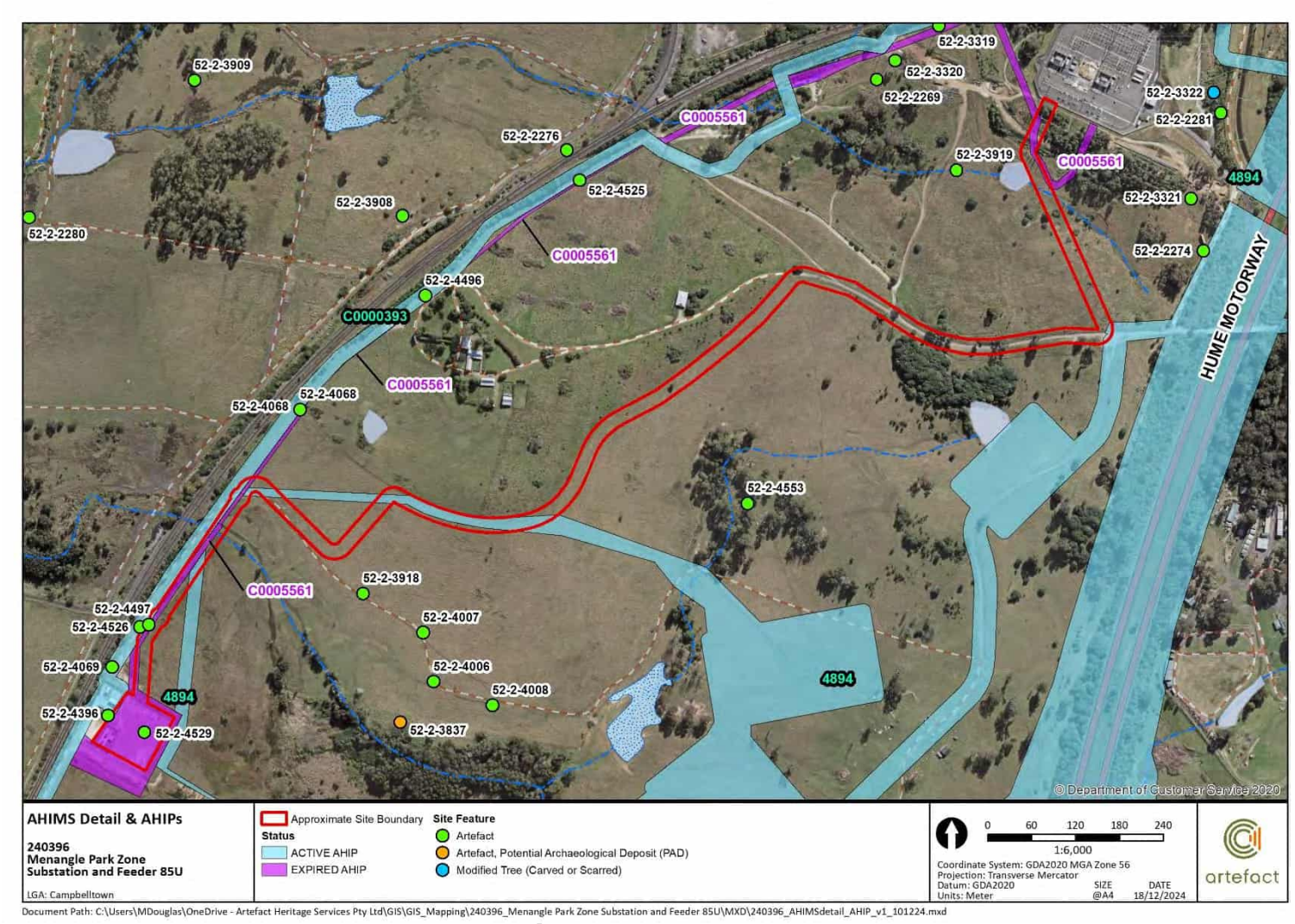


Figure 5: Study area in relation to AHIMS detailed search and active/expired AHIPs



3.2 Relevant previous investigations

A number of archaeological investigations have been completed in the vicinity of the study area. These have generally been associated with the development of infrastructure and urban release projects, including the Menangle Park Urban Release Area. The following discussion presents a review of the most recent and relevant studies and aims to provide contextual information for the current study.

Jo McDonald CHM 2009, Test excavation and archaeological assessment of proposed soil and sand extraction on Aboriginal PAD (AHIMS ID 52-2-3676), Menangle Park West

Jo McDonald CHM undertook test excavations within Menangle Park West, approximately 520 m west of the current study area in an area proposed for sand extraction. Test excavation focused on sandy deposits within 200 m of Howes Creek, which was assessed as containing good archaeological potential. During test excavations Aboriginal stone artefacts were recovered from 13 of the 24 machine dug test pits (1.2 m x 0.8 m) and from each of three additional pits that were excavated around areas with highest artefact density. A total of 168 Aboriginal artefacts were recovered during the project. The primary area of artefact density was within a sand layer approximately 700 m from the Nepean River and within 200 m of Howes Creek. The majority of pits with no archaeological deposit were associated with a deep, brown loamy deposit in the lower portions of the study area bordering the Nepean River. This contrasted with a higher proportion of artefact bearing pits associated with pale, sandy deposits on the north and west facing slopes of a low rise in the southeast corner of the test excavation area. The highest concentration of artefacts was retrieved from a lower slope area overlooking the 4th order tributary and below the 1:100 year flood level. Consistently low densities of artefacts were retrieved from the crest landform above the 1:100 year flood level. Analysis identified nature of the soil deposit, distance from Howes Creek and elevation all influenced the distribution of artefacts across the study area.

Jo McDonald CHM 2010, Archaeological assessment of Indigenous heritage issues, Menangle Park draft structure plan

Jo McDonald completed an archaeological assessment of potential heritage values of the Menangle park precinct in 2009. Assessment included the southern portion of the current study area. The report completed a sensitivity assessment based on the level of identified disturbance within the study area. Mapping was subsequently used to infer archaeological potential. A number of areas of potential were identified based on this however the report did not delineate these into specific areas of PAD.

Consultation with the local Aboriginal community also identified several areas of cultural significance including the Nepean River and the banks of Howes Creek

Niche 2013, Archaeological Report, Menangle Park Subdivision and Infrastructure Project:

Test excavation was undertaken along six transects within the Niche assessment area to test a range of environmental and cultural factors including soil landscape, distance to water, landform and disturbance history.

Transect three was located parallel to Howes Creek. Excavation along this transect recovered 29 artefacts with objects recovered from a depth of 25 cm – 95 cm. Excavation included the recovery of a grinding dish and grinding stone with ochre residue. The test pit within the current study area contained one artefact. Test pits in the immediate vicinity of the current study area contained between one and five artefacts per test pit. Following test excavation, the archaeological and cultural sensitivity of the assessment area was revised, with the current study area including areas

delineated as demonstrating moderate archaeological sensitivity and significance (Zone 3), and areas of low potential for intact archaeology (Zone 5).

Further management of the areas subject to testing was proposed based on the identified zones of sensitivity. Proposed management of Zone 3 was limited to collection of stone artefacts from registered surface sites. No further archaeological management was recommended for Zone 5.

The results of test excavation were not registered on AHIMS during completion of the Niche assessment. To enable the portion of Zone 3 area to be managed by a subsequent assessment undertaken by Artefact Heritage 2019 (discussed below), the portion of Zone 3, which is within the current study area, was registered as Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01) (AHIMS ID 52-2-4529) by Artefact Heritage. The site was registered as a low-density artefact scatter based on the results of test excavation completed by Niche and the supplementary results obtained from adjacent test excavation completed by AECOM and Aurecon Joint Venture (AAJV).

AECOM and Aurecon joint venture (AAJV) 2014, Menangle Park Wastewater Services: technical report

AAJV conducted a survey and test excavation within the proposed Menangle Park wastewater service easement directly adjacent to the current study area. The survey identified two areas of substantial disturbance extending into the current study area. An area of high disturbance associated with the Howe's Creek flood plain and an area of moderate disturbance associated with the clearance of olive groves within the Glenlee estate.

Test excavation was undertaken in two areas across that are within the current study area, including the land surrounding Howe's Creek and land surrounding the unnamed second order tributary in the northern portion of the study area.

A total of 42 test pits were excavated across the two excavation areas. Artefacts were recovered in five test pits. The majority of artefact bearing deposits were located within an upper terrace, lower slope of Howes Creek. MPSW-AS1-13 (AHIMS ID 52-2-4069) is located immediately west of the proposed Menangle Park Zone Substation. The site extent was assessed as a low density artefact scatter of low scientific significance. The assessment considered it possible that the artefacts were subject to impacts associated with historic flood events.

An additional test pit recovered a single artefact within a mid-slope landform, the artefact was assessed as likely to have been washed into its position.

Artefact Heritage 2018, Menangle Park Zone Substation and Feeder: Aboriginal Due Diligence Assessment

Artefact Heritage undertook an Aboriginal due diligence assessment for a proposed new substation to service Menangle Park within Lot 2013 DP1234643, which is within the current study area. The proposal also included a new underground transmission feeder between the Macarthur Bulk supply Point to the new zone substation. A small portion of the proposed feeder was also within the current study area. The assessment included a review of previous archaeological assessment, a search of the AHIMS database, consideration of the environmental context, and a pedestrian survey.

A total of five previously identified artefact sites were present within or immediately adjacent to the inspection area. Two isolated artefacts were identified during the survey, and an area of archaeological sensitivity was identified in association with the proposed location of the temporary substation.

It was recommended that as Aboriginal objects were within the study area and may occur below the ground surface, further archaeological investigation was required. This must include an

Archaeological survey report with a survey undertaken with a Tharawal LALC representative, and a comprehensive Aboriginal stakeholder consultation.

Artefact Heritage 2019 Menangle Park Zone Substation and Feeder: ACHAR

Artefact Heritage undertook an Aboriginal Cultural Heritage Assessment for a proposed 10 m wide feeder cable easement between the location of proposed zone substation within Lot 2013 DP 1234643 and the existing Macarthur Bulk Supply Point located within Lot 31 DP1105615. Part of these proposed works were within the current study area. The assessment included an archaeological survey in conjunction with Glenda Chalker from Cubbitch Barta Native Title Claimant.

A total of seven recorded Aboriginal sites were identified as being potentially impacted by the proposed work. Four of those recorded Aboriginal sites were subject to the conditions of an existing AHIP. Three recorded Aboriginal sites within the study area were not within an existing AHIP boundary. One of those sites, AHIMS ID 52-2-4497, was within the current study area. The assessment found that previous archaeological investigations in the locality had identified much of the landscape in the vicinity of the Nepean River as archaeologically sensitive, especially the alluvial deposits which have the potential to contain buried land surfaces and Aboriginal objects. However, these features were not identified in previous subsurface excavations in the area.

It was recommended that all proposed works within the area of the existing AHIP must comply with the conditions of that AHIP, and Endeavour Energy must liaise with Sydney Water (as the AHIP holder), to ensure the proposed works are compliant with the conditions of AHIP. Endeavour Energy must inform Sydney Water of the identification of additional Aboriginal sites within the area to which the AHIP applies, and that those sites will be impacted. Endeavour Energy must confirm with Sydney Water that all archaeological investigation required as a condition of the AHIP had been completed within that portion of the AHIP that overlaps with Endeavour Energy's proposal

An application for an area based AHIP must be submitted to OEH (now Heritage NSW) for those portions of the study area not subject to AHIP No. C0000393. That application would seek approval to impact Mt Annan Macarthur Sub Station 4 (AHIMS ID 52-2-3319), MPF IF 01 (AHIMS ID 52-2-4497), and MPS AS01 (AHIMS ID Pending)

Kelleher Nightingale Consulting 2022, Menangle Park Site-Wide bulk Earthworks & Vegetation Management: Aboriginal Cultural Heritage Assessment Report

Kelleher Nightingale Consulting (KNC) were engaged to prepare and ACNAR for the Menangle Park Urban Release Area (MPURA). The assessment included a field survey and test excavation program. Thirteen Aboriginal sites were identified as being situated at least partially within the proposed impact area. The archaeological significance of these were considered to range from low to moderate-high. The assessment determined that the transition between the elevated alluvial terraces and adjoining slopes was an area of particularly interest.

A mitigation program comprising archaeological salvage undertaken prior to construction was recommended where at least moderately significant Aboriginal archaeological salvage was required. Areas of low disturbance were proposed to retain higher archaeological potential than those adversely affected by previous land use. Flatter areas were also demonstrated to contain higher density or more intact deposit. With artefacts identified on the slopes being frequently out of context and forming shallow, eroded deposits. Large areas of slope across the MPURA was found to have been subject to previous test excavation which did not recover any artefacts. The very low-density deposit and isolated artefacts identified at several sites were suggested to form a background scatter of Aboriginal objects across the landscape. Additionally, it was found that moderate to low potential exists elsewhere within the study area depending on landform and previous test excavation findings.

KNC also identified that three existing Aboriginal Heritage Impact Permits (AHIPS) had been previously issued for areas which partially overlapped the area of proposed impact. These existing AHIPs allowed impact to Aboriginal objects within their respective boundaries, provided that works are undertaken in accordance with AHIP conditions. Additional AHIP applications for development Stages 2B, 3 North and Spine Road (South) were noted to have been submitted to Heritage NSW prior to any AHIP application for the site-wide bulk earthworks. KNC proposed an AHIP be sought for the remaining area (Figure 6). Portions of this proposed AHIP overlay with the current study area. However, the AHIP is not on the current Heritage NSW register.

Figure 6: Proposed AHIP (shaded in orange) for KNC 2022 in relation to current study area (green polygon)



3.3 Archaeological potential within the study area

The following statements regarding the potential for Aboriginal objects to be identified within the study area are based on the desktop research outlined above:

- The study area has been subject to historic disturbance associated with initial land clearing over the entire study area, and the subsequent construction of Gleenlee Road in the northern portion, and construction of a bridge and concreted area around Howes Creek and construction of the Mengale Park Zone Substation in the southern portion.
- The study area contains particular landscape feature as defined by the Due Diligence Code of Practice. Howes Creek flows through the southern portion of the study area, a minor creek flows through the northern portion, and the Nepean River is situated approximately 1 km to the west of the study area.
- Previous investigations have identified Aboriginal objects within the study area and the potential for others to be identified.
- The KNC 2023 investigation for the Menangle Park Urban Release Area identified archaeological potential within a large portion of the study area and proposed an AHIP be sought prior to any proposed works. At present this AHIP is not on the Heritage NSW AHIP register and will require further investigation to determine if it is still being processed and its' conditions.

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4.0 VISUAL INSPECTION

The visual inspection of the study area was undertaken on 16 December 2024 in fine weather. In attendance was Rebecca Bryant (Senior Heritage Consultant) and Neve Penklis (Graduate Heritage Consultant) from Artefact Heritage and Environment, Rachel Gray (Senior Environmental Consultant) from JBS&G), Jonathon Starnovsky (Project Manager) from Endeavour Energy, and other consultants.

The visual inspection commenced at Glenlee Road, Menangle within the northern portion of the study area (Figure 7) and followed the study corridor for the proposed feeder to the existing Menangle Park Zone Substation. The portion of the feeder corridor that runs north from Glenlee Road to the Macarthur Bulk Supply Point in the northern-most section of the study area (Figure 8) was not accessed due to the long grass and potential snake activity.

The proposed 'feeder' will be constructed underneath the existing Glenlee Road portion of the study area with a 10 m buffer wither side. Glenlee Road slopes moderately to steeply from east to west and there were numerous exposures along the road verge. These were inspected and the silty soil was noted to be orange/brown and included basalt flakes of various sizes ~ < 10 mm – 60 mm, and small water-rolled gravels < 10 mm. The exposed stone material was likely a combination of introduced rock, and natural gravel inclusions within the underlying geology (Figure 9). At the entrance to the State Heritage Registered, Glenlee Estate (Figure 10), the survey veered off from Glenlee Road and followed the study area corridor in a southwest direction around the curtilage of Glenlee Estate. This portion descended quite steeply and was within an open paddock area with thick grass coverage and grazing livestock, including bulls, cows and horses (Figure 11). There were a few exposures along the fence line bordering Glenlee Estate containing silty brownish/red soil. These were inspected for stone artefacts. The stone material identified included a few pieces of ironstone, approximately 20 mm - 30mm in size from the underlying geology. There was also a large piece of basalt material, approximately 90 mm x 60 mm (Figure 12 and Figure 13). It is not clear if this was a result of historical processes or Aboriginal tool-production process. Basalt was also noted elsewhere within the study area, as mentioned below.

The southern portion of the study area corridor outside the Glenlee Estate curtilage curls towards the west and continues parallel to the Main Southern Railway line train line for approximately 320 m to the Menangle Park Zone Substation. The landform in this area appears to have been cut and filled in areas where it levels out around Howes Creek. It has also been modified by the construction of bridge with introduced basalt bedrock on the northern side (Figure 14 and Figure 15). A portion of the area has also been infilled with concrete and a tunnel has been built under the railway line Figure 16. The proposed works in this area will include deep under boring.

The area bordering the east of the existing Menangle Zone Substation is undulating under foot and has been disturbed by the construction of the substation which would have included excavation and fill. There is also a modified drainage depression along this area Figure 17. The artefact reburial site, AHIMS 52-2-4396 (Figure 18) was inspected and confirmed to be outside of the area of proposed works.

Figure 7: View west along Glenlee Road within the northern portion of the study area



Figure 8: View north over portion of study area corridor that connects Glenlee Rd to Macarthur Bulk Supply Point in the northern-most section of the study area



Figure 9: Plan view of exposure containing basalt flakes of varying size, and water-rolled gravels on Gleenlee Road verge within the northern portion of the study area



Figure 10: View east of the entrance to Glenlee Estate



Figure 11: View southwest of study area corridor which follows the curtilage of Glenlee Estate



Figure 12: Plan view of basalt flake within exposure along Glenlee Estate curtilage



Figure 13: Close up of large basalt pictured in Figure 10



Figure 14: View north east from south side of bridge over Howes Creek



Figure 15: View northeast from northside of bridge crossing over Howes Creek. Large pieces of broken basalt bedrock in foreground



Figure 16: View west of drainage area within channelised portion of Howes Creek that extends through a concrete tunnel under raliway line



Figure 17: View north along the east boundary of the Menangle substation



Figure 18: View north east over AHIMS 52-2-4396 (artefact reburial site) to the west of the western boundary of the study area



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5.0 ABORIGINAL POTENTIAL OF THE STUDY AREA

Archaeological potential is closely related to levels of ground disturbance. However, other factors are also taken into account when assessing archaeological potential, such as whether the area is within a landscape feature that is likely to indicate the presence of Aboriginal objects.

5.1 Landscape features that are likely to indicate the presence of Aboriginal objects

Particular landscape features in NSW are known to have been favoured locations for repeated or long-term occupation and, hence, more likely to retain archaeological evidence of past Aboriginal use. The Due Diligence Code of Practice identifies five landscape features that indicate the likely existence of Aboriginal objects, these include:

- *Within 200m of water, or*
- *Located within a sand dune system, or*
- *Located on a ridge top, ridge line, or headland, or*
- *Located within 200m below of a cliff face, or*
- *Within 20m of or in a cave, rock shelter, or cave mouth (Environment 2010)*

Two Aboriginal sites have previously been recorded within the study area, although have since been destroyed. No confirmed Aboriginal objects were identified during the visual inspection; however a portion of the study area is located over Howes Creek where there is potential for Aboriginal objects to be present, in accordance with the Due Diligence Code of Practice. The KNC 2022 investigation for the Menangle Park Urban Release Area identified archaeological potential within a large portion of the study area and proposed an AHIP be sought prior to any proposed works.

Landscape Feature	Presence in study area
Within 200m of water	**Yes.** Howes Creek crosses over the southern portion of the study area and a minor tributary crosses over the northern portion.
Located within a sand dune system	**No.** The study area is not located within a sand dune system.
Located on a ridge top, ridge line, or headland	**No**. The study area is not located on a ridge top, ridge line, or headland.
Located within 200m below of a cliff face	**No.** The study area is not located within 200 m below of a cliff face.

Landscape Feature	Presence in study area
Within 20m of or in a cave, rock shelter, or cave mouth (Environment 2010)	**No.** The study area is not located within 20 m of or in a cave, rock shelter, or cave mouth.

5.2 Ground disturbance

Archaeological potential is closely related to levels of ground disturbance. However, other factors are also taken into account when assessing archaeological potential, such as whether artefacts were located on the surface, and whether the area is within a landscape feature that is likely to indicate the presence of Aboriginal objects. The Due Diligence Code of Practice defines disturbed land:

> *Sec 7.5 (4) For the purposes of this clause, land is disturbed if it has been the subject of human activity that has changed the lands surface, being changes that remain clear and observable.*

This includes disturbed land via:

> *(a) soil ploughing*
>
> *(b) construction of rural infrastructure*
>
> *(c) clearing of vegetation*
>
> *(e) construction of buildings and the erection of other structures*
>
> *(f) construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure)*

The study area has been subject to historic ground disturbance associated with vegetation clearance throughout the study area and subsequent use for livestock grazing. The construction of the Gleenlee Road in the northern portion, and the Menangle Park Zone substation, bridge, and cutting and filling around Howes Creek in the southern portion of the study area would have required subsurface excavations which would have resulted in the removal or displacement of natural soils to some degree. However, there is potential for Aboriginal objects to be present in areas less impacted. Additionally, basalt material was found in the northern portion of the study area, near the Glenlee Estate curtilage. Although the material showed some characteristics of an Aboriginal object, further investigation would be required to confirm if it was a result of Aboriginal tool-production or historical processes.

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6.0 THE DUE DILIGENCE PROCESS

The Due Diligence Code of Practice provides a series of questions that must be answered to determine the outcome of the due diligence process. These questions are addressed in Table 4.

Table 4: Due Diligence questions and responses

Question	Answer	Comment
Will the activity disturb the ground surface or any culturally modified trees	**Y**	The proposed works within the study area will require subsurface excavation, along with the removal of the existing Menangle Park Zone substation within the southern portion of the study area.
Are there any: • Confirmed AHIMS records • Other sources of information • Landscape features	**Y**	There were two previously recorded AHIMS sites within the study area (AHIMS ID 52-2-4529 and AHIMS ID 52-2-4497). Both are noted on AHIMS as 'destroyed' under a now-expired AHIP. There are five more sites registered as being within 100 m of the study area. The study area has been identified in previous investigations as being within an area of Aboriginal heritage sensitivity (Niche 2013; AECOM and Aureon 2014; Artefact Heritage 2018; KNC 2022). The study area is located within 200 m of water, a landscape feature known to be associated with Aboriginal objects. The study area has been subject to significant levels of ground disturbance in portions of the study area that would have likely moved or removed Aboriginal objects
Can harm to Aboriginal objects be avoided	**N**	No confirmed surface Aboriginal objects were identified during visual inspection of the study area. However, there is potential for subsurface Aboriginal objects that would likely be harmed by the project.
Does a desktop assessment and visual inspection confirm the presence of Aboriginal objects, or that they are likely to be there	**Y**	There are two registered sites within the study area but have been destroyed. However, there is potential for additional Aboriginal objects to be present within the study area.

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Is further assessment required	**Y**	In accordance with the Heritage NSW due diligence guidelines, the current report has established that Aboriginal objects have been previously found within and near the study area, and additional objects may be present beneath the ground surface within the study area. Heritage guidelines specify that if a proposed activity is likely to impact those Aboriginal objects or areas of archaeological potential, further archaeological investigation and Aboriginal stakeholder consultation is required.

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7.0 CONCLUSION

The following conclusions and recommendations regarding Aboriginal heritage are based on consideration of:

- Statutory requirements under the *National Parks and Wildlife Act 1974* as amended
- Due Diligence Code of Practice
- The results of the AHIMS search and visual inspection
- Previous archaeological investigations and AHIPs within, and in close proximity, to the study area
- The likely impacts of the proposed development.

It was found that:

- Two previously recorded (but now destroyed) are registered within the study area: AHIMS ID 52-2-4497 AHIMS ID 52-2-4529
- Five previously recorded Aboriginal sites are located within 100 m or within the immediate vicinity of the study area
- Areas of archaeological potential have been identified in previous archaeological investigations.
- A portion of the study area overlaps with an existing AHIP 4894 issued to Transport for NSW.
- A large portion of the study area is proposed to be included in an AHIP for the Menangle Park Urban Release Area (KNC 2022), however the status of this is unknown
- The proposed activity would involve ground disturbance across the inspection area and would likely involve harm to Aboriginal objects.

The following recommendations are therefore made:

- A full archaeological and cultural assessment must be undertaken to identify if Aboriginal objects are located within the study area and if they would be harmed by the proposed works.
- This assessment must comply with the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010) by completing:
    - Review of existing knowledge: Review of previous archaeological works completed within the local and regional area.
    - Review of the landscape context: Desktop assessment of the archaeological implications of the landscape features (soil landscapes, historic land use, geomorphic character, and natural resources) relevant to the study area.
    - Summary and discussion of the local and regional archaeological character of Aboriginal land use and its material traces based on the finds of the previous two steps.

  - Development of a predictive model for the nature and distribution of archaeological evidence of Aboriginal land use based on the previous three steps.
  - Archaeological survey to test the prediction developed in the previous step. Survey of the study area would include the involvement of a site officer representing the Tharawal LALC. It is anticipated that the Tharawal LALC will prepare a brief report to be appended to and summarised within the report.
  - Discussion of the results of the archaeological survey and re-evaluation of the regional and local archaeological character.
  - Assessment of likely impacts to Aboriginal objects and Potential Archaeological Deposits (PADs) based on the current design plans.
  - Assess likely impacts and provide recommendations for any practical measures that may be required to protect and conserve identified Aboriginal objects and places identified within the study area.

- It will be necessary to determine the status of existing and potential AHIPs and how these would be managed in relation to the proposed works.
- Depending on the above points, it may be necessary to lodge an application for an AHIP prior to commencement of the proposed activity, which would need to be supported by an Aboriginal Cultural Heritage Assessment Report.

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Jo McDonald CHM Pty Ltd 2010. Archaeological Test Excavations at SFPAD5 (45-5-3780), Spring Farm, report to Landcom.

