Menangle Park Zone Substation Feeder| Review of Environmental Factors

Endeavour Energy

Report

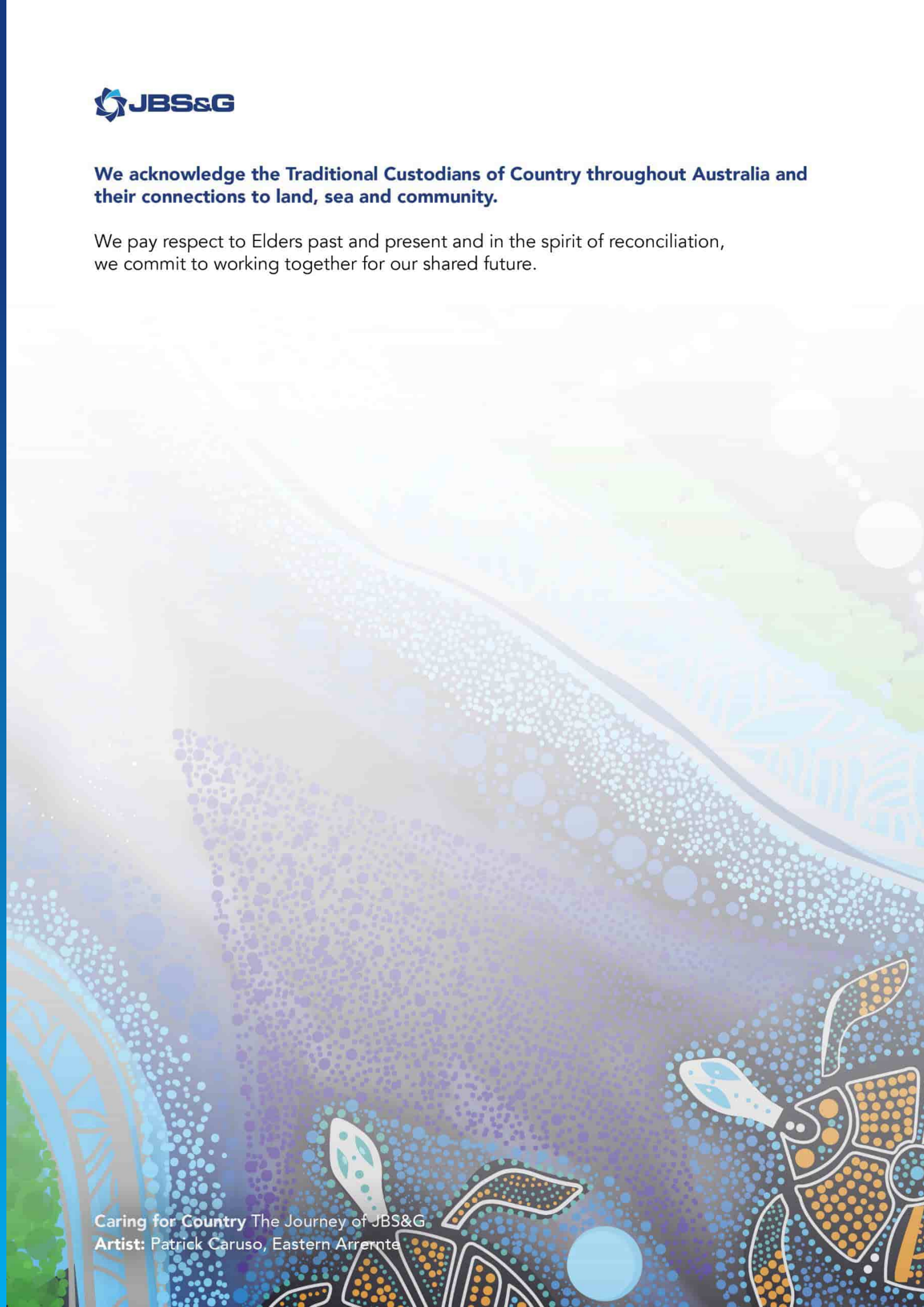
JBS&G 68033 | 166,488

11 September 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.



Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

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Abbreviations

Term	Definition
AADT	Annual Average Daily Traffic
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ANO	Authorized Network Operator
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
BSP	Bulk Supply Point
BS	British Standard
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CLEP	*Campbelltown Local Environmental Plan 2015*
CoP	*NSW Code of Practice for Authorized Network Operator*
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
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
LLS Act	*Local Land Services Act 2013*
m	metre

Term	Definition
MNES	Matters of National Environmental Significance
MPURA	Menangle Park Urban Release Area
MVA	Mega Volt Amp
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

1. Introduction

1.1 Endeavour Energy

Endeavour Energy is a major electricity distribution network provider in New South Wales (NSW), servicing over 2.7 million people across Sydney's Greater West, the Blue Mountains, the Southern Highlands, Illawarra and the South Coast of New South Wales (NSW). Endeavour Energy plays a vital role in maintaining and modernising the electrical grid to support growing demand and service new opportunities for growth centres around the state.

1.2 Background

NSW Department of Planning and Environment (DPE) has identified the Greater Macarthur Growth Area as an area of substantial growth with the Greater Macarthur 2040 interim plan highlighting delivery of a large-scale housing development, including approximately 40,000 new homes within the area by 2056. The Menangle Park Growth Area Precinct is within the Greater Macarthur Growth Area, and has been identified to meet the requirements of the Greater Macarthur 2040 interim plan. The Menangle Park Growth Area precinct is expected to become a new urban community with a town centre and around 5,250 new homes under the Greater Macarthur 2040 interim plan. As such, there is a forecasted need to increase the electrical capacity in the Menangle Park Growth Area Precinct.

Currently, Endeavour Energy has a 66/11kV 15 MVA mobile substation, located within lot 2013 of DP 1234643. The mobile substation was developed to support the increase in electricity demand in the immediate surrounding suburb of Menangle Park. 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 energy shortages 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.

In order to address the forecasted increase in energy demand, Endeavour Energy (the proponent) proposes to upgrade the existing mobile substation to establish the new permanent Menangle Park Zone Substation (ZS) and associated feeders. The construction and operation of the new substation will strengthen reliability and service the large-scale housing development in the Menangle Park region in line with NSW DPE plans. This proposal will enhance the supply security and reliability of new developments by providing a 66/11kV feeder (including fibre optics related to the functioning of the electricity network) for the new proposed ZS.

1.3 Purpose of this Review of Environmental Factors

Endeavour Energy is an Authorised Network Operator (ANO) and must complete an environmental impact assessment under Part 5 of the EP&A Act in accordance with the New South Wales Code of Practice for Authorised Network Operators (the Code). The appropriate assessment approvals process in accordance with the Code for the proposal is Class 4 – Review of Environmental Factors (REF).

The REF has considered the requirements of the Guidelines for Division 5.1 Assessments (DPE 2022) and the factors listed in section 171 of the Environmental Planning and Assessment Regulation 2021 and the Code of Practice for Australian Network Operators (CoP). 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.

2. The Proposal

2.1 Proposal identification

Endeavour Energy proposes to establish a new 66kV underground feeder, 85U, from TransGrid's Macarthur Bulk Supply Point (BSP) to the proposed new permanent Menangle Park Zone Substation (ZS) (the proposal, refer **Appendix A**). The proposal is located on Fitzpatrick Road, within Lot 41 of Deposited Plan (DP) 1285744, Lot 2012 DP1234643, Lot 2008 DP1234643, Lot 32 DP1105615, Glenlee Road (road reserve), Lot 32 DP 1105615 and Lot 31 DP1105615. The proposal site is within the suburb of Menangle Park, approximately 49 kilometres (km) southwest from Sydney CBD and approximately 1km east of the Nepean River. The proposal site location is shown in **Figure 2-1** and the site layout in **Figure 2-2.** There is no ancillary facility proposed for use during the construction of the proposal.

A separate REF was prepared by JBS&G Australia to assess the construction and operation of the ZS and is not part of the scope of this REF. The construction and operation of the ZS and feeder is referred to as the Project herein.

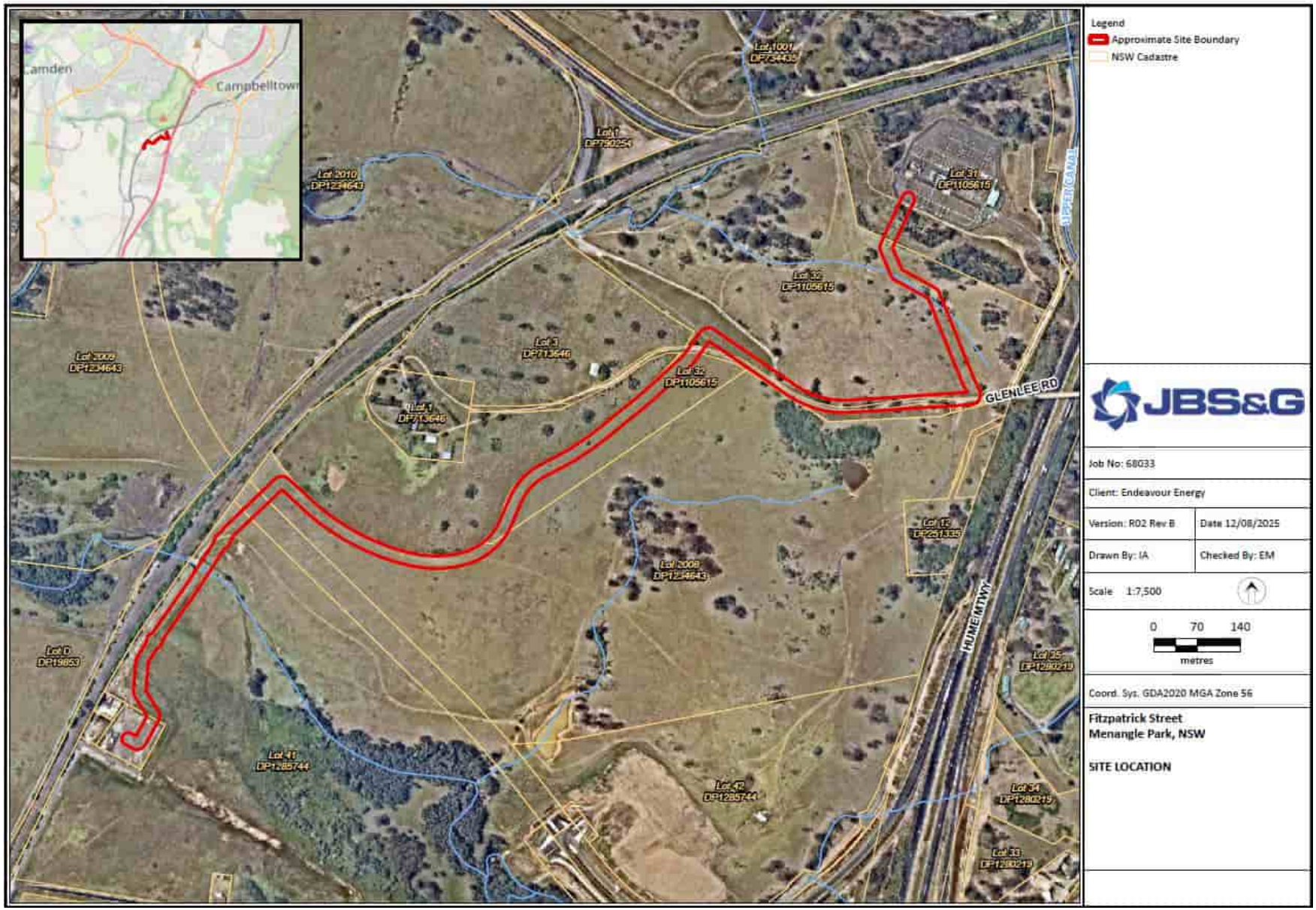

Figure 2-1: Site location

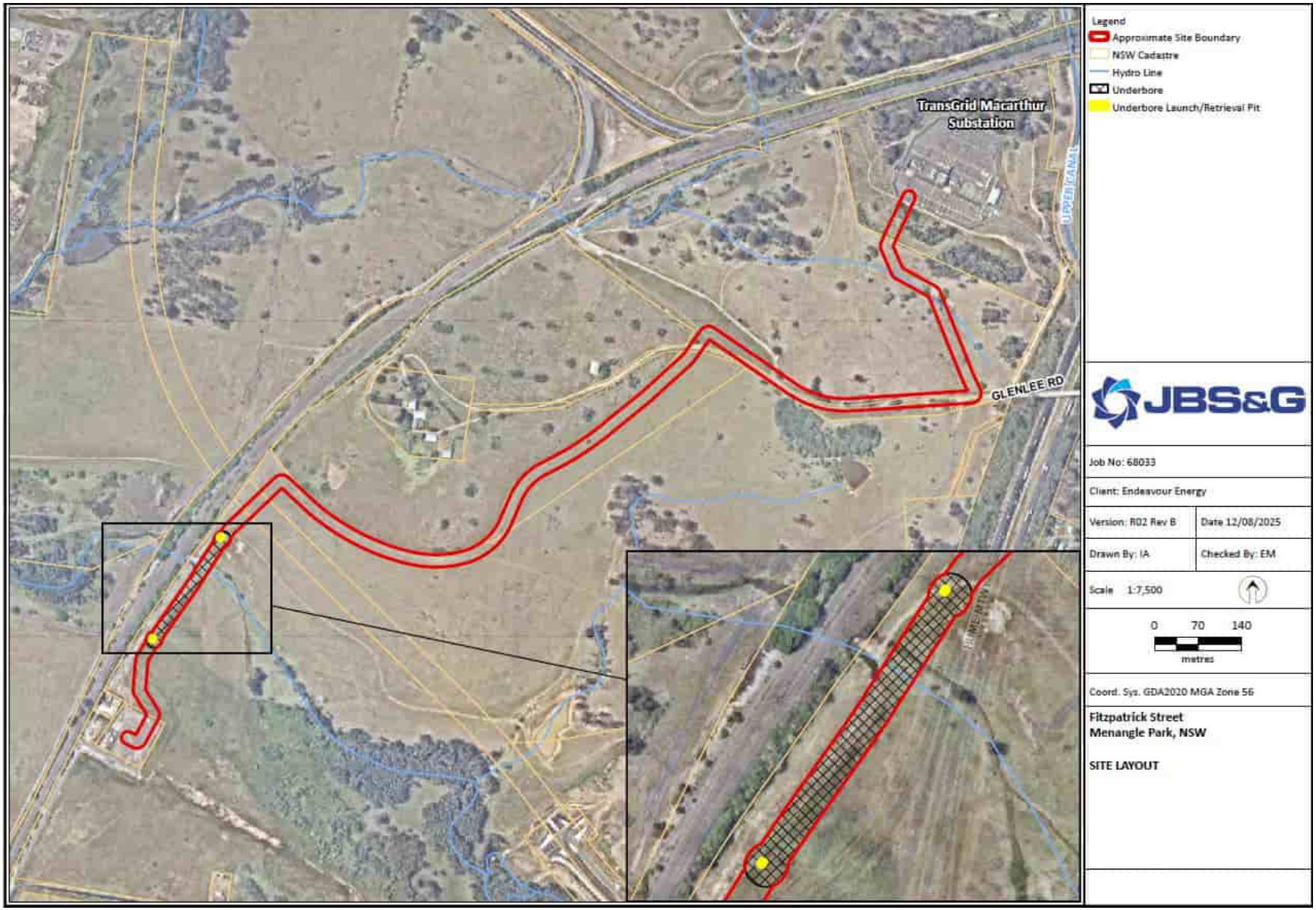

Figure 2-2: Site layout

2.2 Objectives

The objectives of the proposal are to:

- Service the large-scale development in the region; and
- Enhance supply security for 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 feeder route to support the proposed ZS.

2.3.2 Justification for the proposal

Option 2 would enable servicing the large-scale housing and infrastructure development in the Menangle Park region to be undertaken as part of the Greater Macarthur Region 2040 interim plan (refer to **Section 1.2**). The proposal would connect the BSP to the new ZS, ultimately facilitating the provision of a diversified 33kV supply and associated electricity network via the new proposed ZS. This 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, reliance would remain on the existing temporary mobile substation, which will have load at risk from 2025 with the total capacity exceeded by 2027. Without investing in additional electrical capacity in the area, there will be a shortage in energy supply, and customers will be unable to connect to the network.

Analysis of the two options was undertaken and is summarised in **Table 2-1**.

Table 2-1: Justification table of options considered

	Proposal objectives	Options 1: Do nothing	Options 2: Proposed new feeder
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, both the proposal objectives cannot be achieved with Option 1.	Yes, the proposal objectives can be achieved with Option 2.

The analysis found that Option 2 is the preferred, as it would meet the proposal objectives.

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 41 DP1285744 Lot 2012 DP1234643 Lot 2008 DP1234643 Lot 32 DP1105615 Glenlee Road (road reserve) Lot 32 DP 1105615 Lot 31 DP 1105615
Coordinates (approximate) **GDA94-MGA56**	Easting: 292565.616 Northing: 6225220.947
Local government area	Campbelltown City Council
Address	Fitzpatrick Street, Menangle Park NSW 2563 to 60 Menangle Road, Menangle Park NSW 2563

2.4.2 Existing site and study area description

The proposal site is located in the suburb of Menangle Park within the Campbelltown City Council Local Government Area (LGA). The proposal is located within a rural setting of undulating grass hills, traversing paddocks currently used for agricultural grazing (**Figure 2-3, Figure 2-10**). The proposal site is predominantly located on private land and not accessible to the public, with agricultural fencing present along the private property boundary to the south and to the north of Glenlee Road (**Figure 2-4, Figure 2-7**). Glenlee Road is a public road and is partially sealed with asphalt, providing access to private properties and heritage listed Glenlee Estate directly north of the proposal (**Figure 2-6**).

The feeder route traverses one creek (**Figure 2-8**) which drains to the west and into the Nepean River, located around 1km west of the proposal site. Howes Creek is located in the southern portion of the proposal site where it is proposed to underbore the feeder. The proposal also traverses one overland drainage line on the northern end of the proposal site in proximity of the BSP (**Figure 2-5**). Howes Creek appears to be characteristic of a small perennial creek, and the northern drainage line appears to be ephemeral in nature.

The proposal site is predominantly cleared of vegetation, with residual juvenile trees, shrubs and weeds scattered across the site. An area of exposed soils was observed during the site inspection on 16 December 2024 around 25m south from the proposed feeder route (**Figure 2-9**), however this was attributed to livestock observed dust bathing in the affected area (refer **Section 5.3**). Vegetation was generally in good condition with no observed signs of stress.

The Main Southern Railway Line runs parallel to the southern portion of the proposal (**Figure 2-8**). A fence runs along the perimeter of the private property boundaries. There is a water pipeline proposed by Sydney Water that would run from Fitzpatrick Street to the south-east of the proposal site and to the north-east (refer **Appendix C**).



Figure 2-3: Rural paddock for agricultural grazing facing proposed ZS (south).



Figure 2-4: Hill along feeder route facing north. Fence is along lot boundary.



Figure 2-5: North view along Glenlee Road towards Macarthur BSP.



Figure 2-6: Glenlee Road facing west with exposed soils and vegetation parallel to road.



Figure 2-7: Lockable gate into Glenlee Estate from Glenlee Road.



Figure 2-8: Paddock facing west with trainline and riparian corridor (left)



Figure 2-9: Exposed soils near riparian corridor and bridge (top right)



Figure 2-10: View on landfill hill along proposed feeder route facing north

2.4.3 Key design features

Key features of the proposal include the following:

- Installation and operation of a new 66kV underground feeder 85U (approximately 2.1km) that connects the proposed ZS to the Macarthur Bulk Supply Point (BSP); and
- Installation and operation of a new fibre optic cable related to the functioning of the network.

Design drawings are presented in refer **Appendix A**.

2.4.4 Access

The proposal would be accessed via the existing road network, including Fitzpatrick Road and Glenlee Road. Access during construction would be via the proposal site extent. No formal access tracks are proposed.

2.4.5 Work methodology

The proposal would involve the following work methodology:

- Staged removal of groundcover to facilitate trenching;
- Trenching up to 2 metres (m) deep and 0.5m wide (refer **Figure 2-2**):
  - Across paddocked areas in the north between TransGrid Macarthur BSP and Glenlee Road, and paddocked areas between Glenlee Road and new Menangle Park ZS.
  - Within the road reserve of Glenlee Road (to be reinstated to Campbelltown City Council road specifications following works).
  - Backfilling trench with stabilised sand.
- Under-boring to a maximum depth of 5m under Howes Creek via underbore launch and retrieval pits (2m x 5m to depth of 2m);
- Connection and commissioning of feeder to new Menangle Park ZS and TransGrid Macarthur BSP;
- Removal of one tree (*Olea europaea* subsp. *Cuspidate*, common name African Olive) adjacent to Glenlee Road; and
- Make good works following backfill of trenching to be undertaken progressively.

2.4.6 Plant and equipment

The plant and equipment proposed for the construction of the feeder consists of:

- 5 x trucks;
- 4 x 20T Excavators;
- 2 x non-destructive digging;
- 1 x generators for jointing sheds; and
- 1 x Horizontal Directional Drill.

2.4.7 Ancillary facility

There is no formal ancillary facility or laydown area proposed for the construction of the feeder. During construction, vehicles and equipment will be accommodated within the proposal site as trenching progresses. Material will be temporarily stored adjacent trenching for the proposed feeder including imported material in preparation for backfill. Excavated material from the trench will be excavated into a truck and removed from site. Material (where possible) that can be utilised as backfill material will be stockpiled adjacent the trench

line. As there is no formal ancillary facility individual assessment is not required, the informal stockpiles have been assessed within this REF as part of the construction of the feeder.

2.4.8 Timing, duration and hours

This proposal is proposed to commence works in late 2025/early 2026. This timing is indicative and may change depending on weather and other conditions.

It is anticipated that the Project which includes the feeder and ZS would take approximately 24 to 30 months to complete. The proposal (feeder only) would take up to five months to complete.

At peak times, up to 8 staff members/contractors are expected on site per day.

Majority of the 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.

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 for activities undertaken by public authorities, such as Endeavour Energy, which do not require 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 prescribed determining authority as per section 5.1(1) of the EP&A Act.

Clause 171 of the EP&A Regulation 2021 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. This environmental impact assessment has also been prepared in accordance with the NSW Code of Practice for Authorised Network Operators (the Code). The Code is the approved Code under section 201 of the EP&A Regulation and sets out the environmental assessment requirements for ANOs. Accordingly, this environmental impact assessment is deemed as a Review of Environmental Factors (REF).

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 B** 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 2.43 of TI SEPP defines electricity transmission or distribution network as including above or below ground electricity transmission or distribution lines (including related bridges, cables, conductors, conduits, poles, towers, trenches, tunnels, access structures, access tracks and ventilation structures) and telecommunication facilities that are related to the functioning of the network.

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 construction works for laying and installing underground and overhead cables and wires for the purpose of a 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.

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 proposed feeder traverses through the following zones:

- R3 – Medium Density Residential;
- RE1 – Public Recreation;
- SP2 – Infrastructure;
- RU2 – Rural Landscape;
- R2 – Low Density Residential; and
- R5 – Large Lot 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**.

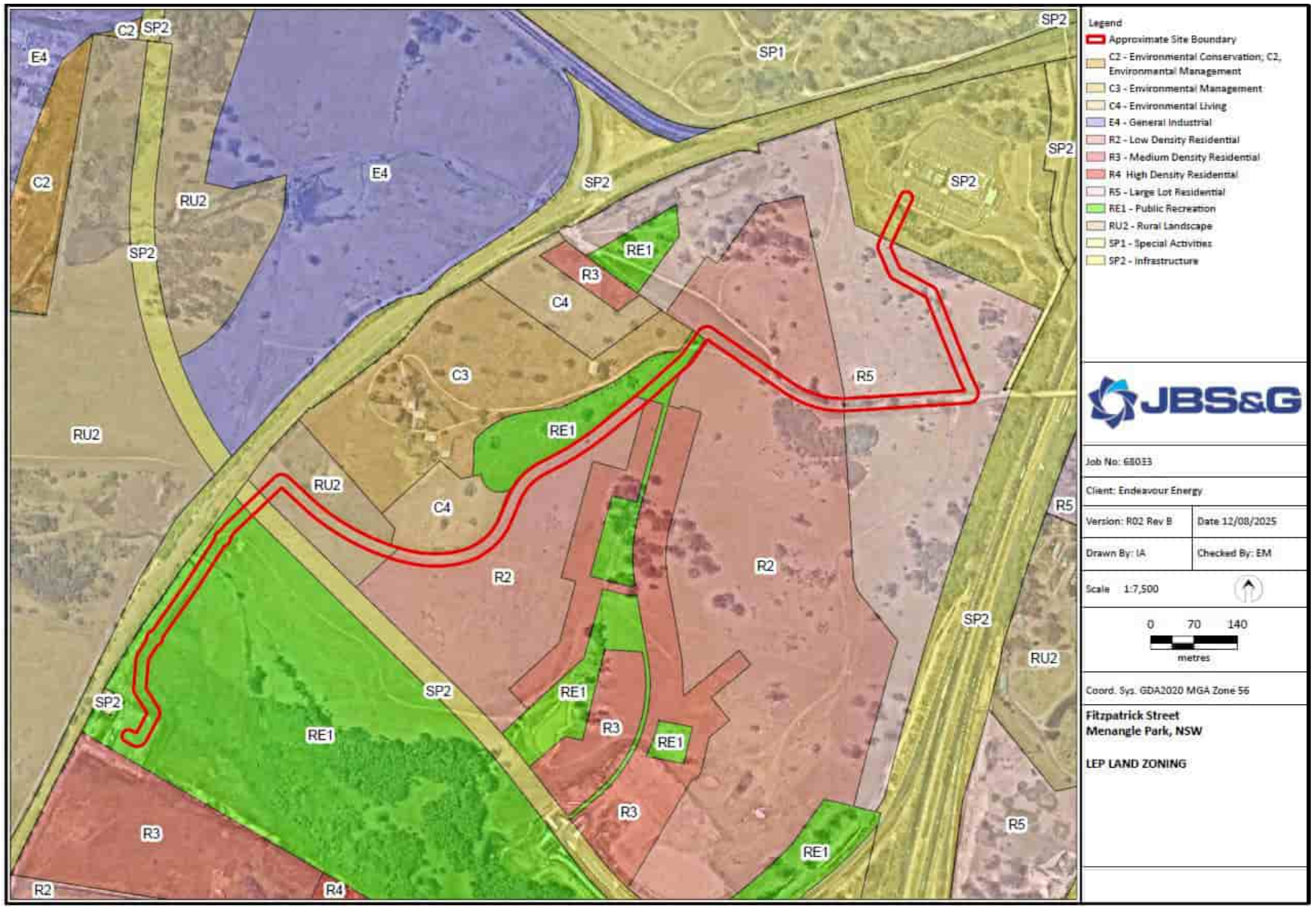

Figure 3-1: Land zoning under CLEP

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, including groundcover during trenching works, 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 I**) in which numerous Aboriginal sites were identified within 100m of the site extent. The assessment concluded that no Aboriginal objects, archaeological sites or areas of archaeological potential were identified within the proposal site. No further assessment is required to be undertaken in order to determine whether an AHIP under the NPW Act is required.

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). Assessment of potential impacts to threatened species, populations and ecological communities listed under the BC Act are considered in **Section 5.1** and **Appendix E**. It concluded that the site is not located within any Areas of Outstanding Biodiversity Value. 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 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.

3.2.5 Crown Land Management Act 2016

The *Crown Land Management Act 2016* (Crown Land Management Act) 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 a portion of Glenlee Road is mapped as Crown Land.

While the feeder route traverses land mapped as Crown Land at Glenlee Road, consultation with NSW Crown Lands is not required under Division 2.6 section 2.23 in which the Minister can give consent for its Crown land manager to make a development application over dedicated or reserved Crown land for the installation, repair, maintenance or replacement of services on the land. Council is the vested land owner for Glenlee Road and approval from Council will be sought prior to commencement of construction within land designated as Crown Land.

As the works will occur within a road corridor section 152A(2) of the *Roads Act 1993* (Roads Act) permits the road authority to grant an easement in accordance with the Crown Land Management Act.

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 requires works on the local Glenlee Road, including temporary interruptions to traffic. A Road Opening Permit (ROP) is required for the proposal under section 138 of the Roads Act.

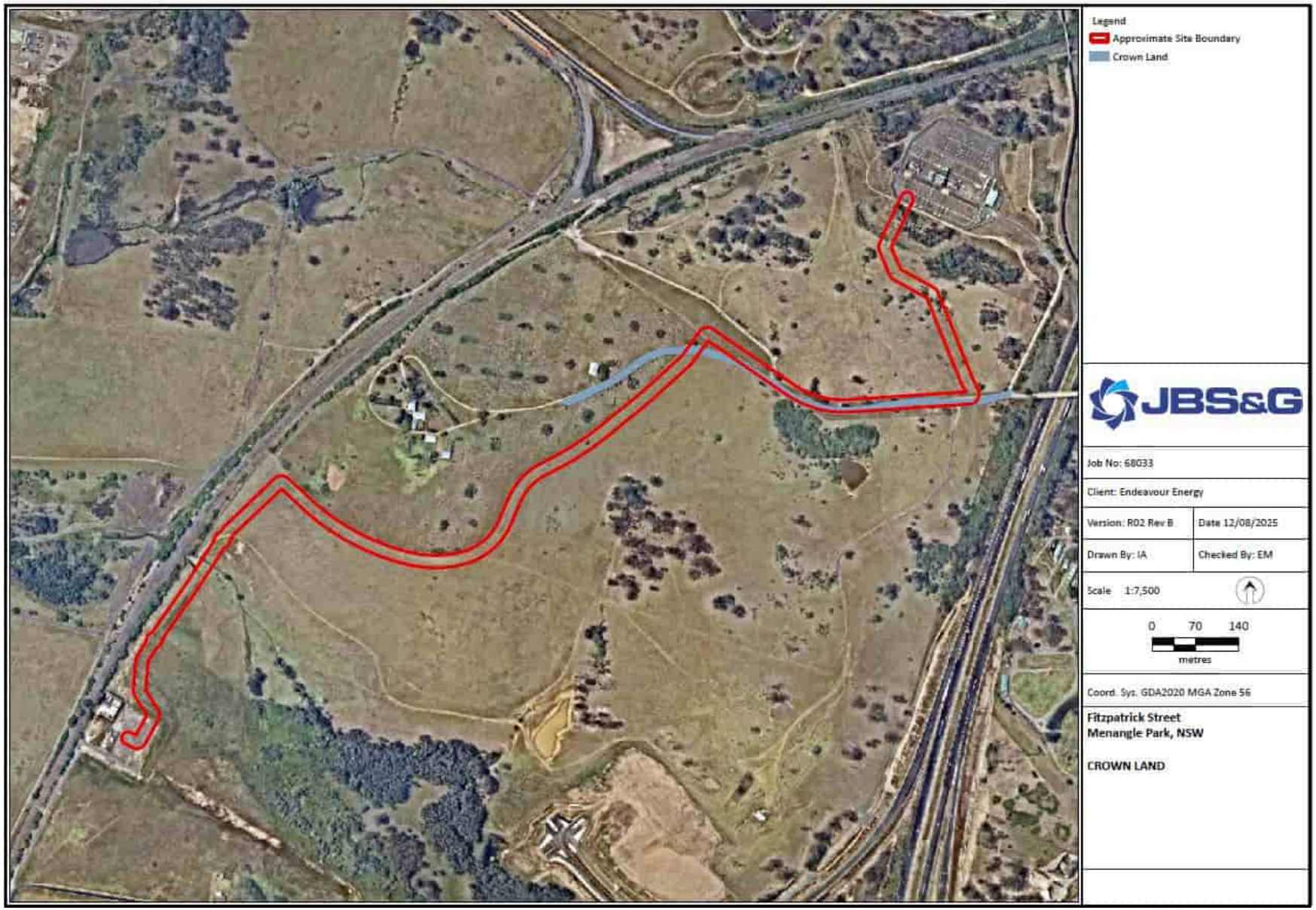

Figure 3-2: Crown land

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 B** and **Section 5.1.** The assessment found there is unlikely to be a significant impact resulting from the proposal on MNES and the environment of Commonwealth land. Accordingly, referral to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) 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, 2025) was undertaken, on 18 November 2024 and no Native Title holders or claimants were identified at the proposal site.

4. Community Engagement and Agency Consultation

The consultation undertaken as a part of this REF meets the Code of Practice for ANO. The outcome of this consultation in the sections below. Endeavour Energy will ensure its notification requirements under the Consultation Protocol are undertaken prior to and upon completion of work.

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)	*W*ill the development *have a substantial impact on stormwater management services provided by a council, or*	No – the proposal would not involve any substantial impacts on stormwater management services provided by a council.
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	*W*ill 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)	*W*ill 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)	*W*ill 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)	*W*ill 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).*	Yes - Consultation is required with Campbelltown City Council due to excavation of the surface of Glenlee Road for the installation of the feeder. TISEPP notification was issued to Council on 9 December 2024. No feedback was received within the 21-day statutory notification period. A Road Opening Permit (ROP) under the Roads Act will be sought separately prior to commencement of construction works.
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*	No - No local heritage items or heritage conservation areas are located within the proposal site.

TI SEPP clause		Applicable to proposal?
	conservation area, that is not also a State heritage item, in a way that is more than minor or inconsequential	
2.12 *(2)*	**Consultation with councils—development with impacts on flood liable land** *Is the development located on flood liable land,* *If so, will the development change flood patterns other than to a minor extent?*	No – the development is not located on flood liable land.
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.

TI SEPP clause		Applicable to proposal?
		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 approval subject to conditions under the current development assessment policy framework. Conditions of approval will likely include the requirement for infrastructure to be designed to accommodate potential future subsidence impacts.
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 Campbelltown City 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 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 21 days. A copy of the notification is provided in **Appendix D**. No community feedback or responses have been received.

4.2.2 Sydney Water

At the time of preparing this REF, Endeavour Energy has advised JBS&G that consultation with Sydney Water's consultant SMEC and Dahua (land developer) is being undertaken separately to this REF. Formal notification to Sydney Water of the new feeder was sent on 30 June 2025. No response received as of 14 July 2025. JBS&G were advised that the proposal will not interfere with the proposed Sydney Water pipeline. An easement approval will be gained prior to commencement of works by Endeavour Energy's design and property team once the design is finalised and sent for review. The Sydney Water design is presented in **Appendix C**.

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 entire proposal site and identify how the proposal satisfies the relevant planning framework. The BAR is presented in **Appendix E** 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*; and
- *Threatened Species Survey and Assessment: Guidelines for developments and activities – Working Draft.*

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 feeder route.

The following databases were reviewed to inform the BAR:

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

Field surveys

A survey was undertaken on the 16 December 2024 and on the 30 May 2025 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.

5.1.2 Existing environment

Plant community types

Review of the State Vegetation Type Map (refer **Figure 5-1**) indicated the presence of two Plant Community Types (PCT) mapped as occurring within the proposal site:

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

The site surveys were undertaken to ground-truth PCT identified at the site via desktop assessment, and confirmed the presence of PCT 3320 as occurring over a total of 4.07ha of the proposal site. This PCT aligns with the BC Act Critically Endangered Ecological Community (CEEC) listed threatened ecological community (TEC) 'Cumberland plain Woodland in the Sydney Basin Bioregion'. Vegetation within the proposal site was found to align with the BioNet Vegetation Classification PCT. Field validated native vegetation assigned to PCT 3320 was stratified into three vegetation zones based on varying condition class (refer to **Figure 5-2**):

- Vegetation zone 1: *PCT 3320 (canopy)* covering 0.16ha of the proposal site;
- Vegetation zone 2: *PCT 3320 (poor condition grassland)* covering 3.87ha of the proposal site; and
- Vegetation zone 3: *PCT 3320 (degraded)* covering 0.05ha of the proposal site.