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APPENDIX A: AHIMS EXTENSIVE SEARCH

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AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Menangle 2 km x 2km

Client Service ID : 955632

Artefact Heritage and Environment - Pyrmont

Date: 29 November 2024

32 Pirrama Road Suite 56, Jones Bay Wharf, 26-32 Pirrama Road
Pyrmont New South Wales 2009

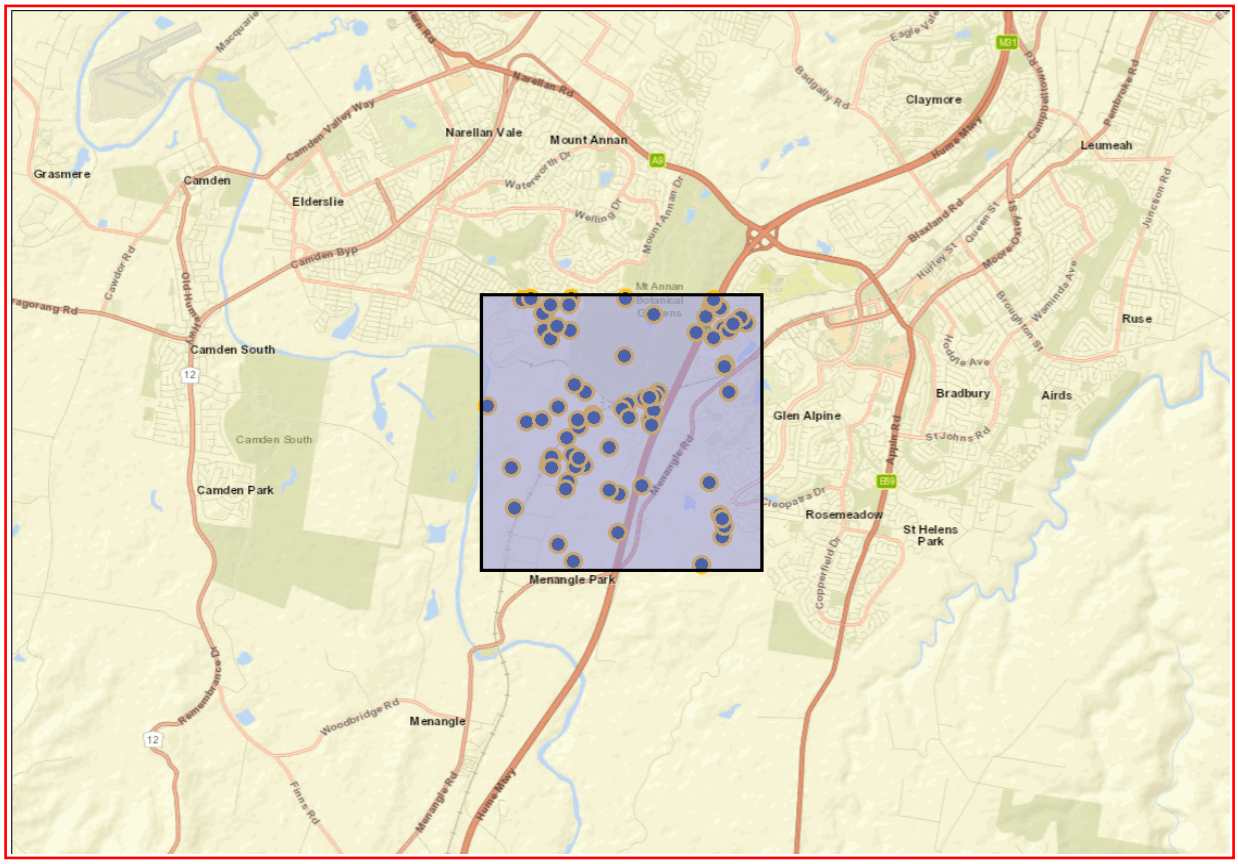
Attention: Rebecca Bryant

Email: rebecca.bryant@artefact.net.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 291590.0 - 295590.0, Northings : 6223765.0 - 6227765.0 with a Buffer of 0 meters, conducted by Rebecca Bryant on 29 November 2024.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

81	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Heritage NSW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

Appendix K Statement of Heritage Impacts

DRAFT

20 January 2025

Rachel Gray
Senior Environmental Consultant
JBS&G
Level 1, 50 Margaret Street, Sydney, NSW
rgray@jbsg.com.au

Dear Rachel,

Re: Statement of Heritage Impact - Menangle Park Zone Substation and Feeder 85U Review of Environmental Factors

Project background

Endeavour Energy is proposing to upgrade an existing substation and install a new underground transmission feeder route at Menangle Park. Artefact Heritage and Environment (Artefact) have been engaged by JBS&G (the proponent) on behalf of Endeavour Energy to prepare a Statement of Heritage Impact (SoHI) to inform a Review of Environmental Factors (REF). The proposed feeder route skirts around a State Heritage Register (SHR) listed item - Glenlee outbuildings, gardens & gatelodge [Glenlee] (#00009).

The aim of this report is to identify the potential impacts that the proposed new and upgrade works would have on nearby heritage items or areas of archaeological potential at Menangle Park. This report also provides advice on appropriate heritage approval pathways and provides management recommendations for mitigating the heritage impacts.

Study area

The study area is located within Menangle Park, Menangle, NSW. The southern portion includes the existing electricity substation wholly within the area legally defined as Lot 2013 DP1234643. The study area then extends through a corridor of undulating land in a northwest direction, crossing through portions of Lot 41 DP1285744, Lot 2012 DP1234643, Lot 2008 D1234643, Lot 4 DP628052, Lot 32 DP1105615, and Lot 31 DP1105615 (Figure 1). The study area is within the City of Campbelltown Local Government Area, in the parish of Menangle, county of Cumberland.

The location of the study area is shown in Figure 1.

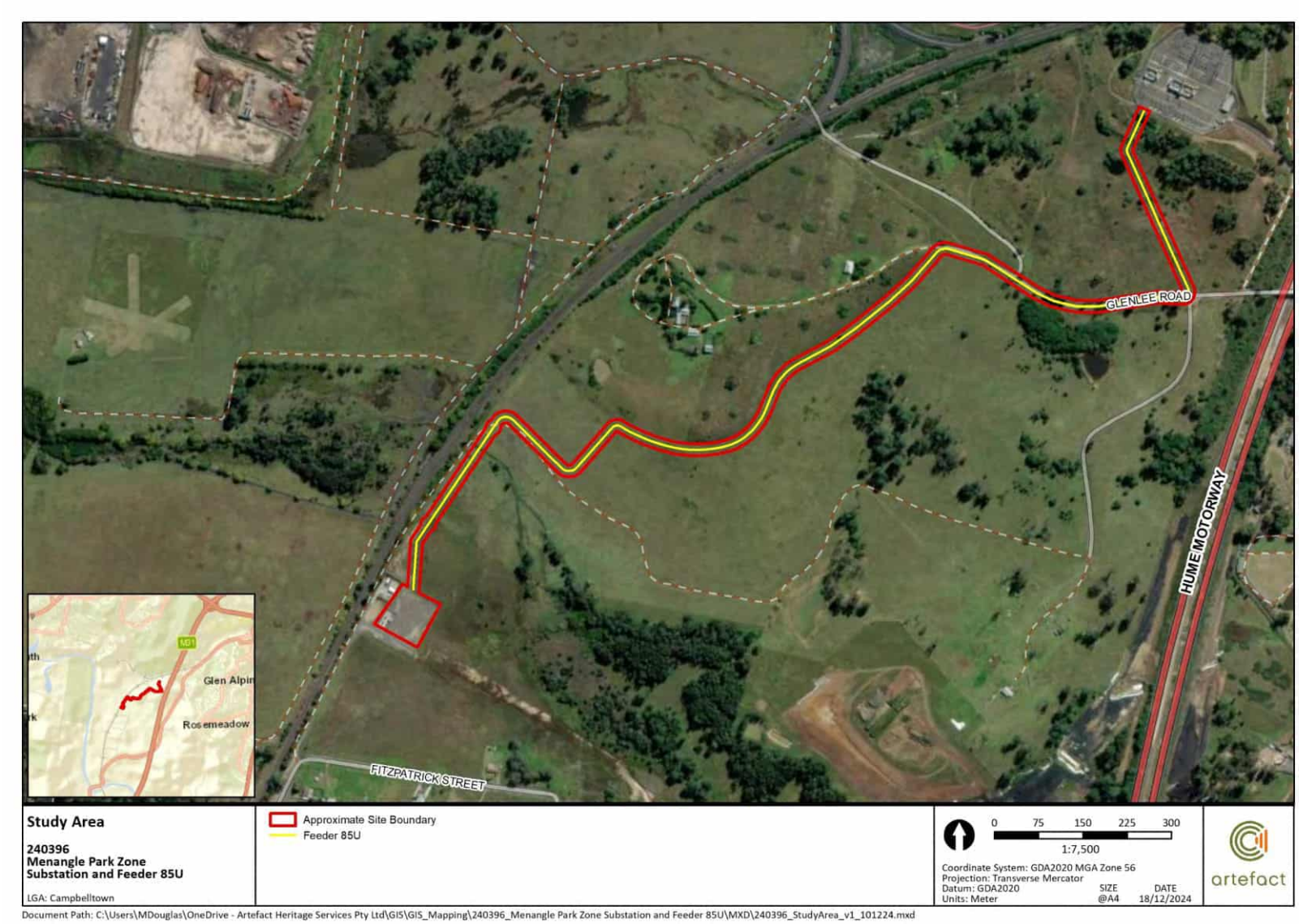


Figure 1: Study area

Proposed works

The proposed works would include the removal of the temporary 66/11kV mobile substation at Menangle Park Zone Substation within the southern section of the study area, and the construction of a new permanent 66/11kV 35 MVA substation in the same location. The new substation would be supplied by two 66Kv feeders; the existing feeder 85P and a new feeder 85U from Macarthur Bulk Supply Point at the northeast end of the study area. Installation of the new feeder would involve a combination of mechanical trench excavation and underboring of an approximately 100m-long section underneath Howes Creek at the south end of the study area.

The new substation would enhance the supply security and reliability of new infrastructure developments in the Menangle Park region by providing a diversified 33kV supply and associated fibre optic network.

The proposed location of the new substation and feeder route is shown in Figure 1.

Methodology

This report has been prepared in consideration of relevant state and federal heritage legislation, including the following:

- *Environmental Protection and Biodiversity Conservation Act 1999*
- NSW *Heritage Act 1977* (Heritage Act)
- NSW *Environmental Planning and Assessment Act 1979*
- *State Environmental Planning Policy (Transport and Infrastructure) 2021*.

This report has been informed by, and has been prepared in accordance with, relevant heritage guidelines and standards including:

- *Assessing heritage significance: Guidelines for assessing places and objects against the Heritage Council of NSW criteria* (Department of Planning and Environment, 2023)
- *Guidelines for preparing a statement of heritage impact* (Department of Planning and Environment, 2023)
- *Material Threshold Policy* (Department of Planning and Environment, 2022)
- *Investigating Heritage Significance Guidelines* (NSW Government, 2021)
- *Levels of Heritage Significance* (NSW Heritage Office, 2008)
- *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Department of Planning, 2009)
- *The Burra Charter*: The Australia ICOMOS Charter for Places of Cultural Significance (Australia ICOMOS 2013).

Limitations

During the site visit, there was restricted access to parts of the study area. There was no access to the northern portion of the study area (off Glenlee Road) – it was only viewable from the Glenlee Road, and there was no access to the substation opposite Fitzpatrick Street that is proposed to be upgraded. In both instances, photographs were taken of the substations at the closest possible points to address this limitation.

This report does not include an assessment of Aboriginal heritage. This has been addressed in a separate report.

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Heritage listings

A search of relevant state and federal statutory and non-statutory heritage registers was undertaken on 17 December 2024. This included a search of the following:

- World Heritage List
- Commonwealth Heritage List
- National Heritage List
- SHR
- Section 170 Heritage and Conservation Registers
- Campbelltown LEP 2015
- Register of the National Estate (RNE)
- National Trust of Australia Register (NTAR)
- NSW State Heritage Inventory (SHI) database.

No heritage items are within the study area. There is only **one** state heritage registered item, Glenlee (SHR #00009), located adjacent to the study area.

The next closest site, Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) [SHR #01373], is located **more than 200m** away from the study area and therefore is not discussed further in the report.

A summary of the relevant heritage listings is provided in Table 1 and shown in Figure 2.

Table 1: Results of register searches relevant to the study area

Item name	Register	Listing ID	Significance
Glenlee, outbuildings, garden & gatelodge	SHR	No. 00009	State
	Campbelltown LEP 2015	No. I00009	State
	RNE	No. 3277	State
	NTAR	No. 7769	State

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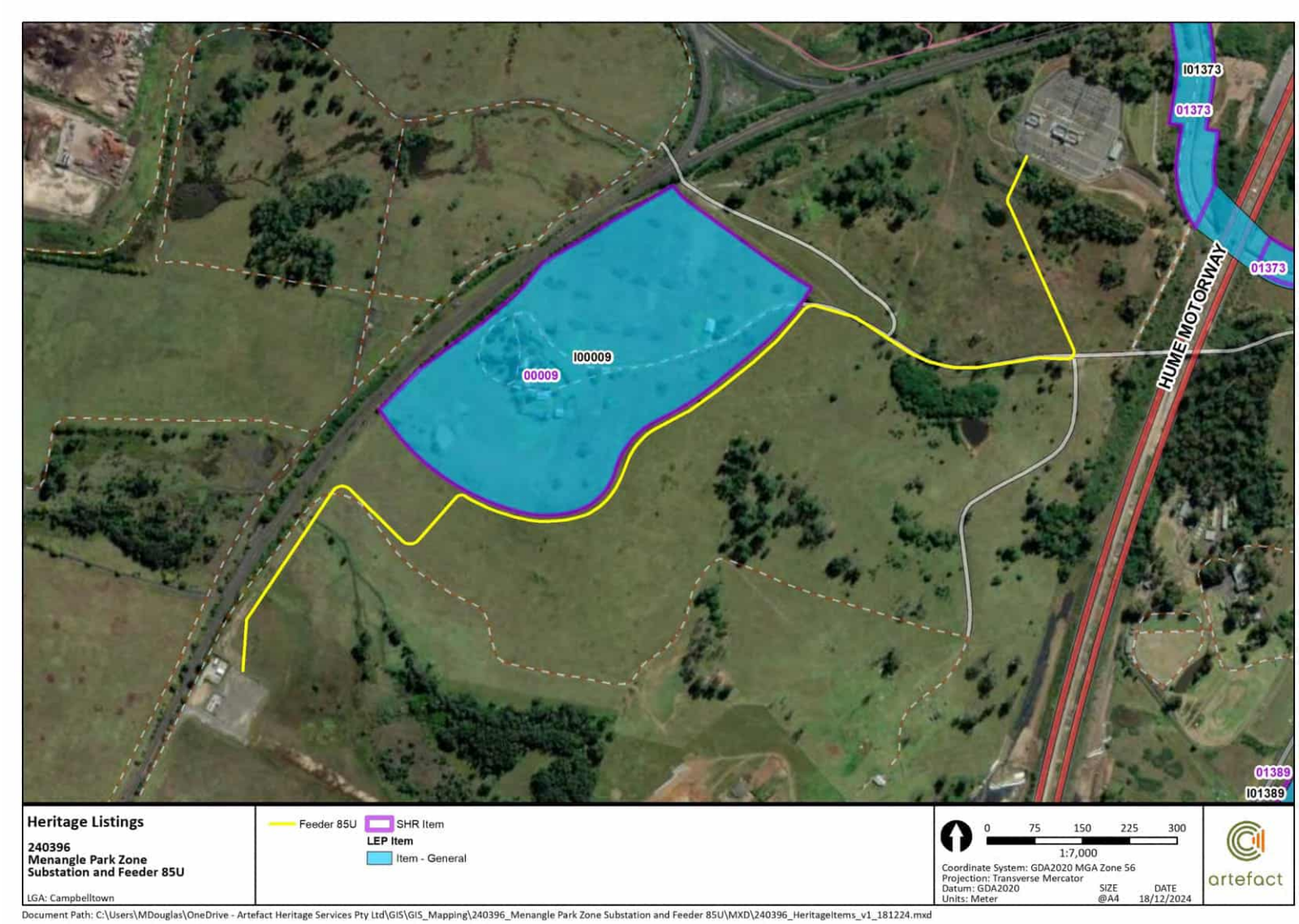


Figure 2: Heritage items adjacent to and near the study area.

Historical overview

This section is a brief history synthesised from the State Heritage Inventory listing for Glenlee[1] and a more recent history by Dr Terry Kass.[2] The aim of this history is to attempt to understand how the land was used over time so as to identify whether there were specific locations of activities that might have left archaeological evidence.

Most of the historical writing has focused on Glenlee homestead and its colonial architecture. However, the Glenlee Estate was a farm mostly leased to tenant farmers who undertook various agricultural activities such as dairying, pig farming and even horticulture. This may have left archaeological evidence in the broader area of the Glenlee Estate outside the SHR curtilage and potentially within the study area.

Colonial occupation

Two bulls and seven cows arrived with the First Fleet in 1788. They were purchased when the ships stopped at Cape Town and had a relatively short trip to Sydney. Nevertheless, in a move that was considered disastrous for the colony, the cattle wandered off from their herdsmen at Sydney Cove and disappeared without trace. In 1795 following up reports from Aboriginal people, the wild cattle were found thriving, south of the Nepean River.[3] The area became known as the Cowpastures.

The Cowpastures was a poorly defined region, largely as it wasn't mapped but described as being south of the Nepean. In reality the area of the Cowpastures was a floodplain of the Nepean located where the river runs against hills around Menangle and Narellan west to the Razorback range. Governor Hunter visited the area in December 1795 and from his account traversed the area to the east of the Nepean (and likely the project study area) "where I saw forty feeding in a beautiful pasture in the valley".[4]

Hunter reserved the area south of the Nepean River to allow the herd to grow and by 1801 Governor King report the cattle numbers as 500-600 head. However, in 1805 John Macarthur returned from England from his court martial with a commission from Lord Camden to develop the wool industry in New South Wales. He was given an order for a unique grant of 5000 acres (2024 ha) of the best pasture land in the colony, to be increased by a further 5000 (2024 ha) if his wool growing proved successful.[5]

Macarthur had already run sheep on Elizabeth Farm at Parramatta and on his land at Seven Hills. He chose land at the Cowpastures, which he called 'Camden' and later 'Camden Park' after his patron. The land Macarthur chose was on the west bank of the Nepean near the study area.

Macarthur's grant stimulated other settlement in this area especially along the east and north banks of the Nepean. These grants have been detailed by Kass,[6] with three relevant grants detailed below.

[1] Heritage NSW, "Glenlee, outbuildings, garden & gatelodge," Heritage Management System, accessed December 9, 2024, https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=5045216.
[2] Kass, Terry. "2.4 Menangle Park & Glenlee (European Context)." In Glenlee, Outbuildings, Garden & Gatelodge Lots1, 2 & 3 DP713646, Glenlee Road, Menangle Park, NSW SHR Listing No.00009 Conservation Management Plan, 15–67, 2020.
[3] Campbell, J. F. "The Wild Cattle of the Cowpastures and the Village of Cawdor." *Journal of the Royal Australian Historical Society* 14, 1 (1928): 43-56.
[4] Quoted by Campbell, p44.
[5] Margaret Steven, 'Macarthur, John (1767–1834)', Australian Dictionary of Biography, National Centre of Biography, Australian National University,1967
[6] Kass 2020: 15-16.

Parish of Menangle Portion 1: Michael Hayes' 120 acres, 1812

Michael Hayes received a 120-acre grant called Hayes' Farm on August 25, 1812. Hayes, a Sydney dealer and prominent Roman Catholic layman, mortgaged the land in 1814 but faced financial difficulties. He advertised the grant for sale in 1816, which William Howe acquired on October 25, 1816. Howe chose this grant to build Glenlee House, rather than using his own 3000-acre grant from January 1818.

Parish of Menangle Portion 2: Owen Connor's 100 acres, 1816

Owen Connor received a 100-acre grant on June 20, 1816. He mortgaged the land multiple times, indicating he was living on it. In 1821, Connor assigned 50 acres to Nicholas Brien, who leased and developed the land. Connor, an elderly man without local relatives, later assigned half of his grant to Brien for £200, likely in exchange for care in his old age.

Nicholas Brien (or Bryan/Bryant) was a settler who developed the land significantly. After his death, his widow Mary Bryan arranged a long-term lease with Reverend John Joseph Therry in 1835. The land eventually passed to James Fitzpatrick in 1866, who allowed the Cummins family to occupy it. By the 1920s, Chinese market gardeners were leasing parts of the grant near the river for crop cultivation.

Parish of Menangle Portion 3: Robert Campbell's 88 acres, 1812

Robert Campbell received an 88-acre grant called Fancy Farm on August 25, 1812. He mortgaged it to Samuel Terry in 1821 and then sold it to William Howe for £130 in 1825. An early survey by James Meehan showed a stockyard at the north-eastern corner of this grant.

Willam Howe, Glenlee Estate

Willaim Howe was born in Scotland in 1777. In 1813 he joined the 1st Royal Scots Regiment as an ensign and took part in the Napoleonic Wars. He left the army in 1815 and in July 1816 arrived in NSW as a free settler in the *Atlas* with his wife and four children. As was the case for free settlers Howe was able to obtain a land grant of 3,000 acres from Governor Lachlan Macquarie on 13 January 1818.[7]

Prior to the grant being formalised Howe purchased Michael Hayes' 120-acre grant on October 25, 1816. Howe also purchased 700 sheep and 400 lambs for £200 from Alexander Riley. This was funded by a mortgage on Howes property including the promise of a grant.[8] Howe's grant was Lot 10 Parish of Narellan and comprised hilly land north-east of the Nepean.

Howe moved his residence to a nice bungalow "Molles Mains" by 1820. Howe was resident there when he was appointed a magistrate in January 1820.[9] However this was only a lease, and Howe began to organise construction of his family home Glenlee. This building was located on rising ground overlooking the Nepean River and MacArthur's Camden Park homestead.

In 1823, Howe commissioned Henry Kitchen, the colony's first non-convict architect, to design Glenlee homestead. Kitchen died before work commenced. In April 1823, Parramatta builders Robert Gooch and Nathaniel Payten were engaged to construct the house. With construction still incomplete, Howe and his builders were in court over payment nearly two years later.

[7] Vivienne Parsons, 'Howe, William (1777–1855)', Australian Dictionary of Biography, National Centre of Biography, Australian National University, 1966
[8] Raymond, Michael. "A History of Glenlee Menangle Road, Campbelltown." Unpublished manuscript. Heritage NSW Library, 1978.
[9] Raymond 1978: 3.

The matter was heard before John Stephen in May 1825. Stephen made an award of damages in favour of Payton for £600.0.0 and in favour of Gooch for £200.0.0 as well as awarding costs in respect of both proceedings against Howe.[10]

Completed in 1824, the homestead is described as a splendid example of Regency Colonial architecture. The two-storey structure, built from a combination of brick and drab-coloured sandstone, boasts a formal Palladian composition. Its unique features include a recessed verandah on the main facade and a cantilevered stone staircase at the rear, believed to be the oldest of its kind in Australia.[11]

The house was constructed on the crest of a flat ridge with views to the south and west over the Nepean. Visitors to the house commented on its setting both its prominence of its location and the views across the Nepean.[12] Mrs Felton Mathews writing in October 1833 noted “Glenlee is an ugly ill-planned house with extensive farm buildings about it”.[13] The farm building would have been associated with the dairy farm which Howe had established.

Glenlee swiftly gained renown as one of the colony's premier dairy farms. Its "Sun and Thistle" butter became famous as the first dairy product exported to England from NSW. The estate also pioneered the cultivation of English grasses for fodder and field peas, practices uncommon elsewhere in the colony at the time. The paddocks were separated from each other by hedges of quince or lemon-tree rather than fences. Evidence from advertisements in newspapers indicate that Howe was breeding dairy cattle and horses as well.

Table 2: Portions acquired by William Howe to form the Glenlee Estate (Source: Kass, 2020)

Parish	Portion	Area	Original grantee	Date of sale to Howe
Menangle	1	120 acres	Michael Hayes	25 October 1816
Narellan	10	3,000 acres	William Howe	13 January 1818
Narellan	28	40 acres	John Howson	30 October 1821 Confirmed 18 & 19 March 1825
Narellan	27	40 acres	William Tyson	26 & 27 January 1824
Menangle	4	200 acres	Mary Reiby	13 July 1827
Menangle	5	80 acres	James Bean	2 & 3 November 1837
Narellan	25	45 acres	John Love	Leased on 1 July 1839
Narellan	26	45 acres	John Hoare	Leased on 1 July 1839

[10] Raymond 1978: 4.
[11] Heritage NSW 2024.
[12] Kass 2020.
[13] Cited in Kass 2020: 20.

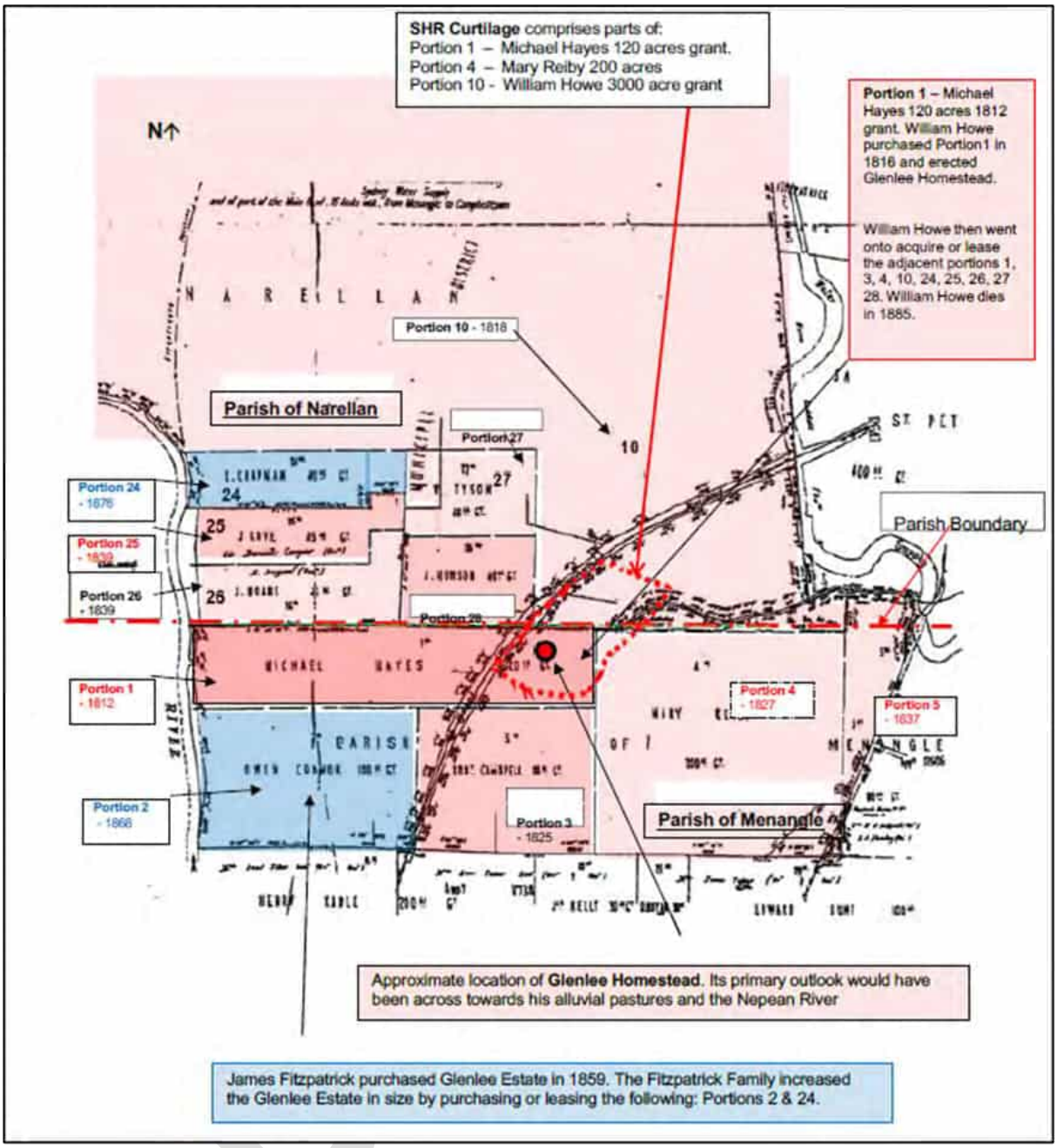


Figure 3: The Glenlee Estate (Source: Kass, 2020)

It is clear from the histories written by Kass and Rowland that towards the end of the 1830's Howe was struggling with debt. Although farming sheep to a limited extent, Howe was not part of the squatting "boom" of the 1830s as he did not hold squatting runs in the interior. The 1840's depression however effected the whole colony beginning with the economically exposed Squatters and then the banks which lent them their capital.[14] With an economic depression there was little demand for rural properties or stock and little capital to refinance loans.