The vegetation within vegetation zone 1 was in poor condition. The understory was dominated by exotic species and environmental weeds. The vegetation within vegetation zone 2 was severely degraded, consisting primarily of environmental and priority weeds. The vegetation within vegetation zone 3 was in a degraded condition although native species were identified within each stratum.

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.

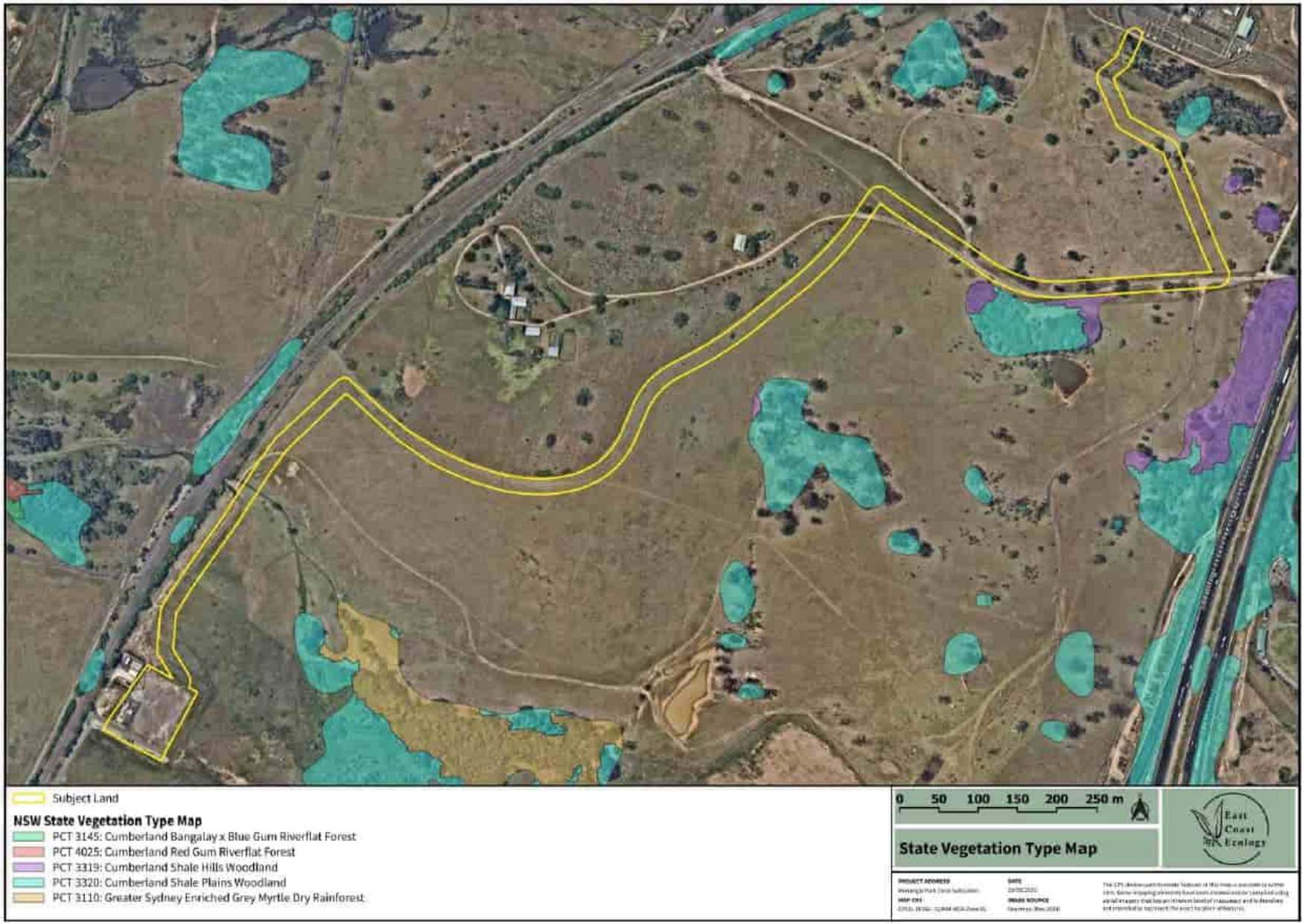

Figure 5-1: NSW State Vegetation Type map surrounding proposal site (Source: BAR (ECE 2025) Appendix E)

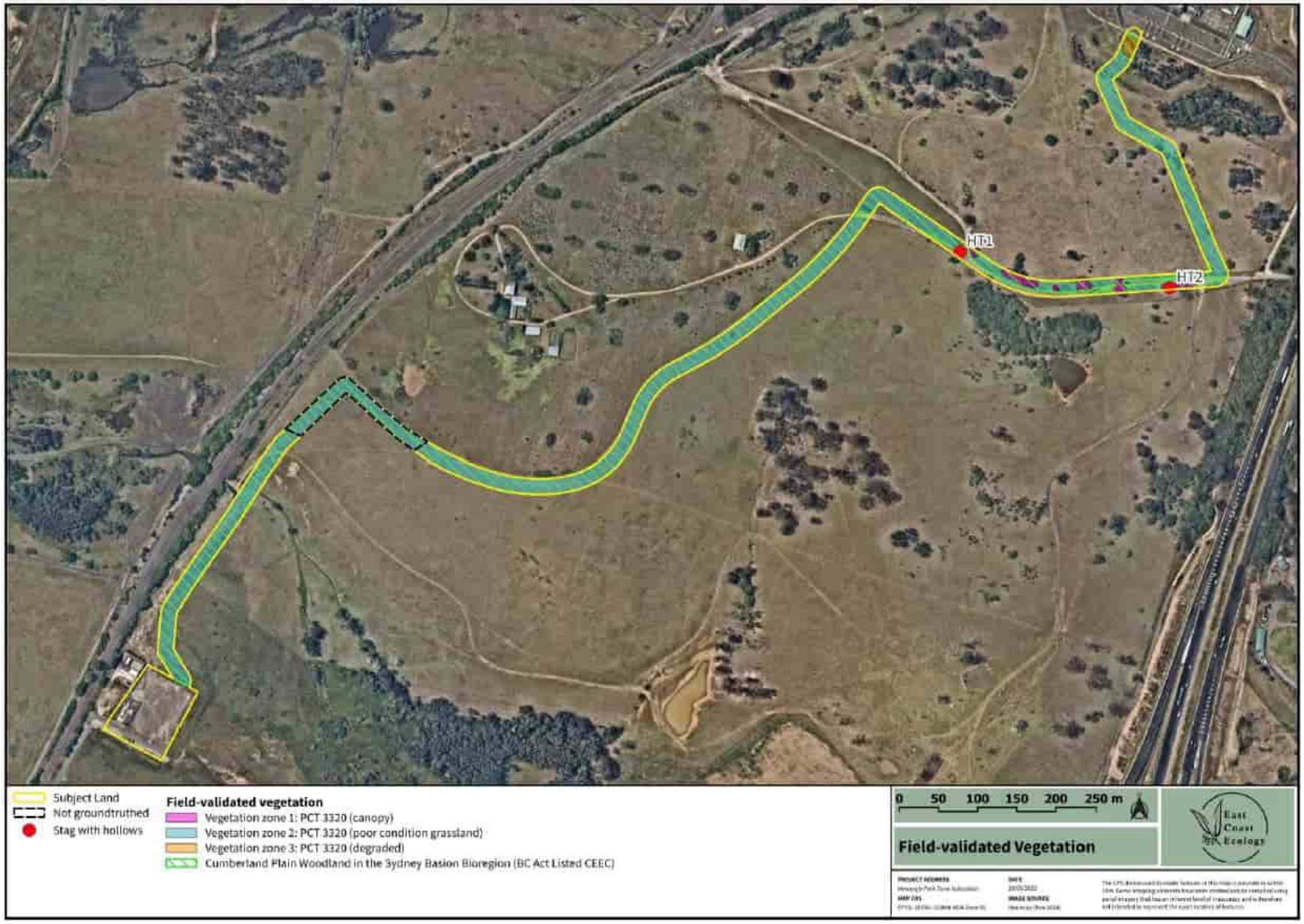

Figure 5-2: Field-validated vegetation communities (Source: BAR (ECE 2025) Appendix E)

Threatened flora

Database searches identified 10 threatened flora species recorded within a 5km radius of the proposal site (refer to **Table 5-1**). The BAR found that no threatened flora species are likely to occur within the site.

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
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**). Bionet records of threatened species are presented in **Figure 5-3**.

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
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

Scientific Name	Common Name	BC Act	EPBC Act	Records within 5km
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
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.

Two mapped watercourses occur within the proposal site, one of which was identified during field surveys. The watercourses were reported to comprise exotic vegetation with some scattered native ground covers observed. The BAR found that these watercourses are unlikely to provide habitat for threatened fauna species given the level of degradation and presence of livestock.

Two hollow-bearing stags were identified within 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 surveys. The small and medium hollows may be occasionally used for roosting by threatened microbats (e.g. Southern Myotis).

Vegetation within the proposal site was found to provide only minor foraging habitat for protected fauna species.

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

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

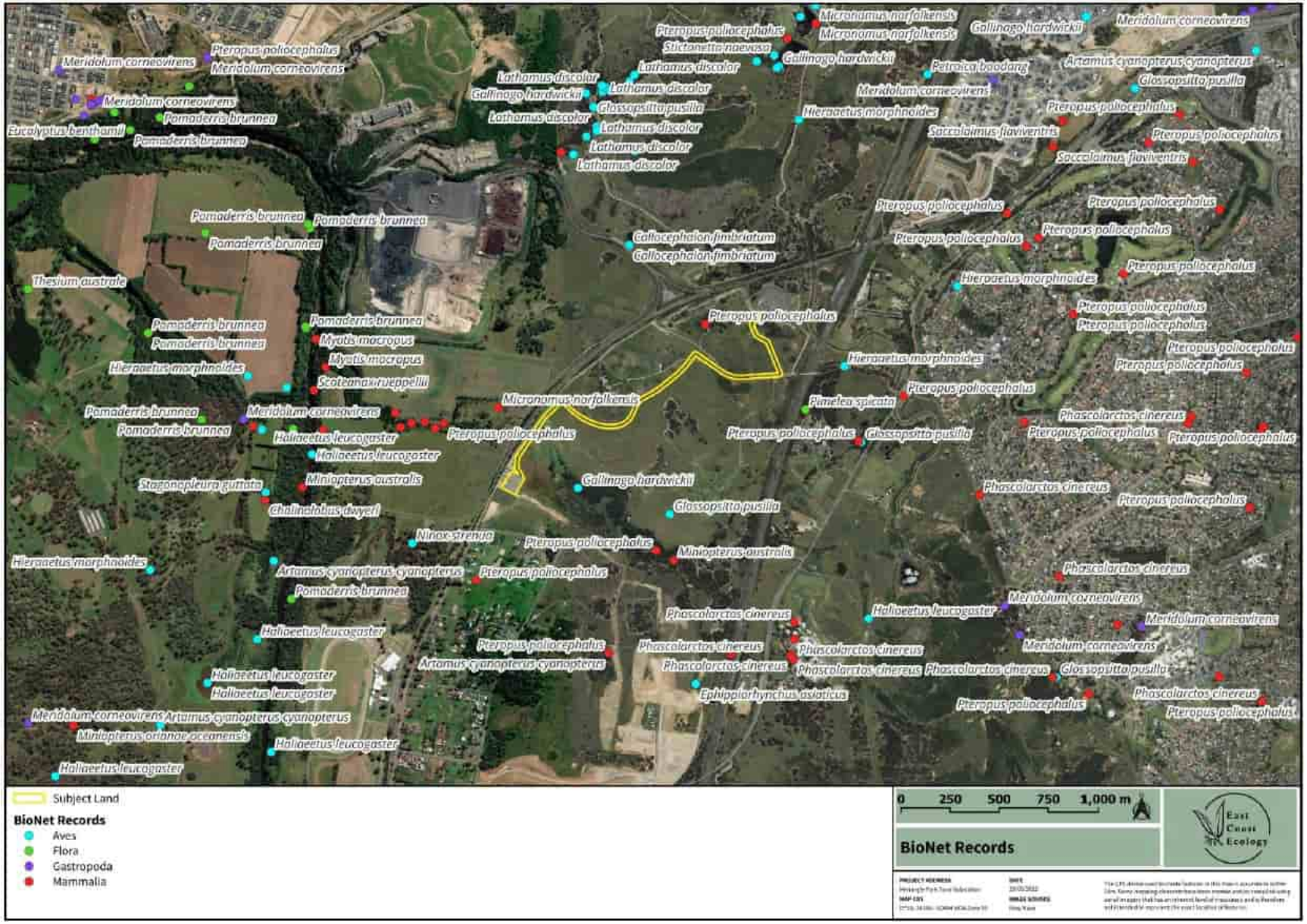

Figure 5-3: Bionet records in proximity of the proposal site (Source: BAR (ECE 2025) Appendix E)

5.1.3 Impact assessment

Construction

PCT and CEEC

Up to 4.07ha of PCT3320 will be impacted by the proposal. Vegetation present in the proposal site was in poor condition and would be impacted by trenching works and machinery movement within the proposal site.

A Test of Significance (ToS) under the BC Act for the CEEC that PCT3320 is listed under found that the proposal will not have a significant impact on this ecological community (refer to Appendix C of the BAR, presented in **Appendix E** of this REF).

Threatened Flora

The BAR determined threatened flora 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. Safeguards will be implemented to mitigate potential impacts to threatened flora species.

Threatened Fauna

The BAR found 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

Impacts to vegetation would be associated with trenching, and movement of plant and machinery within the proposal site. Sensitive and/ or specialist fauna habitats are unlikely to be directly impacted by the proposal given the minor foraging habitat, and no hollow-bearing stags will be removed by the proposal.

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 consists predominantly of agricultural land that has already fragmented the landscape by clearing a barrier for fauna movements. Given the proposal includes the removal of one tree (priority weed African Olive) and removal of ground cover to facilitate trenching, it is unlikely to cause further habitat fragmentation.

Operation

Threats to habitat

There would be no direct or indirect impacts to habitat compared to the existing environment during operation.

Predatory and pest species

Vegetation clearance associated with the proposal is unlikely to increase predatory species populations. The proposal 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.

One priority weed observed in the proposal site (African Olive) is to be removed, which may result in the spread of the weeds due to disturbance of the tree and potential spread of seeds via wind or water. Safeguards are proposed to manage the potential spread of priority weeds.

5.1.4 Safeguards

Table 5-5: Biodiversity safeguards

Number	Safeguard
B01	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* (TfNSW, 2024).
B02	Vegetation removal will be undertaken in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B03	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.
B04	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; and • Protocols to manage weeds, pathogens and pest species, including African Olive which is to be removed.
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	Any unexpected habitat removal will be undertaken by staged clearing in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B07	Habitat will be replaced or re-instated in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B08	Weed species (including African Olive) will be managed in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B09	Pathogens will be managed in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

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, 2025)
- WaterNSW Greater Sydney Drinking Water Catchment map (WaterNSW, 2025a);
- WaterNSW Continuous water monitoring network (WaterNSW, 2025); 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 21,400km^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 feeder route traverses two waterways which drain to the west and into the Nepean River, located around 1km west of the proposal site. Howes Creek is located in the southern portion of the proposal site where it is proposed to underbore, and one overland drainage line is on the northern end of the proposal site in proximity of the BSP. The southern creek appears to be characteristic of a small perennial creek, and the northern drainage line appears to be ephemeral in nature.

Around 210m northeast of the northernmost extent of the proposal is the Upper Canal which ultimately flows to Prospect Reservoir 30km north.

During periods of rainfall, surface water would generally be absorbed by the unsealed ground, and during heavy rainfall, surface water runoff would be directed to Howes Creek.

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

Groundwater surrounding the proposal site is expected to flow north west into the Nepean River, situated approximately 1km west of the site. Review of Water NSW boreholes (WaterNSW, 2025) 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 120m north of the feeder route, along the entrance road into the Glenlee Estate. GW101106 has a reported standing water level (SWL) of 17m below ground surface (bgs).

Within a 1km radius of the proposal site, three active monitoring bores are identified approximately 520m west, however no SWL is reported for any of these bores. The monitoring bores include:

- GW114887 with a depth of 228.3m;
- GW114886 with a depth of 190.3m; and

- GW114885 with a depth of 102.0m.

Alliance Geotechnical Pty Ltd (Alliance) were engaged by Endeavour Energy to prepare the Geotechnical Investigation Report in November 2024 (Alliance 2024) (refer **Appendix F**). Alliance (2024) reported groundwater seepage encountered during borehole drilling where a localised groundwater table was encountered at depths of 1.0m, 1.5m and 1.6m.

GeoEnviro (2018) prepared a Contamination and Waste Classification Assessment in February 2018 (GeoEnviro 2018) **(Appendix G**) which reported low or negligible concentrations of contaminants in analysed. Slightly elevated concentrations of Cadmium and Zinc were reported to be likely associated with background levels from surrounding disturbed terrain, and therefore not considered significant. The investigation concluded that the site has a low risk of gross ground chemical contamination.

5.2.3 Impact assessment

Construction

There is potential for localised impacts to surface water during construction activities, including from the following:

- Site clearing including vegetation removal;
- Underboring under the Riparian corridor;
- Trenching for the transmission mains; and
- 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.

Alliance (2024) states that groundwater inflow is to be anticipated in trench excavations in the south-western portion of the site, and in under bore launch and receival pits. Where groundwater inflow is slow, it is anticipated that conventional sump-and-pump methods should be sufficient to manage inflow and maintain a dry excavation, in conjunction with temporary surface drainage lines cut into excavation benches/batters as required. If strong groundwater inflow is encountered when excavating underboring pit locations, the use of steel sheet piles driven below the depth of excavation may be considered to reduce water ingress into the excavation.

If groundwater source is encountered during construction, a Water Supply Work approval is to be obtained from WaterNSW in accordance with Chapter 3 Part 2 of the *Water Management Act 2000* before any groundwater dewatering works can commence.