In July 1839 Howe offered Glenlee as a security for a loan of £20,350 from the estate of William Redfern to buy cattle and horses from the estate of William Redfern. On 4 December 1849, having accepted his inability to repay the loan Howe released the equity of redemption on the property for the

[14] Dyster, B. "The Depression of the 1840s in New South Wales." In Australian Dictionary of Biography. Australian National University: National Centre of Biography, 2022

£20,350 owed by him and the property was transferred to the estate of William Redfern. Glenlee was leased to Howes sons until 1859.[15]

William Howe died in 1855 a respected resident of the district.

While there is limited historical material to use it appears that Glenlee was the focus of Howes estate, and various building such as dairy's, stores and shearing sheds were erected in the vicinity of the homestead.

Fitzpatrick era

Following Howe's death in 1855, the property was acquired by James Fitzpatrick, a former convict who had arrived in 1822 as one of 43 Irish protesters on the ship *Mangles* with a 7 year sentence for being out during the curfew. Initially assigned to Hamilton Hume, Fitzpatrick was part of the Hume and Hovell expedition to Port Phillip in 1824-25. Fitzpatrick settled in Appin after the expiry of his sentence in 1829 and began purchasing squatting runs as well as farms in the Appin district.

On 8 November 1859, Thomas Wills, the surviving trustee of William Redfern's estate, conveyed to James Fitzpatrick of The Grange near Narellan the land included in the 1839 mortgage, for £14,500.62.

The Fitzpatrick family stewarded Glenlee for over a century, overseeing various subdivisions and developments.

Kass notes that the estate was enlarged by Fitzpatrick.

Table 3: Acquisition of portions at Glenlee by James Fitzpatrick

Parish	Portion	Area	Original grantee	Date of sale to Fitzpatrick
Menangle	2	100 acres	Owen Connor	31 May 1866
Narellan	24	40 acres	Robert Chapman	3 March 1876

The extent of the buildings associated with Glenlee in the period 1858-1862 can be seen on the survey plans for the Great Southern Railway. The railway ran through the estate and the survey plan, and the plan of the land resumed for the railway show a cluster of buildings around the Glenlee homestead, delineated by fields and roads.[16] Of relevance to the study is a large, enclosed area to the south of the homestead, measuring about 11 acres (4.77ha). A smaller enclosed area of 0.25 acres (0.10 ha) adjoined this paddock to the south. A small hut measuring about 6.5 by 5m with a chimney is also shown (Figure 4).

[15] Kass 2020: 21-22.
[16] "New South Wales Railways Granville to Picton Part 2, Ms2002Sy." 1862. Crown Plan. "Great Southern Railway, Proposed Extension, Campbelltown to Picton." 1858. "Old System Deed, Book 80 No 475," 1862.

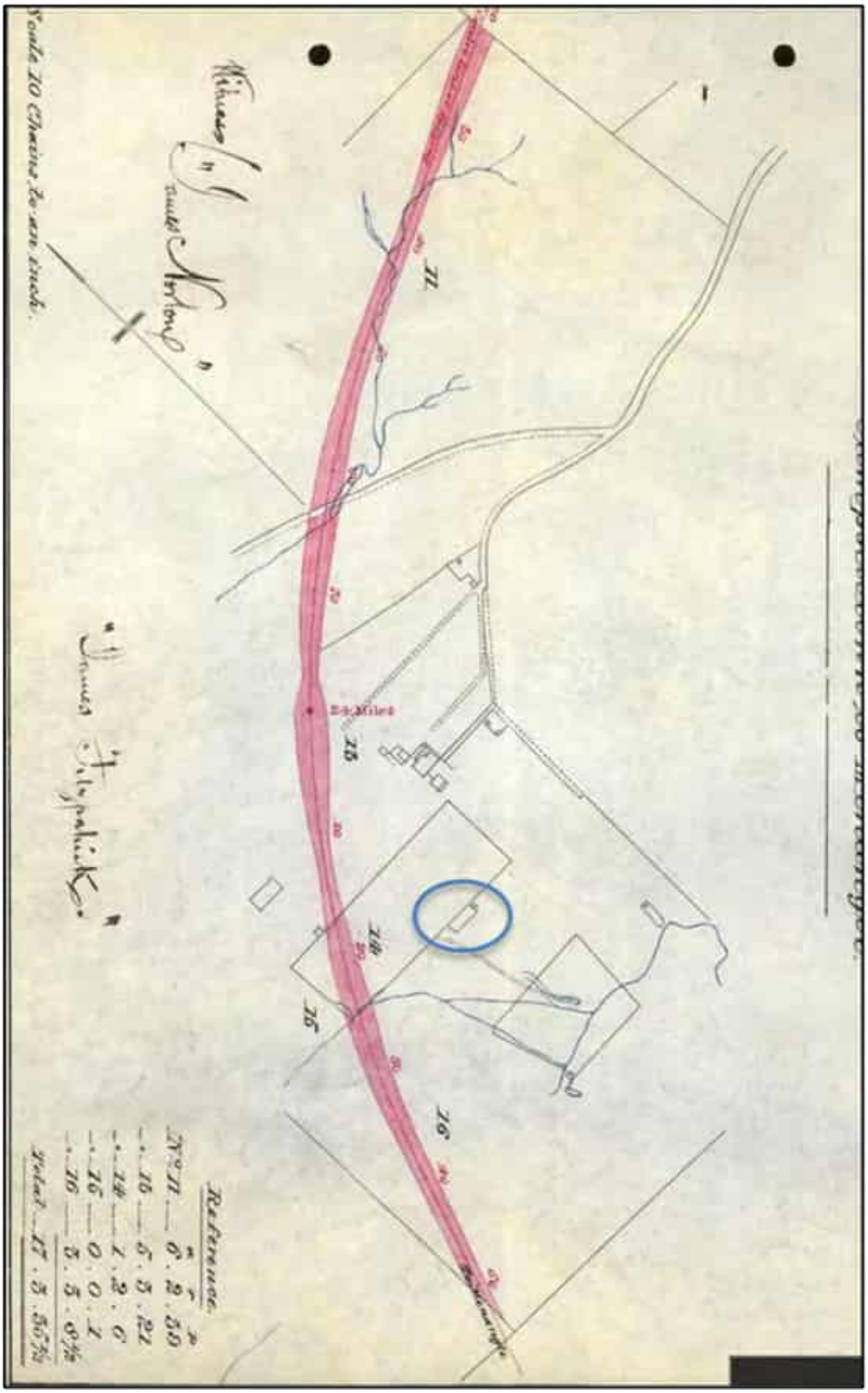


Figure 4: Railway survey plan with the location of the field and hut highlighted (Source: Old System Deed, Book 80 No 475 1862)

Glenlee remained in the hands of the Fitzpatrick family for many years. James Fitzpatrick died there on 27 July 1882. Following Fitzpatrick's death various families such as Cummins, Michael J Vardy, the Tabers, Conroy and Doyle leased Glenlee. Joseph Lawler, probably one of the tenants, lived on the Glenlee estate, in cottage on the "hillside south-east of Glenlee House". He died on 5 June 1896.

Similarly, "on the flat immediately south of Glenlee House and on the eastern side of the railway" Moloney remembered a market garden enclosed with quince hedges conducted by a Chinese market gardener Ah Shoo, who later died in Liverpool.[17] This may be the area highlighted in Figure 4 but the land is on a slope and is not a flat. There are flats immediately south of this area and this may be the site of Ah Shoo's garden.

An advertisement offering Glenlee for a lease of five years, consisting of 3,000 acres was issued in 1885. The property included a 'superior gentleman's residence and convenient outhouses, together with large stables, coach houses and loose boxes on the property'.[18] A second series of advertisements for leases of the Estate were issued in 1891. It was then occupied by Sydney Burdekin and John Kidd.[19]

An application to bring the estate under the provisions of the Real Property Act was made by sole surviving trustee of the will of James Fitzpatrick, Patrick James O'Donnell, of Cootamundra, grazier, on 7th November 1900.[20] J I O'Donnell is listed as being an annual tenant. The certificate of title was eventually issued on 2nd May 1910. Unfortunately, the related plans and sketches do not cover the areas to the south of Glenlee homestead so there is no information on the occupancy of the property.[21]

Glenlee was described as a well-managed farm in an article in the *Australian Town and Country Journal* of April 1905.[22] A.H. Conroy and Doyle were the present tenants of Glenlee, which they held on a long lease from the owner, Mr. Fitzpatrick.[23] Alfred Hugh Beresford Conroy and George F Doyle were a partnership active in the early 1900s breeding sheep and pigs. They had properties around Molong and Orange before they took up the lease of Glenlee.

Australian Town and Country Journal's description has been edited and reorganised and reads as follows:

He will see a farm of 3386 acres,…

The whole farming operations are divided into three departments, the accounts of which are kept separately, so that the firm always knows how each is paying. Each department is under the direct control of an employee, who receives, in addition to his wages, a percentage of the profits realised in the business confided to his care.

The farm is subdivided into a number of small paddocks, some 200 acres being reserved for cultivation, which the proprietors call the insurance fund. The main object of this "Insurance fund" is to provide against the contingency of drought.

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[17] Kass 2020: 26-27.
[18] "Advertising" Evening News (Sydney, NSW : 1869 - 1931) 13 January 1885: 8.
[19] "Advertising" The Daily Telegraph (Sydney, NSW : 1883 - 1930) 10 April 1891: 7.
[20] PA No 11904
[21] The plans are reproduced in Kass.
[22] *Australian Town and Country Journal*. "Glenlee.—A Well Managed Farm." April 5, 1905.
[23] Conroy who as active in political circles, being the first member for the seat of Werriwa, married Doyle's sister who having produced three children decamped to Sydney and divorced him. Doyle was an experienced sheep breeder who later on established a leading Romney Marsh stud.

The Dairy Herd

They usually have about 40 cows in milk, and so good and careful is the management that the average daily quantity of milk per cow, including those drying off, never falls below 2½ gallons.

The herd consists of the Shorthorn-Ayrshire cross, the best points of both breeds being brought to their highest perfection. The milking shed contains eight bails, together with all the most approved appliances. Water is laid on, so that the whole premises may be sluiced down with a hose every day. The morning's milk is sent away to Sydney, but the evening's milk is retained on the farm, the cream being sent to the creamery, while the skim milk is fed to the pigs

The Stud Sheep.

The pride of Glenlee is the beautiful flocks of stud sheep, which are favourably known throughout the State, and which have held the place of honour at many shows. The same careful management is devoted to the sheep as to other departments, and the results are equally good. Small paddocks are considered better than large ones for sheep, and no paddock exceeds :t00 acres. In the larger ones last season lambs numbered 90 per cont, of the ewes, whilst In a smaller paddock 102 per cent, were marked, which shows the superiority of the small paddock.

On .Glenlee there is also a flock, of stud Romney Marsh sheep, which was . recently augmented by the importation of six shearing ewes from, England. These came from the celebrated flock of Mr. Charles Pile, and are closely related to the winning strains of blood, that have, during the past ten years, secured a notable record for Mr. Pile's flocks at the leading agricultural shows in England and New Zealand. These ewes were also in lamb to some of the most noted Romney Marsh rams in England.

The Pigs.

The piggeries constitute another department. Most people are accustomed to associate pigs with dirt, but a visit to Glenlee would soon dispel the notion that a pig can only thrive when wallowing in filth. Messrs. Conroy and Doyle apply the principle of cleanliness to the piggeries, as to everything else, with the happiest results. There are 17 small runs, with sheds in each, and eight cemented styes, all of which are kept scrupulously clean. Water taps are placed at convenient spots, so that the hose can play on all the premises, and clean out every nook . and corner and the pigs are provided with special luxury, in the shape of a well-constructed bath, built of cemented bricks. Besides the small runs, a couple of large grazing paddocks, through which a creek runs, are allotted to the pigs. The animals themselves are aristocrats In their way, the breeds being the best that can be produced by importation, the Berkshires and Yorkshires being from Hawkesbury and Callan Park strains. The Berkshires and Yorkshires are well-known, not so the large Baek. or lop eared as they are sometimes called. These are all from pedigree pigs, imported directly from England, and are all duly registered in the association books of that country. Tho chief value of these is said to be in their great fecundity and remarkably early maturity.

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> *Poultry and Bees.*
>
> *About an acre and a quarter ,is fenced with 6ft wire netting, and subdivided into ten big yards and a number of smaller one, for the sole occupation of the fowls. There are the usual buildings, with roosts, breeding houses, and incubators, and water is laid on to every pen. There are fourteen hives of Italian bees, which are kept chiefly to fertilise certain crops. Though last year was a bad one for bees, a net return of 10s was received from each hive.*
>
> *Water is laid on to the farm from the canal which carries Sydney's water supply. To provide for emergency, there are two huge reserve tanks, each holding 20,000 gallons. When the canal ceased to run, some little time ago, the water from the reserve tanks was pumped to a number of raised Iron tanks, and from them flowed into all the pipes lending to the dwelling house, the cow yards, and the piggeries.*

Unfortunately, illustrations or maps of the farm are limited, so the locations of the infrastructure remain largely unknown. The poultry would have been kept near the residences for supervision against fox attacks. The sheep which were being kept for breeding not wool would have required a modest shearing shed. The pigs would have been located at some distance from the homestead because of the smell.

The dairy is shown on a plan dated 13 March 1907 by Licensed Surveyor J M Conroy (Figure 5) which is reproduced in Kass.[24] The plan also shows the location of Glenlee Station which opened on the 19th August 1884 and closed on the 9th June 1947. The station appears to have been a simple platform where dairy products could have been loaded.

The plan does not show any buildings that are associated with the sheep or the piggery which were likely located outside the area depicted on the plan. Other maps of the area, including the 1909 *Staff Map*[25] and the 1917 *Military Manoeuvre* map,[26] are not sufficiently detailed to show the farm layout.

It is also not clear what happened to the Conroy and Doyle partnership. Their last mention in the Australian Newspapers in relation to Glenlee is 1910. Conroy's wife, Doyle's sister, deserted him and ultimately divorced him around this time so this may have resulted in the partnership breaking up. There is no record in the newspapers of a bankruptcy or court case. Conroy continued his political career and Doyle kept breeding sheep.

Kass notes that John Glenlee Fitzpatrick took up residence in Glenlee about 1910, and that by the 1920s the Fitzpatrick family of Glenlee employed dairymen to run the dairies on their property. A 1933 topographic map only shows the main building and appears to have been derived from the 1917 map. The *Manoeuvre Map* was updated in 1940, but the buildings remained unchanged.

In April 1945 the Department of the Army, Central Office - Survey Section flew aerial surveys around Camden, with films V22 and V23 showing the Glenlee Estate.[27] The detailed photographs allow individual fields, crop marks, buildings, and roads to be identified (Figure 6). The aerial imagery shows that the feeder route does not cross the remains of any buildings or structures, but it does run

[24] Kass 2020: 30.
[25] "University of Sydney Officers' Course of Instruction in Duties of General Staff, June 1909." 1 inch to 1 mile. Sydney: Government Printer, 1909. https://collection.sl.nsw.gov.au/record/74VKm3AqAA8Z.
[26] War Office. General Staff. Commonwealth Section. "Map of Liverpool-Menangle Manoeuvre Area, New South Wales." 1 in. to 1 mile. Commonwealth Department of Defence, 1917. https://nla.gov.au/nla.obj-446122626.
[27] Commonwealth Department of Defence. *Aerial Survey Photography Negatives of SI56-5 Camden, Film Number MAP1509 Run 2 Frame V22 and V23*. April 30, 1945. Film. Geosciences Australia.

along the access road to Glenlee and later to the north crosses the road to the dairy which was formerly part of the main road into the homestead complex.[28]

A proposal by the government in 1946 to resume Glenlee for a mental hospital met strong local opposition, especially since it was a historic property. As a working dairy farm, it employed a number of local people. Glenlee had two dairies, which produced 10,800 gallons of milk per month, and employed 32 people. The proposal did not proceed.

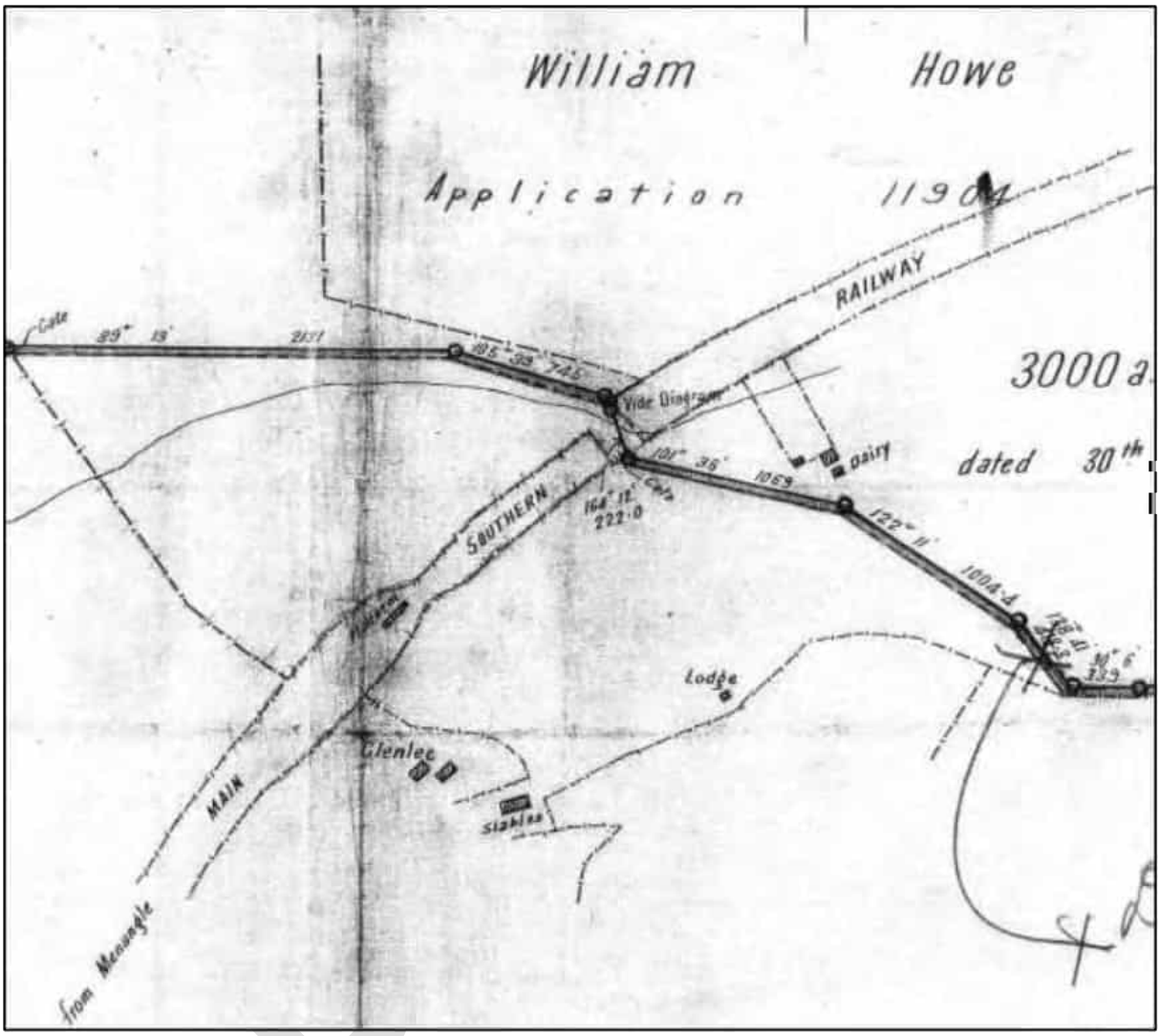


Figure 5: Extract from a 1907 plan showing some of the buildings at Glenlee (Source: Kass, 2020)

[28] This road was abandoned by the 1960s.

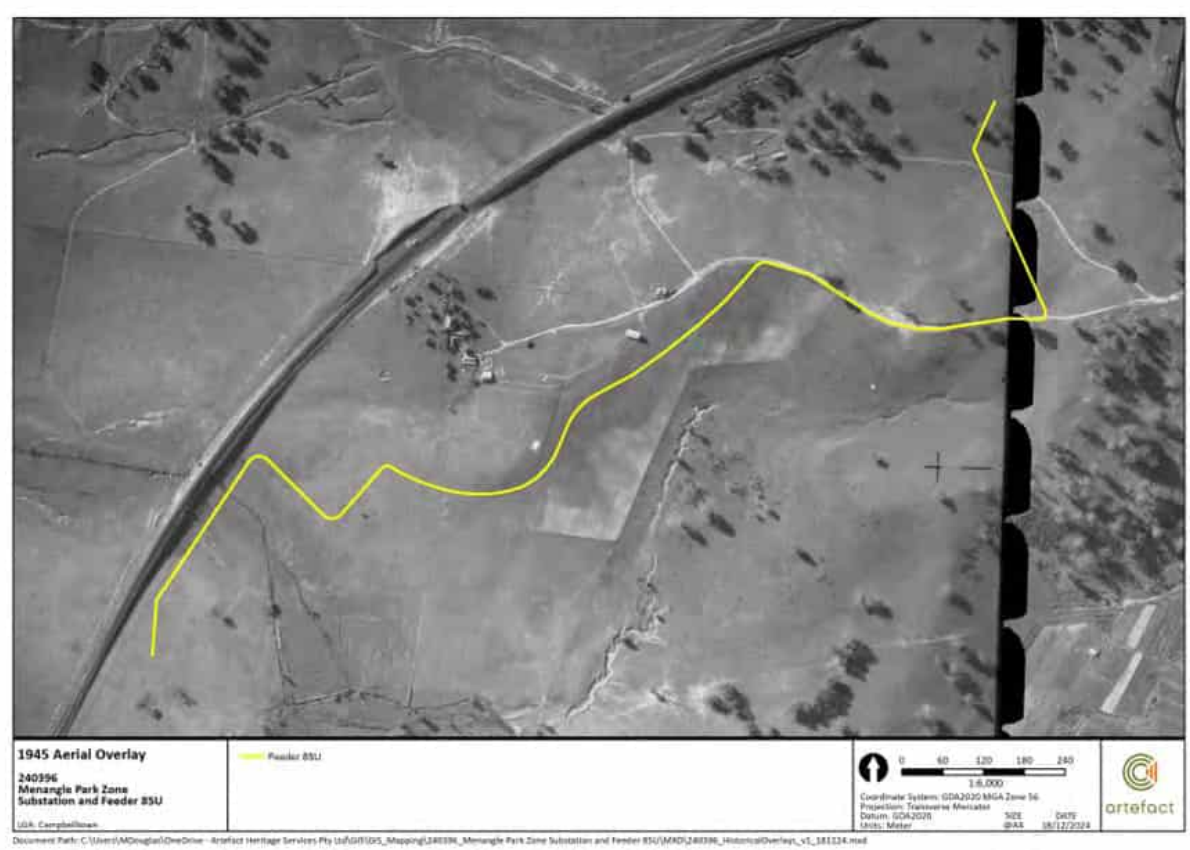


Figure 6: Aerial image of Glenlee, dated 30th April 1945, showing no structures in the immediate vicinity of the proposed feeder route (Source: Geoscience Australia)

Despite the encroachment of industry in the mid-twentieth century, including the construction of a nearby coal washery and transhipment facility in the 1950s, Glenlee maintained its agricultural significance, supplying milk to Sydney and breeding award-winning Ayrshire cattle. Reviews of the aerial photography from the 1940s onwards held by Geosciences Australia and the NSW Historical Aerial Imagery Viewer show that the core of the Glenlee Estate remained rural land up to the present.

In 1968, the State Planning Authority acquired Glenlee, recognising its historical importance. Extensive restoration work in the late 1970s and 1980s returned much of the homestead to its 1820s appearance, while preserving elements of its evolution, such as the 1890s-style drawing room. A large olive farm was established to the north and northeast of the Homestead from 1999 to 2014 when the olive trees were removed.

Today, Glenlee Estate encompasses 45 acres of significant colonial rural landscape. The property showcases a carefully composed homestead group with outbuildings and gardens, perched on a raised platform offering panoramic views. A long, winding driveway provides visitors with impressive vistas of the surrounding countryside.

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Assessment of significance

The following statement of heritage significance has been extracted from the SHI entry for the SHR heritage item:

The Glenlee estate is a rural cultural landscape of exceptional significance including elements of Aboriginal heritage significance, association with early influential European settlers and the exceptional composition of the architecture and landscape setting of the homestead group.
It is the core remnant including the accessway of the Glenlee estate, an important and rare surviving early 19th century pastoral holding in the Mount Annan/Menangle district of the Cow Pastures once considered as one of the best and earliest dairy farms in the colony. The estate was one of the first farms in Sydney's west to make the change from cereal cropping to dairying in the 19th century and the property continued to prosper throughout the 19th and 20th centuries.

The landscape of the area of the estate is of exceptional aesthetic value as a rare reminder of the former pastoral industry which once characterised the area. It is still possible to appreciate the siting of the homestead in view of, and with frontage to, the Nepean River as part of the original land grant. The mid-19th century Southern Railway, though sited close to the homestead group, was constructed to maintain this visual relationship. The siting of the homestead group in a context of undulating landform, is an outstanding example of colonial landscape planning to form a picturesque composition with direct sightlines to the neighbouring Camden Park estate and the Great Dividing Range.

The Glenlee homestead group is a rare and significant complex of buildings and plantings, approached by a formal drive and sited with commanding views over the countryside to the west and south-west. It includes the remnant core of a rare early colonial farm estate focussed on the fine and sophisticated Regency design of the main house with its rare recessed portico. In addition, it includes its original servants' wing, outbuildings, farm buildings, a gatehouse and early plantings including a landmark bunya pine near the house.

The homestead dates from 1823 and is one of only a handful of early surviving colonial houses in the Sydney region, remarkable for its level of integrity and its original setting on the estate amongst 19th century farm buildings and plantings. It demonstrates exceptional architectural sophistication for the period of construction (c.1823) and a rare example of Old Colonial Regency style, of which both Henry Kitchen and Francis Greenway (both of whom the house's design has been attributed to) were key practitioners.

Glenlee is significant for its association with free settler William Howe and family. Howe established the estate, was instrumental in establishing the Bank of NSW in Camden, and an important early free colonist who did much to promote pastoral interests in Sydney's west, and was one of the first farmers in the district to successfully make the change from cereal cropping to dairying.

Glenlee is also significant for its association with emancipated convict James Fitzpatrick and his family, who were responsible for the continued expansion of the estate and for its operation as a successful dairy farm. The family were prominent

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local citizens and remained in residence at Glenlee for over a century, demonstrating a remarkable pattern of continued usage of the property.

Howe and Fitzpatrick families held Glenlee from c.1822 to 1859 and 1859 to 1968/9 respectively, and the history of these families on the estate is a microcosm of the development of colonial Australia in the 19th and early 20th centuries.

Glenlee is also significant for its association with Colonial architect Henry Kitchen, and with Colonial Architect Francis Greenway, who may have played a role in its redesign.