Disposal of pumped groundwater would be undertaken in accordance with the Dewatering Section in EE's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

Operation

Given the proposed feeder would be buried and the groundcover would be reinstated, it is not expected that the proposal would 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).

Number	Safeguard
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.
W14	Any potential dewatering that may be required will need to be done in accordance with Endeavour Energy's standard *EMS 0014 – Dewatering sites* and the ***Environmental Guidelines Handbook April 2024*** (Endeavour Energy, 2024).
W15	The works are not expected to intercept groundwater more than 3ML. In such a case, a water access licence isn't required as it would be exempt under the *Water Management (General) Regulation 2025* and *Water Management (Water Supply Authorities) Regulation 2025*. Should >3ML be extracted, the dewatering guideline in Endeavour Energy's Environmental Guidelines Handbook April 2024 (Endeavour Energy, 2024) must be followed.

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, SIXMaps, 2025);
  - eSPADE V2.2 (DPIE, 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, 2025).
- Contamination
  - Searches of the following public registers were undertaken on 10 June 2025:
    - NSW EPA Contaminated Land Register (as per section 308 of the POEO Act) (EPA, 2025);
    - NSW EPA list of Contaminated sites notified to the EPA (as per section 60 of the POEO Act) (EPA, 2025a) 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, 2025).

Geotechnical Investigation Report (Alliance, 2024) (**Appendix F**) was undertaken for the proposal site which assessed the surface and subsurface conditions. The report was reviewed to inform this chapter and included the following:

- Existing geotechnical subsurface and groundwater conditions;
- Thermal Resistivity test results;
- Geotechnical design parameters of encountered site soils for retention design;
- Excavation conditions and methodologies; and
- Temporary batter slopes and retention structures.

A Contamination and Waste Classification Assessment (GeoEnviro 2018) (**Appendix G**) was prepared to assess the subsurface ground conditions at the ZS. Given the proximity of the ZS to the proposal site, and assessment of the wider area undertaken in the report, the contamination assessment has been reviewed to inform this chapter, and included the following:

- Assessment on the contamination of the site to ensure suitability of the site for the proposal;
- 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 proposal.

5.3.2 Existing environment

Topography

The topography of the surrounding area is characterised by undulating hilly terrain. The topography within the proposal site ranges between 75 mAHD at Howes Creek in the southern extent, to 125 mAHD at Glenlee Road. Topography at the proposal site is presented in **Figure 5-4**.

Geology and Soils

The site is predominantly underlain by Bringelly Shale, consisting of shale, carbonaceous claystone, laminite, lithic sandstone and rare coal. In the south west corner of the proposal, past the creek line, the site is underlain by Alluvial Deposits, consisting of unconsolidated grey to brown to beige humic micaceous silty clay, quartz lithic silt, fine to medium grained quartz-rich to quartz-lithic sand, and polymictic pebble to cobble gravel.

Review of eSPADE on 3 June 2025 indicates the soil landscape for the southern portion of the site is characterised by fluvial soil belonging to the Theresa Park Landscape Group which is typically made up of variable and poorly structured silty and sandy loads. The northern portion of the site is characterised 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.

Alliance (2024) (**Appendix F**) undertook intrusive investigations which reported topsoils generally across the proposal site between 0.1m below ground and the ground surface comprises variable sand, clay and silty clay with low to medium plasticity. The southern portion of the site was characterised by sand and clayey sand granular alluvium as well as clay, silty clay and sandy clay cohesive alluvium. The northern portion is dominated by residual clay and silty clay soil and fine grained sandstone bedrock.

No fill was encountered during the intrusive investigations.

Acid Sulfate Soils

Review of eSPADE on 3 June 2025 indicates 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.

Salinity

The feeder route is primarily in an area of moderate salinity potential with a portion on area of mapped high salinity potential as per the Salinity potential Western Sydney map (DCCEEW, 2002). During the site inspection undertaken by JBS&G on 16 December 2024, an area of exposed soils was observed around 54m north from Howes Creek, 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.

Contamination

The proposal site has historically been used for agricultural purposes within a rural area and scattered vegetation. The site is predominantly cleared of trees with grass cover and some dirt tracks visible but no apparent land use.

The sites 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 Unexposed Ordinance mapping (UXO) (Australian Government-Defence, 2025) 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 and surrounding area including proposal site. No fill was encountered during the Alliance (2024) geotechnical investigation.

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

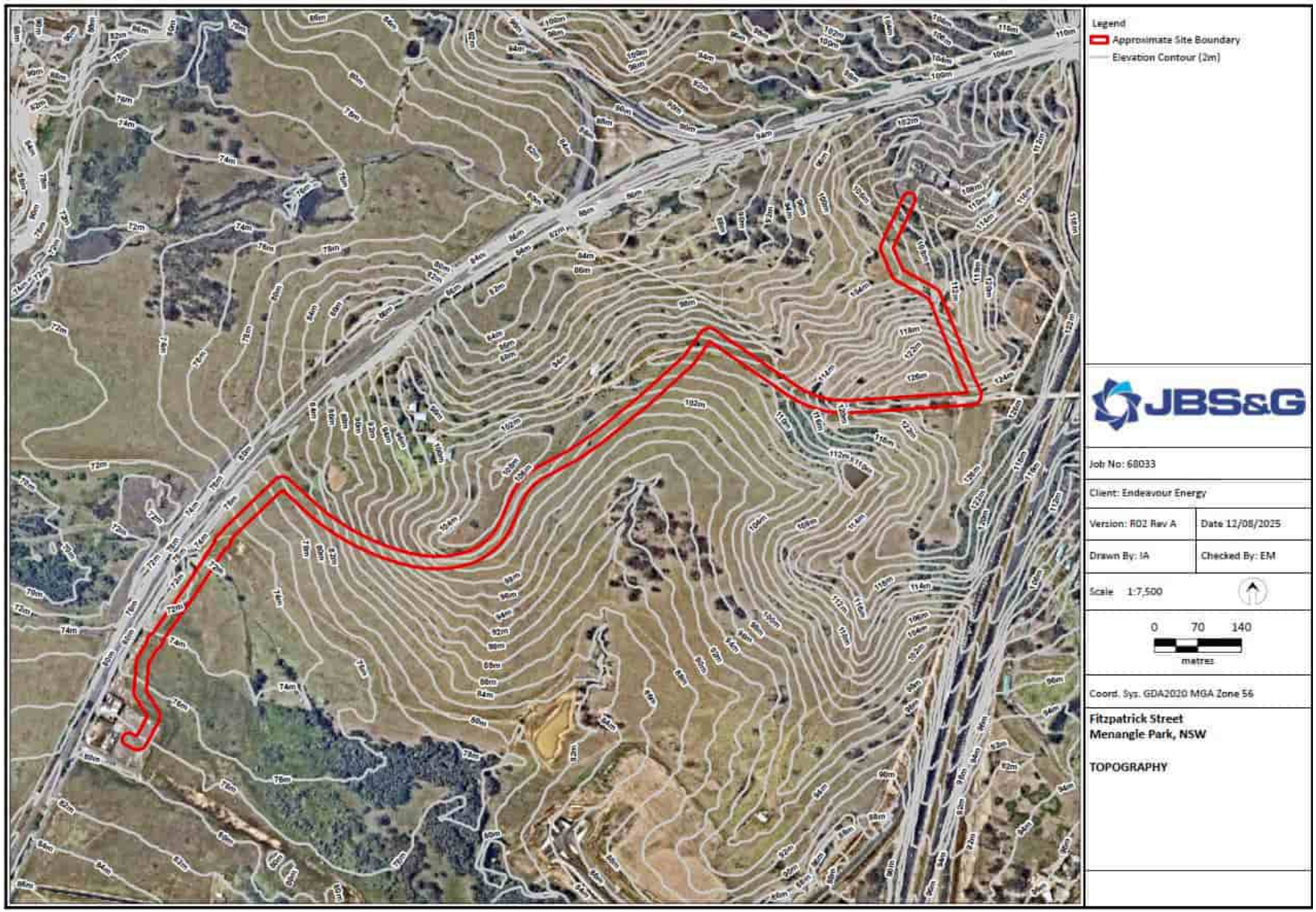

Figure 5-4: Topography at the proposal site

5.3.3 Impact assessment

Construction

Soils

The following construction activities that involve soil disturbance are:

- Trenching and underboring for the feeder;
- Temporary stockpiling of material within the proposal site;
- Vegetation removal including one African Olive tree and groundcover; and

Loose soil, organic material from tree removal are potential impacts from the clearing.

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

Contamination

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. Safeguards outlined in **Table 5-7** will be implemented to mitigate these impacts.

The risk of gross ground contaminants from the proposal site is considered low. If any unexpected interaction with fill increases the potential of encountering contamination. Removal of all spoil from the site will be in accordance with the *NSW Waste Classification Guidelines 2014* (EPA, 2014).

Operation

No operational impacts to soils or contamination are anticipated to result from the proposal. 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.
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). Natural soil classified and validated as Virgin Excavated Natural Material (VENM) should be reused at an approved site or disposed at a licensed waste facility.
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.

Number	Safeguard
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).
SC08	All excavated topsoil, fill, VENM and waste should be segregated into separate stockpiles to prevent cross contamination.

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

Access to the proposal would be via Glenlee Road to the north, and Fitzpatrick Street to the south. Glenlee Road is a local road located in the northern extent of the proposal site, connecting private properties to the west to Menangle Road in the east. It is a two-lane bi-directional road, is sealed with asphalt in moderate condition and does not have stormwater infrastructure to direct surface water run-off. The speed limit for the road is 50 km/h.

Fitzpatrick Street is located to the south of the proposal, providing alternative access to the site via the new ZS site. 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 (TfNSW, 2025a) 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 and Glenlee Road. The roads may be utilised by local cyclists accessing residences in the surrounding areas.

Access

Access to the southern portion of the proposal site would be via an unnamed access road directly south of the ZS. 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.

Glenlee Road is located within the northern portion of the proposal site. Glenlee Road is a partially sealed asphalt and gravel road with sections of exposed soil to the east. The road provides access to private properties including the heritage listed Glenlee Estate to the west of the proposal site. There is no throughfare provided via Glenlee Road to feeder roads or other local roads.

The Macarthur BSP and the agricultural property between the ZS and Glenlee Road are secured with fencing and lockable gates.

5.4.3 Impact assessment

Construction

Potential impacts on traffic and transport resulting from the construction of the proposal would include:

- Noticeable minor increase in construction vehicle movements along Racecourse Avenue, Fitzpatrick Street and Glenlee Road including an estimated 13 separate plant; and
- Temporary full and/or partial closure of Glenlee Road to facilitate trenching.

The use of Fitzpatrick Street for temporary construction traffic, and works within the Glenlee Road corridor 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 to residents on Fitzpatrick Street would remain unaffected, as no works are proposed that would require traffic control or road closures on this road.

Partial and/or full closure of Glenlee Road would potentially impact upon local residents and property owners accessing private properties serviced by the road. Access will be maintained at all times, and where not possible this will be communicated with surrounding properties.

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.
T04	A Traffic Guidance Scheme will be prepared, and traffic control will be organised and include contraflow arrangements where possible during trenching works to maintain access.
T05	Notification to properties accessed via Glenlee Road will be made regarding full and/or partial closures.
T06	Obtain a Road Opening Permit from Campbelltown City Council in accordance with section 138 of the Roads Act (refer **Section 6.2**).

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* (NPI) (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, 2025).

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)). Noise category R1 was 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).

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 (Day Design, 2024).

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:

- Scenario 1: Underboring; and
- Scenario 2: Trenching.

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

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 2.4.8**. Inputs to the TfNSW Noise Tool are presented in **Appendix G**.

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:

- 60 Menangle Road located approximately 170m north of the proposal site;
- 232 Racecourse Avenue located approximately 390m south of the proposal site;
- 22 Fitzpatrick Street located approximately 365m south of the proposal site;
- 36 Fitzpatrick Street located approximately 495m south of the proposal site; and
- 46 Fitzpatrick Street located approximately 490m south of the proposal site.

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

Table 5-11: TfNSW Noise Tool inputs for construction phase

Input section	Feeder route (underbore)	Feeder route (excavation)
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)	Microdrilling rig (soilmec SM-5)	13.5 excavator
Line of sight to sensitive receivers?	Yes – line of sight to the row of residences on Fitzpatrick Street south of the ZS; 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.

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 no vibration intensive plant are to be used as part of the proposal.

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 ZS and the Hume Highway, approximately 1km east of the proposal site.

The noise environment is characterised by the trainline to the west of the proposal site (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 (Day Design, 2024) is summarised in **Table 5-12** below.

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

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

A total of nine residential receivers were identified within a 500m radius of the feeder route. The closest residential receiver to the feeder route is the Glenlee Estate, located around 185m west of the feeder route.

A total of four non-residential receivers were identified within 500m of the proposed feeder route including two industrial spaces, one passive recreation area and one place of worship, the Sadahan Sewana Buddhist Centre Campbelltown, around 250m south east of the 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.

Scenario 1: Underbore

Residential receivers

The underboring for part of the installation of the feeder includes the use of a microdrilling rig (Soilmec SM-5) which is predicted to be the noisiest tool for surrounding sensitive receivers during standard hours and OOHW. Underboring will be undertaken over a two week period. Sensitive receivers and predicted noise contours for this scenario are presented in **Figure 5-5**.

There were no residential sensitive receivers predicted to be impacted from the underboring activity of the feeder installation.

Table 5-13: Underboring of feeder summary of affected residential receivers during standard construction hours and OOHW for Microdrilling rig (Soilmec SM-5) (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	130m	0	Not triggered
		70 – Highly intrusive	50m	0	Not triggered
		75 – Highly affected	30m	0	Not triggered
Day (OOHW) (Saturday 7am-8am, 1pm-3pm)	45	50 – Clearly audible	270m	0	Not triggered
		60 – Moderately intrusive	130m	0	Not triggered
		70 – Highly intrusive	50m	0	Not triggered
		75 – Highly affected	30m	0	Not triggered
		60 – Moderately intrusive	50m	0	Not triggered
		70 – Highly intrusive	25m	0	Not triggered

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
		75 – Highly affected	15m	0	Not triggered

Non-residential receivers

No non-residential receivers are predicted to be impacted by noise generated works during the feeder underboring stage of the proposal.

Table 5-14: Underboring of feeder 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	85m	0	Not triggered
		75 – Highly affected	30m	0	Not triggered
Passive recreation	60	70 - – $L_{Aeq(15\ minute)}$ noise level above NML	50m	0	Not triggered
		75 – Highly affected	30m	0	Not triggered
Industrial	75	75 – Highly affected	15m	0	Not triggered

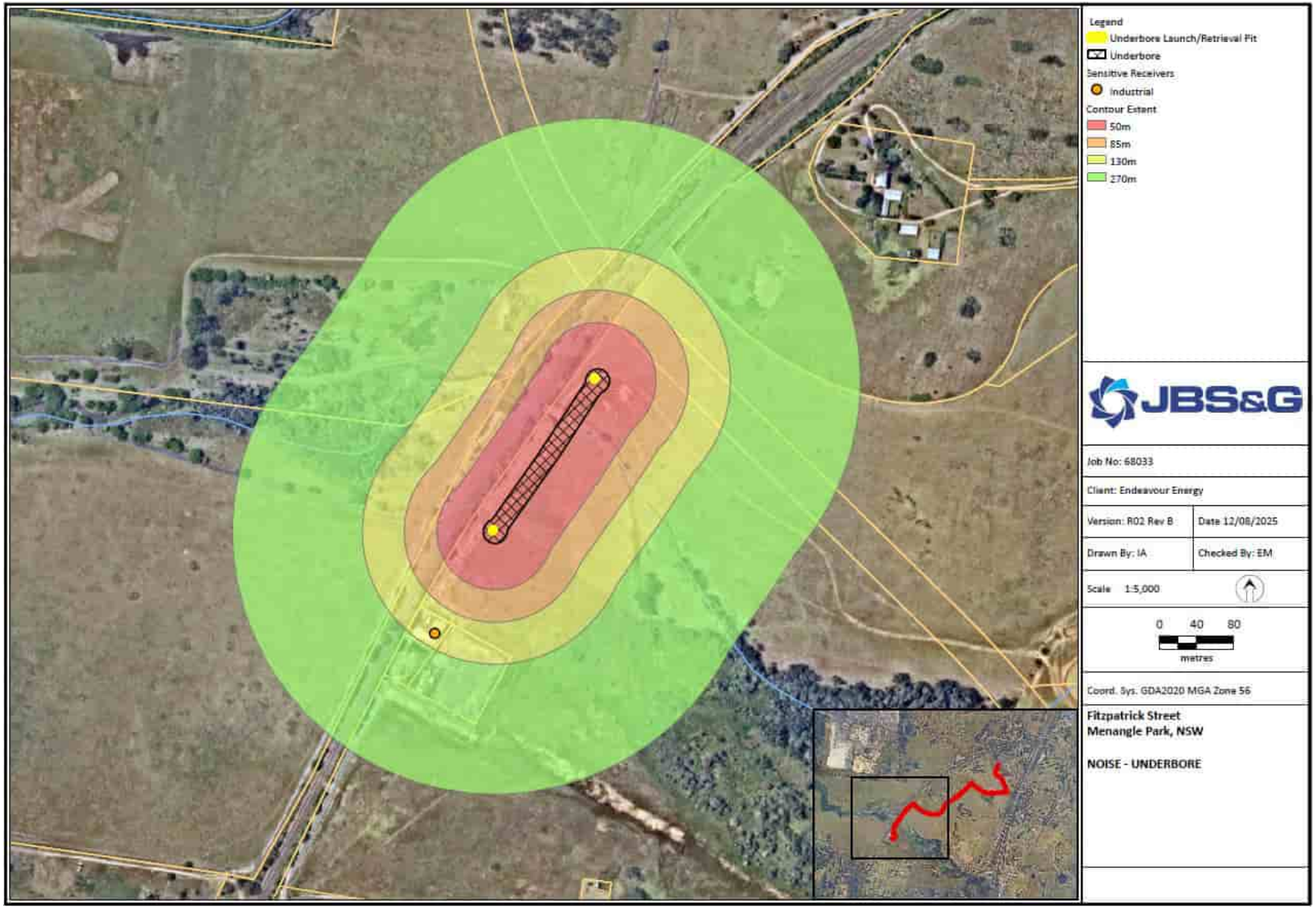

Figure 5-5: Construction noise contours for underbore on feeder route

Scenario 2: Trenching

Residential receivers

The installation of the feeder, excluding the section of underboring, includes the use of a 13.5T excavator 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 5-6**.

Table 5-15: Installation of feeder summary of affected residential receivers during standard construction hours and OOHW for 13.5T excavator (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	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
		60 – Moderately intrusive	20m	0	Not triggered
		70 – Highly intrusive	10m	0	Not triggered
		75 – Highly affected	5m	0	Not triggered

There were no residential sensitive receivers predicted to be impacted from the underboring activity of the feeder installation.

Non-residential receivers

No non-residential receivers are predicted to be impacted by noise generated works during the feeder trenching stage of the proposal.

Table 5-16: Installation of feeder 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	25m	0	Not triggered
		75 – Highly affected	15m	0	Not triggered
Passive recreation	60	70 – $L_{Aeq(15\ minute)}$ noise level above NML	20m	0	Not triggered
		75 – Highly affected	15m	0	Not triggered
Industrial	75	75 – Highly affected	15m	0	Not triggered

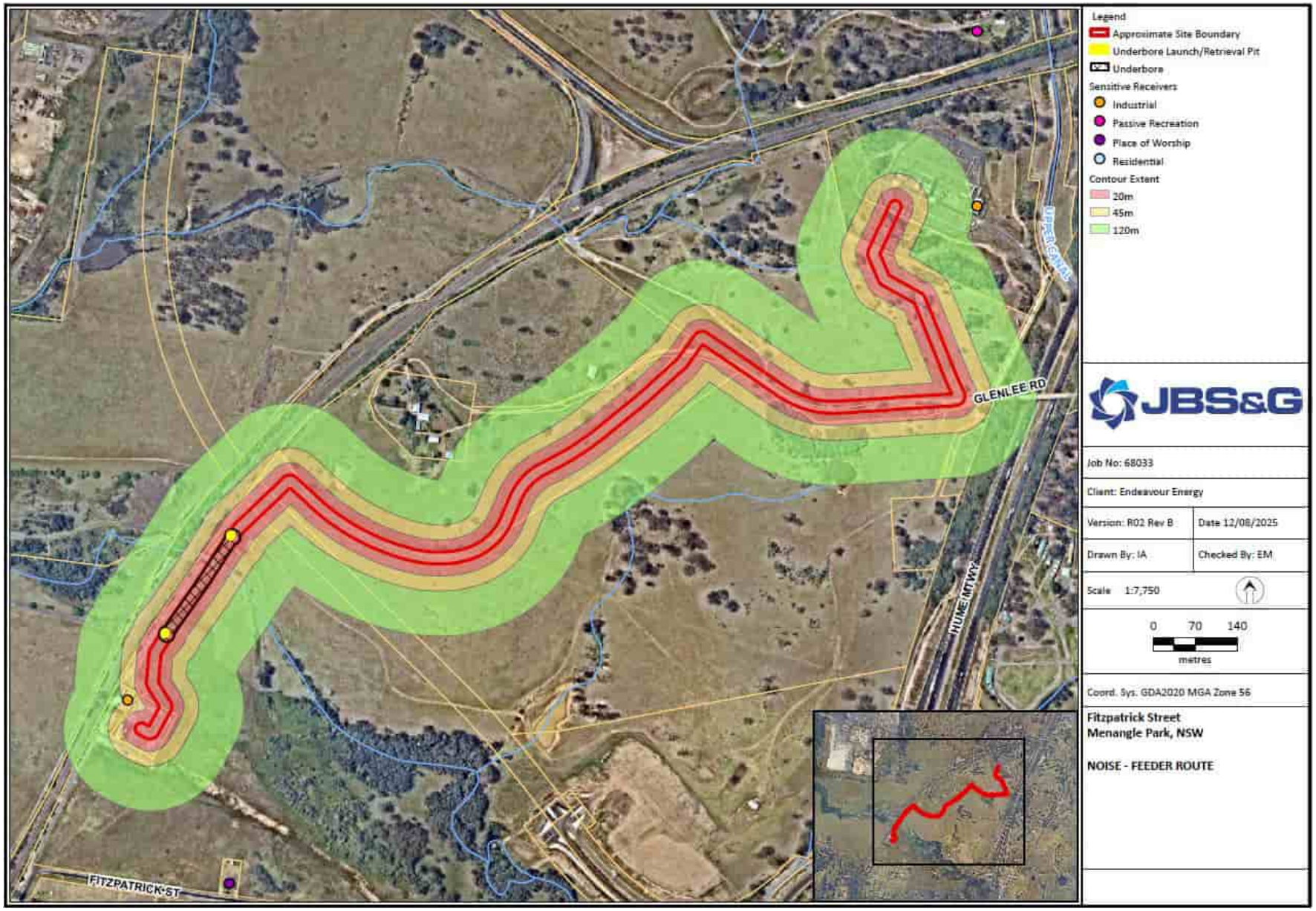

Figure 5-6: Construction noise contours for trenching along the feeder route

Construction vibration

No vibration impacts are predicted during construction given no vibration intensive plant is proposed, and distance to structures from proposed trenching and underbore works.

Operation

As the feeder will be underground and will not make any noise or vibration, there are no expected noise or vibration impacts of the feeder during operation.

5.5.4 Safeguards

Table 5-17: Noise and vibration safeguards

Number	Safeguard
NV01	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.
NV02	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.
NV03	Use quieter emitting methods. Ensure plant and equipment are fitted with appropriate silencers that are maintained in good working order for the duration of the works.
NV04	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.
NV05	No OOHW other than the hours assessed in this section should be undertaken without approval from the Endeavour Energy Environmental Services team and would require additional assessment.

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) to assess potential impacts to Aboriginal Heritage associated with the proposal.

Following receipt of additional information that was not considered in the DD prepared by Artefact, Kelleher Nightingale Consulting Pty Ltd (KNC) were engaged to prepare a DD incorporating this information (refer **Appendix I**). KNC aimed to identify if Aboriginal objects were likely to be located in the study area and if so, whether the proposed works were likely to harm those objects.

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

5.6.2 Existing environment

Previous archaeological investigations

Comprehensive archaeological investigations have been previously conducted within and surrounding the proposal site for the Menangle Park Urban Release Area (MPURA) which includes various stages of land releases, proposed residential developments and associated infrastructure projects. The archaeological investigations have resulted in the identification of two registered AHIMS sites within the current proposal site and several within 200m of the proposal site.

The reports are summarised in the DD prepared by KNC (**Appendix I**), and are summarised as follows:

- Heritage Concepts (2006) conducted a review of background information, consultation with the Tharawal Local Aboriginal Land Council (LALC) and an archaeological field survey prior to the construction of the Macarthur Substation and associated infrastructure. This involved the north portion of the proposal site past Glenlee Road;
- JMCHM (2009) assessed the Howes Creek corridor in 2009 for the proposed extraction of soil and sand in an area adjacent to the Nepean River. This assessment included an in-depth review of land use history and archaeological excavation of the Howes Creek corridor along the western side of the railway tracks traversing the proposal site;
- HLA Envirosciences (2007) conducted a desktop review of previous assessments, Aboriginal community consultation and an archaeological field survey to support the Camden gas project. The assessment traversed with the access track north of Howes Creek, approximately 150m southeast of the current proposal site;
- A large portion of the current proposal site was assessed during investigations for the MPURA by Niche Environment and Heritage (2013) which included a review of previous studies and development of predictive models;
- An Aboriginal Cultural Heritage Assessment Report (ACHAR) and subsequent test excavation was undertaken by Niche (2013) over 28ha of land including the majority of the proposal site. The assessment identified zones of moderate and low archaeological potential, with no areas of high potential;
- KNC (2019) conducted a comprehensive review of previous investigations and test excavations across two areas, Menangle Park North located approximately 300m northwest of the proposal site and Menangle Park South located approximately 2km south of the proposal site;
- Following the 2019 investigation, KNC (2025) were engaged to prepare an ACHAR to support an AHIP covering the wider MPURA area, including the majority of the proposal site area;

- A portion of the current proposal site was assessed for its Aboriginal cultural heritage values during investigations by Artefact Heritage (2017) for the proposed Spring Farm Parkway, including an archaeological field survey. This incorporated a narrow corridor south of the Glenlee estate property that continues south from the railway corridor, passing along the northern bank of Howes Creek and the eastern side of the ZS;
- AECOM (2014) conducted archaeological investigations for the Menangle Par Wastewater Services project which covered a site area immediately adjacent to the southern end of the proposal site; and
- Archaeological assessment was required for a proposal by Endeavour Energy to establish a new mobile interim Menangle Park ZS to service the initial Menangle Park electricity load growth (Artefact 2018). A portion of this assessment area follows the southern end of the proposal site alignment and crosses the northern extent of the proposal site, south of the Macarthur Substation.

The reports were reviewed and summarised by KNC (2025), which found:

- Aboriginal archaeological sites previously recorded within proximity of the proposal site generally consist of artefact scatters and isolated finds, with one culturally modified (scarred) tree identified >200 metres east of the current proposal site. Within the surrounding area, Aboriginal archaeological sites have mostly consisted of isolated artefacts or low density artefact scatters identified within disturbed contexts.
- Past test excavation programs undertaken within the sloping landforms of the Bringelly Shale geological landscape have identified a very low archaeological potential within these landforms. Better archaeological integrity is encountered within the alluvial terrace landforms south of Howes Creek where impacts from land use disturbance has been limited (e.g. site MPRP 8).
- Archaeological evidence suggests that whilst Aboriginal objects are known to occur in and near the proposal site, the likelihood of intact subsurface deposit will vary significantly based on the level of environmental and anthropomorphic disturbance. The proposal site has been subject to a high level of land use disturbance, leading to a low likelihood of any intact archaeological deposit remaining within the proposal site.

Other heritage searches

A review of other relevant publicly available statutory and no-statutory heritage registers for Aboriginal heritage items was undertaken and no Aboriginal archaeological sites or Aboriginal heritage items were recorded on these databases within the proposal site, except for two AHIMS sites listed as “destroyed” (refer section below).

The State Heritage Register contains the historic property known as ‘Glenlee’ (SHR #00009) which is located adjacent the proposal site on the western side of the central portion of the feeder route. The area is not listed for Aboriginal heritage values, although the listing notes the area close to the residential house on the property may have archaeological potential associated with its occupation and use by the Dharawal Aboriginal people prior to and immediately after European settlement.

AHIMS search

A search of the Aboriginal Heritage Information Management System (AHIMS) database was completed on 2 June 2025 to identify registered (known) Aboriginal sites or declared Aboriginal places within or adjacent to the proposal site (AHIMS Client Service ID: 1010154) (refer to **Figure 5-7**). The AHIMS results showed 41 Aboriginal sites recorded in or near the proposal site, 38 listed as ‘Artefact’ features, one listed as ‘Artefact, Potential Archaeological Deposit (PAD)’, one registered as ‘PAD’ and one instance of a ‘modified tree ((carved or scarred)’. Of these records, one site is listed as ‘partially destroyed’ and nine sites are listed as ‘destroyed’. Refer to **Figure 5-7**.

Previously recorded sites within the proposal site, and in proximity of the proposal site

Previous recorded sites within the proposal site

There are two previously recorded AHIMS sites located within the proposal site. Both sites have been destroyed under an AHIP (AHIP C0005561) and include:

- Menangle Park Feeder Isolated Find 01 (MPFIF 01) – AHIMS 52-2-4497; and
- Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01) – AHIMS 52-2-4529.

Previous recorded sites within proximity of the proposal site

In addition to the above, there are five previously recorded sites recorded in close proximity to the proposal site, including:

- MPSW-AS1-13 – AHIMS 52-2-4069, destroyed under AHIP C0000393;
- MP – Reburial – 2017 – AHIMS 52-2-4396 within AHIP C0000393;
- Menangle Park Feeder Artefact Scatter – 01 – AHIMS 52-2-4526, destroyed under AHIP C0000393;
- MPRP 8 Menangle Park Rezoning Project 8 – AHIMS 52-2-3915 within 4648 and AHIP 5401; and
- MPSW-IA1-13 - AHIMS 52-2-4068 – removed to different location under AHIP C0000393 (AHIMS 52-2-4396).

The existing AHIPS in relation to the proposal site can be identified in **Figure 5-8**.



Figure 5-7: AHIMS search results (Source: KNC 2025, Appendix I)



Figure 5-8: Existing AHIPs in relation to the proposal site (Source: KNC 2025, Appendix I)

Landscape Assessment

The proposal site is located across land that traverses several landforms characterise by gentle to moderate slopes, ridges and the low-lying Nepean River Floodplain. The shallow depth of clay encountered within the boreholes conducted during the previous geotechnical investigation (Alliance, 2024) (**Appendix F**) is reflective of the erosional risk associated with sloping landforms, and indicates the limited potential for intact archaeological deposits to remain. Alluvial landscapes located south of Howes Creek are more favourable to artefact preservation, however they have been subject to high levels of disturbance, reducing the potential for intact archaeological deposits to remain this location.

The proposal site is located in proximity to landform features (within 200 metres of waterways; ridgelines) which are often associated with Aboriginal occupation/activity as determined by *the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010). Based on the landscape assessment, the proposal site has the potential to retain Aboriginal objects and archaeological deposit in contexts where the ground has not been subject to significant disturbance.

Visual inspection

A visual site inspection was undertaken on 30 May 2025 by KNC. Several areas within the proposal site boundary were located within unfavourable landform conditions, or areas subject to high levels of disturbance by existing infrastructure. Areas within the proposal site was observed to be modified with little to no intact original soil. These areas are not conducive to artefact survivability and do not display archaeological potential.

5.6.3 Impact assessment

The proposal site was assessed under the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010). No Aboriginal objects, archaeological sites or areas of archaeological potential were identified within the proposal site as a result of the due diligence assessment.

Two previously registered sites located within the proposal site (AHIMS 52-2-4497 and AHIMS 52-2-4529) have been destroyed under AHIP C0005561 and are no longer extant, and therefore will not be impacted by the proposal. One artefact reburial site was identified directly adjacent to the proposal site (MP - Reburial – 2017; AHIMS 52-2-4396), however the site is located outside of the proposal site and will not be impacted by the proposal.

Contemporary land use has led to high levels of disturbance within the proposal site due to road construction, existing water and electricity-related infrastructure and agriculture. As such, no areas of archaeological potential were identified within the proposal site.

The proposal would involve ground disturbance across the site, however it is not expected the works will encounter Aboriginal objects. Any unexpected occurrence of Aboriginal sites or objects will be managed with the safeguards outlined in **Table 5-18** below.

KNC concluded that there are no archaeological constraints to the proposal and according to the Heritage NSW *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010), the proposed works can therefore proceed with caution.

5.6.4 Safeguards

Table 5-18: Aboriginal heritage safeguards

Number	Safeguard
AH01	Endeavour Energy will notify the applicable AHIP holders of the proposed works and confirm conditions of these permits prior to commencing works. This can be undertaken during landholder notifications.
AH02	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

Number	Safeguard
	the vicinity of the material/find, and the Endeavour Energy project manager must be contacted immediately.
AH03	If human skeletal remains are identified, works are to stop and the NSW Police and EE project manager are to be notified immediately after the find.

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 J** 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 gatelodge) located adjacent to the proposal site boundary which is listed on the SHR (#00009), CLEP (item I00009), RNE (#3277) and NTAR (7769). The next closest site,

Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) (SHR #01373, CLEP item I01373), is located more than 200m north-east the site. These sites are shown in **Figure 5-9**.

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 (refer **Figure 5-10**) was reviewed in the SoHI which identified individual fields, crop marks, buildings, and roads. The aerial imagery shows that the feeder route does not cross the remains of any buildings or structures, but it does run 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.

The SoHI concluded that the whole of the proposal site is considered to be of nil to low potential except for the areas in **Figure 5-10** which are considered to have low archaeological potential.