The area close to the house has high archaeological potential associated with its occupation and use by the Dharawal Aboriginal people prior to and immediately after European settlement, and for its association with the former pastoral uses of the estate, its outbuildings and former outbuildings. The area presents some opportunities to study and interpret the lifestyle and culture of the Dharawal people, through interpretation of the landscape and the discovery of associated artefacts. It also presents opportunities to study and interpret the former pastoral and continuing agricultural uses of the estate and area.[29]

Physical description

The SHR entry for Glenlee contains a detailed description of the heritage item. The following physical description of parts of Glenlee relevant to the study area has been extracted from the SHI:

Farm: (45 acres / 18.2ha)
Significant colonial rural cultural landscape, with deliberately sited curving entrance road to give dramatic view of homestead group and river and mountains beyond, past a gate lodge, a square stuccoed brick building with a hipped, originally shingled roof, later corrugated iron-clad.

The wider landscape is of grazed paddocks, with stands of remnant older indigenous trees, particularly on higher ground. An olive grove has been established southeast and northeast of the house in the c.1990s…

… Drive:
While most of the drive to Glenlee lies outside its State Heritage Register curtilage boundary, the long serpentine drive to Glenlee Road is deliberately sited to manipulate impressive, wide-ranging views both of the Razorback Range in the background to the west, the lower range of Camden Park estate and Menangle's setting across the Nepean River, Mount Annan to the north-west, and lower hillocks alongside and within Glenlee estate itself.

The Glenlee Road end of the driveway is marked by a prominent, mature Bunya Bunya pine (Araucaria bidwillii) tree planting, clearly visible from the Hume Highway (which cuts under Glenlee Road (now partly an overbridge), and from Glenlee Road itself on approach from east and west (Stuart Read, pers.comm., 21/5/2019)…

[29] Heritage NSW, 2022. "Glenlee, outbuildings, garden & gatelodge". *SHI database no. 5045216.*

…Views and framing plantings:
The homestead enjoys a broad panoramic view (southwest to northwest) across the Great Southern Railway line to and an important visual connection between the Great Dividing Range, Nepean River and Camden Park estate ridgeline.
Low Cape honeysuckle (Tecomaria capensis) hedges underline the panoramic views out to Mount Annan in the north-west, and frame views west and south-west towards Camden Park, the Razorback and the Great Dividing Ranges. Lower again hedges of sweet box (Murraya paniculata) and Cape leadwort (Plumbago capensis) define inner areas of garden such as a rear 'courtyard' east of the house. Beds of hardy perennials and ground covers such as Nile / African lilies (Agapanthus praecox), bird-of-paradise flower (Strelitzia reginae)(Stuart Read pers.comm., 7/11/2016).

There is a dramatic and impressive view of Glenlee homestead and its broad landscape opening up suddenly near the crest of the access road (Glenlee Road) from off Menangle Road.[30]

Visual inspection

A visual inspection of the area was undertaken on 16 December 2024 in fine weather. In attendance was Rebecca Bryant (Senior Heritage Consultant) and Neve Penklis (Graduate Heritage Consultant) from Artefact Heritage, Rachel Gray (Senior Environmental Consultant) from JBS&G, Jonathon Starnovsky (Project Manager) from Endeavour Energy, plus other consultants.

The northern most section of the study area contained the existing Macarthur Bulk Supply Point, which was situated in an area of cleared grass with minimal bushland (Figure 7). The substation was inaccessible due to locked gates was not clearly visible behind the trees. However, no historical features were observed in the area.

The northern section of the study area includes an approximately 450m long section of Glenlee Road, which provides access to Glenlee Estate. Glenlee Road is an eroding, asphalt road with infrequent exposures on the road verge (Figure 8). The road sloped moderately to steeply from the east to west until it reached Glenlee, which was not accessible. On approach to Glenlee drive, the road became increasingly eroded and gravelly with numerous potholes (Figure 9). There was evidence of subsurface impacts due to services (Figure 10). No evidence of former road surfaces was visible.

From Glenlee Road the study area continued south across a field of cleared grass farmland. It skirted the edge of Glenlee, which is situated on top of a steep descending slope (Figure 11). The heritage item was separated from the study area by a fence around the property. Views towards the Glenlee homestead were largely obscured by the existing vegetation, including olive trees, along the boundary of the property (Figure 12). The field contained livestock and there was further evidence of subsurface services (Figure 13). Other visible modifications to the landscape included the Main Southern Railway line to the west of the study area. A tunnel cut into the embankment provides access to other fields (Figure 14). A steel girder bridge provided access over Howe's Creek (Figure 15).

The southern portion of the study area between Howe's Creek and existing Menangle Park Zone Substation contained a modified drainage depression (Figure 16 and Figure 17). Further evidence of subsurface services was visible on approach to the substation (Figure 18).

No surface evidence of archaeological features was observed during the site inspection.

[30] Heritage NSW, 2022. "Glenlee, outbuildings, garden & gatelodge". *SHI database no. 5045216*.



Figure 7: Macarthur Bulk Supply Point (inaccessible)



Figure 8: Eroding asphalt on Glenlee Road



Figure 9: Gate of Glenlee property, noting poor condition of road



Figure 10: Evidence of subsurface impacts from services



Figure 11: Cleared grass farmland outside the Glenlee property



Figure 12: Glenlee property from the base of the slope (north view)

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Figure 13: Livestock grazing on the farmland



Figure 14: Main Southern Railway line and tunnel accessing other paddocks west of the study area



Figure 15: Steel girder vehicle bridge over Howe's Creek



Figure 16: South view of the existing Menangle Park Zone Substation



Figure 17: Modified drainage depression adjacent to the substation



Figure 18: Subsurface services near the substation

Historical archaeological assessment

This SoHI provides a baseline assessment of historical archaeological potential for the study area. The assessment has been informed by previous archaeological assessments, reviews of available historical plans and maps, and additional historical research.

Previous assessments

The archaeological potential of Glenlee homestead has been assessed by Higginbotham[31] and more recently by Casey & Lowe.[32] Both reports focused on Glenlee House and the curtilage of the heritage listing, which is located adjacent to the study area.

Higginbotham's report is brief and primarily focuses on Glenlee and the buildings shown on the railway survey. The report is based on one map and a limited foot survey. Higgenbotham identified potential archaeological remains of outbuildings, roads, carriageways, paths and huts, however these are not mapped or assessed in detail. Furthermore, the report does not cover the wider Glenlee Estate or the current area of the proposed works. As a result, it provides little information on archaeological potential for the study area.

Casey & Lowe's archaeological assessment is more comprehensive and is based on the historical research undertaken by Terry Kass which includes additional historical mapping. The assessment included a brief review of archaeological investigations of similar homesteads and farms in Western Sydney, including Belgenny Farm, Bella Vista, Bungarribee, Maryland Homestead, the Denbigh Estate, and the Raby Estate. Archaeological work at all these sites revealed evidence of farm buildings, infrastructure such as drives and fence lines, and evidence of farming practices in the landscape.[33] Based on this, while generally positive about the archaeological potential around the homestead, Casey & Lowe noted that the archaeological remains within the paddock areas are expected to have been disturbed, particularly by the land preparation for the recent (1999-2014) olive grove. The establishment and removal of the olive groves would have involved deep ploughing of the soil, as well as the use of large heavy tractors for the removal of the grove and root systems.[34] These areas were mapped by Casey Lowe as having Nil to Low archaeological potential, although the areas of former structures were assessed as being of Low-Moderate potential.

Archaeological potential

The archaeological potential of each phase of historical development for the study area is presented in terms of the likelihood of the presence of archaeological remains, considering the land use history and previous impacts at the site. The assessment is based on the historical research outlined above and in consideration of Casey & Lowe's assessment of the archaeological potential of Glenlee House. This evaluation is presented using a standard grading of archaeological potential covering areas in the general vicinity of the proposed works.

The fences at Glenlee were recorded as being formed by quince or lemon-tree hedges according to accounts from 1833 and Lang's account from 1837. A later report (undated) quoted by Kass also noted "a market garden enclosed with quince hedges" located "on the flat immediately south of Glenlee House and on the eastern side of the railway",[35] which may be part of the study area. A

[31] Higgenbotham, Edward. "Glenlee House, Menangle Road, Campbelltown, NSW: Site Survey of Archaeological Remains." Produced for Peter Thorp and Associates by E. Higginbotham, 1985.
[32] Casey & Lowe Pty. "Glenlee, Outbuildings, Gardens & Gatehouse, Menangle Park Revised Historical Archaeological Assessment." Report to Tropman & Tropman Architects, 2021.
[33] Casey & Lowe 2021: 5-6.
[34] Casey & Loew 2021: 17.
[35] Kass p27.

newspaper report describing Glenlee Estate noted that “Every paddock is wire fenced, newly constructed”.[36]

It seems likely that the original Glenlee Estate had hedge type fencing which according to Pickard was relatively rare in the colony, but later subdivisions to create paddocks for sheep and cattle were constructed by post and wire fences. Archaeological remains of post and wire fences would be represented by the post holes, while the hedges would likely be represented by lines of roots and soil discolouration. It is unlikely that other substantial remains of the fences would have survived when they were removed.

The potential of the roads and carriageways at Glenlee caught Higgenbotham’s attention as he had recently (1984/85) undertaken archaeological work at Elizabeth House and Vaucluse House where his excavations were able to locate former alignments of carriage drives and paths.[37] Both these projects demonstrate that the archaeological remains of such structures exist even if buried by later deposits. The key remains were evidence of the gravel (or metalled) surface and underlying footing for the surface.

However, it should be noted that in the normal course of maintenance tracks and roads are often resurfaced involving excavation of the existing surface and foundation, grading to remove ruts and potholes and then relaying of a foundation layer and road surface. This action would remove most evidence of earlier road surfaces. Furthermore, owing to the more rural location of the estate, it is likely that earlier roads and carriageways at Glenlee would primarily have been dirt or gravel. No historical evidence has been identified of substantial upgrading or formalisation of the roads and carriageways prior to when they were asphalted. This limits the potential for substantial evidence of earlier road construction to survive in the study area. While archaeological evidence of previous road alignments and construction may survive in the study area, the date of these would likely to be more recent than the original carriageways observed in the 1830s.

A review of historical maps and plans has not identified the presence of any other substantial structures within the study area. The main estate buildings were primarily located near the main homestead, and while other outbuildings and huts were located in the surrounding fields, they do not appear to overlap the study area (Figure 19). It is likely that former outbuildings located in the fields would have been smaller in size and/or would have primarily served as agricultural structures such as sheds. Remains of these outbuildings would likely be more ephemeral in nature, possibly consisting of postholes. Substantial occupation deposits are unlikely to be found in association with these outbuildings.

Based on the location of the study area and the historical research the following assessment of archaeological potential has been made. The whole of the study area is considered to be of Nil to Low except for the areas discussed in Table 4 and Figure 20, which are considered to have Low archaeological potential.

It is noted that with the exception of isolated finds, the potential archaeological remains would likely be limited to evidence of structural remains or agricultural infrastructure such as building remains, fence posts, or field drains. Substantial deposits of artefacts are unlikely to be present.

[36] *Camden News*. “The Glenee Estate.” August 24, 1905. http://nla.gov.au/nla.news-article133122092.
[37] Broadbent, James. "Garden Archaeology at Elizabeth Farm and Vaucluse House." *Historic Environment* 4, no. 3 (1985): 17-28.

Table 4: Summary of archaeological potential for the study area

Historical phase	Events	Archaeological potential
Phase 1: 1812-1859	Establishment of Howe's estate 'Glenlee'	Low potential for remains of the original driveway/ carriageway for Glenlee. Low potential for remains of early fences and field systems. Nil to Low potential for evidence of undocumented outbuildings
Phase 2: 1859- c1910	Fitzpatrick era – mainly leased to tenants	Low potential for remains of farm buildings, fences, and earlier road alignments
Phase 3: 1910-1960s	Mostly used as a dairy by the Fitzpatrick family	Low potential for remains of the former road to the dairy which incorporated the original driveway/ carriageway for Glenlee



Figure 19: Proposed feeder route overlain on the 1862 plan, showing the outline of the fenced paddocks and roads that intersect the feeder route, and the former buildings and structures that are avoided (Source: Old System Deed, Book 80 No 475 1862)

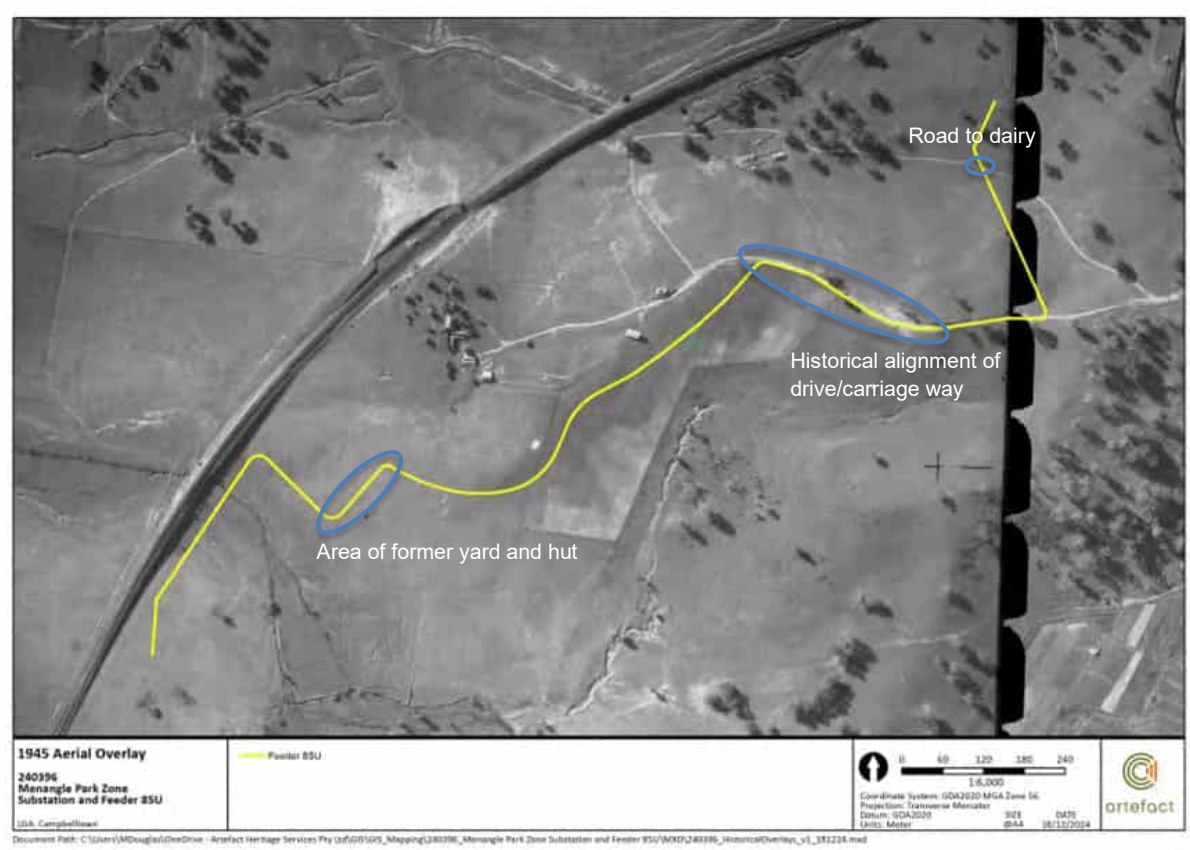


Figure 20: Location of areas of archaeological potential

Archaeological research potential

"Archaeological research potential is the ability of archaeological evidence, through analysis and interpretation, to provide information about a site that could not be derived from any other source, and which contributes to the archaeological significance of that site and its 'relics'".[38]

Archaeological potential identifies whether archaeological remains might be present on the site. Archaeological research potential assesses whether archaeological remains are significant. This is a critical part of any archaeological assessment, as archaeological management is based on significance rather than simply the presence of archaeological remains.

While Casey Lowe reported on the archaeological research of properties similar to Glenlee, the research questions generally related to information about site formation and identification. The most developed of these projects was the work at Belgenney Farm.

Higgenbotham's three seasons of excavation at Belgenny farm had a research focus on (successfully) identifying the location of a hut and recording it, but also had the aim of investigating the research theme of "Landscape of the Assigned Servant".[39] Higgenbotham stated that the 'Landscape of the Assigned Servant' was a relatively new theme in historical and archaeological investigation. "It seeks to understand the assignment of convicts as farm labour, up to the end of transportation to NSW in 1840. The theme includes the living and working conditions of convicts on

[38] Heritage Branch of the Department of Planning. 'Assessing Significance for Historical Archaeological Sites and "Relics"', 2009, p11.
[39] Higgenbotham, Edward. "Report on the Archaeological Investigation (Season 3, 2010) of the Site of the 'Small Miserable Hut', near Belgenny Farm, Elizabeth Macarthur Avenue, Camden, N.S.W." Prepared for Belgenny Farm Trust by Edward Higginbotham, 2010.

farms, as well as the administration and control of this convict population, through the magistrates and Mounted Police, the courthouses and gaols".[40] This theme has only a limited application to the study area though as it is not expected that evidence of convict labour from this period would be identifiable in the study area, and the study area avoids former domestic sites.

There are research questions to be asked about the location of some farm activities and how the Glenlee Estate was farmed. There is a suggestion in the historical research that Glenlee was a modern farm in the sense that new and innovative practices were implemented there during the historical phases. Evidence of farming activities in the form of buildings, agricultural infrastructure, and landscapes might be able to round out the history of Glenlee as a farm. However, the research potential would depend on the condition and type of archaeological remains that survive. For example, while evidence of post and wire fences or quince / lemon-tree hedges could survive, minor remains of these may not be able to demonstrate the type of post and wire fences used or how the hedges were created and maintained.

Carriageways and farm roads have been noted as being important in the way a homestead is presented to the owners' visitors, and archaeologists have recorded carriageway surfaces from sites such as Elizabeth Farm and Vaucluse House. If evidence of the original carriageway into Glenlee homestead is encountered, then it would add to the overall history of the homestead. It might be difficult however to attribute evidence of a carriageway to a particular phase in Glenlee's history given that carriageways would have been continually maintained, and this maintenance would likely have replaced original surfaces.

Overall, it is considered that if intact archaeological remains of historical farming activities were identified then they may have moderate research potential, and as a result the archaeological remains may reach the threshold of local significance. It is noted however that the archaeological potential of the study area has been assessed as being Nil to Low or Low, and if the archaeological remains are minor and/or heavily truncated then it is unlikely that they would reach the threshold of local significance.

As substantial deposits of historical artefacts are not expected to be present in the study area, it is important to note that archaeological remains that could be present would be considered 'works' rather than 'relics' as defined under the Heritage Act.

Table 5: Summary of archaeological research potential for the study area

Historical phase	Events	Archaeological potential	Archaeological research potential
Phase 1: 1812-1859	Establishment of Howe's estate 'Glenlee'	Low potential for remains of the original driveway/ carriageway for Glenlee. Low potential for remains of early fences and field systems	Remains of original carriageways would have a **moderate** archaeological research potential to document how the early drives were constructed. Remains of farm buildings and fences would have a **moderate** archaeological research potential to address questions about where farming activities occurred. Intact remains would reach the threshold of local significance.

[40] Higgenbotham 2010 p20.

Phase 2: 1859- c1910	Fitzpatrick era – mainly leased to tenants	Low potential for remains of farm buildings and fences	Remains of farm buildings and fences would have a **moderate** archaeological research potential to address questions about where farming activities occurred. Intact remains would reach the threshold of local significance.
Phase 3: 1910-1960s	Mostly used as a dairy by the Fitzpatrick family	Low potential for remains of the former road to the Dairy which incorporated the original driveway/carriageway for Glenlee	Remains of original carriageways would have a moderate archaeological research potential to document how the early drives were constructed. Intact remains would reach the threshold of local significance.

Assessment of heritage impact

Physical impacts

The proposed works would not be located within the heritage curtilage of Glenlee (SHR & LEP #00009). The proposed feeder route has been designed so that it would be located immediately adjacent to the curtilage but would not extend into it. The heritage property would be separated from the study area by the extant property fence, which would not be modified, and as a result there would be no risk of works inadvertently entering the heritage item. Therefore, the proposed works would cause **little to no** physical impacts to Glenlee (SHR & LEP #00009).

Visual impacts

The proposed works would not involve the installation of any permanent installations or above ground infrastructure within or in the immediate vicinity of Glenlee (SHR & LEP #00009). The proposed feeder would be installed underground outside the curtilage of the heritage item and there would be no physical modification of any elements that form part of the heritage item. Above ground modifications would be limited to the location of the existing substation to the south, however, this is located more than 400m from the heritage item. As a result, it is not expected that the removal and replacement of the existing substation would cause an adverse impact to the setting of Glenlee.

While the works are being carried out there would be temporary visual impacts caused by the presence of equipment and plant near the heritage item. However, this impact would be localised, would be temporary in nature, and would be resolved upon the completion of the works and the reinstatement of the ground surface. Overall, the proposed works would cause **little to no** visual impacts to Glenlee (SHR & LEP #00009).

Archaeological impacts

Historical research and a review of historical maps and ariel imagery has identified little to no evidence of substantial historical development within the study area. As a result, it has been identified that the proposed works would be limited to areas that have been assessed as having Nil to Low and Low potential to contain archaeological remains of agricultural activities that would reach the threshold of local significance. In addition, the proposed works would be limited to the single feeder route that would include sections of underboring. Therefore, given the low archaeological potential, it is expected that the proposed works would cause **little to no** impacts to significant archaeological remains.

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It is not expected that there would be any impacts to state significant archaeological remains or remains that are considered to be 'relics' as defined under the Heritage Act.

Summary of heritage impact

A statement of heritage impact has been prepared according to NSW Heritage guidelines and is presented in Table 6.

Table 6: Statement of heritage impact

Development	Discussion
What aspects of the Proposal respect or enhance the heritage significance of the study area?	The proposed works have been designed to avoid the curtilage of the heritage listed Glenlee (SHR & LEP #00009) and would not cause any long-term impacts to the heritage item.
What aspects of the Proposal could have a detrimental impact on the heritage significance of the study area?	The proposed works would be undertaken in the immediate vicinity of Glenlee (SHR #00009) and the presence of equipment and plant would cause temporary visual impacts to the heritage item. However, the visual impact would be minimal and would be resolved upon the completion of the work. As a result, there would be no long-term impacts to the heritage item. Given the low potential for archaeological remains it is expected that there would be little to no archaeological impacts.
Have more sympathetic options been considered and discounted?	The works have been designed to avoid any long-term impacts to the heritage listed Glenlee (SHR & LEP #00009). It is not expected that an alternative design would be less impactful, and therefore the proposed design is suitable.

Approval pathway

The proposed works would be located adjacent to the heritage curtilage of Glenlee (SHR & LEP #00009). However, the works would not extend into the heritage curtilage and would not cause any adverse heritage impacts. Furthermore, it has been assessed that there is generally Nil to Low or Low potential for archaeological remains of local significance, and no impacts to archaeological 'relics' are expected. As a result, no approvals or permits under the Heritage Act are required.

Conclusions and recommendations

Conclusions

This SoHI has made the following conclusions:

- The proposed works are located outside the curtilage of Glenlee (SHR & LEP #00009). Therefore, there would be **little to no impact** on the heritage item
- The proposed works adjacent to Glenlee (SHR & LEP #00009) would cause temporary visual impacts to the heritage item while the work is being conducted, however, the visual impacts would be resolved upon the completion of the works
- The study area has been assessed as generally having Nil to Low or Low potential to contain archaeological remains of local significance associated with historical farming activities. The

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potential archaeological remains would be limited to archaeological 'works' and not archaeological 'relics' as defined under the Heritage Act

- Due to the low archaeological potential, it is expected that the proposed works would cause little to no impacts to significant archaeological remains
- As the proposed works are located outside of the curtilage of Glenlee (SHR & LEP #00009) and would cause little to no impacts, no external approvals or permits are required under the Heritage Act.

Recommendations

This SoHI makes the following recommendations:

- An unexpected finds procedure must be implemented during ground disturbing works. In the event that potential archaeological remains are discovered during works, works must cease in that location and the remains must be protected, and a suitably qualified archaeologist must be contacted to assess the potential archaeological remains and advise on the required archaeological management. If unexpected 'relics' or state significant archaeological remains are identified, further assessment and approvals may be required
- If there are substantial changes to the proposed scope of works, further assessment should be undertaken to identify if there would be any additional heritage impacts.

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Appendix L Bushfire Assessment

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Bush fire Risk and Operations Plan

Menangle Park Zone Substation and Feeder 85U

Lot 2013 DP1234643 - Fitzpatrick Street, Menangle Park, NSW, 2563

Reference: 242008

Disclaimer

Please note that every effort has been made to ensure that information provided in this report is accurate. It should be noted that the information is for the client for the specific purpose for which it is supplied. This report is strictly limited to the purpose including the facts and matters stated within it and is not to be used, directly or indirectly, for any other application, purpose, use or matter. The photos within this report are submitted in confidence and not for public release.

Due consideration has been given to site conditions and to appropriate legislation and documentation available at the time of preparation of the report. As these elements are liable to change over time, the report should be considered current for a period of 12 months following the preparation of the report. Should further information become available regarding the conditions at the site, BEMC reserves the right to review the report in the context of the additional information. BEMC has made no allowance to update this report and has not considered events occurring after the time its assessment was conducted.

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Title	Bush fire Risk and Operations Plan			
Description	Menangle Park Zone Substation and Feeder 85U Lot 2013 / DP1234643 - Fitzpatrick Street, Menangle Park, NSW, 2563			
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Version Number	**Modified By**	**Modifications Made**	**Date Modified**	**Status**
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2 INTRODUCTION

JBS&G on behalf of Endeavour Energy has engaged BEMC to complete a Bush fire Risk and Operations Plan to operate and maintain a 66/11kV 35MVA Menangle Park Zone Substation at Lot 2013 DP1234643 - Fitzpatrick Street, Menangle Park, NSW, 2563 and a new feeder 85U from Macarthur Bulk Supply Point (**the Site, Figure 1, page 7 and Figure 2, page 8**),

Section 5.5 of the Environment Planning and Assessment Act 1979[1] (EP&A Act) requires that an environmental impact assessment must consider to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed activities. An assessment of potential hazards associated with the substation projects prior to determining the environmental assessment has been completed.

This Bush fire Risk and Operations Plan addresses the potential impacts associated with Bush fire risk. This assessment demonstrates how the proposed substation meets the development criteria for Bush fire protection, specifically for the protection of life and safety, infrastructure and environmental values associated with the Site.

The Project is in a designated Bush fire prone area. All new development on Bush fire prone land must comply with the *NSW Rural Fire Service (RFS) document Planning for Bush fire Protection 2019*[2] (PBP 2019).

This Bush fire Assessment Report supports the environmental impact statement (EIS) for the Project. It documents the assessment of Bush fire risk in accordance with PBP 2019. This technical paper provides an assessment of the forecast impacts of the Project on the surrounding landscape and as required by PBP 2019, with special consideration for the vulnerability of the Project and the mitigation measures in regard to Bush fire.

2.1 PROJECT OVERVIEW

The Project is located in the Campbelltown area of NSW, in the suburb of Menangle Park, about 6.7 km south-west of Campbelltown CBD. The proposed location of the substation is at Lot 2013 DP1234643 (**Figure 2, page 8**).

Endeavour Energy propose to establish a permanent 66/11kV 35MVA Menangle Park Zone Substation (ZS). The substation will strengthen reliability and service the large-scale infrastructure development in the Menangle Park region in line with NSW Department of Planning and Environment (DPIE) plans. The new substation will enhance the supply security and reliability of new developments by providing a diversified 33kV supply and associated fibre optic network.

The new substation will be supplied by two 66kV feeders; the existing feeder 85P and a new feeder 85U from Macarthur Bulk Supply Point (BSP).