Figure 5-9: Heritage listed items adjacent to the proposal site (Source: Appendix J)

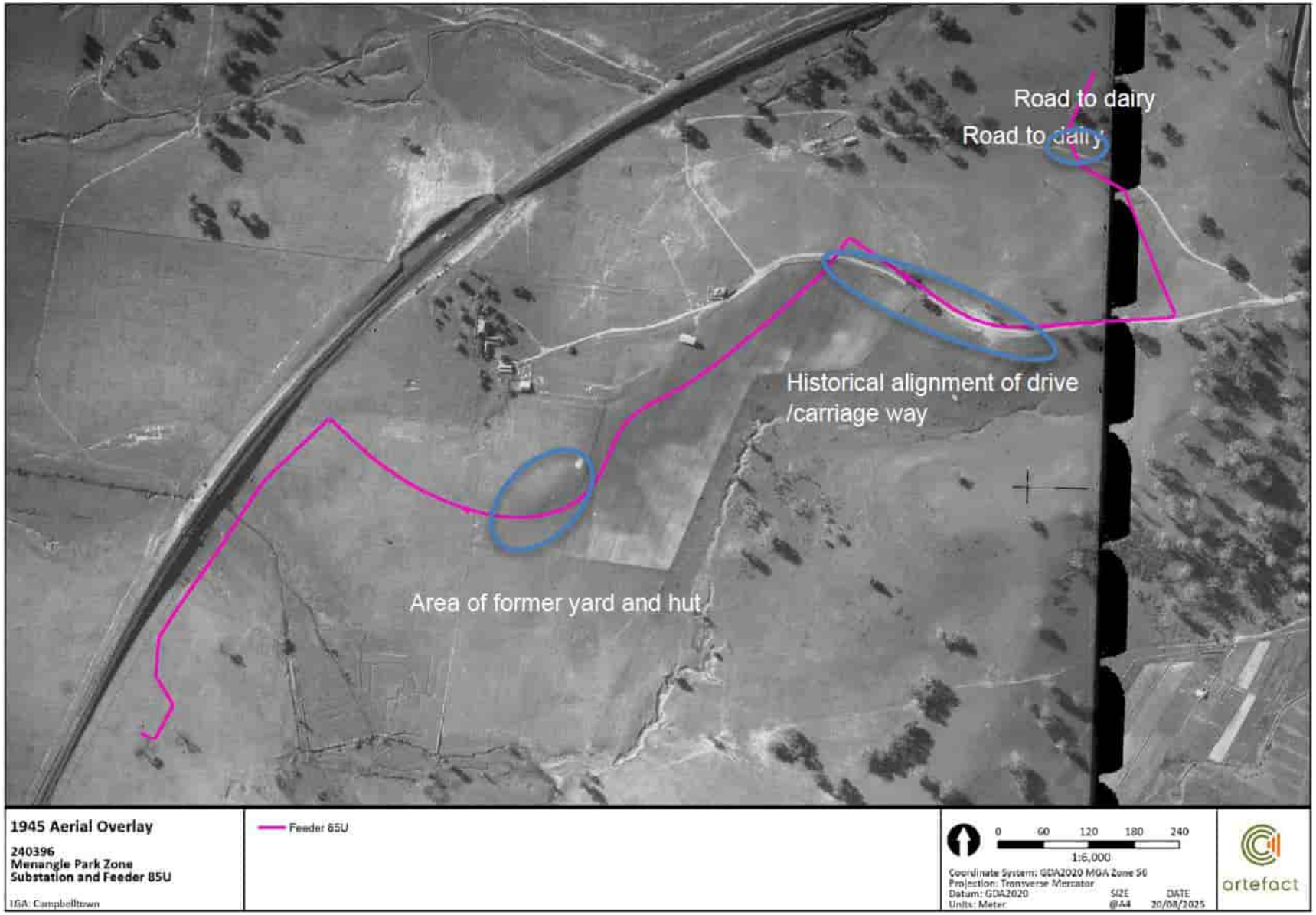

Figure 5-10: Location of areas of archaeological potential within proposal (Source: Appendix J)

5.7.3 Impact assessment

Physical impact

The Glenlee Estate heritage site is not within the site boundaries and is separated by the existing property fence which would not be modified. There would be no risk of construction works inadvertently entering the heritage item. In addition, no vibratory works are proposed along the feeder that would affect the heritage item. Therefore, the proposal would cause little to no physical impacts to the state heritage listed item.

Visual impact

During construction, there would be temporary visual impacts caused by the presence of equipment and plants near the heritage item, however, this impact would be localised and temporary in nature. The visual impact would be resolved upon completion of construction, and the reinstatement of the ground surface removes any visual impact near the heritage item. 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 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 5-19: 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.

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, 2025).

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 23 June 2025 identified an air quality monitoring station (Site ID: Campbelltown West) around 3.5km north-east of the proposal site. The website reported hourly averages for 10am-11am 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 $0.1x10^{-4}\ m^{-1}$.

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 removal of one tree, and trenching, as well as the temporary stockpiling of excavated material and imported material (including stabilised sand).

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.

5.8.4 Safeguards

Table 5-20: 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.

5.9 Bushfire

5.9.1 Methodology

A Bushfire Risk and Operations Plan (Bushfire Assessment) was conducted by Bushfire Environmental Management Consultancy (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. This assessment focuses on the operation of the ZS, and does not include the feeder route as it would be underground.

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

Construction bushfire risk

Key potential impacts relating to bushfire risk 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 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.

Operation

As the proposal (feeder route) would be located underground, there is no expected bushfire risk during the operation of the proposal.

5.9.4 Safeguards

Table 5-21: Bushfire safeguards

Number	Safeguard
BF01	Emergency management during construction phase should be administered through the site specific Construction Environmental Management Plan (CEMP) and Safe Work Method Statements (SWMS). The principles within this document shall be used to guide the site-specific operations and risk plans during the construction phase.

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 5-22**).

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 5-22**).

Table 5-22: 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 70m AHD with a slight decline west towards the Nepean River. 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, residents located on the neighbouring property to the west of the proposal, on Fitzpatrick Street to the south of the proposal, and road users of Fitzpatrick Street during construction and operation, and Glenlee Road during construction.

Specifically, there are five residents south of the proposal with direct line of sight to the site of the ZS and construction of the feeder route. 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. There is also one sensitive receiver along the feeder route known as the Glenlee Olive Estate.

The visual sensitivity is considered low given the proposed ZS site (southern portion of the feeder route) is located adjacent to a construction ancillary site for unrelated construction works, currently contains a mobile substation and there is a low number of residents with visibility of the proposal site.

Landscape character assessment

The proposal passes through land zoned as RE1 Public Recreation, SP2 Infrastructure, RU2 Rural Landscape, R2 Low Density Residential and R5 Large Lot Residential under the CLEP. The landscape is generally characterised by open paddocks with scattered vegetation, and rural residential lots. The feeder route traverses undulating hills across agricultural paddocks with scattered vegetation. 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.

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 proposed temporary staging of works to install the feeder, 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 5-22**).

Landscape character assessment

Impacts to landscape character during construction would be the presence of heavy machinery, vehicles, temporary fencing and removal of one tree on the feeder route. Given the nature of the surrounding landscape including widespread redevelopment areas, and remnant agricultural land use and rural residential areas, and limited viewpoints, the magnitude of impact is considered to be low.

With a low sensitivity and moderate magnitude of impact, the landscape character impact rating during construction is considered to be low (refer **Table 5-22**).

Operation

Visual assessment

The proposed feeder route will be underground and will not be visible to visual receptors or future receptors associated with the future redevelopment of the area. As such, the magnitude of change to visual amenity is considered to be negligible.

With a low sensitivity and negligible magnitude of impact, the visual impact rating is considered to be negligible (refer **Table 5-22**).

Landscape character assessment

The proposed feeder route will be underground and will therefore not impact the landscape character of the current site or the future landscape character that is associated with the future redevelopment of the area. As such, the magnitude of change to landscape character is considered to be negligible.

With a low sensitivity and negligible magnitude of impact, the landscape character impact rating during operation is considered to be negligible (refer **Table 5-22**).

5.10.4 Safeguards

Table 5-23: 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.

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 Glenlee Road (refer to **Section 5.4**);
- 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 scope of works within this proposal would not have any negative impacts to the local community during operation.

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 5-24: Socio-economic safeguards

Number	Safeguard
SE01	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**).

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 (vegetation removal);
- Surplus construction materials;
- Wastewater;
- Excess spoil from trenching and underboring; and
- Excess backfill materials.

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

Fill material

There is the potential for fill material to be imported onto the site during the construction works. Any imported fill should be certified at source location as pathogen and weed free Virgin Excavated Natural Material (VENM) or ENM (Excavated Natural Material) in accordance with the POEO Act and the *Protection of the Environment (Waste) Regulation (2014)*.

This material should be stockpiled in dedicated areas and managed accordingly with the appropriate Endeavour Energy standards including *EMS 0013 – Spoil management* and the *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

Operation

Once constructed, the proposal will not be expected to generate any waste.

5.12.2 Safeguards

Table 5-25: 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 classified, verified and either reused or disposed of at a licensed waste or recycling facility as appropriate.

Number	Safeguard
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.
WH08	Any imported fill should be certified at source location as pathogen and weed free Virgin Excavated Natural Material (VENM) or ENM (Excavated Natural Material) in accordance with the POEO Act and the *Protection of the Environment (Waste) Regulation (2014)*.
WH09	If fill material is proposed to be imported onto site, fill material should be stockpiled in dedicated areas and managed in accordance with the appropriate Endeavour Energy standards including *EMS 0013 – Spoil management* and the *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).

5.13 Utilities and Services

5.13.1 Existing environment

The location of buried services are not known to currently exist along the feeder route, however they are likely to occur along Glenlee Road.

Sydney Water have proposed a pipeline that traverses the proposal site. This will be a potable water trunk main that will service the new development in Menangle Park. Refer to **Appendix C** for the pipeline design. Endeavour Energy has advised JBS&G that consultation with Sydney Water's consultant SMEC and Dahua (land developer) is being undertaken separately to this REF (refer **Section 4.2.2**). An easement approval will be gained prior to commencement of works by Endeavour Energy's design and property team once the design is finalised and sent for review.

5.13.2 Impact assessment

The proposal includes excavation up to two metres below the ground surface, whereby there is a risk of impacting 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 -: 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.

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. Other forms of EMF producing infrastructure includes the surrounding transmission lines, the closest line being perpendicular to Glenlee Road, 20m east of the feeder route.

5.14.2 Impact assessment

Construction

During the installation of the feeder, 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

Electric fields are largely shielded by the ground and cable insulation, so they are minimal. Magnetic fields, however, can penetrate the ground and may be present at the surface, depending on cable depth and current load. A 66kV underground electricity cable does emit electromagnetic fields (EMF), particularly extremely low frequency (ELF) magnetic fields, which are a natural byproduct of electrical transmission.

According to ARPANSA (Australian Radiation Protection and Nuclear Safety Agency), there is no established scientific evidence that typical exposure to ELF EMF from powerlines, substations, or underground cables causes health effects.

Underground cables are often buried deep enough to minimize surface EMF exposure AND The feeder route is not expected to produce electromagnetic emissions such that there would be health impacts to nearby residents or community members, as the feeder will be designed to meet relevant EMF standards. Therefore, the operation of the proposal is not expected to increase risks associated with EMF.

5.14.3 Safeguards

Table -: 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).

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. The assessment for the cumulative impact includes ongoing or proposed projects within Menangle Park and the immediate surrounding suburbs and their associated impacts.

5.15.1 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.

It is understood that the locality will be developed into a residential area as per the Menangle Park Growth Area plans, however no DAs have been lodged to progress such development, and therefore cumulative construction impacts are unlikely. Endeavour Energy will participate in ongoing discussions with Dahua Group and Sydney Water to ensure that the feeder route aligns with the masterplan and doesn't interfere with Sydney Water infrastructure.

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.

5.15.2 Safeguards

Table 5-26 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.

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	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* (TfNSW, 2024).
B02	Vegetation removal will be undertaken in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B03	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.
B04	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; and Protocols to manage weeds, pathogens and pest species, including African Olive which is to be removed.
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	Any unexpected habitat removal will be undertaken by staged clearing in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B07	Habitat will be replaced or re-instated in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
B08	Weed species (including African Olive) will be managed in accordance with Endeavour Energy's *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
Water, hydrology and flooding	

Number	Safeguards
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.
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.
W14	Any potential dewatering that may be required will need to be done in accordance with Endeavour Energy's standard *EMS 0014 – Dewatering sites* and the *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
W15	The works are not expected to intercept groundwater more than 3ML. In such a case, a water access licence isn't required as it would be exempt under the *Water Management (General) Regulation 2025* and *Water Management (Water Supply Authorities) Regulation 2025*. Should >3ML be

Number	Safeguards
	extracted, the dewatering guideline in Endeavour Energy's Environmental Guidelines Handbook April 2024 (Endeavour Energy, 2024) must be followed.
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).
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). Natural soil classified and validated as Virgin Excavated Natural Material (VENM) should be reused at an approved site or disposed at a licensed waste facility.
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).
SC08	All excavated topsoil, fill, VENM and waste should be segregated into separate stockpiles to prevent cross contamination.
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.
T04	A Traffic Guidance Scheme will be prepared, and traffic control will be organised and include contraflow arrangements where possible during trenching works to maintain access.
T05	Notification to properties accessed via Glenlee Road will be made regarding full and/or partial closures.
T06	Obtain a Road Opening Permit from Campbelltown City Council in accordance with section 138 of the Roads Act (refer **Section 6.2**).

Number	Safeguards
Noise and vibration	
NV01	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.
NV02	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.
NV03	Use quieter emitting methods. Ensure plant and equipment are fitted with appropriate silencers that are maintained in good working order for the duration of the works.
NV04	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.
NV05	No OOHW other than the hours assessed in this section should be undertaken without approval from the Endeavour Energy Environmental Services team and would require additional assessment.
Aboriginal heritage	
AH01	Endeavour Energy will notify the applicable AHIP holders of the proposed works and confirm conditions of these permits prior to commencing works. This can be undertaken during landholder notifications.
AH02	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.
AH03	If human skeletal remains are identified, works are to stop and the NSW Police and EE project manager are to be notified immediately after the find.
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.

Number	Safeguards
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.
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	Emergency management during construction phase should be administered through the site specific Construction Environmental Management Plan (CEMP) and Safe Work Method Statements (SWMS). The principles within this document shall be used to guide the site-specific operations and risk plans during the construction phase.
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.
LV02	Fencing with material attached (e.g. shade cloth) to be provided around the construction compounds to screen views from roads and neighbouring properties.
Socio-economic	
SE01	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.

Number	Safeguards
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 classified, verified and either reused or 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.
WH08	Any imported fill should be certified at source location as pathogen and weed free Virgin Excavated Natural Material (VENM) or ENM (Excavated Natural Material) in accordance with the POEO Act and the *Protection of the Environment (Waste) Regulation (2014)*.
WH09	If fill material is proposed to be imported onto site, fill material should be stockpiled in dedicated areas and managed in accordance with the appropriate Endeavour Energy standards including *EMS 0013 – Spoil management* and the *Environmental Guidelines Handbook April 2024* (Endeavour Energy, 2024).
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).
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.

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
Roads Act 1993	Road Opening Permit is required from Campbelltown City Council in accordance with section 138 of the Roads Act.	Prior to construction
National Parks and Wildlife Act 1974	Section 90a of the NPW Act requires an AHIP be obtained to permit harm to known Aboriginal objects. There are AHIPs within the proposal site. Confirmation with AHIP owners regarding AHIP requirements is to be undertaken prior to construction. No AHIP is required specifically for this scope of works.	Prior to construction

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: Eloise Marshall

Position: Project Scientist

Company name: JBS&G Australia Pty Ltd

Signature



Date: 11/09/2025

REF reviewed by:

Name: Roweena D'Souza

Position: Senior Principal

Company name: JBS&G Australia Pty Ltd

Signature



Date: 11/09/2025

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.

9. References

Air Quality NSW. (2025). *NSW air quality in my area*. Retrieved from NSW Department of Planning, Housing and Infrastructure - Air Quality: https://www.airquality.nsw.gov.au/air-quality-in-my-area

ARPANSA. (2002). *Maximum Exposure levels to Radiofrequency Fields - 3 kHz to 300 GHz. Radiation Protection Series No. 3.* Australian Radiation Protection and Nuclear Safety Agency.

Australia ICOMOS. (2013). *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance.*

Australian Government-Defence. (2025). *Unexplored Ordnance Map*. Retrieved from https://uxo.defence.gov.au/where-unexploded-ordnance

BOM. (2025). *Groundwater Dependent Ecosystems Atlas*. Retrieved from Australian Bureau of Meteorology: http://www.bom.gov.au/water/groundwater/gde/map.shtml

Campbelltown City Council. (2018). *Bow Bowing Bunbury Curran Creek Strategic Floodplain Risk Management Study and Plan.*

DCCEEW. (2002). *Salinity Potential of Western Sydney*. Retrieved from The Sharing and Enabling Environmental Data Portal (SEED): https://datasets.seed.nsw.gov.au/dataset/salinity-potential-of-western-sydney473ff

DCCEEW. (2025). *NSW State Vegetation Map (SVMT)*. Retrieved from Sharing and Enabling Environmental Data in NSW (SEED Portal): https://geo.seed.nsw.gov.au/Html5Viewer412/index.html?viewer=SEED.SEED&local=en-au&runWorkflow=AppendLayerCatalog&CatalogLayer=SEED_Catalog.318.Flora%20Sites,SEED_Catalog.317.NSW_VegetationFormation_5m,SEED_Catalog.317.NSW_VegetationClass_5m,SEED_Catalog.

DCCEEW. (2025a). *Protected Matters Search Tool*. Retrieved from Department of Climate Change, Energy, the Environment and Water: https://pmst.environment.gov.au/#/map?lng=131.52832031250003&lat=-28.6905876542507&zoom=5&baseLayers=Imagery,ImageryLabels

DCCEEW. (2025b). *NSW Biodiversity Values Map and Threshold Tool*. Retrieved from https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap

DEC. (2006). *Assessing Vibration: A Technical Guideline.* Department of Environment and Conservation.

DECC. (2009). *Interim Construction Noise Guideline*. Retrieved from https://www.epa.nsw.gov.au/your-environment/noise/industrial-noise/construction-noise

DECCW. (2010). *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.* NSW Department of Environment, Climate Change and Water.

Department of Customer Service. (2025). *SIXMaps*. Retrieved from Spatial Information eXchange: https://maps.six.nsw.gov.au/

Department of Customer Service. (2025). *SIXMaps*. Retrieved from Spatial Information eXchange: https://maps.six.nsw.gov.au/

Department of Planning. (2009). *Assessing Significance for Historical Archaeological Sites and 'Relics' .*

DPE. (2021). *Order conferring biodiversity certification - Cumberland Plain Conservation Plan.* NSW Department of Planning and Environment.

DPE. (2022). *Guidelines for Division 5.1 assessments.* NSW Government - Department of Planning and Environment.

DPE. (2023). *Assessing heritage significance: Guidelines for assessing places and objects against the Heritage Council of NSW criteria.*

DPE. (2023a). *Guidelines for preparing a statement of heritage impact.*

DPE. (2023b). *Material Threshold Policy.* 2023.

DPE. (2025). *The website of the Atlas of NSW Wildlife*. Retrieved from NSW BioNet: https://atlas.bionet.nsw.gov.au/UI_Modules/ATLAS_/AtlasSearch.aspx

DPE. (2025). *Threatened Biodiversity Data Collection*. Retrieved from NSW BioNet: http://www.bionet.nsw.gov.au/

DPE. (2025a). *Vegetation Classification System*. Retrieved from NSW BioNet: http://www.bionet.nsw.gov.au/
DPI. (2025). *Protecting habitats - Key Fish Habitat Maps - Hawkesbury-Nepean*. Retrieved from Department of Primary Industries: https://www.dpi.nsw.gov.au/fishing/habitat/protecting-habitats#KFH
DPIE. (2020). *Biodiversity Assessment Method.* Department of Planning, Industry and Environment.
DPIE. (2025). *eSPADE v2.2*. Retrieved from NSW Government: https://www.environment.nsw.gov.au/eSpade2Webapp/
Endeavour Energy. (2024). *Environmental Guidelines Handbook.*
EPA. (2014). *Waste Classification Guidelines.* Environment Protection Authority NSW.
EPA. (2017). *Noise Policy for Industry.* Retrieved from NSW Environment Protection Authority: https://www.epa.nsw.gov.au/your-environment/noise/industrial-noise/noise-policy-for-industry-(2017)
EPA. (2025). *NSW EPA Contaminated Land Register Search*. Retrieved from https://app.epa.nsw.gov.au/prclmapp/searchregister.aspx
EPA. (2025a). *NSW EPA List of notified sites*. Retrieved from https://www.epa.nsw.gov.au/your-environment/contaminated-land/notified-and-regulated-contaminated-land/list-of-notified-sites
NNTT. (2025). *Native Title Vision: Visualising native title matters*. Retrieved from National Native Title Tribunal: https://www.nntt.gov.au/assistance/Geospatial/Pages/NTV.aspx
NSW Government. (2021). *Investigating Heritage Significance Guidelines .*
NSW Government. (2025). *NSW Planning Portal Spatial Viewer*. Retrieved from https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address
NSW Heritage Office. (2008). *Levels of Heritage Significance.*
NSW Spatial Services. (2025). *Search and Discovery - Historical, Aerial and Satellite Imagery*. Retrieved from NSW Government Spatial Services: https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery
RFS. (2005). *Standards for Asset Protection Zones.* NSW Rural Fire Service.
RFS. (2019). *PLANNING FOR BUSHFIRE PROTECTION: A guide for councils, planners, fire authorities and developers.* NSW Rural Fire Service.
SES. (2025). Retrieved from NSW State Emergency Service Hawksbury Nepean Floods: https://www.ses.nsw.gov.au/hawkesbury-nepean-floods
Stroud W.J., S. L. (1985). *Wollongong-Port Hacking 1:100 000 Geological Sheet 90299129, 1st edition.* Geological Survey of New South Wales.
TfNSW. (2023). *Guideline for landscape character and visual impact assessment.* Transport for NSW.
TfNSW. (2024). *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects.* Transport for NSW.
TfNSW. (2024a). *Construction Noise and Vibration Guideline*. Retrieved from Transport for New South Wales: https://www.transport.nsw.gov.au/system/files/media/documents/2023/EMF-NV-GD-0056_Construction_%20Noise_and_Vibration_Guideline%20_Roads.pdf
TfNSW. (2025). *Construction and Maintenance Noise Estimator Tool.* Retrieved from Transport for New South Wales: https://www.transport.nsw.gov.au/operations/roads-and-waterways/environment-and-heritage/reducing-road-traffic-noise
TfNSW. (2025a). *Project update. Spring Farm Parkway Stage 1.* NSW Government. Transport for NSW.
WaterNSW. (2025). *Continous water monitoring network*. Retrieved from WaterNSW: https://realtimedata.waternsw.com.au/water.stm
WaterNSW. (2025a). *Greater Sydney Drinking Water Catchment Map*. Retrieved from WaterNSW: https://mapprod.waternsw.com.au/portal/apps/Embed/index.html?webmap=94a8a8e7ca654f10a03184efaef8b91b&extent=147.5845,-35.9615,153.572,-33.561&zoom=true&scale=true&search=true&searchextent=true&legendlayers=true&basemap_gallery=true&disable_scroll=true&the

Appendix A Project Design Drawings

PROPOSED UNDERBORE ROUTE

PROPOSED UNDERGROUND FEEDER 85U ROUTE

EXISTING EE EASEMENT

TRANSGRID ALLOCATED CONNECTION POINT
VEGETATION CLEARING WILL BE REQUIRED
IN THIS AREA

PROPOSED JOINT BAYS

DEPTH OF TRENCH APPROXIMATELY 1.8m TO TOP OF DUCT

UNDERBORE DESIGN

POTENTIAL INCREASED DEPTH DUE TO JEMENA AND APA GAS PIPES. NDD IS REQUIRED

TYPICAL TRENCH DEPTH 900mm TO TOP OF DUCTS
APPROX 1400mm TO BOTTOM OF TRENCH

TRBH-001

TRBH-002 (REMOVED)

TRBH-003

TRBH-004

TRBH-005

TRBH-006

TRBH-007

RIPARIAN CORRIDOR

GLENLEE ROAD

GLENLEE ROAD

LOT 41 DP1285144

LOT 3 DP713646

LOT 2008 DP1234643

LOT 31 DP1106615

LOT 32 DP1106615

GAS

GAS

MENANGLE PARK ZS

COORDINATES IN MGA56/2020

PRELIMINARY DESIGN NOT FOR CONSTRUCTION

AMENDMENTS		HISTORY
JOB NO	NPR-61	
DESIGN	J.M	
DRWN	J.M	
CHKD	J.S	
DATE	23/07/2024	
APP'D	J.S	
A		

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ORIGINAL SCALE 1:4000

APPROVED

DESIGNED	J.M	DATE	21/05/24
DRAWN	J.M		
CHECKED			

Endeavour Energy

REFERENCE DRAWINGS

DO NOT SCALE
DIMENSIONS IN MILLIMETRES

AUTHORISED/CERTIFIED

DESIGN DELIVERY MANAGER 23/07/2024

MARK-UP
NPR-000951
MENANGLE PARK ZS TO MACARTHUR BSP
FEEDER 85U

A1

NPR-951

SHEET No 1 OF 1 SHEETS

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 result in 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, and the feeder would not be visible, therefore the visual impacts would be minimal. **Section 5.5** did not identify noise impacts for residential receivers requiring mitigation. 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. Given the feeder will not be visible, 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 minor vegetation clearance, and noise, dust and light impacts to the surrounding environment during construction. All impacted PCT has been assessed as being in poor condition, therefore is not of high significance. A ToS was prepared and concluded (**Appendix E**) there will be no significant environment impact of the proposal on TECs. 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 during construction due to visual amenity and heavy vehicle movement. No operational visual or traffic impacts are expected from this proposal. 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 5-23**.
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.	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 adjacent habitat outside of the proposal site is likely to experience a negligible increase to indirect impacts created by noise, dust and light spill during construction. This may deem such

Factor	Impact
	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 life, whether living on land, in water or in the air.	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 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	The proposed vegetation clearing would have a minor negative impact on the existing environment. 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.	The proposed vegetation clearing will adversely impact the visual quality of the environment. Safeguards are proposed to limit the extent of vegetation clearing and therefore the impact will be negative but minor.
Any risk to the safety of the environment.	Safety risks would be limited primarily to the trenching and installation stage of the proposal. Construction 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, 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.

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 proposal site 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.

Appendix C Sydney Water proposed pipeline

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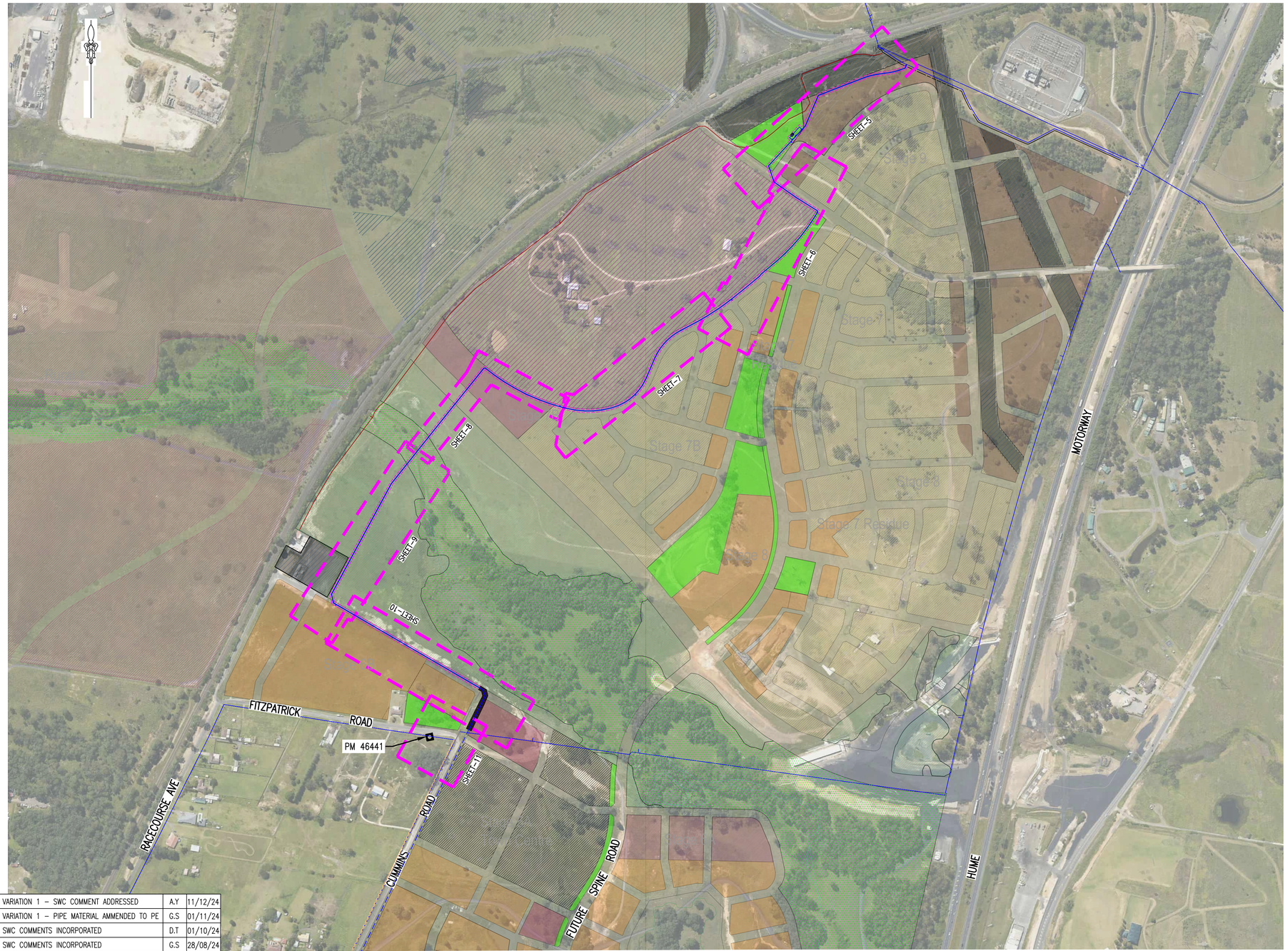
A1

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT



SHEET SCHEDULE		
SHEET	DRAWING	DESCRIPTION
1	CASE186560PW-D-1.21	KEY PLAN, SHEET SCHEDULE
2	CASE186560PW-D-2.21	NOTES - SHEET 1 OF 2
3	CASE186560PW-D-3.21	NOTES AND REMARKS - SHEET 2 OF 2
4	CASE186560PW-D-4.21	SETOUT POINT TABLE AND FITTINGS SCHEDULE
5	CASE186560PW-D-5.21	PLAN & LONG SECTION - SHEET 1 OF 7
6	CASE186560PW-D-6.21	PLAN & LONG SECTION - SHEET 2 OF 7
7	CASE186560PW-D-7.21	PLAN & LONG SECTION - SHEET 3 OF 7
8	CASE186560PW-D-8.21	PLAN & LONG SECTION - SHEET 4 OF 7
9	CASE186560PW-D-9.21	PLAN & LONG SECTION - SHEET 5 OF 7
10	CASE186560PW-D-10.21	PLAN & LONG SECTION - SHEET 6 OF 7
11	CASE186560PW-D-11.21	PLAN & SECTION - SHEET 7 OF 7
12	CASE186560PW-D-12.21	DETAIL - TIE IN POINT-CH-0
13	CASE186560PW-D-13.21	DETAIL - TRENCHLESS CONCRETE ENCASEMENT DETAIL
14	CASE186560PW-D-14.21	DETAIL - OFFTAKE AND PE TO DICL FITTINGS CONNECTIONS
15	CASE186560PW-D-15.21	DETAIL - VALVE INSTALLATIONS
16	CASE186560PW-D-16.21	DETAIL - PE TO DI PIPE ANCHOR, COMBINED THRUST BLOCK
17	CASE186560PW-D-17.21	DETAIL -INLINE VALVE INSTALLATION, BEND AND TEE THRUST BLOCK
18	CASE186560PW-D-18.21	DETAIL - TRENCH STOP
19	CASE186560PW-D-19.21	DETAIL - STOP VALVE INSTALLATION
20	CASE186560PW-D-20.21	DETAIL - PRESSURE REDUCING VALVE
21	CASE186560PW-D-21.21	DETAIL - PRESSURE REDUCING VALVE FITTINGS SCHEDULE

LEGEND:

- PROPOSED HYDRANT
- PROPOSED STOP VALVE
- PROPOSED TAPER
- PROPOSED AIR VALVE
- PROPOSED SCOUR VALVE
- EXISTING HYDRANT
- EXISTING STOP VALVE
- EXISTING TAPER
- EXISTING AIR VALVE
- EXISTING SCOUR VALVE
- EXISTING GAS
- EXISTING OVERHEAD POWER LINE
- DN450 PE PRESSURE SEWER
- EXISTING AHP
- HOWES CREEK

BORE LOG

- TOP SOIL
- SILTY CLAY, HIGH PLASTICITY
- SILTY CLAY, LOW TO MEDIUM PLASTICITY
- SHALE, VERY LOW TO LOW STRENGTH
- SILTY STONE, LOW TO MEDIUM STRENGTH
- SAND STONE, GREY, LOW TO MEDIUM STRENGTH
- SILTY CLAY MEDIUM TO HIGH PLASTICITY
- SAND MEDIUM GRAIN
- CLAYEY SAND MEDIUM GRAIN

IMPORTANT NOTE:
PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITY SHOULD BE CONTACTED FOR POSSIBLE LOCATION OF FURTHER UNDERGROUND SERVICES AND DETAILED LOCATIONS OF ALL SERVICES.

CONSTRUCTION NOTE:
THE PROPOSED WORKS AS DETAILED HERE ON MUST BE CONSTRUCTED IN ACCORDANCE WITH THE WATER SUPPLY CODE OF AUSTRALIA - WSA 03-2011 SYDNEY WATER EDITION 2014. THE CONSTRUCTOR MUST HAVE A COPY OF THESE DOCUMENTS ON SITE AT ALL TIMES.

No.	AMENDMENT DESCRIPTION	BY	DATE
11	VARIATION 1 - SWC COMMENT ADDRESSED	A.Y	11/12/24
10	VARIATION 1 - PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
09	SWC COMMENTS INCORPORATED	D.T	01/10/24
08	SWC COMMENTS INCORPORATED	G.S	28/08/24
07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24
05	SWC COMMENTS INCORPORATED	G.S	22/05/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23
02	SYDNEY WATER RESUB. - PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23
01	ISSUED TO SYDNEY WATER	G.S	14/04/23

IMPORTANT NOTE:

EXISTING GAS MAIN WITHIN DAHUA GROUP LAND TO BE DISCONNECTED AND MADE REDUNDANT AS PER SMEC COMMUNICATION WITH GAS PROVIDER.
EXISTING GAS MAIN CLASH WITH PROPOSED DN500 (OD559) WATER MAIN AT CH1525.10, REFER TO SHEET 9. WATER CONTRACTOR MUST CONTACT GAS PROVIDER TO MAKE NECESSARY ARRANGEMENT. GAS PROVIDER DETAILS:
TOM ROFE.
0409918677
TROFE@AGL.COM.AU

LOCALITY PLAN

1:4000

0 80 160 240 320 400 METRES

SCALE 1:4000

SURVEY CONTROL				
	EASTING	NORTHING	REDUCED LEVEL	REMARKS
◘	292 780.132	6 224 913.329	81.856	PM 46441
NOTE: CO-ORDINATES ARE GDA94				
FROM CRAIG & RODES, 1786G-T01 [00] RO, DATED 24/05/2017				

* (P) ------ PROPOSED 6m WIDE WATER MAIN EASEMENT
* (PP) ⊕ EXISTING POWER POLE FROM SURVEY

BEFORE YOU DIG www.byda.com.au
THE ESSENTIAL FIRST STEP. LEGALISED 1ST JULY 2015, NSW.
FINE UP TO $22,000 FOR INDIVIDUALS & $440,000 FOR CORPORATIONS.
MAX. 5 YEARS JAIL SENTENCE.

PIPE SCHEDULE

SIZE DN	TYPE	CLASS	LENGTH	PIPE JOINTING METHOD
OD710	PE100	PN25	570	BFJ, EFJ
DN500	DICL	PN35	30	RRJ
DN500	DICL	PN16	46	FJ
DN750	RCP	CLASS 4	77.5	RRJ
DN150	DICL	PN16	14.50	FJ
OD630	PE100	PN25	1076	BFJ, EFJ
DN450	DICL	PN35	2.5	RRJ
OD500	PE100	PN25	394	BFJ, EFJ
DN375	DICL	PN35	6.06	FJ
DN225	uPVC	SN8	32	RRJ

PLAN TO BE READ IN CONJUNCTION WITH CURRENT SYDNEY WATER STANDARDS
SYDNEY WATER CORPORATION

PRIOR TO COMMENCEMENT OF EXCAVATION FOR PROPOSED AND EXISTING SERVICES CONTACT :-
DIAL BEFORE YOU DIG ..... Ph. 1100
ELECTRICITY ..... Ph. .....
GAS ..... Ph. .....
TELECOMMUNICATIONS ..... Ph. .....
..... Ph. .....
GIVING AT LEAST 48 HOURS NOTICE.