[1] Environmental Planning & Assessment (1975) No 203 https://legislation.nsw.gov.au/

[2] NSW Rural Fire Service (2019). Planning for Bushfire Protection – A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners, NSW Rural Fire Service

The scope also includes removing the temporary 66/11kV mobile substation from Menangle Park ZS. Preliminary design/layout for the Feeder route and ZS are presented in Attachments 1, 2 and 3 and further details on the project scope below.

Menangle Park ZS

Site preparation works including:

- Temporary fencing
- Site Clearing
- Civil Works
- Conduits and Trenching
- Transformer Bunds
- Concrete and Footings

Establish a new 66/11kV zone substation including:

- Two 35MVA transformers with space for a future third 35MVA transformer
- A permanent building to accommodate 66kV GIS, 11kV switchgear, protection and control panels, SCADA, communications, batteries, LCC's, PIU's and amenities.

Install:

- Driveway to access power transformers and the switchroom building
- Substation lighting
- Site drainage and sewer and water connection
- Security fencing, signage and gates
- Lightning protection (including 11.5m lightning pole) and insulation
- Fire management system, hydrant system and deluge showers
- Battery systems, earthing, protection, and control systems
- Communication systems including an antenna mounted on 15m concrete pole (note: not currently shown on drawings, to be updated)

Establish landscaping.

Test and commission the installed equipment.

Carry out the Distribution Works including reconnect existing Menangle Park Mobile ZS feeders and low voltage street supply to the new permanent Menangle Park ZS.

After commissioning of the permanent substation, the existing mobile zone substation will be decommissioned and removed. This will involve:

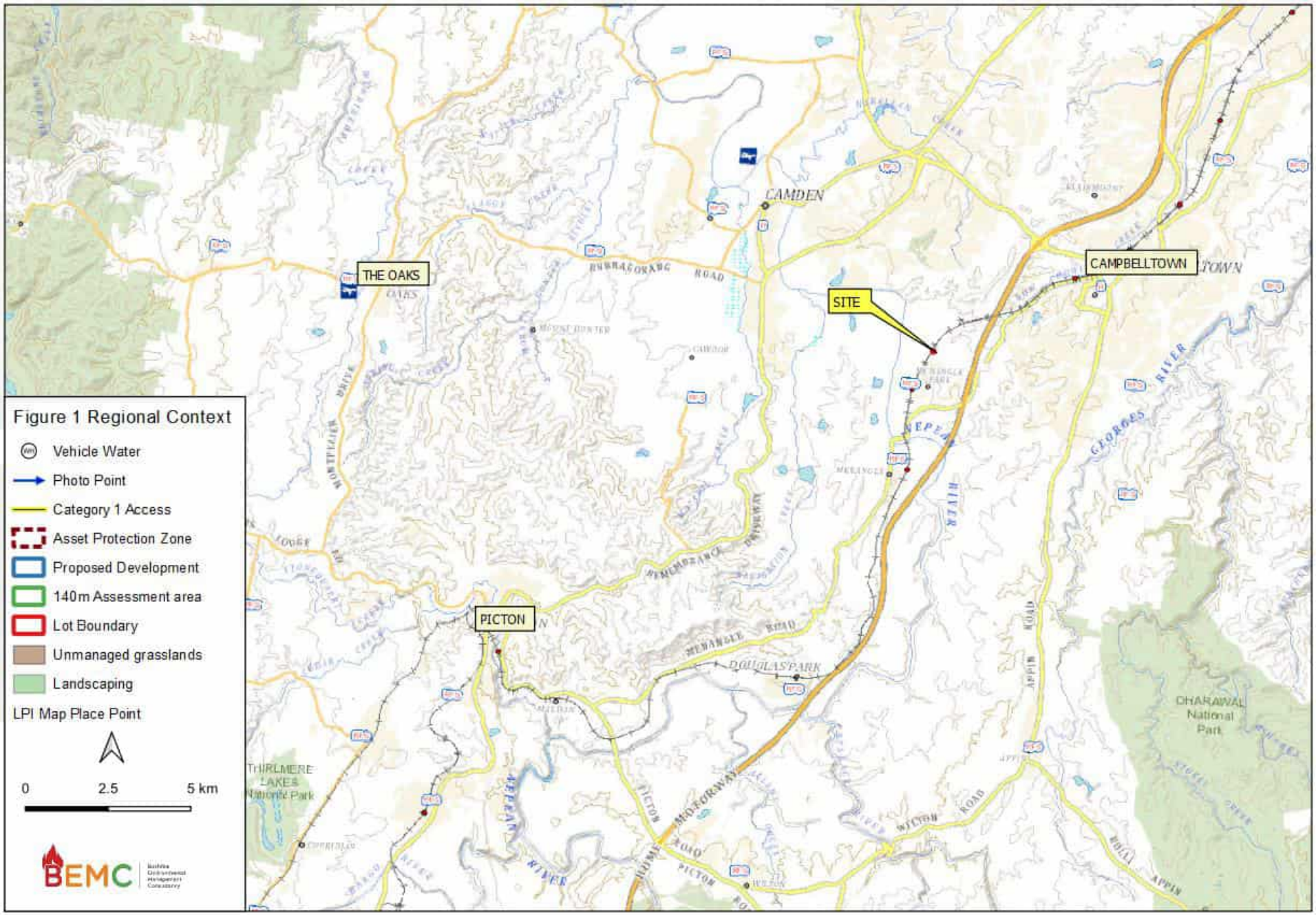
- Relocating decommissioned equipment identified as a spare to relevant storage locations.
- Removal of facilities associated with the mobile zone substation including the amenities building, auxiliary transformer, driveway, bund and security fence.

Transmission Mains

Install new 66kV Feeder 85U from Macarthur BSP to Menangle Park ZS

- The route is approximately 2.1km with 2 joint bays approximately 680-700m apart.
- The feeder will underbore the Riparian corridor (details on depth and length will be provided after Underbore specialist design has been completed).
- Most of the feeder will be open trenched with a depth of cover of approximately 900mm to top of conduit.
- Install fibre optic cable in trench.
- There are 2 sections of this feeder which are still potentially requiring further investigation pending geotechnical assessments, survey data and information from Transport for NSW (TfNSW), and Transgrid.

BE BUSHFIRE READY • BE BUSHFIRE READY • BEMC


Figure 1 Regional Context
Vehicle Water
Photo Point
Category 1 Access
Asset Protection Zone
Proposed Development
140m Assessment area
Lot Boundary
Unmanaged grasslands
Landscaping
LPI Map Place Point
0
2.5
5 km
BEMC
THE OAKS
CAMDEN
SITE
CAMPBELLTOWN
PICTON
THIRLMERE LAKES National Park
DHARAWAL National Park
RUSBRAGORANG ROAD
MOUNTAIN DRIVE
REMEMBRANCE DRIVEWAY
MENANGLE ROAD
DOUGLAS PARK
PICTON ROAD
HUME MOTORWAY
APPIN ROAD
WILTON ROAD
GEORGES RIVER
NEPEAN RIVER
MENANGLE PARK


SITE
Figure 2 Site Location
Proposed Development
Lot Boundary
Cadastral
SixMap Imagery
0
250
500 m
BEMC

3 LEGISLATIVE FRAMEWORK

The statutory requirements outline the relevant statutory and regulatory obligations relevant to Bush fire risk management for the Project. This section also includes relevant policies, standards, and guidelines for the consideration of Bush fire risk for new development.

***Environmental Planning and Assessment Act* 1979**

The (NSW) EP&A Act requires that any development on Bush fire-prone land (BPL) for any purpose complies with the aim and objectives of PBP 2019. SSD is exempt from this requirement but is generally encouraged to comply with PBP. As such, a Bush fire Safety Authority is not required for SSD. However, the SEARs issued under the EP&A Act for this SSD project requires this Project to be assessed against the PBP 2019.

***Environmental Planning and Assessment Act*, 1979: Section 10.3 Bush fire Prone Land**

The designation of Bush fire Prone Land (BPL) in NSW is required under the EP&A Act (s.10.3). BPL Maps provide the trigger for the various development assessment provisions. The BPL Map is a trigger for the consideration of Bush fire matters for new development. It is not intended as a detailed measure of risk.

***Environmental Planning and Assessment Act*, 1979: Section 4.41 Approvals etc legislation that does not apply**

A consented SSD project is not required to secure a Bush fire safety authority under section 100B of the Rural Fires Act 1997.

Rural Fires Act, 1997

The (NSW) Rural Fires Act 1997[3] (RF Act) establishes the NSW Rural Fire Service, defines its functions and makes provision for the prevention, mitigation and suppression of rural fires. Section 63 of the RF Act requires public authorities and owners and occupiers of land to prevent Bush fires and to manage land they are responsible for. The RF Act states that it is the duty of public authorities, landowners and occupiers to take all notified and practical steps to prevent ignition and minimise spread on or from their land. Permits are required to light fires for Bush fire fuel hazard reduction or to clear fire breaks. The Act reiterates that certain instruments under the EP&A Act, NPW Act, Local Government Act 1993, Biodiversity Conservation Act 2016, and the Local Land Services Act 2013 do not apply when responding to fire emergencies.

The RF Act provides for the RFS Commissioner to declare the Bush fire danger period which generally runs from October to March (inclusive), which can be modified by the RFS. Total fire bans (TOBANs) may be issued by the RFS Commissioner in the interests of public safety.

Section 63 places an ongoing Bush fire management requirement on the Project to mitigate the risk of Bush fire within the Project site.

[3] Rural Fires Act (1997), Accessed online: https://www.legislation.nsw.gov.au/#/view/act/1997/65

3.1 GOVERNMENT PLANS, POLICIES, STANDARDS AND GUIDELINES

The relevant guidelines and requirements in NSW for the consideration of Bush fire risk for new development are:

Planning for Bush fire Protection 2019 NSW Rural Fire Service

This document contains specifications for planning and building on land identified as Bush fire prone. PBP seeks to provide for human safety (including fire fighters) during Bush fire events and minimise the effects of Bush fires on property; while considering development potential, site characteristics and protection of the environment. As SSD, the Project is exempt from the requirement under the EP&A Act to comply with PBP. However, the SEARs require compliance with PBP to consider the level of Bush fire risk to and from the Project.

SUBSTATION, substations, and transmission lines are not specifically addressed in PBP. The document sets standards for electrical transmission for residential subdivision and special fire protection purpose developments, the intent of which is to reduce Bush fire risk to nearby buildings or surrounding bush. However, the document also provides guidance for the consideration of Bush fire risk for electrical infrastructure more broadly, which can apply to this Project.

The main Bush fire risk associated with electricity assets as identified by PBP is the risk of ignition associated with electrical conduction. For this risk, PBP refers to ISSC3 - Guide for Management of Vegetation in the Vicinity of Electricity Assets[4] (ISSC, 2016). However, ISSC3 does not provide guidance for transmission lines. Commercial and industrial development with no residential component is held to the aims and objectives of PBP and requires that appropriate Bush fire protection measures be put in place, however, no particular measures are mandated.

Standards for Asset Protection Zones NSW Rural Fire Service[5]

This document provides standards for the establishment and maintenance of asset protection zones. Relevant Asset Protection zones as identified in this document have been considered in the Bush fire planning and design for this Project with the SUBSTATION area and onsite substation being managed as an APZ.

Guide for Bush fire Prone Land Mapping[6]

The identification of Bush fire prone land (BPL) in NSW is required under the EP&A Act. It is the responsibility of local government to prepare the Bush fire Prone Land Map (BPLM) for the local government area. The RFS Commissioner certifies the BPL according to guidance provided by NSW RFS (2015). BPL assessments are based on allocation of the vegetation present into one of three broad categories, as follows:

- Category 1: which includes areas of forest, woodland, heath, forested wetland and timber plantation. Highest risk category

[4] Minimum Vegetation Clearances for Power Lines, ISSC3 - NSW Resources and Energy - NSW Government Accessed online: https://www.resourcesandenergy.nsw.gov.au/energy-supply-industry/pipelines-electricity-gas-networks/electricity-networks/safety/ISSC3-guideline-for-managing-vegetation-near-power-lines.pdf

[5] NSW Rural Fire Service (2005). Standards for Asset Protection Zones. NSW Rural Fire Service, Sydney.

[6] NSW Rural Fire Service (2005). https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0011/4412/Guideline-for-Councils-to-Bushfire-Prone-Area-Land-Mapping.pdf

- Category 2: rainforests and "lower risk vegetation parcels" these parcels contain remnant vegetation, but it is limited in its connectivity to larger areas and contain land management practices and a Bush fire plan that identifies the appropriate management of Bush fire risk
- Category 3: which includes grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands. Moderate risk category
- Exclusion: Areas of vegetation less than 1 hectare and greater than 100 metres separation from category 1, 2 or 3 vegetation; small patches or strips of remnant vegetation; managed grasslands; agricultural cropland; gardens; and mangroves are not mapped as Bush fire prone.

ISSC 20 – Guideline for the Management of Activities Within Electricity Easements and Close to Electricity Infrastructure[7]

The proposed substation transmission line is required to comply with ISSC 20 - Guideline for the Management of Activities Within Electricity Easements and Close to Electricity Infrastructure[8] (ISSC, 2012) which was written to protect public safety and electricity assets and by offering guidance on the management of activities in electricity easements including the consideration of access and safety aspects associated with the operation and maintenance, repair, replacement, upgrade or renewal of electricity infrastructure on property, whilst being mindful of the property owner's rights to maximise use and enjoyment of the land.

Lighting of fires, including planned or prescribed burns, is a controlled activity under ISSC 20 and is subject to consultation and negotiation with the network operator.

[7] Industry Safety Steering Committee. 2012. ISSC 20 Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure. https://www.energy.nsw.gov.au/sites/default/files/2022-08/2012_09_ISSC20_ElectricityEasements.pdf

[8] ISSC 20 - Guideline for the Management of Activities Within Electricity Easements and Close to Electricity Infrastructure https://energy.nsw.gov.au/sites/default/files/2018-09/ISSC-20-Electricity-Easements_0.pdf.

4 LIMITATIONS

Australia has a history of high consequence Bush fires, which have caused loss of life, damage, and disruption. Risk based land use planning provides the tolerable Bush fire risk levels through documents such as PBP 2019, legislation, policy, and guidelines.

Risk based land use planning has consistently been identified as one of the key means to reduce natural disaster risks to assets and communities. Improved risk-based land use planning in areas that are subject to natural hazard are fundamental to developing and enhancing resilient development, critical infrastructure, and communities.

The objectives of PBP 2019 articulates the criteria to determine tolerable risk to assets and people associated with 'other' development. The project is required to comply with PBP and the level of Bush fire risk to and from the project means PBP has been considered and inform the Bush fire management of the Project area. Electricity assets such as substations and high-voltage transmission lines are not specifically addressed in PBP.

To understand the nature of Bush fire risks posed to the assets, people working within the sites and people using the access road to and from the Site, it is critical to contemplate the elements of Bush fire risk which may be relevant.

5 BUSH FIRE RISK

Bush fires are a normal part of the landscape, and due to climate change are predicted to become more severe, more frequent and an increasingly common part of life in eastern Australia. Climate change modelling predicts increasing frequency and severity of fire events correlating with altered rainfall and drought patterns and increasing numbers of severe and intense heat events. As the dryness of more areas increases beyond levels historically considered 'normal', the footprint of areas with a propensity to burn are likely to increase.

Not all Bush fires lead to loss of life or damage to assets. Bush fires of low to moderate intensity often pose little threat to life, property, and community assets. Fire agencies are very successful at extinguishing low to moderate intensity fires before they lead to injury or death. However, Bush fires that burn during dangerous conditions have a much higher risk of leading to loss of life and property and causing significant injuries and environmental impact. The risk is greatest when fire occurs on hot, dry windy days, and where ignition occurs in heavy fuels, and in steep terrain. These conditions present fire that can spread rapidly, crown in forests, produce powerful convection columns and create extensive spot fires ahead of the fire front. This often makes their control impossible until weather conditions moderate.

When fires reach a certain intensity, they are beyond the capacity of firefighting resources to suppress. Firefighting resources are allocated where they will be most effective at protecting lives, not necessarily where property losses are most likely. Firefighting resources are also unlikely to be allocated to property infrastructure and community assets that cannot be defended safely. The Project is in a remote area and may not be actively defended by fire fighters.

Radiant heat is the primary cause of death or serious injury in a Bush fire, and this can impact people at the site or travelling to or from the site. In addition, wind conditions can cause branches and trees to fall and block access roads, making driving hazardous. Smoke and embers will make driving hazardous.

Fires burning under extreme conditions can behave erratically and with intensity well above what has been assessed in this report. This report takes a balanced approach to considering Bush fire risk and has assumed a credible worst case fire scenario burning up to a Catastrophic Fire Danger Rating (FDR). The risk-based approach used in this assessment is that provided by PBP 2019 with a credible worst-case scenario of FFDI 100 or a 1:50 year Bush fire event. PBP 2019 is based on the worst-case scenarios for each of the bush fire behaviour elements of fire weather, vegetation, slope and assumes no human intervention. All development shall be assessed on an individual basis as broad-brush approaches of documents such as PBP 2019 may not be applicable in every instance.

6 ASSESSMENT METHODOLOGY

This assessment of potential hazards and risks including but not limited to assessment of bush fire risk against the PBP 2019. The aim of PBP 2019 is to provide for the protection of human life and minimise impacts on property from the threat of bush fire, while having due regard to development potential, site characteristics and protection of the environment. The objectives are to:

- Afford buildings and their occupants protection from exposure to a Bush fire.
- Provide for a defendable space to be located around buildings.
- Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings.
- Ensure that appropriate operational access and egress for emergency service personnel and occupants is available.
- Provide for ongoing management and maintenance of Bush fire Protection Measures (BPMs); and
- Ensure that utility services are adequate to meet the needs of firefighters.

PBP 2019 articulates the regulatory framework for new development in NSW, along with the relevant bush fire protection measures to be contemplated in the delivery of bush fire-resilient development design. The document provides detailed provisions for various types of development which is focussed at residential and Special Fire Protection Purpose development which are vulnerable uses such as schools, hospitals, aged care etc.

The Project is considered as 'other development' in PBP 2019. 'Other development' includes industrial, commercial and infrastructure development. PBP 2019 does not provide a framework for the Project in a meaningful way as the document is focussed on new residential development in Bush fire Prone Areas. However, 'other development' must satisfy the aim and objectives of PBP 2019. This assessment includes an analysis of the hazard, threat and subsequent bush fire risk to the Project and provides recommendations that satisfy the aims and objectives of PBP 2019.

PBP 2019 identifies the methodology to determine Bush fire Attack Levels (BAL) based on calculated radiant heat levels at a site. This assessment is based on mapping of vegetation formations and slope assessment in accordance with PBP 2019. This assessment is based on a detailed GIS analysis of the site with accessible public data layers utilising the following resources:

- Planning for Bush fire Protection (2019).
- Aerial mapping, and
- Detailed GIS analysis.

Bush fire risk as influenced by fire history and future mitigation strategies (e.g., hazard reduction burning) has no bearing on the determination of bush fire protection strategies for future development of the Project. This is due to the fact that PBP 2019 assesses bush fire threat based purely on vegetation and slope (i.e., hazard and not risk), making the assumption that a fire may occur at a near worst-case fire weather scenario and with maximum fuel loads.

In undertaking the report, BEMC has undertaken a Broader Landscape Assessment of the bush fire risk and review of the Macarthur Bush fire Risk Management Plan 2012[9] to gain an appreciation of the broader risk affecting the Project.

The more detailed consideration of bush fire risk to the project has followed the methodology outlined in accordance with PBP 2019. The following methodology is from Appendix 1 of PBP 2019 which has been used to determine the BAL at the site. The process to determine BAL is outlined below:

To Determine Bush fire Attack Level

- Step 1: Determine vegetation formation in all directions around the building to a distance of 140 metres.
- Step 2: Determine the effective slope of the land from the building for a distance of 100 metres.
- Step 3: Determine the relevant FFDI for the council area in which the development is to be undertaken.
- Step 4: Determine the separation distance by measuring from the edge of the unmanaged vegetation to the closest external wall of an asset.
- Step 5: Match the relevant FFDI, appropriate vegetation, distance and effective slope to determine the appropriate BAL using the relevant tables in PBP 2019.

The vegetation formations (bush fire fuels) and the topography (effective slope) combine to create the bush fire threat that may affect Bush fire behaviour at the Project site, and which determine the planning and building response of PBP 2019. A detailed assessment has been undertaken to determine the Bush fire hazard and likely radiant heat at the Project.

6.1 BUSH FIRE PRONE LAND

The identification of BPL in NSW is provided under Section 10.3 of the EP&A Act. The Site and Project are on designated BPL (**Figure 4, page 16**) and the surrounding grassland area is not managed which causes a bush fire risk. The Bush fire Prone Land Maps provide the trigger for the consideration of bush fire matters for new development. Much of the Project Area is mapped as Category 3 bush fire Prone Land with the proposed transmission line traversing Category 1 land. Category 1 land surrounds the Site. Bush fire Prone Land is considered an area of land that can support a bush fire or is likely to be subject to bush fire attack.

The grassland surrounding the Site is designated as being bush fire prone on the BFPL map and it is able to carry a bush fire. As such, the unmanaged grassland areas have been treated within this bush fire Hazard Assessment as a hazard.

[9]Macarthur Bush fire Risk Management Plan 2012 viewed at https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0017/2393/Macarthur-BFRMP.pdf



Figure 3 *Bush fire Prone Land Map (Extract online Campbelltown Council, 2025)*

6.2 BROADER LANDSCAPE ASSESSMENT

The Broader Landscape Assessment (BLA) examines the area external to the requirements of the planning proposal, extending for approximately two kilometres. The assessment includes an understanding of the bush fire hazards (vegetation extent), the broader road network, proximity to townsites, emergency response capacities, urban areas and suitable destinations within a context of increasing fire behaviour and exposure within the life of the development. It provides a means of quantifying the characteristics and the potential for a landscape scale bush fire when considering the suitability and risk to the development.

The BLA utilises a point-based assessment process to quantify the landscape risk. This enables the identification of the ***actual*** bush fire risk and determines if strict adherence to PBP 2019 is warranted, and if a proposed development is appropriate in the bush fire hazard context.

The likelihood of a bush fire, its severity and intensity, and the potential impact on life and property varies depending on where a site is in the broader landscape. Landscape scale fires will place greater pressure on emergency response capability and will have a wider impact on roads and the length of time roads cannot be safely used. This will affect the likelihood of successful evacuations taking place across larger areas. Multiple factors have been considered for the landscape scale assessment. Key considerations in our assessment have included:

- Extent and continuity of vegetation.
- Topography.
- Prevailing winds.
- The potential fire run and area that is likely to be impacted by the fire.
- The impact on evacuation routes to safer places considering road networks, distances, and
- Landscape factors.
- The location and exposure of the development to Bush fire.
- The ability to seek Bush fire shelter on site or at alternative locations.
- The extent of neighbourhood-scale damage the Bush fire may produce.

Table 1 *Bush fire risk strategic study*

ELEMENT	0 points	1 point	3 points	5 points	SCORE
LAND-USE					
Will the proposed development impact on adjoining lands	Positive impacts on the ability of adjoining landowners to implement Bush fire Protection Measures.	Reduce the requirements of adjoining landowners to implement Bush fire Protection Measures	Adjoining landowners will be required to increase Bush fire Protection Measures	Significantly inhibit adjoining landowners to implement Bush fire Protection Measures.	3
Will the proposed development impact on utilities or add hazards	Positive impacts on utilities or add hazards.	Minor impact on utilities or add hazards although considered within planning constraints.	Major impact on utilities or add hazards.	The wildfire risk profile of significant infrastructure will increase due to this development.	3
Community profile	High social-economic connected community	Rural disconnected community	Low social-economic connected community	Vulnerable development	3
Catastrophic landscape Wildfire Behaviour	Not possible given the broader landscape.	Unlikely given the broader landscape.	Likely given the broader landscape.	Very likely given the broader landscape.	3
EMERGENCY RESPONCE					
Proximity to potential built refuge	Within 5km	5-10km	10-50km	>50km	1
Impact on the ability of emergency services to respond, within fire growth period	Within 5-minutes of a fire stations (RFS or F&R)	Within 45-minutes of >5 fire stations (RFS or F&R)	Within 45mins-minutes of >5 fire stations (RFS or F&R)	<5 fire stations (RFS or F&R) within 45 hr	1
Proposed development within aviation response areas	Located within 15 minutes flight from a Large Air Tanker (LAT) airbase	located within 15-30 minutes flight from a Large Air Tanker (LAT) airbase	located more than 30-minute flight from a Large Air Tanker (LAT) airbase	It is unlikely aviation services deployed to this location.	0
WATER					
Water availability	Stand-along, visual dedicated firefighting water provided	Relies on water system within 70m of furthest elevation of building	Relies on water system within 70m of furthest elevation of building	Relies on natural water supplies (dams, creeks etc.)	0

ELEMENT	0 points	1 point	3 points	5 points	SCORE
		ACCESS			
Local road pattern is suitable during a bush fire	Multiple evacuation routes are possible and connect with the public road network in a direction away from the wildfire threat to refuge location.	More than one egress routes are provided from the property to a safer location.	One egress route is provided, which is <200m from the property to a safer location.	Only one access or egress route with no nearby safe location.	3
Relationship between hazard and vehicle access	Seamless integration with existing settlement - no effect on evacuation.	Short bushland pinch points that may restrict access temporarily or carry fire across roads. Unlikely impact on evacuation.	Pinch points that are likely to restrict access along evacuation routes for short periods (15-30mins) and carry fire across roads.	Large areas of bushland or multiple pinch points along evacuation routes that could block evacuation routes for an extended time.	1
		FUEL HAZARD			
Vegetation continuity	Forested vegetation beyond 140m from the site is scattered with low continuity due to urban development.	Forested vegetation beyond 140m from the site is scattered and isolated, forming a dominate fast moving grassland or open woodland fire event.	Patches of forested vegetation associated riparian and isolated ridgelines beyond 140m from the site may result in localised forest fire event.	Continuous forested areas within mountainous terrain beyond 140m from the site will result in broadscale landscape emergency management operations.	0
Vegetation connectiveness	Forested vegetation corridors beyond 140m are restricted and do not enable landscape fire to enter and move through the site by a continuous fire path.	Forested vegetation corridors beyond 140m from the site exist, although separation >100m between forested vegetation restricting the fire head growth	Forested vegetation corridors beyond 140m from the site exist, although separations <100m existing providing some impact on fire head growth.	Forested vegetation corridors beyond 140m from the site provide for passage of landscape fire to enter and move through the site.	0
Vegetation Location	Wildfire within forests can only approach from one direction surrounded by a suburban, township or urban area managed in a minimum fuel condition.	Wildfire within forests can approach from two directions and the site is within a suburban, township or urban area managed in a minimum fuel condition.	Wildfire within forests can approach from several directions although gaps within forested vegetation are present.	Wildfire within forests can approach from several directions and have hours or days to grow and develop before impacting the site.	3

ELEMENT	0 points	1 point	3 points	5 points	SCORE
Separation	Hazard separation between forested hazard and buildings of greater than 100m.	Hazard separation between forested hazard and buildings of 50-100m	Hazard separation between forested hazard and buildings of 30-50m	Hazard separation between forested hazard and buildings of <30m	5
Vegetation flammability	Within the dominated fire direction, the fire fuel is restricted to surface, partially managed and separated through land use practises.	Within the dominated fire direction, the fire fuel is highly aerated, with significant separations (>50m) between these patches with partially managed vegetation between.	Within the dominated fire direction, the fire fuel is highly aerated, with <50m between these patches with partially managed vegetation between	Within the dominated fire direction, the fire fuel is highly aerated, continuous continuity vertically and horizontally with flammable species.	1
				TOTAL	

6.1 BROADER LANDSCAPE ASSESSMENT RECOMMENDATIONS

The BLA provides a quantifiable assessment of the landscape risk to guide the appropriate level of bush fire protection measures to mitigate bush fire risk to acceptable levels. Future changes in weather[10] [11] [12] have been considered within this assessment and the requirements for bush fire protection measures to be adequate for the life of the property.

The site has an accumulated score between **15 - 30** is considered **MODERATE** risk, strict compliance with PBP 2029 is not warranted and minor deviations from the acceptable solutions of PBP within prior consultation with NSW RFS through a PRE-DA process and applying fire engineering to calculated accurate radiant heat exposures are warranted to achieve acceptable risk level.

[10] Clarke, H., Lucas, C., Smith, P., 2012. Changes in Australian fire weather between 1973 and 2010, International Journal of Climatology. DOI: 10.1002/joc.3480

[11] Douglas, G., 2017. Property Protection from Extreme Bush fire Events under the Influence of Climate Change. Doctor of Philosophy at the Western Sydney University, Sydney, Australia

[12] Lucas, C. 2010. On developing a historical fire weather data-set for Australia. Australian Meteorological and Oceanographic Journal. 60.1-14

6.2 Bush fire Risk Management Plan

The Macarthur Bush fire Risk Management Plan (Risk Plan) is a strategic document that identifies community assets at risk and sets out a five-year program of coordinated multi-agency (state and local) treatments to reduce the risk of bush fire to the assets.

The Risk Plan follows the RFS guidelines for the assessment of bush fire risk. Identifying the level of bush fire risk firstly involved identifying important community assets considered to be at risk from bush fire in the Macarthur BFMC area, and then assessing the likelihood and consequence ratings. The risk planning process requires that all asset types assess the likelihood of a bush fire occurring. This involves considering fire history, including ignition cause and patterns, known fire paths, access, containment potential and potential fire run (size of the vegetated area).

The Risk Plan does not identify the project (**Figure 4, page 19**) although identify the human settlement asset to the south asset number 82 Menangle Park Residential area with a 3A (High bushfire risk). The Risk Plan identifies the broader context as being a Land Management Zone. The Risk Plan notes the following for the Land Management Zone:

Purpose of LMZ: To meet relevant land management objectives in areas where APZs, IMZs or SFAZs are not appropriate.

Suppression objectives: As per the land management and fire protection objectives of the responsible land manager. To undertake mosaic burning to reduce the likelihood of spread of fires.

Zone characteristics: An area in the landscape where land management outcomes are also prioritised such as those related to social, cultural or environmental values, or those related to the management of agricultural and natural resource assets.

Treatment Scheduling: Managed for Natural and cultural outcomes



Figure 4 *Extract from Bush fire Risk Management Plan for the site (source Macarthur Bush fire Risk Management Plan)*

6.3 BUSH FIRE HISTORY

NSW NPWS databases[13] and UNSW 100 Years of Bush fire Data[14] was accessed to determine the fire history surrounding the site There is no fire history within 5km of the site, although the broader landscape (10km) have a documented history of bush fires. **Figure 5, page 20** shows the fire history within 10km of the site. The following large wildfires within 10km recorded:

- Wildfire – 777ha – 1991/2 Wildfire- east of site,
- Wildfire – 109,915ha – 2001/2 Wildfire- east of site, and
- Wildfire – 265ha – 2002 Wildfire- east of site.

While not having been subject to direct bush fire attack, the surrounds have a history of high intensity large bush fires.

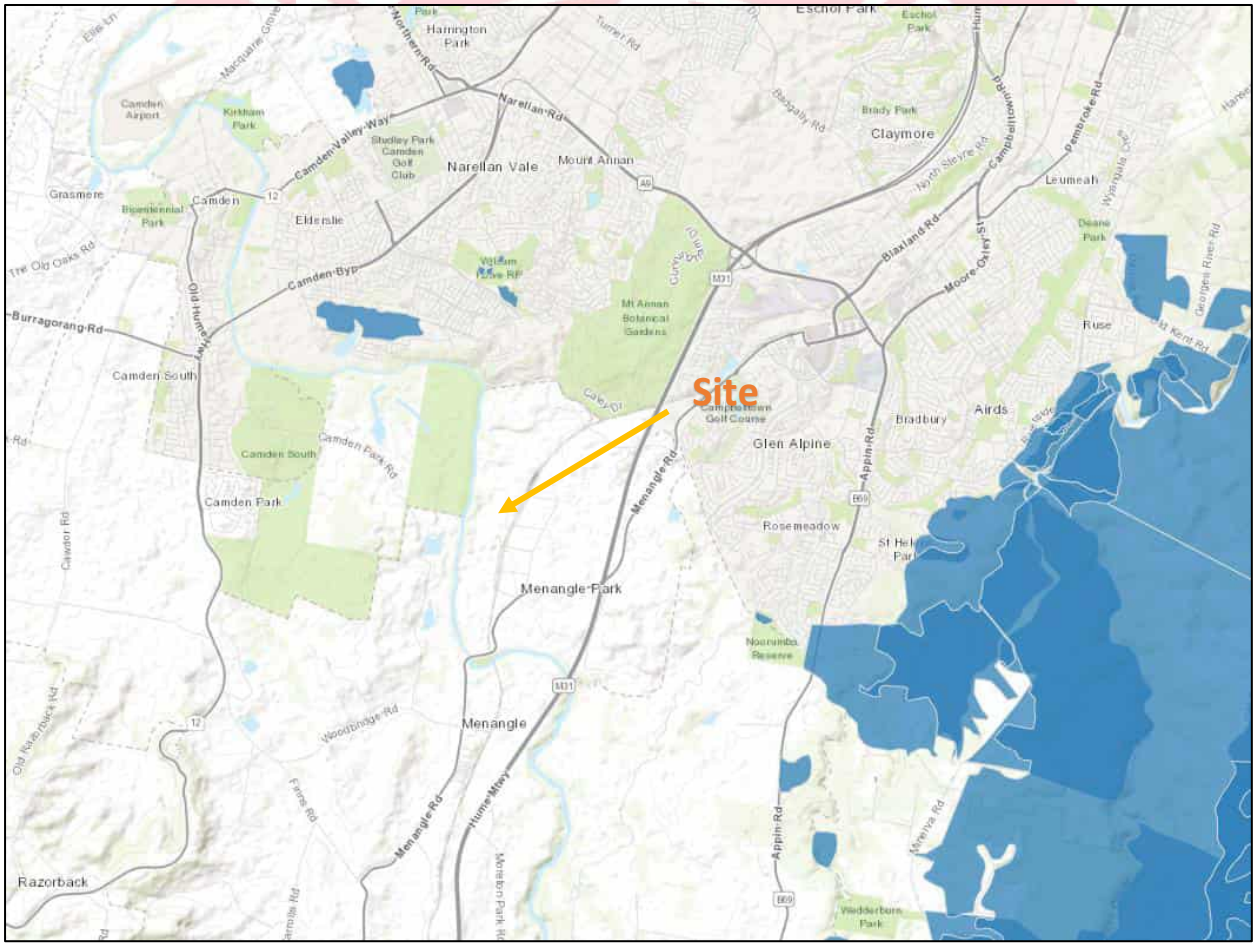


Figure 5 *Bush fire History (Extract UNSW 100 Years of Bush fire Data 2025)*

[13] NSW NPWS databases. https://geo.seed.nsw.gov.au/vertigisstudio/web/?app=cabd04d595ec43c1aaf4298e80e83ec2

[14] UNSW 100 Years of Bush fire Data. https://100-years-of-bushfire-unsw-au.opendata.arcgis.com/

6.4 Fire Weather

The fire weather is dictated by PBP 2019 and assumes a credible worst-case scenario and an absence of any other mitigating factors relating to aspect or prevailing winds. The Forest Fire Danger Index (FFDI) measures the degree of danger of fire in Australian vegetation.

For the purposes of PBP 2019, the FFDI required to be used for development assessment purposes is based on local government boundaries. The Project Area has a FFDI of 100 as required by the RFS and PBP 2019.

It may be possible that days of higher FFDI may be experienced at the Project Area. This may result in fire situations where conditions challenge survivability of buildings and their occupants. The framework provided for by PBP 2019 has been used in this assessment.

6.4.1 Australian fire danger rating system

The principal objective of the new Australian Fire Danger Rating System (AFDRS) is to implement a more accurate and nationally consistent system that will enable improved decision-making by response agencies and industry and provoke the desired community response to messaging in order to improve public safety.

The AFDRS uses the latest scientific understanding about weather, fuel and how fire behaves in different types of vegetation to improve the reliability of fire danger forecasts. This strengthens the ability of those working in emergency services to be better prepared, make improved decisions, and provide better advice to the community.

It is aimed at a simplified, action-oriented Fire Danger Rating System.

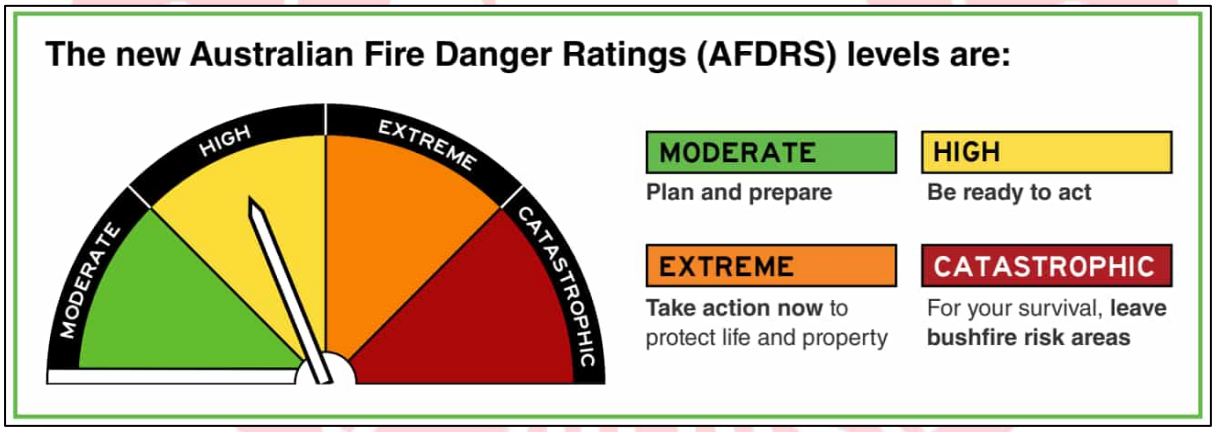


Figure 6 *New Australian Fire Danger Rating System (AFAC, 2022)*

MODERATE: ***Plan and Prepare*** - Have a plan and be ready to act if a fire starts.

HIGH: ***Be ready to act*** - Be alert for fires in your area and be ready to leave or be ready to defend.

EXTREME: ***Take action*** - Act before a fire starts.

CATASTROPHIC: ***Leave high risk areas*** - Protect your life, leave early.

6.5 FM GLOBAL PROPERTY LOSS PREVENTION DATA SHEETS

FM Global Property Loss Prevention Data Sheets[15] provide standards help you reduce the chance of property loss due to fire, weather conditions, and failure of electrical or mechanical equipment, which can be applied to bush fire risk mitigation.

Data Sheet *Understanding the Hazard: Wildland Fire Exposure (P0414)* has been reviewed with the following recommendations incorporated into this plan where appropriate:

- Keep gutter free of debris.
- Cover vents with wire mesh to keep embers out.
- Treat wooden exterior walls with fire retardant paint.
- Remove all combustible yard storage.
- Develop written contingency plans.
- Fully trained and equip emergency response team where required.
- Create clearance zones around buildings and structures.
- Protect windows and frames with shutters.
- Consider protecting ay combustible exteriors walls with sprinklers.
- Provide adequate and reliable water supply.

Data Sheet 9-19, Wildland Fire has been reviewed with the following recommendations incorporated into this risk analysis:

- Strips of vegetation less than 20 m wide perpendicular to the exposed building wall and not within 20 m of the building or other vegetation is not considered a bush fire threat (such as perimeter screening vegetation).
- Apply construction schedules to protect built assets from direct flame, radiant heat and embers.
- Remove all combustible elements (vegetation, wooden fencing and landscaping) within 1.5m of the built asset.
- If the level of radiant heat is higher than 12.5 kW/m^2 for combustible wall construction (timber), or higher than 30 kW/m2 (rounded up from 27 kW/m2 in FM Global Property Loss Prevention Data Sheet 1-20 for this application only) for non-combustible exposed wall construction, then the wildland fire exposure exceeds the passive protection of the exposed building. If the wildland fire exposure exceeds the passive protection further works are required, such as increasing the reduced-fuel zone (APZ); upgrading the construction materials or providing and adequately designed exterior sprinkler systems.
- Avoid combustible yard storage.

Data Sheet 1-20, Protection Against Exterior Fire Exposure has been reviewed with the following recommendations incorporated into this risk analysis:

- The type, height and bulk of yard storage needs to be considered for the separations to buildings.
- Loaded trailers are considered yard storage.
- Provide > 10 m horizontally between combustible yard storage and building air intakes or exhaust vents.
- The location of hydrants needs to be considered in consecutively with yard storage plans.
- Locate dumpsters > 9m from building if opening (windows and doors) in exposed wall and wall has a < 1-hr fire rated.

[15] FM Global Property Loss Prevention Data Sheets. https://www.fm.com/resources/fm-data-sheets

- Provide a water supply capable of providing a minimum duration of 60 minutes to a specific application design within automatic-type sprinklers, water-spray nozzles, corrosion-resistant pipe and fittings and various other requirements.

Data Sheet 3-29, Reliability of Fire Protection Water Supplies
FM Global client loss history in sprinklered buildings shows that lack of adequate valve supervision, impairment handling, and lack of adequate testing and maintenance cause approximately 80% of sprinkler system failures. A further 16% of sprinkler system failures are attributed to prematurely shutting off the sprinkler system during a fire event. There is almost no history of uncontrolled fire losses at adequately sprinklered properties where a single water supply exists that is properly designed, installed, maintained, and tested. For this reason, FM Global recommends a single adequate and reliable fire protection water supply. Additional considerations, such as facility size/value, business continuity, occupancy, arrangement and condition of water supply and geographic location may drive the need for higher levels of reliability and water supply duplication.

Data Sheet 10-1, Pre-incident and emergency response planning has been reviewed with the following recommendations incorporated into this risk analysis where appropriate:

- One of the most significant hazards at a facility is the unexpected, emergency, or upset condition.
- re-incident planning involves working with relevant public services to evaluate current protection systems, building construction, contents, and operating procedures that can impact emergency response.
- Emergency response planning involves developing action plans for site-specific incidents considering the facility's needs and requirements.
- Evaluate the exposure of the facility to any applicable perils and assess the ability to resume
- business after the incident.
- Develop a pre-incident plan that can be executed at the time of an incident.
- Include the expected level of response by facility personnel and external emergency services.
- Implement an incident command system and establish emergency response training requirement.
- Establish clear communication protocols to be followed in an emergency.
- Review and update the pre-incident plan with the appropriate parties and review equipment, storage, property, construction, occupancy, protection, exposures, and any other changes that could affect incident planning.

Data Sheet 10-3, Hot Work Management has been reviewed with the following recommendations incorporated into this plan where appropriate:

- All hot work fires and explosions are preventable. Improperly managed hot work remains a leading cause of large fires and explosions
- Failing to identify and isolate combustible construction in the hot work area increases the likelihood and severity of a hot work fire.
- Failing to identify and isolate combustibles in a hot work high-risk area increases the likelihood and severity of a hot work fire.
- In-service fire protection systems significantly reduce the severity of a hot work fire.
- The overwhelming majority of hot work fires occur while the work is being done or within 60 minutes of completion, highlighting the importance of a fire watch both during and following hot work.

6.6 BUSH FIRE HAZARD ASSESSMENT

The vegetation formations (bush fire fuels) and the topography (effective slope) combine to create the bush fire threat that may affect bush fire behaviour at the site, and which determine the planning response. An assessment of the bush fire hazard is necessary to determine the application of bush fire protection measures such as setbacks from the hazard.

6.6.1 Vegetation Structure

Predominant vegetation is classified by structure or formation using the system adopted by David Keith (2004) and by the general description using PBP 2019. Vegetation types give rise to radiant heat and fire behaviour characteristics. The predominant vegetation has been determined for the Site over a distance of at least 140 metres in all directions from the proposed Site boundary or key assets on the Site. Where a mix of vegetation types exist, the type providing the greater hazard to the Project Area is said to predominate. The land surrounding the dominated with unmanaged grasslands derived from Site is PCT 3320 - Cumberland Shale Plains Woodland (Keith Vegetation Class: Coastal Valley Grassy Woodlands) with small patches of PCT 3110 Greater Sydney Enriched Grey Myrtle Dry (Keith Vegetation Class: Dry Rainforests) within riparian areas in the surrounding creek line and water courses. Inside the facility would be managed to Asset Protection Zone Standards and would be managed land.



Figure 7 *State Vegetation Type Map (SEED Portal, 2025)*

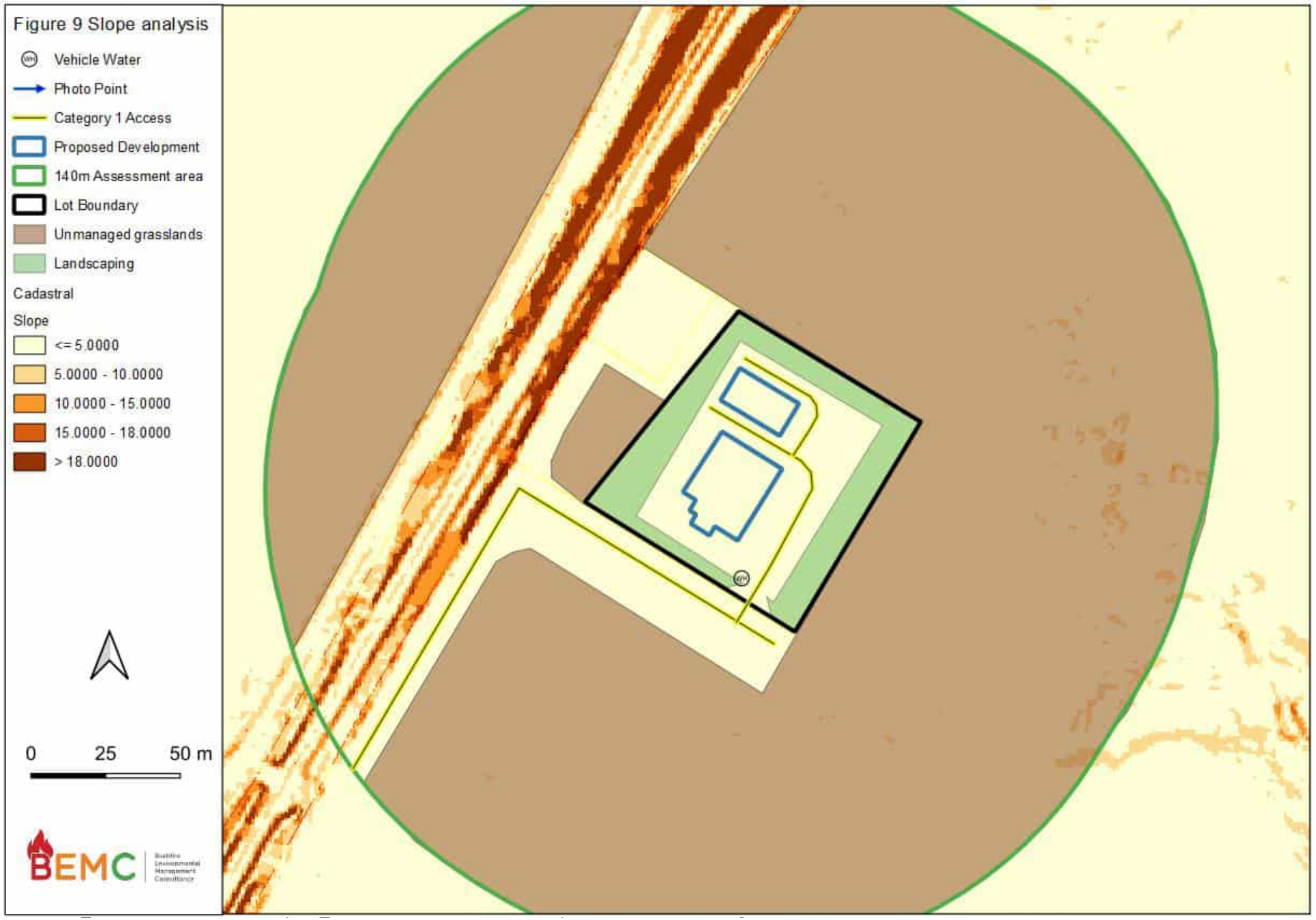
6.7 SLOPES INFLUENCING BUSH FIRE BEHAVIOUR

The slope assessment for the site has been undertaken in the GIS analysis and is a component of determining the BAL rating. The slope of the land under the classified vegetation has a direct influence on the rate of fire spread, the intensity of the fire and the ultimate level of radiant heat flux. The effective slope is the slope of the ground under the hazard (vegetation). It is not the slope between the vegetation and the asset (slope located between the asset and vegetation is the site slope).

The topography of the site and surrounds has been assessed to identify the maximum slope present under the classified vegetation (hazard). Slope data has been calculated from a 1m light detection and ranging (LiDAR) digital elevation model. The source data sets have been captured to standards that are generally consistent with the Australian intergovernmental committee on survey and Mapping LiDAR[16]. Acquisition Specifications with require a fundamental vertical accuracy of at least 0.30m (95% confidence) and horizontal accuracy of at least 0.80m (95% confidence).

The effective slope is considered to be the slope under the vegetation which will most significantly influence the bush fire behaviour for each aspect. This is usually the steepest slope which has been used in this assessment. A detailed slope analysis has been completed at **Figure 9, page 29**. The slopes to the north-east are slight downslope less than 5 degrees.

[16] Elevation Foundation Spatial Data (ELVIS), ANZLIC licence committee on survey and mapping. Accessed online: https://elevation.fsdf.org.au/


Figure 9 Slope analysis
Vehicle Water
Photo Point
Category 1 Access
Proposed Development
140m Assessment area
Lot Boundary
Unmanaged grasslands
Landscaping
Cadastral
Slope
<= 5.0000
5.0000 - 10.0000
10.0000 - 15.0000
15.0000 - 18.0000
> 18.0000
0
25
50 m
BEMC

6.8 SETBACKS FROM HAZARD AND BUSH FIRE ATTACK LEVELS

The forest vegetation surrounding the site is broken into woodland vegetation along riparian and transport corridors resulting in predominate grassland bush fire hazard within 1km of the site. Grass fires is different to that of fires in other vegetation types. Grass fires burn at a higher intensity and spread more rapidly with a shorter residence time with lower embers density and short spotting range.

The predominant (direct) threat to the substation is from grassfire being driven by north westerly or westerly winds into the Site. The risk posed by grassland fire to the site is possible with potential for large runs of uncontrolled fire through the landscape to the north-west creating increased ember potential. The vegetation surrounding the substation is mapped in the Risk Plan (see **Section 6.2, page 22**) as a Land Management Zone with the management objective to:

- As per the land management and fire protection objectives of the responsible land manager. To undertake mosaic burning to reduce the likelihood of spread of fires.

The Bush fire Attack Levels (BAL) for the Site have been determined in accordance with PBP 2019 and the Australian Standards for Construction of Buildings in Bush fire Prone Areas (AS3959:2018) [17] The BAL is a means of measuring the severity of a building or assets potential exposure to ember attack, radiant heat and direct flame contact (**Table 2, page 31**).

The 2022 edition of the National Construction Code (NCC 2022)[18] through AS3959 and in PBP, the BAL is used as the basis for establishing the requirements for construction to improve protection of building elements and to understand the radiant heat exposures for people in the open. The impact of the radiant heat associated with the BAL is shown in **Table 2, page 31.**

The BAL assessment, inclusive of radiant heat and APZs (**Figure 10, page 32**) has been completed based on the current boundary of the Substation facility and that all vegetation within the Substation facility would be managed as an APZ. This will help attenuate/ reduce the radiant heat received on the buildings and infrastructure within the facility.

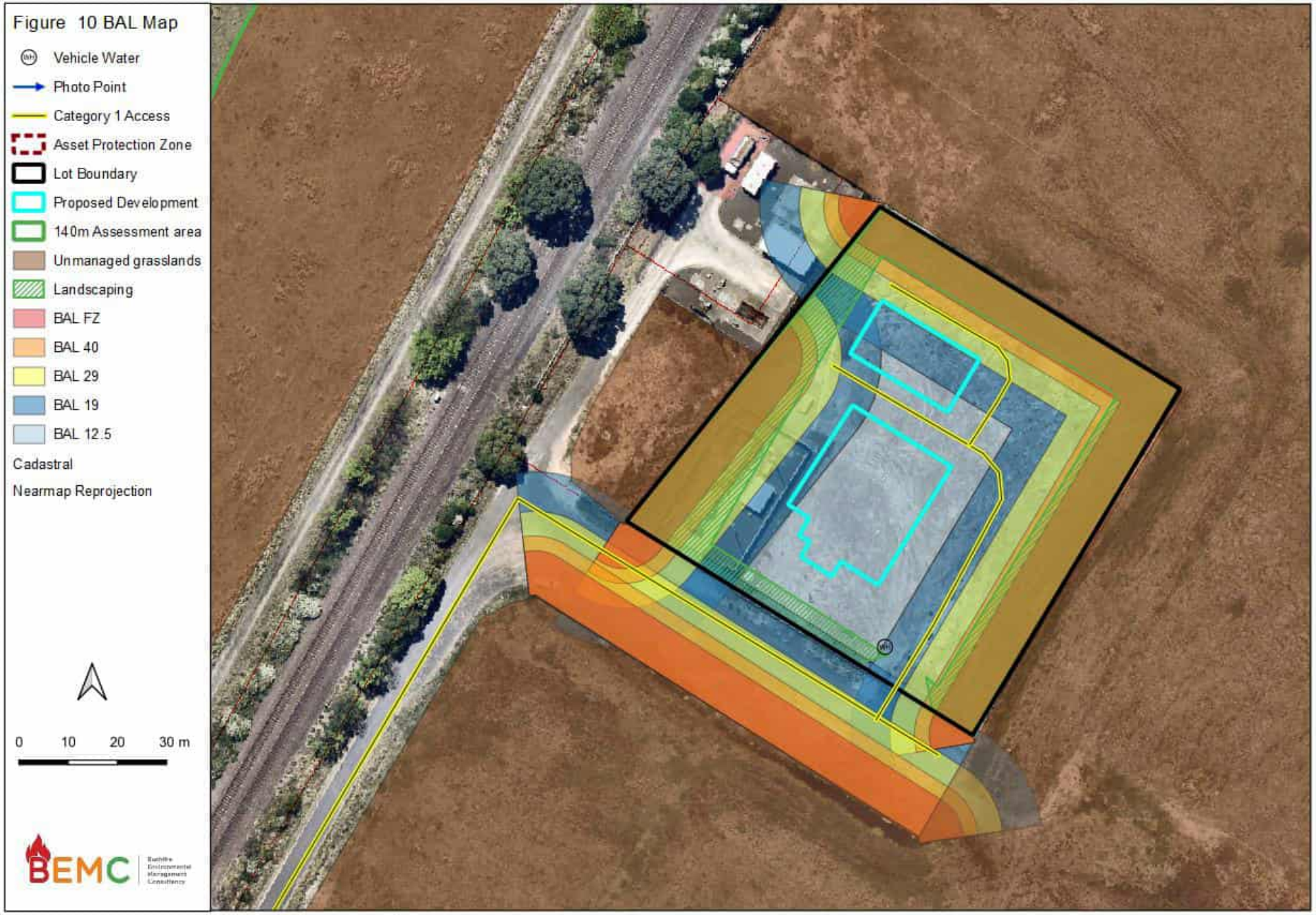
The tolerable risk of radiant heat at the assets will be determined during detailed design work. Subsequent mitigation strategies depending on the vulnerability will then be put into place. The actual location of heat-sensitive components within the substation would not be confirmed until detailed design.

[17] Councils of Standards Australia (2018), AS 3959:2018: Construction of Buildings in Bush fire-prone Areas. SAI Global

[18] Australian Building Codes Board (2010), Building Code of Australia, Class 1 and Class 10 Buildings, Housing Provisions Volume 2.

Table 2 *Bush fire Attack Levels (BAL) (source AS395:2018)*

Bush fire Attack Level	**Radiant Heat Flux exposure**	**Description of predicted** Bush fire **attack and levels of exposure**
BAL - Low	N/A	There is insufficient risk to warrant specific construction requirements
BAL – 12.5	<12.5 kW/m2	Ember attack
BAL – 19	>12.5kWm2 - <19kWm2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux
BAL – 29	>19kWm2 - <29kWm2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux
BAL – 40	>29kWm2 - <40kWm2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux with the increased likelihood of exposure to flames
BAL – Flame Zone	>40kWm2	Direct exposure to flames from the fire front in addition to radiant heat flux and ember attack.


Figure 10 BAL Map
Vehicle Water
Photo Point
Category 1 Access
Asset Protection Zone
Lot Boundary
Proposed Development
140m Assessment area
Unmanaged grasslands
Landscaping
BAL FZ
BAL 40
BAL 29
BAL 19
BAL 12.5
Cadastral
Nearmap Reprojection
0
10
20
30 m
BEMC

7 ASSESSMENT AND MITIGATION OF POTENTIAL IMPACTS – CONSTRUCTION

This section presents an assessment of the potential impacts that could not be avoided or minimised and are expected to occur as part of construction.

The key potential impacts relating to bush fire during construction include:

- On-site ignitions which may result in a fire escaping to the surrounding land and spreading in an uncontrolled manner causing damage to assets external to the site.
- Occupational fire risk being the risk of workers being caught by out-of-control Bush fire impacting the site or while using the access and egress routes.
- Provision of access for first responders.
- Water for firefighting - given the remote location, an adequate supply of water is essential for first response firefighting purposes.
- Emergency management during construction.

7.1 ON-SITE IGNITIONS

Construction activities pose risks for on-site ignitions which may result in a fire escaping to the surrounding land. These mainly arise from hot work, fire risk work, vegetation clearing and management and use of vehicles onsite.

Hot work (activities involving high temperatures) and fire risk work (activities involving heat or with the potential to generate sparks) from maintenance activities may cause fire ignition. These works will be managed under a Hot Work and Fire Risk Work procedure, with measures including suspension of activities on days of elevated fire danger. Certain maintenance activities, including hot works, are prohibited by law on any day declared to be a Total Fire Ban (TOBAN)[19]. Essential work during operations may be completed on a TOBAN providing it complies with the Hot Work and Fire Risk Work procedure and any exemption provided by the NSW RFS.

All land managers have responsibilities to prevent the occurrence and spread of fire on or from their land. Escaped fire may result in legal action and punitive damages. Reputational risk is an issue to be managed to ensure that contractors do not initiate an out-of-control fire that impacts surrounding assets and values.

The Project and associated APZ is in existing managed and cleared lands. The substation facility would be managed as an APZ. **Table 3, page 34** provides guidelines on what activities should be undertaken during Fire Danger Periods.

[19] NSW RFS Total Fire Ban http://www.rfs.nsw.gov.au/fire-information/fdr-and-tobans

7.2 STRATEGIES TO SUPPRESS UNPLANNED FIRES

Fire suppression actions start from the time the fire is detected until it is extinguished. Bush fire suppression operations are to ensure the safety of all staff and visitors; the effective protection of human life, facility, and community assets; and reduces ignition potential on site to acceptable levels. On 'Total Fire Ban' days no vegetation management or hot works will be undertake unless notification and approved through *S.99 NSW RFS* is obtained. Only general maintenance works that do not require mechanical machinery that can create an ignition source will be permitted during 'Total Fire Ban' days.

***Table 3** Activities and Fire Behaviour Ratings*

ELEMENT	NONE	MODERATE	HIGH	EXTREME	CATASTROPHIC
Preparedness for ignition	Assessing the required level of day-to-day preparedness by monitoring Fire Danger Indexes and synoptic conditions on a continuous basis throughout the fire season. Identifying pre-emptive incident management and ensure staff are aware of response procedures. Prior to each fire season an annual and biannual inspection of the fire management requirements.				
Response to ignition	No requirements for specific wildfire preparedness or suppression.	Plan and commence preparation for a wildfire. Check fire equipment.	Fire suppression equipment tested, water ready and ready to act.	Fire suppression equipment tested, water ready and ready to act. Monitor for ignition points, if fire growth	Leave bush fire risk areas.
Minimise hot works through appropriate work scheduling		If deemed appropriate. Hot works should be accompanied by a spotter and a fire extinguisher.	If deemed appropriate. Hot works should be accompanied by a spotter and a fire extinguisher.	No hot works	No hot works
Minimise vegetation maintenance activities through appropriate work scheduling		No requirements	If deemed appropriate. Vegetation management should be accompanied by a spotter and a fire extinguisher/ fire vehicle.	If deemed appropriate. Vegetation management should be accompanied by a spotter and a fire extinguisher / fire vehicle.	No vegetation maintenance activities

7.3 OCCUPATIONAL FIRE RISK

Considering the bush fire risk and recent fire history to the east of the Site, a key risk management activity during construction would be to not expose people to unreasonable risk. The most effective way to reduce loss of life risk is to not occupy the Project Area on above established thresholds for FFDI and fires within the surrounding landscape. This would need to occur with an understanding of the evacuation time from the Site and potential for fire to burn through the evacuation roads.

It is recommended that non-essential works be postponed on days with Fire Danger Rating (FDR) of Extreme or greater. This will reduce the risk to personnel by out-of-control bush fire impacting the Site or access and egress routes.

7.4 NS187 PASSIVE FIRE MITIGATION DESIGN OF MAJOR SUBSTATIONS

NS187 passive fire mitigation design of major substations[20] provides industry best practise for Fire mitigation design of substations. The document provides guidance for protecting the substation against bush fires. It does not cover the requirements for protecting the bush against fire from equipment failure. Key points in protection during bushfire events include:

- Availability to maintain supply during and after the bushfire to support the needs of the local community.
- Overall approach taken will be site dependent and based on substation criticality.
- Table 3 within *NS187 passive fire mitigation design of major substations* provides the radiant heat flux limits for different equipment types.
- Adequate set-backs from property boundaries or suitable fire barriers are considered the main defence against radiant heat damage from bushfires.

The following principles are applied:

- Substations deemed to be in bushfire-prone areas shall satisfy all the requirements of AS 3959 Construction of buildings in bushfire-prone areas and the NSW Rural Fire Services (RFS) guide, Planning for Bushfire Protection (PBP).
- A minimum distance to combustibles (using 12.5 kW/m^2 where flame impingement is possible) shall be adopted at the boundary, or the yard fence depending on the land use within the boundary.
- Substation should be able to shut down safely in the event of radiant heat damage. Assessment of criticality should consider substation importance, reliability of supply, repair / replacement options, potential bushfire exposure and other aspects.
- Consideration shall be given to further measures aimed at preventing a fire from entering through openings, roof systems, or any other means.
- All external doors must match the fire performance FRL of the building and be fitted with fire resistant smoke seals at the base of the door to prevent embers entering under the door.
- All switchyard equipment must therefore be adequately set back from the boundary or fire barriers are to be provided and consideration shall be given to the protection of combustible switchyard equipment against ember damage.

[20] NS187 passive fire mitigation design of major substations https://www.ausgrid.com.au/-/media/Documents/Technical-Documentation/NS/ns187.pdf

- APZ widths may potentially reduce where critical exposed elements nearest the boundary are able to be locally protected and/or rapidly replaced following a bushfire event.
- Substations must be inspected and cleaned regularly to prevent the build-up of any combustible matter.
- Where bushfire protection is required, the radiant heat exposure limits provided in Table 3 (extracted and provided in **Table 4, below**).
- The radiant heat limits are applicable to identified critical substation structures and HV components. Critical elements are those deemed to be essential for return to service following a bushfire event.

Item	Maximum allowable radiant heat flux (kW/m^2)	Comment
Cable	12.5 20	PVC Cables begin to distort and may ignite. Ignition of XLPE cables between 85 and 550 seconds.
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. Applies where elastic deflections due to elevated temperatures are not critical.
Porcelain bushing/Insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions.
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators.
Transformer tank	>35 (see Note 1)	Refer to above regarding bushings and cables.
Combustibles	12.5	Piloted ignition may occur on timber.

Table 4 *Radiant Heat Exposure Limits for Bushfires (extract Table 3 NS187 passive fire mitigation design of major substations)*

8 ASSESSMENT AND MITIGATION OF POTENTIAL IMPACTS

This section presents an assessment of the potential impacts that could not be avoided or minimised and are expected to occur as part of operation. The key potential impacts relating to bush fire during operation include:

- On-site ignitions which may result in a fire escaping to the surrounding land and spreading in an uncontrolled manner causing damage to assets associated with the substation or external to the site.
- Occupational fire risk being the risk of workers being caught by out-of-control bush fire impacting the site or while using the access and egress routes.
- Provision of access for first responders.
- Water for firefighting - given the remote location, an adequate supply of water is essential for first response firefighting purposes.
- Emergency management during operation.
- Disruption to power supply if the site is impacted by fire, and
- Loss of critical infrastructure.

8.1 ON SITE IGNITIONS

Hot work (activities involving high temperatures) and fire risk work (activities involving heat or with the potential to generate sparks) from maintenance activities may cause fire ignition. These works would be managed under a Hot Work and Fire Risk Work procedure, with measures including suspension of activities on days of elevated fire danger.

8.2 DISRUPTION TO POWER SUPPLY IF THE SITE IS IMPACTED BY FIRE

Uncontrolled bush fire has the potential to impact the substations and associated infrastructure. Bush fire impact could damage or destroy the substation infrastructure to an extent that can stop the transmission of power for the site and cause power outage. Mitigation measures will be considered in the detailed design.

8.3 LOSS OF CRITICAL INFRASTRUCTURE

Uncontrolled bush fire has the potential to impact the substation and associate infrastructure directly. Bush fire impact can damage or destroy the batteries, transmission lines, other critical infrastructure or the transmission network that can stop the transmission of power and cause power outage. Bush fires can cause the destruction of assets that are essential to power transmission.

8.4 APZ MAINTENANCE

Ongoing vegetation management would be in accordance with Bush Fire Operations Plan which would include routine inspections of the Project. Ongoing management would fall under an inspection and maintenance program, which would include identification, recording, prioritisation, and rectification of defects. These vegetation management standards are essential to maintain the safe and effective functioning of the transmission connection, and to minimise the risk of fire ignition from vegetation coming into proximity to the substation. APZs will be managed in accordance with RFS Standards for Asset Protection Zones to provide minimal ground fuel to support a fully developed bush fire.

8.5 MITIGATION MEASURES

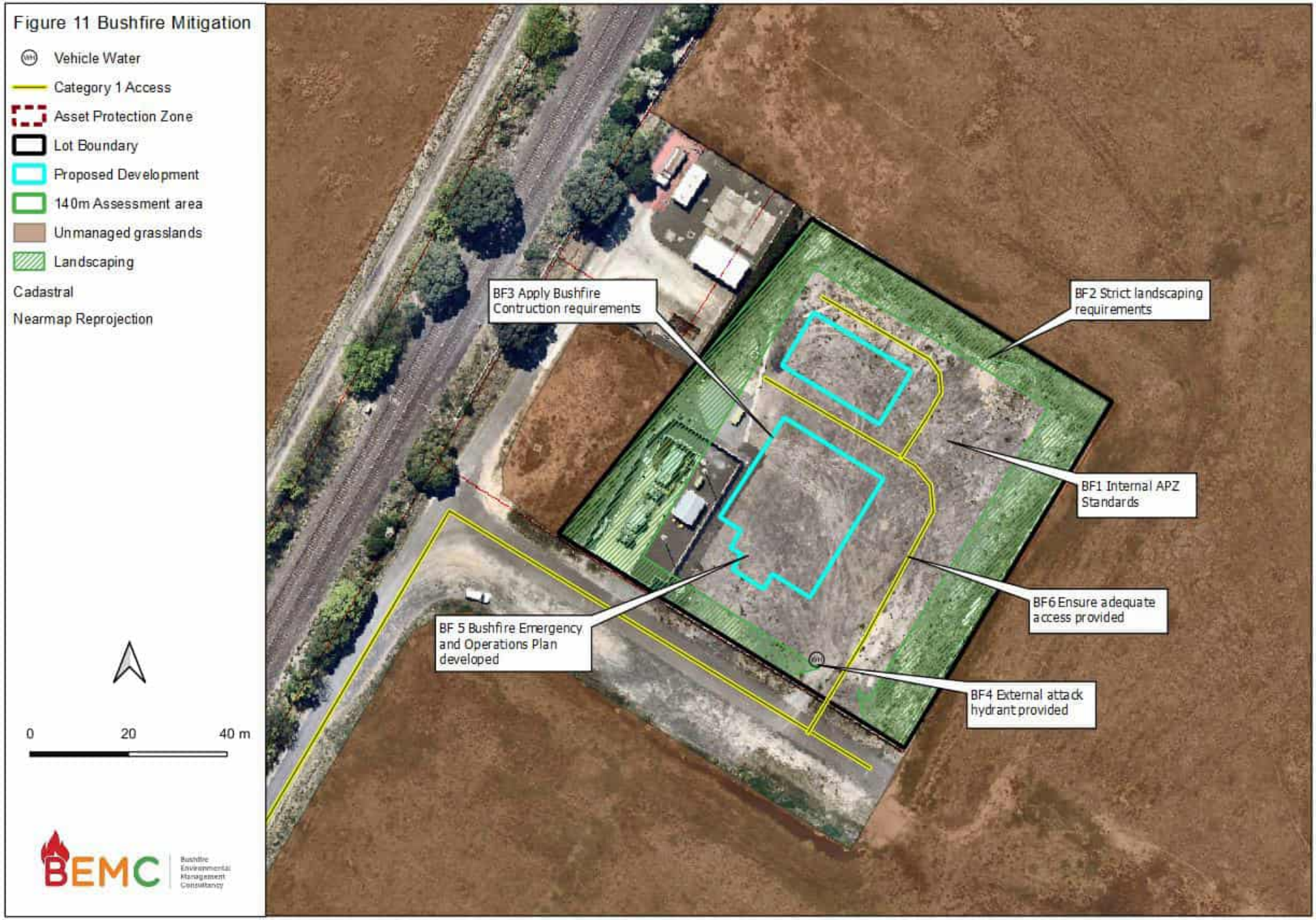
The following recommendations are provided to mitigate the impact of Bush fire.

Table 5 *Mitigation Measures - Design, Pre-Construction and operations*

ID	Identified mitigation measure	Applicable location (s)
BF1	***ASSET PROTECTION ZONES*** The construction site and SUBSTATION Facility would be managed as an APZ in accordance RFS Standards for Asset Protection Zones. At the commencement of building works the entire construction site would be managed as an APZ as outlined within Appendix 4 of 'Planning for Bush fire Protection 2019' and the NSW Rural Fire Service's document 'Standards for asset protection zones'. APZ requirements are: Screening vegetation and related landscaping features shall be placed outside the designated APZ. **Trees** ▪ Tree canopy cover should be less than 15% at maturity; ▪ Trees at maturity should not touch or overhang the building; ▪ Lower limbs should be removed up to a height of 2m above the ground; ▪ Tree canopies should be separated by 2 to 5m; and ▪ Preference should be given to smooth barked and evergreen trees. **Shrubs** ▪ Create large discontinuities or gaps in the vegetation to slow down or break the progress of fire towards buildings should be provided; ▪ Shrubs should not be located under trees; ▪ Shrubs should not form more than 10% ground cover; and ▪ Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation. **Grass** ▪ grass should be kept low (as a guide grass should be kept to no ▪ more than 100mm in height); and ▪ leaves and vegetation debris should be removed.	**As per Figure 10**

BF2	***LANDSCAPING*** The landscaping provided to provide a visual buffer shall comply with the following provisions: ▪ No vegetation or yard storage within 10m of buildings or transformers. ▪ A 1.5m clear egress is provided around the immediate curtilage of all structures. ▪ Fencing and gates in BAL 29 or within 6m of a building should be of non-combustible materials. ▪ Garden mulch will not be permitted. Alternatives include gravel, coffee rock, scoria, pebbles, shells or recycled crushed bricks shall be applied. ▪ No timbers permitted within landscaping area. ▪ Tree branches <2m from ground surface to be trimmed annually. ▪ No shrubs to be planted under tree canopy. ▪ Gaps >1m shall be applied between shrubs. ▪ Grasses removed annually.	**As per Figure 10**
BF3	***BUSH FIRE CONSTRUCTION LEVEL*** Vulnerable buildings and/or critical assets would be constructed to appropriate BAL levels in accordance with the Australian Standard for the Construction of Buildings in Bush fire Prone Areas (AS3959). This will be refined during detailed design. The following shall be applied: ▪ The external wall and roof will be non-combustible, and all vents metal screened with aperture <2mm. ▪ External critical elements are those deemed to be essential for return to service following a bushfire event shall be located in areas exposed to <12kW/m^2 radiant heat load. ▪ All external doors must match the fire performance FRL of the building and be fitted with fire resistant smoke seals at the base of the door to prevent embers entering under the door. ▪ Covering openings with a with steel, bronze, or aluminium to maximum allowable aperture of 2mm or weather strip with a flammability index not greater than 5 (AS1530.2).	**As per Figure 10**
BF4	***WATER*** Reticulated water provided. External attack hydrant through the fire hydrant booster is provide.	**As per Figure 10**

BF5	***EMERGENCY MANAGEMENT*** Emergency management during construction phase should be administered through site specific construction operations and risk plans. The principles within this document shall be used to guide to the site-specific operations and risk plans during the construction phase. A comprehensive Bush fire Emergency Management and Evacuation Plan would be completed for the operational phase of the Project (**Section 9, page 42**). The Bush fire evacuation procedures would be completed in accordance with NSW Rural Fire Service Guide to Developing A Bushfire Emergency Management Plan. ***Ignition Prevention***: ▪ Hot work (activities involving high temperatures) and fire risk work (activities involving heat or with the potential to generate sparks) from construction activities may cause fire ignition. These works will be managed under a Hot Work and Fire Risk Work procedure, with measures including suspension of activities on days of elevated fire danger. ▪ Certain construction activities, including hot works, are prohibited by law on any day declared to be a TOBAN. ▪ Essential work during construction may be completed on a TOBAN providing it complies with the Hot Work and Fire Risk Work procedure exemption from the NSW RFS. ▪ Substations must be inspected and cleaned regularly to prevent the build-up of any combustible matter. ***Ignition Suppression*** Firefighting equipment will be maintained and accessible to all active construction site during the declared Bush fire danger season, and site personnel trained in its use. Equipment should be appropriate to the activities being conducted and the fire danger at the time of works, but as a minimum must include: ▪ Extinguishers. ▪ Knap sacks. ▪ Hand tools (e.g., fire rakes).	**As per Figure 10**
BF6	***ACCESS*** The public road provides Category 1 fire appliances access to and the south of the facility. Within the fenced compound, unobstructed pedestrian access is required to enable fire fighters to operate. The following access requirements are recommended: ▪ A vehicle access gate be provided. ▪ Internal access to all buildings and north side of transformer 1 and 2 to have a trafficable surface with capacity of 23T with a maximum grade of not more than 15 degrees, crossfall not more than 6 degrees, minimum vertical clearance of 4 metres is provided above the surface of the trafficable surface clear of obstructions, curves have a minimum inner radius of 6 metres, minimum distance between inner and outer curves is 6 metres ▪ Turn-a-round provided in accordance with Appendix 3 of PBP 2019.	**As per Figure 10**


Figure 11 Bushfire Mitigation
Vehicle Water
Category 1 Access
Asset Protection Zone
Lot Boundary
Proposed Development
140m Assessment area
Unmanaged grasslands
Landscaping
Cadastral
Nearmap Reprojection
0
20
40 m
BEMC
Bushfire Environmental Management Consultancy
BF3 Apply Bushfire Contruction requirements
BF2 Strict landscaping requirements
BF1 Internal APZ Standards
BF6 Ensure adequate access provided
BF 5 Bushfire Emergency and Operations Plan developed
BF4 External attack hydrant provided

9 EMERGENCY MANAGEMENT

The proposed development initially involves clearing and construction of the site, and then ongoing operation and maintenance works. Throughout these stages, the development will consider the safety of staff and contractors, and any attending emergency service workers if a bush fire impacts the site.

The design of the project will need to consider and provide vegetation management, access and water supplies within the asset protection zone around the substation facility that should mitigate the impact of uncontrolled bush fire during both construction and operations.

9.1 EMERGENCY MANAGEMENT DURING CONSTRUCTION

Emergency management during construction phase should be administered through site specific construction operations and risk plans (Bush fire Emergency Response Plan). The principles within this document shall be used to guide to the Bush fire Emergency Response Plan during the construction phase. This includes the establishment and maintenance of:

- APZ and landscaping within the APZ.
- Water supplies and vehicle access to the water supplies.
- Ignition prevention and suppression, and
- Firefighting equipment.

9.2 EMERGENCY MANAGEMENT DURING OPERATIONS

At a minimum, a comprehensive Bush fire Emergency Management and Evacuation Plan shall be completed for the operational phase and ongoing usage of the Project. A Bush fire Emergency Management and Evacuation Plan is developed to meet the bush fire planning requirements *NSW Rural Fire Service, Planning for Bush fire Protection 2019*.

The preference is a Bushfire Management Plan is developed. A Bushfire Management Plan bring together the Bush fire Emergency Management and Evacuation Plan and a Bush Fire Operations Plan with the following additional information:

- Location of site infrastructure and assets.
- Fire-fighting water supply plan.
- Site access and neighbour/ internal road plan.
- Identification of built, natural and cultural assets in and around the site.
- Emergency escape routes, refuges, and location of any nearby Neighbourhood Safer Places.
- Location of Fire Management Zone, specifically Asset Protection Zones.
- Location of hazards (Physical, Chemical and Electrical) that will impact on fire-fighting operations and procedures to manage identified hazards during fire-fighting operations.
- Aviation assets (helipads and aviation water supplies) and risks (powerlines), and
- Fire history in and around the site.

10 CONCLUSION

This bush fire risk assessment has been completed for the project considering the requirements of PBP 2019, and NS187 passive fire mitigation design of major substations. The project is within bush fire prone land and bush fire risk is a key consideration for the project. The report has undertaken a landscape scale bush fire risk assessment and site-specific risk assessment.

The new feeder 85U from Macarthur Bulk Supply Point is underground and requires no further consideration from bushfire impacts. Design of the substation facility shall consider industry best practise identified within NS187 passive fire mitigation design of major substations.

This report is a bush fire risk assessment that addresses the potential impacts associated with bush fire risk and provides the required information to assist in adequate design and plan for the construction and operation of the project.

The bush fire season in the Project Area generally runs from September to March, although commencement has been declared as early as August. Days of elevated fire danger are frequent and mostly occur during August to April. Dry electrical storms and north-westerly winds are common during the fire season and the area surrounding the Site has a history of bush fires. Substantial bush fires can and do occur in the area. Appropriate measures must be in place to mitigate the bush fire risks from and to the project and mitigation measures have been recommended in this report for the project.

Bush fire mitigation measures during construction and operations are required to be supported by Bush fire Emergency Response Plan during construction, and Bush fire Emergency Management and Evacuation Plan for operations, although a Bushfire Management Plan will provide a wholistic approach to bushfire risk for the project.

11 APPENDIX 1 PLATES (PHOTOGRAPHS)

Plates 1 –7 depict the elements in and around the site that are considered within the bush fire hazard assessment.



Plate 1 *(P1) Access between substation and Fitzpatrick Street*



Plate 2 *(P2) Access into the property*



Plate 3 *(P3) Development site*



Plate 4 *(P4) Grasslands to the south*



Plate 5 *(P5) Grasslands to the south*



Plate 6 *(P6) Grasslands to the north*



Plate 7 *(P7) Railway corridor to the to the west*

12 APPENDIX 2 BUSH FIRE PROTECTION MEASURES

The following information on building survivability and the application of Bushfire Protection Measures is provided for the landowners and should be considered continually for the life of the development. These measures facilitate meeting the aims and objectives of PBP 2019 and mitigating bushfire risk.

Why do buildings burn during bush fires?

Research has been undertaken to over the last decades to analysis and determine the elements that determine the survivability of a building during a bush fire event. As the research is validated, these elements are incorporated into planning documentation that guides construction in bush fire prone areas, such as Australian Standard 3959 and NSW RFS Planning for Bushfire Protection.

Research has illustrated that there are three ways a bush fire impacts a building:

1. Direct flame contact,
2. Radiant heat from the bush fire, and
3. Embers generated by the bush fire.

Most people expect direct flame contact to be the biggest risk to homes in a bush fire, but this is not the case. Over 80% of house loss during bush fires occurs because of ember attack; the burning firebrands of bark, leaves and twigs with winds drive away from the main fire front. They find weaknesses in houses such as gaps, cracks to combustible construction materials and can quickly lead to ignition of the building.

Significantly, vegetation that is established adjacent to the building and within the Asset Protection Zone following the construction of the building, which provides fuel for burning embers to ignite and increase the ignitability of the building. It is critical that the Asset Protection Zone are maintained throughout the life of the property, so that wildfire is not encouraged closer to the building.

The research has illustrated three main passive protection measures are critical to the survivability of a building to a bushfire attack:

1. **The size of the separation between the bushfire threat (unmanaged vegetation) and building;**
2. **The standard of landscaping and vegetation management within the above separation; and**
3. **The construction standards of the building.**

In terms of the above, the following principles should be applied throughout the lifetime of the building:

1. Any future alterations and additions to the building are undertaken with materials that comply with the relevant BAL of the building at the time of construction.
2. The separations between the building and bush fire threat (known as the Asset Protection Zones (APZ)) are maintained to low flammability. This means restricted gardens and combustible elements such as timber landscaping and furnishings. It is critical to maintain '*fire hygiene'* around the building.

The risk to an existing building, and what improvements can be made can be assessed through The Resilient Building Council found at https://rbcouncil.org/ and the Bushfire Resilience Rating Home Self-Assessment App https://rbcouncil.org/resilience-ratings/ .

Australia Standard 3959 Construction of buildings in Bush fire prone areas and Bush fire Attack Level (BAL)

Bush fire Attack Level (BAL) ratings refer to the fire intensity your house is likely to be subjected to in a bush fire, expressed in terms of radiant heat. The BAL assessment forms the construction component of the bush fire assessment process. The other component is the Bush fire planning, which includes Asset Protection Zones (APZ), separation to provide defendable spaces, access, water, electricity, gas, landscaping and emergency management.

Furthermore, the measures contained in the *Australian Standard 3959 Construction of buildings in Bushfire Prone Areas* for each BAL construction level are not for fire resistance. The building will burn. The construction standards are aimed at slowing the ignition and fire spread of the building to provide adequate time to enable occupants to shelter within the building as the bushfire front passes. The degree of vegetation management within the APZ, the unpredictable nature of behaviour of fire, and extreme weather conditions make building adjacent to vegetation very dangerous.



Relationship between fire behaviour and BAL (Western Australian Government, (2017) The WAPC's Guidelines for Planning in Bushfire Prone Areas (Guidelines), https://www.planning.wa.gov.au/dop pub pdf/Bushfire Guidelines Version 1.2 Aug2017.pdf)

Design and Siting

The design and siting of a building can be of critical importance during bush fire attack event. The appropriate design and siting can reduce the impact of bush fire attack mechanisms of direct flame, radiant heat, ember attack, smoke, and wind.

NCC 2022 indicates that the class 1 buildings should be protected from other building fires and provides a minimum 900mm separation between the boundary and dwelling. Consideration should be given to increasing the side-set back to 6m to neighbouring buildings to limit the potential of building-to-building fires. If this separation is not possible, upgrading the elevation facing the adjacent building to BAL40 standards, reducing glazing-to-glazing construction between buildings and other fire protection measures such as sprinklers should be considered when the residential developments are designed.

Key principles to consider when designing and siting a new development include the following:

- Avoid building on ridges, saddles and build on level ground wherever possible.
- Utilise cut-in benches, rather than elevating the building when building on sloping land.
- Avoid raised floors and protect the sub-floor areas by enclosing or screening.
- Provide an appropriate shelter room that is located on the lowest or non-bush fire hazard side of the building, near building exits and provides the occupant views of the outside environment.
- Reduce bulk of building, limit re-entrant corners[21], and incorporate simplified roof that can self-clean of debris.
- No gutters on second or consecutive storeys of building and avoid box gutters.
- If gutters are installed, incorporate gutter guards with a flammability index more than 5 when tested to AS1530.2, or aluminium, bronze, or stainless steel with maximum aperture of 5mm.
- Limit glazing elements on the sides of the building exposed to the bush fire threat and use shutters to protect glazing elements.
- Carparking provided in a location that does not interfere with escape routes.
- Position development so any gas supplies and overhead electricity are positioned not to impede egress to and from the site.
- Class 10a buildings (such as shed, carport, and garages) should be a minimum of 6m away from any other building. Consider the storage of hazardous materials (petrol, kerosene, alcohol, LPG, natural gas, acetylene, vehicle, machinery etc.) within Class 10a buildings when siting in proximity to Class 1a occupied building and escape routes.
- Provide unobstructed access around the entire building supported by a minimum 1.5m wide concreted path to the external wall.

Asset Protection Zones

An APZ is an area surrounding a development that is managed to reduce the bushfire hazard to an acceptable level to mitigate the risk to life and property. The required width of the APZ varies with slope and the type of hazard. An APZ should be maintained in perpetuity to ensure ongoing protection from the impact of bush fires. Maintenance to the below standards should be undertaken on an annual basis, in advance of the fire season, as a minimum.

For a complete guide to APZs and landscaping, download the NSW RFS document Standards for Asset Protection Zones at www.rfs.nsw.gov.au/resources/publications .

An APZ can consist of both an Inner Protection Area (IPA) and an Outer Protection Area (OPA) as indicated below. An APZ can include footpaths, lawns, swimming pools, driveways, open space / parkland, car parking, and suitable class 10 structures (fences, pools decks etc).

Isolated areas of shrub and timbered vegetation are generally not a bush fire hazard as they are not large enough to produce fire of an intensity that will threaten dwellings. These areas include narrow strips of vegetation along road corridors.

Any areas that are designated Asset Protection Zones, should be delineated by rural fencing, signposted or bollards (whatever is practical in the circumstances) to ensure vegetation creep does not occur and further landowners and ground management are aware that the area is to be maintained for Bush fire protection purposes.

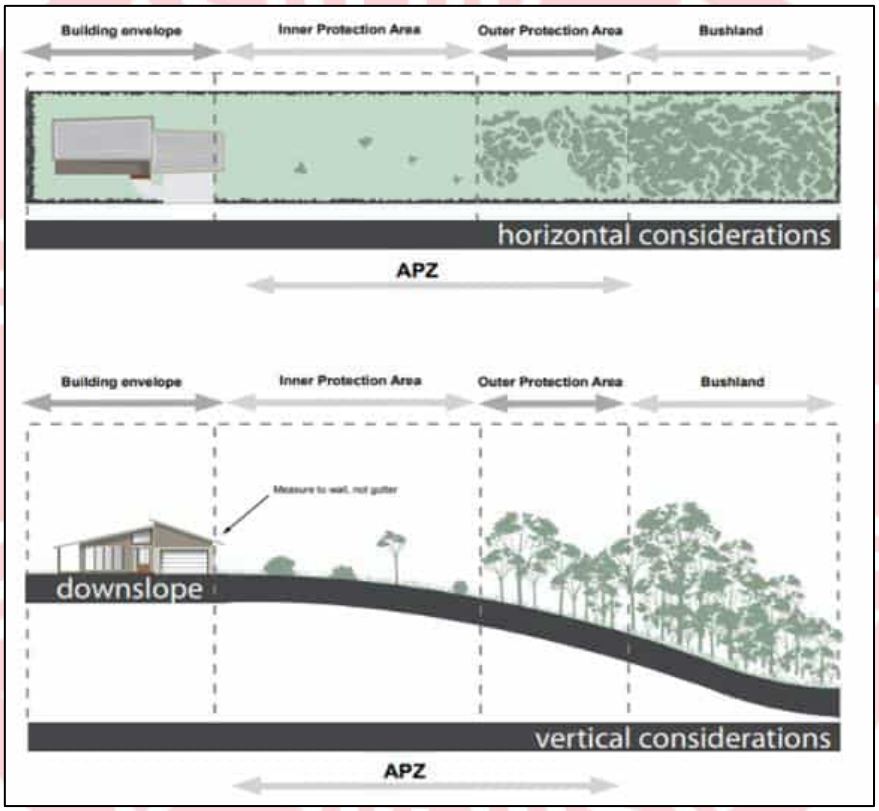
[21] Quarles, S.L., Christine Standohar-Alfano. C., Hedayati, F., Gorham, D. J., 2023. Factors influencing ember accumulation near a building. International Journal of Wildland Fire 32(3) 380-387 https://doi.org/10.1071/WF22132







Definition of Asset Protection Zones



Components of an APZ (Figure A4.1 - PBP 2019)

Inner Protection Area (IPA)

The IPA extends from the edge of the OPA to the development. The IPA is the area closest to the asset and creates a fuel-managed area which can minimise the impact of direct flame contact and radiant heat on the development and be a defendable space. The intent of an IPA is to stop the transmission of flame and reduce the transmission of radiant heat by the elimination of available fire fuel. This area also allows airborne embers to fall safely without igniting further outbreaks and provides a safer firefighting position and is operationally important for implementation of clear fire control lines.

In practical terms the IPA is typically the curtilage around the dwelling, consisting of a mown lawn and well-maintained gardens. When establishing and maintaining an IPA the following requirements apply:

- Vegetation within the IPA should be kept to a minimum level. Litter fuels (leaves and vegetation debris) within the IPA should be continually removed and kept below 1cm in height and be discontinuous. There is minimal fine fuel at ground level which could be set alight by a bushfire.
- Canopy cover should be less than 15% (at maturity). Trees (at maturity) should not touch or overhang the building and should be separated by 2 to 5m.
- Lower limbs of canopy trees should be removed up to a height of 2m above ground.
- Preference should be given to smooth barked and evergreen trees.
- Large discontinuities or gaps in the shrub vegetation shall be established to slow down or break the progress of fire towards buildings.
- Shrubs should not be located under trees and not form more than 10% ground cover
- Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.
- Grasses should be kept mown (as a guide grass should be kept to no more than 100mm in height), and
- Woodpiles, wooden sheds, combustible material storage areas, large areas / quantities of garden mulch, stacked flammable building materials etc. are not permitted in the IPA.

Outer Protection Area (OPA)

An OPA is located between the IPA and the unmanaged vegetation. Vegetation within the OPA can be managed to a more moderate level. The reduction of fuel in this area substantially decreases the intensity of an approaching fire and restricts the pathways to crown fuels, reducing the level of direct flame, radiant heat and ember attack on the IPA.

Because of the nature of an OPA, they are only applicable in forest vegetation.

In practical terms the OPA is an area where there is maintenance of the understorey and some

separation in the canopy. When establishing and maintaining an OPA the following requirements apply:

- Tree canopy cover should be less than 30%, canopies should be separated by 2 to 5m
- Shrubs should not form a continuous canopy and form no more than 20% of ground cover
- Grasses should be kept to no more than 100mm in height with leaf and other debris should be mown, slashed or mulched.

Furthermore, the edge of the APZ should be clearly delineated to ensure vegetation creep does not occur over time, reducing the separation between the bushfire hazard and building.

Gardens and vegetation within the APZ

All vegetation will burn under the right conditions.

In choosing plants for landscaping consideration should be given to plants that possess properties, which help to protect buildings. If the plants themselves can be prevented from ignition, they can improve the defence of buildings by:

- Filtering out wind-driven burning debris and embers.
- Acting as a barrier against radiation and flame, and
- Reducing wind forces.

Consequently, landscaping with vegetation of the site should consider the following:

- Meet the specifications of an Inner Protection Area (IPA) detailed in PBP 2019.
- Priority given to retaining or planting species which have a low flammability and high moisture content.

- Priority given to retaining or planting species which do not drop much litter in the bushfire season, and which do not drop litter that persists as ground fuel in the bush fire season, and
- Create discontinuous or gaps in the vegetation to slow down or break the progress of fire towards the dwellings.
- Avoid gardens within 10m of the exterior building envelop.
- Trees and shrubs within 40m are not continuous, but instead arranged as discrete patches separated by a ground layer with low fuel hazard, such as mown grass.
- Position courtyards, gardens, and grassed areas in locations that facilitate the protection of the building.
- Install pebble/rock garden beds avoiding the use of mulch and wood chip.

Consideration should be given to vegetation fuel loads present on site. Careful thought must be given to the type and physical location of any proposed site landscaping.

Inappropriately selected and positioned vegetation has the potential to 'replace' any previously removed fuel load.

Whilst it is recognised that fire-retardant plant species are not always the most aesthetically pleasing choice for site landscaping, the need for adequate protection of life and property requires that a suitable balance between visual and safety concerns be considered. **The below list of know ground fire-retardant plants is intended as a guide only, check with your local council for information more specific to your area.**

Lomandra longifolia	*Dampiera*
Lomandra hystrix	*Scaevola aemula*
Anigozanthos hybrids	*Succulents (most)*
Agapanthus orientalis	*Carpobrotus (Pigface)*
Liriope muscari	*Cotyledon*
Carpobrotus glaucescens	*Ajuga australis*
Casuarina glauca	*Myroporum*
Ajuga	*Nepeta* (catmint)
Brachyscome	*Mesembryanthemum*

Strategically positioned elevated vegetation (fire-retardant tree and shrub species) can act as 'windbreaks' and 'ember filter', reducing wind velocities and suppressing the density of embers attacking a building. It is critical that this vegetation is:

- On flat ground place >30m from the building (ideally 40m forming the outer perimeter of the IPA).
- >20m separation from the hazardous vegetation.
- Located on the side of the bush fire hazard.
- No gardens of shrubs under the trees.
- Shrub patches no greater than $10m^2$.

The below list of know fire-retardant trees and shrubs is intended as a guide only, check with your local council for information more specific to your area:

Melia azederach (Cape Lilac)	*Citrus trees*
Brachychiton aecerifolius (Flame tree)	*Loquot*
Magnolia grandiflora	*Arbutus Quercus (only the deciduous oak)*
Pyrus (most ornamental pears)	*Feijoa*
Magnolia Little Gem	*Gleditzia*
Ulmus chinensis (Chinese Elm)	*Ficus (all including edible)*
Acacia howitii	*Aloe (all)*
Cercis (Judus Tree)	*Correa*
Acmena smithii (Lilypily)	*Acacia iteaphyla*
Prunus (all including ornamental)	*Scaevola crassifolia*
Cupaniopsis anacardiopsis (Tuckeroo)	*Viburnum tinus*
Malus (apple trees)	*Atriplex (saltbush)*
Eleocarpus	*Escallonia*
Mullbery	*Maireana (Cottonbush)*
Eremophila (Emu bush)	*Leucophyta brownii*
Melaleuca nodosa	*Plectranthus*
Syzygium (lilypilly)	*Santolina*
Photinia	*Coprosma*
Rhagodia (saltbush)	*Strelitzia*
Acacia Cyclops	*Senna (Silver Cassia)*

Recent post-fire research from the 2019/20 bushfire season suggests greenness factor (the extent to which plants are actively growing) had an impact on building survivability to a bushfire, indicating that maintained green grasses and landscape watering features are beneficial during a bushfire.

It is essential that any vegetation and landscaped areas and surrounds are subject to ongoing fuel management and reduction to ensure that fine fuels do not build up.

Best practise landscaping features within the APZ

A combination of hard (materials) and soft (design) landscaping will benefit the survivability of a building during a bushfire event. The type, quantity and condition of fuel has a very important effect on bushfire behaviour in proximity to a building. Poorly located vegetation that burns readily may expose a house to increased levels of radiant heat and flame contact. Best practise landscaping is:

- All outbuildings are located >10m from the dwelling and any deck stair and building attachments. There is no flammable material (garden or landscaping) within the 10m separation.
- If the outbuildings are located <10m the elevation of both buildings facing each other should be upgraded to a 60/60/60 FRL.

- A 1.5m clear egress is provided around the immediate curtilage of the dwelling and any deck stair and building attachments.
- Provide clear pedestrian egress with no flammability within 6m either side (evacuation route) from the public road (or driveway if public road is >70m from dwelling) to the dwelling.
- Remove other flammable objects within 6m of the dwelling[22]. These include caravans, outdoor furniture, barbeques, gas bottles, wood piles and organic mulch.
- Fencing and gates in BAL 29 or within 6m of a building should be of non-combustible materials.
- Avoid flammable mulches within the entire APZ. Alternatives include gravel, coffee rock, scoria, pebbles, shells or recycled crushed bricks.
- Use non-combustible, moveable containers and pots that can be relocated within 6m of the building.
- Restrict the use of timber and use materials such as brick, earth, stone, concrete and galvanised iron
- An intensive area of planting perpendicular to the bush fire vegetation centred on a contoured garden mound provide in the outer limits of the inner protection area can be effective screening.
- Clumping shrubs and trees so they do not form a continuous canopy in a direction towards the buildings and are separated by areas of low fuel (maintained green grass lawn).

Further information can be found here - Landscaping for bushfires

Access Requirements

In the event of a serious bushfire threat to the proposed development, it will be essential to ensure that adequate ingress/ egress and the provision of defendable space are afforded in the development/building design.

Local Area Traffic Management (LATM)

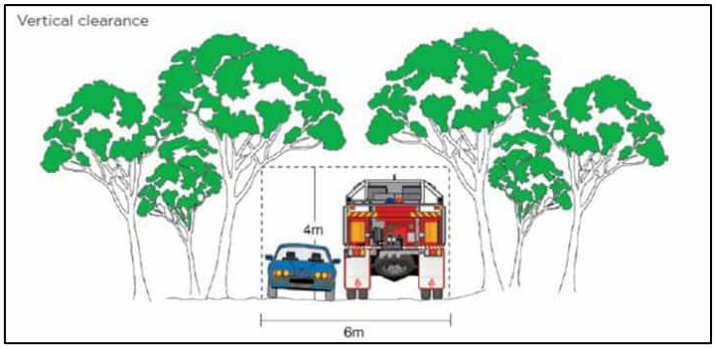
The objective of LATM is to attain an acceptable level of speed, volume, and composition of traffic within a local area and reduce the number of road accidents. This is achieved by modifying the street environment through the installation of various traffic control devices. LATM devices by their nature are designed to restrict and or impede the movement of traffic, especially large vehicles, which conflicts with the intent for access required by the NSW RFS and may significantly increase response times for emergency services.

Where LATM devices are provided they are to be designed so that they do not impede fire vehicle access.

Vertical clearance

An unobstructed clearance height of 4 metres should be maintained above all access ways including clearance from building construction, archways, gateways/doorways, and overhanging structures (e.g., ducts, pipes, sprinklers, walkways, signs and beams). This also applies to vegetation overhanging roads and fire trails.

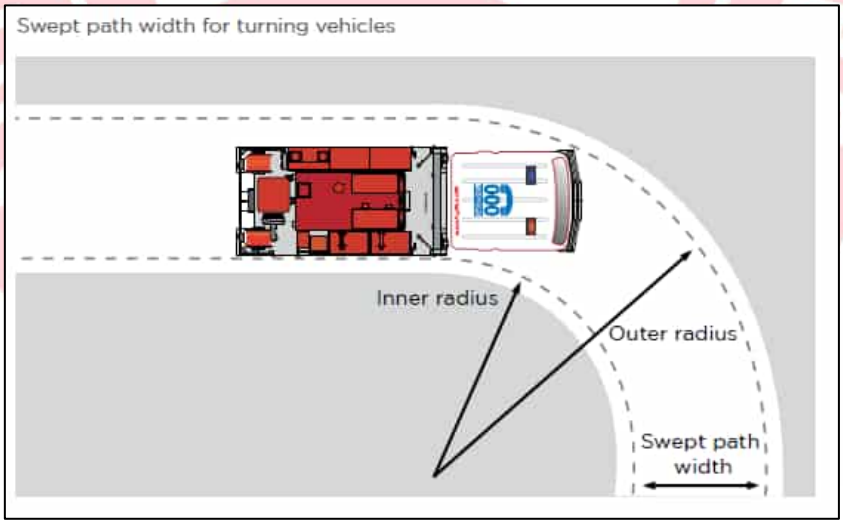
[22] Hedayati F., Stansell C., Gorham D.J., Quarles S.L., 2018. Near-Building Non-combustible Zone. (Insurance Institute for Business & Home Safety). Available at https://ibhs.org/wp-content/uploads/member_docs/Near-Building_Noncombustible_Zone_Report_IBHS.pdf

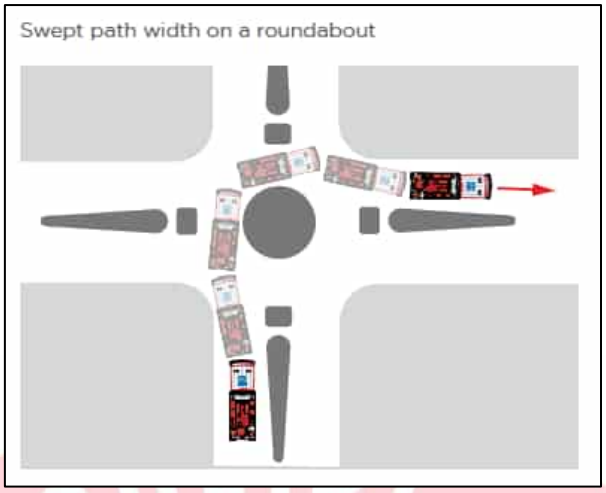


Vehicle Turning Requirements

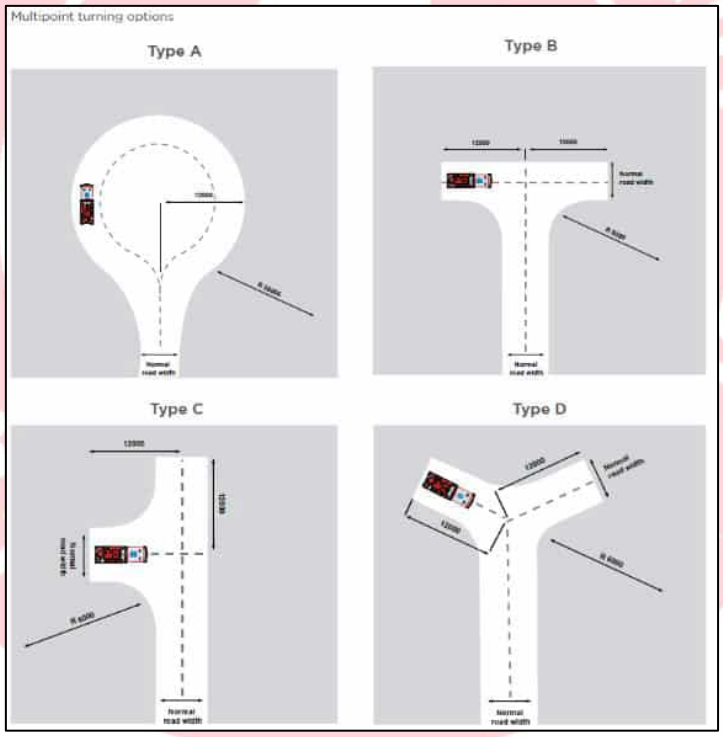
Fire crews must have rapid access and egress for vehicles, therefore curved carriageways should be constructed using the minimum swept path. The below diagrams from PBP2019 provide indication of the requirements to be achieved.

Minimum curve radius (inside edge (m))	Swept path (m) wide
<40	4.0
40 -69	3.0
70 - 100	2.7
>100	2.5





Where a turning head is proposed the NSW RFS requires that dead ends having a length greater than 20 metres should be provided with a turning head area which avoids multipoint turns.



Passing Bays

The construction of passing bays, where required, shall be 20m in length, provide a minimum trafficable width at the passing point of 6m.



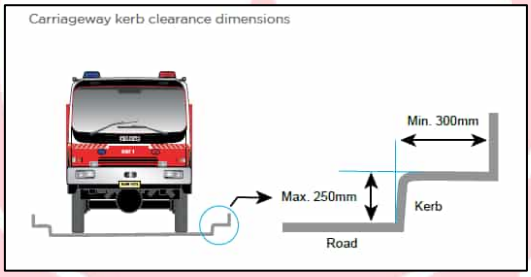
Parking

Parking can create a pinch point within the road reserve. The location of parking should be carefully considered to ensure fire appliance access is unimpeded. Hydrants should be located clear of any parking areas to ensure that access is always available.



Kerb Dimensions

All kerbs constructed around access lanes should be no higher than 250mm and free of vertical obstructions at least 300mm back from the kerb face to allow clearance for front and rear body overhang.



Road Types

Property access is required to be 4m wide all-weather road. Can be sealed or unsealed.



Water Supply

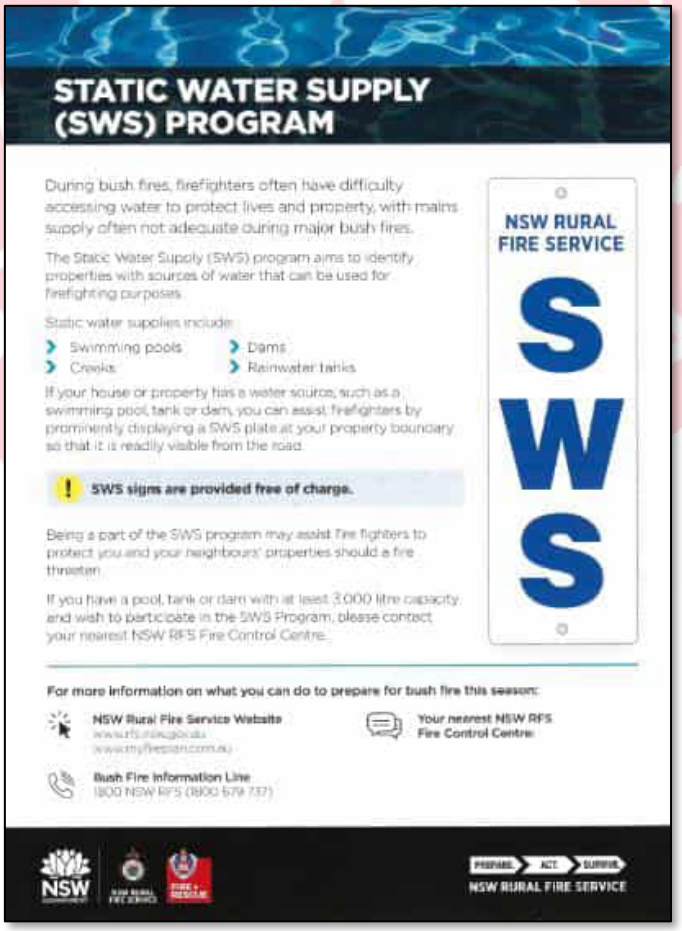
The intent of water measures is to provide adequate services of water for the protection of dwellings during and after the passage of a bush fire. Reticulated water (street hydrants) is the preferred option although pressure loss is common during large fires and the provision of an alternative water supply provides obvious benefits to fire suppression.

A static water supply for fire-fighting purposes should be above-ground, accessible, clearly marked and manufactured from concrete or metal. If raised, the tank stand should be made from non-combustible material. These static water supplies (tanks) should be positioned on the non-hazard side of the building and have 65mm Storz outlet with a ball valve fitted to the outlet within the IPA. If not appropriate, they should be appropriately shielded to protect the tank and fire fighters accessing the water. Category 1 fire appliances should be able to access within 4 m of static water supply with a hardened ground surface to support this access.

All exposed water pipes, values, taps and fittings should be metal and the supply line from tank to ball valve have the same bore size.

Where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump and are shielded against bush fire attack. Any hose and reel for firefighting connected to the pump shall be 19mm (internal diameter), and fire hose reels are constructed in accordance with AS/NZS 1221:1997 Fire hose reels and installed in accordance with AS 2441:2005 Installation of fire hose reels.

Where static water supply is the only water supply for firefighting purposes provided the following signage should be installed at the front gate and at a location that is clearly visible (assume smoke) to approaching emergency services to guide them to the static water supply.



Electricity, Gas supplies and Hazardous materials

The intent of electricity, gas and hazardous material measures is to locate these utilities and materials so as not to contribute to the risk of fire to a building.

Electricity

Location of electricity services should limit the possibility of igniting the surrounding bush land or the fabric of buildings. Where practicable, electrical transmission lines are underground. If overhead, electrical transmission lines are installed with short pole spacing (30m), unless crossing gullies, gorges, or riparian areas, then no part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.

For further information visit https://www.electricitysafety.com.au/

Gas

Any reticulated or bottled gas should be installed and maintained according to the requirements of the relevant authorities and AS/NZS 1596:2014. All fixed gas cylinders are kept clear of all flammable materials to 10m and shielded on the hazard side. All above-ground pipes and connections to and from gas cylinders are metal, and polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not permitted. Furthermore, if gas cylinders need to be kept close to the building, safety valves are directed away from the building and at least 2m away from any combustible material, so they do not act as a catalyst to combustion. Gas utilities should be positioned to not impede fire fighters accessing water supplies while undertaking suppression operations.

Hazardous Materials

Hazardous materials are any materials that can fuel the fire, such as leaf litter, grass, garden mulch and woodpiles. They can also be made up of solid combustibles or flammable liquids and gases such as petrol, kerosene, alcohol, LPG, natural gas, and acetylene. Vehicle, machinery, and other mechanical equipment that utilise fuels for operations can also be considered hazardous. The incorrect design and placement of carport and garages in residential developments could propagate fire towards the residential dwelling. Any liquids or fuels that are considered hazardous should be positioned away from the dominant bush fire threat. If located in a building/structure, it should be a minimum of 6m away from any other building. Vegetation surrounding these locations shall be maintained to IPA standards and the construction standards shall minimise the impact of ember attack to ignite the structure.

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