UTILITIES

TYPE	DATE	REF.	TYPE	DATE	REF.
WATER: DN100 Water	2018	HYDRA			
PROP WATER: DN100 Water	2018	SMEC			
PROP STORMWATER: SWD	2018	SMEC			
TELSTRA	2018	DBYD			
OPTUS:	2018	DBYD			
OPTICAL FIBRE:	2018	DBYD			
STORMWATER:	2018	DBYD			
GAS:	2018	DBYD			

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
WATER SERVICE CO-ORDINATOR .....
CONSTRUCTOR .....
COMPLETED ..... W.A.C. PREPARED .....

DESIGNER .....
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS.

PIPE SCHEDULE

SIZE DN	TYPE	CLASS	LENGTH	PIPE JOINING METHOD / NOTES
				REFER PIPE SCHEDULE TABLE ABOVE

DESIGN HEAD 160 m
NO BOUNDARY TRAPS REQUIRED.

AUSTRALIAN HEIGHT DATUM

SCALES
PLAN 1:500 SECTION HOR. 1:500 VERT. 1:125
CROSS SECTIONS ..... NATURAL
LENGTHS, DEPTHS & LEVELS ARE IN METRES.

NO AMENDMENTS ARE TO BE MADE TO THIS PLAN WITHOUT REFERENCE TO SYDNEY WATER. THIS PLAN IS NOT NECESSARILY UP TO DATE OR CORRECT AND SYDNEY WATER ACCEPTS NO RESPONSIBILITY.

U.B. DIRECTORY 365 D10 (41st Edition)

SHEET 1 OF 21 File No. N/A

Sydney WATER SYDNEY WATER CORPORATION

CASE186560PW

Menangle Park Water
POTABLE WATER TRUNK MAIN
DN500 MAIN EXTENSION TO CUMMINS ROAD
MENANGLE PARK

PLAN DRAWN DATE: 11/12/2024 VERSION: 11 SHEET 1 OF 21 SHEETS

FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 - MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD-IN)-VAR1\CASE186560PW-D-1.21.DWG

DESIGNED: T.R *DRAFTED:* G.S *VERIFIED:* T.R *REVIEWED:* S.G *APPROVED:* G.F *ISSUED:* 11/12/2024

A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT

GENERAL

G1. WATER SERVICING COORDINATOR & DESIGNER: SMEC AUSTRALIA PTY LTD
LEVEL 6, 3 HORWOOD PL. PARRAMATTA N.S.W. 2150
PH: (02) 9925 5555 REFERENCE: 78115.88
FOR: DAHUA GROUP AUSTRALIA
SUITE 2 LEVEL 20, 201–207 ELIZABETH ST. SYDNEY N.S.W. 2000

G2. WORK DETAIL IN HERE TO BE CONSTRUCTED AS PER WATER SUPPLY CODE OF AUSTRALIA SYDNEY WATER EDITION 2014 WSA CODE 03–2011–3.1, SYDNEY WATER CIVIL SPECIFICATION (REV 10) & SYDNEY WATER MECHANICAL SPECIFICATION (REV 12). MAIN TO BE LAID GENERALLY AT STANDARD DEPTH BELOW TOP OF KERB EXCEPT WHERE OTHERWISE SHOWN. MAIN TO BE INSTALLED AS PER SET OUT TABLE. FOR MAIN COVER REFER LONG SECTION.

G3. PRECAUTIONS MAY BE NECESSARY IN THE VICINITY OF SUB–STATION EARTHING.

G4. THE MINIMUM NUMBER OF FIELD COMPACTION TESTS REQUIRED TO SATISFY THE WATER SUPPLY CODE OF AUSTRALIA ARE:
- PIPE EMBEDMENT ZONE: 86
- TRENCH FILL ZONE – TRAFFICABLE: 25
- TRENCH FILL ZONE – NON TRAFFICABLE: 172
- COMPACTION TEST AROUND STRUCTURES: 120
- COMPACTION TEST FREQUENCY AND LOCATION TO COMPLY WITH SYDNEY WATER TECHNICAL SPECIFICATION– CIVIL (REV10). NUMBER OF TEST SHOWN ABOVE IS INDICATIVE ONLY. PIPE TESTER TO DETERMINE NUMBER OF TESTS AND LOCATION.

G5. COMPACTION OF THE TRENCH FILL SHALL BE TO COMPLY WITH SYDNEY WATER TECHNICAL SPECIFICATION (CIVIL REV10). CLAUSE C2.8 AND CAMPBELTOWN COUNCIL. THE MOST STRINGENT SPECIFICATIONS SHALL BE FOLLOWED , HOWEVER THE STANDARD DRY DENSITY SHALL NOT BE LESS THAN 98%. TRENCH FILL MATERIAL (NON TRAFFICABLE AND FUTURE TRAFFICABLE) TO BE IN ACCORDANCE WITH SYDNEY WATER TECHNICAL SPECIFICATION CIVIL (REV 10) SECTION C2.

G6. REFER TO THE BELOW DTC LIST FOR WATER MAIN FLANGE CONNECTION DETAILS , SCOUR PUMP, AIR VALVE AND HYDRANT

DRAWING No.	ISSUE	DATE
DTC–1113	C	31/07/24
DTC–1145	B	31/07/24
DTC–1206	B	31/07/24
DTC–1210	B	31/07/24
DTC–1212	B	31/07/24
DTC–1215	B	31/07/24
DTC–1217	B	31/07/24

G7. INTEGRAL BYPASS VALVES TO BE UTILISED FOR ALL STOP VALVES ON DN500 AND DN450 MAINS. FOR PITS, REFER TO WAT – 1308–S(VERSION 2 ISSUED 2012)

G8. AS THIS IS A MINE SUBSIDENCE AREA ALL PIPES ARE TO BE FULLY WELDED PE PIPES. ANY FLANGED FITTINGS SUCH AS TEES, BENDS, STOP VALVES, HYDRANT AND AIR VALVES SHALL BE PROTECTED BY FLEXIBLE MEMBRANE (i.e POLYSTYRENE) TO PREVENT SHEARING OF THE PIPES AS GROUND MOVEMENT OCCURS.

SUBSIDENCE PARAMETERS FOR MENANGLE PARK ARE:
- MAXIMUM HORIZONTAL STRAINS 2mm/m
- MAXIMUM TILT 4mm/m
- MAXIMUM RADIUS OF CURVATURE 10km
- DESIGNED IN ACCORDANCE WITH THE MINE SUBSIDENCE BOARD BLANKET APPROVAL (WITHIN MENANGLE PARK DISTRICT)

G9. PEA GRAVEL SHALL BE BACK FILLED AROUND PRECAST CONCRETE PIT. TYPICAL WIDTH OF BACK FILL SHALL BE 400. THE AVERAGE SIZE OF PEA GRAVEL SHALL BE 7 mm.

G10. 50 THICK POLYSTYRENE SHALL BE INSTALLED AROUND FLANGED FITTING AND TO BE EXTENDED AT LEAST 1m OVER THE ADJACENT PE 100 PIPE.

G11. ALL POTABLE WATER FIXTURES TO BE CONSTRUCTED TO FINISH SURFACE LEVEL & CLEAR OF DRIVEWAYS. WATER CONTRACTOR TO COORDINATE WITH MAIN CONTRACTOR AT TIME OF CONSTRUCTION.

G12. WATER MAINS TO BE LAID OVER LOW VOLTAGE ELECTRICAL CABLES. MINIMUM CLEARANCE TO BE 225, UNLESS NOTED OTHERWISE.

G13. CLEARANCES BETWEEN WATER MAIN AND OTHER UNDERGROUND SERVICES TO COMPLY WITH THE WATER SUPPLY CODE OF AUSTRALIA (SYDNEY WATER EDITION) WSA 03–2011–3.1 – TABLE 5.5.

G14. ALL SCOUR FACILITY TO BE CONSTRUCTED AS PER DTC–1215 AND DTC–1217 AND SHALL HAVE A DN225 DISCHARGE PIPE TO BE INSTALLED TO THE PIT AS PER DTC–1217. DISCHARGE PIPE TO BE EXTENDED AT 0.8% GRADE TO THE SCOUR PROTECTION AREA WHERE THE WATER MAIN WILL BE SCOURED TO THE ENVIRONMENT. SCOUR LINES TO BE CONNECTED IN THE FUTURE TO THE STORM WATER DRAINAGE SYSTEM (WHERE POSSIBLE). REFER TO SHEET 18 FOR TYPICAL SCOUR PROTECTION DETAILS.

G15. UNLESS NOTED OTHERWISE, ALL DIMENSIONS ARE IN mm AND ALL COORDINATED ARE TO GDA94 AND ALL THE LEVELS ARE METER (LEVEL DATUM A.H.D)

G16. SUBSOIL CONDITION TO BE CHECKED FOR PITS AND HEADWALL LOCATIONS. MIN ALLOWABLE BEARING CAPACITY TO BE 100 KPa.

G17. ALL WEAKER MATERIAL NOT MEETING THE MINIMUM ALLOWABLE BEARING CAPACITY SHALL BE EXCAVATED AND REPLACED WITH SELECTED FILL MATERIAL COMPLYING WITH SYDNEY WATER TECHNICAL SPECIFICATION–CIVIL.

G18. ANY OVER EXCAVATED MATERIAL SHALL BE BACKFILLED WITH GRADE N25 MASS CONCRETE. REFER TO NOTE C2 ON SHEET 3.

G19. WATER MAIN CONTRACTOR SHALL ENGAGE A QUALIFIED GEOTECHNICAL ENGINEER ON SITE, TO CONFIRM THE MINIMUM BEARING CAPACITY FOR PIPE LAYING AS PER SW TECHNICAL SPECIFICATION, CIVIL AND ALSO TO CONFIRM THE MINIMUM HORIZONTAL AND VERTICAL ALLOWABLE SOIL BEARING CAPACITYOD 50kPa. THE MIN BEARING CAPACITY OF 50KPa. IF THE ACTUAL VALUES BECOMES LESS THAN THE SPECIFIED VALUES, THE DESIGNER SHALL BE INFORMED AND THE PIPE EMBEDMENT AND THRUST BLOCKS (IF APPLICABLE) SHALL BE REDESIGNED TO SUIT THE GEOTECHNICAL CONDITION OR SOIL IMPROVEMENT TO BE CARRIED OUT TO ACHIEVE THE DESIRED VALUES

PIPEWORK

P1. ALL PIPES ARE HIGH DENSITY POLY ETHYLENE PE100 PN25 TO AS4130

P2. ALL DUCTILE IRON FLANGES TO BE CLASS 16 TO AS4087 FIGURE B5. STAINLESS STEEL FLANGES TO BE CLASS 16 TO AS4087 (AMENDED) FIGURE B7. DUCTILE IRON PIPES IN ACCORDANCE WITH WSA–PS–200 & AS2280.

P3. DICL PIPES AND FITTINGS TO BE WRAPPED IN BLUE POLYETHYLENE SLEEVING.

P4. TYPE "M" EMBEDMENT SUPPORT WITH GEOTEXTILE WRAPPING TO BE ADOPTED. PROVIDE MIN. 250 LAP AT ALL FILTER FABRIC JOINTS. ALL IMPORTED SELECTED FILL SHALL BE COMPLIED TO WSA–PS 350 & 351

P5. PIPE WORK TO BE PROVIDED WITH TRENCH STOPS ARE SPECIFIED ON THE LONG SECTIONS AND TYPICAL DETAILS PROVIDED IN SHEET NO. 18.

P6. MAXIMUM SYSTEM DESIGN PRESSURE IS 1600 kPa. TEST PRESSURE SHALL BE 2000 kPa.

P7. ALL FLANGE BOLT HOLE ORIENTATIONS SHALL BE OFF–CENTRE. FLANGE GASKET MATERIAL AND THICKNESS SHALL BE 1.5 mm ELASTOMERIC GASKET.

P8. ALL BURIED FASTENERS SHALL BE STAINLESS STEEL GRADE 316.

P9. ORIENT SPRING HYDRANT LUGS SO THAT IN PLAN VIEW THEY ARE PARALLEL TO THE CENTRELINE OF THE MAIN (I.E. THE TWO LUGS ARE ON EITHER SIDE OF THE CENTERLINE).

P10. MARKING SYSTEMS, INDICATOR PLATES FOR LOCATION HYDRANTS SHALL BE AS PER WAT–1352, 1353–S.

P11. STOP VALVES SHALL BE RESILIENT SEATED GATE VALVE IN ACCORDANCE TO WSA–PS–260. VALVES ON DN500 AND DN450 TO BE INTEGRAL BYPASS AS PER SYDNEY WATER TECHNICAL SPECIFICATION – MECHANICAL CLAUSE M9.5. ALL GATE VALVES TO BE RESILIENT SEATED TO AS 2638.2 GATE VALVES SHALL CLOSE ANTI– CLOCKWISE AND SHALL HAVE NON–RISING SPINDLES . EXTENDED SPINDLES TO 50 BELOW UNDERSIDE OF COVERS OR SURFACE BOX. PROVIDE INDICATORS AT SURFACE LEVEL ADJACENT TO VALVE SPINDLE TO SHOW OPEN AND CLOSE DIRECTION.

P12. AIR VALVES SHALL BE IN ACCORDANCE TO WSA–PS–265. AIR VALVE TO BE CONSTRUCTED IN ACCORDANCE TO DTC 1210.

P13. ALL HYDRANTS SHALL BE DN80 AND IN ACCORDANCE TO WSA–PS–267 IN ACCORDANCE WITH DTC–1207.

P14. THRUST BLOCKS FOR ALL TEES TO BE AS PER THRUST BLOCK DESIGN, REFER TO DETAIL "D" ON SHEET 14

P15. CONCRETE FOR THRUST BLOCK SHALL BE CURED FOR A MINIMUM 14 DAYS BEFORE SUBJECT TO THRUST LOADINGS.

P16. PRESSURE REDUCING VALVE (PRV) TO BE CONSTRUCTED AS PER SYDNEY WATER DEEMED TO COMPLY DRAWINGS DTC–6400 TO DTC–6413. PLEASE REFER TO PRV GENERAL ARRANGEMENT SHEET 20.

P17. WATER MAINS TO COMPLY WITH SWC EPS 500 AND EPS 210.

P18. ALL FLANGE BOLTS, NUTS AND WASHERS SHALL BE S.S. GRADE 316.

P19. ALL BOLTS TO BE TORQUED UP AS PER SYDNEY WATER DEEMED TO COMPLY DRAWINGS DTC–1145.

P20. ALL DI PUDDLE & THRUST FLANGES TO BE FACTORY FITTED AS PER AS/NZS 2280.

P21. ALL PE PIPE AND FITTINGS TO BE PE100 U.N.O, WITH PRESSURE CLASS AS NOMINATED IN THE DESIGN DRAWINGS

P22. PE PIPE TO BE SUPPLIED, INSTALLED AND TESTED IN ACCORDANCE WITH PE CODE WSA 01–2004–31 AND HAVE PRODUCT CERTIFICATION TO AS/NZ4130.

P23. PE CONNECTIONS SHALL BE BUTT WELD. WELDS TO BE UNDERTAKEN IN ACCORDANCE WITH WSA 03–2011–3.1. WELD INSPECTION AND TESTING TO BE COMPLETED IN ACCORDANCE WITH SYDNEY WATER CIVIL TECHNICAL SPECIFICATION.

P24. ALL PE PIPES JOINTS SHALL BE DEBEADED IN ACCORDANCE WITH SYDNEY WATER CIVIL TECHNICAL SPECIFICATION.

P25. CONNECTIONS TO OTHER MATERIALS SHALL BE STUB FLANGE WITH SS316 BACKING RING.

P26. POLYTHYLENE FITTINGS TO BE IN ACCORDANCE WITH SYDNEY WATER EPS–500

P27. ALL PE BENDS SHALL BE MOULDED LONG RADIUS BENDS. FABRICATED BENDS SHALL NOT BE USED BENDING OF PE PIPE SHALL COMPLY WITH THE MANUFACTURERS REQUIREMENTS.

P28. PE PIPE SHALL BE CURVED IN LOCATIONS INDICATED ON LONGITUDINAL SECTIONS. THE BENDING RADIUS SHALL NOT BE LESS THAN 30XOUTSIDE DIAMETER OF THE PIPE.

P29. PE STUB FLANGE TO METALLIC FLANGE CONNECTION SHALL BE ACCORDANCE WITH DTC–1145

P30. ELECTRO FUSION JOINTS TO BE INSTALLED AS MINIMUM AS POSSIBLE AND WHERE BEING INSTALLED THEY HAVE TO BE PICKED UP BY PROJECT SURVEYOR AND SHOWN ON THE WORK AS CONSTRUCTED DRAWINGS.

No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE
05	SWC COMMENTS INCORPORATED	G.S	22/05/24	11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24	10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23	09	SWC COMMENTS INCORPORATED	D.T	01/10/24
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23	08	SWC COMMENTS INCORPORATED	G.S	28/08/24
01	ISSUED TO SYDNEY WATER	G.S	14/04/23	07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
				06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....

DESIGNER .....
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

Sydney WATER
SYDNEY WATER CORPORATION

CASE186560PW | SHT 2 OF 21 SHTS.

SYDNEY WATER CORPORATION
FOR DETAILS OF SERVICES SEE SHEET 1

PLAN DRAWN DATE: 11/12/2024 VERSION:11

SHEET 2 OF 21 SHEETS

FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD–IN)–VAR1\CASE186560PW–D–2.21.DWG

DESIGNED: T.R *DRAFTED:* G.S *VERIFIED:* T.R *REVIEWED:* S.G *APPROVED:* G.F *ISSUED:* 11/12/2024

CONCRETE

C1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS 3600 & AS 3600 SUPPLEMENT, AS 3725 & SUPPLEMENT, AS 1379:1997 & SUPPLEMENT, EXCEPT WHERE VARIED BY THE SUB CONTRACT DOCUMENTS.

C2. UNLESS NOTED OTHERWISE CONCRETE GRADES SHALL BE AS FOLLOWS

ELEMENT	GRADE
MASS CONCRETE – FOR OVER BREAK, BLINDING CONCRETE AND OVER EXCAVATION.	N25
THRUST BLOCKS AND FITTINGS	N32

- FOR MIX PROPORTIONS, REFER TO CL. 3. 6.3, SYDNEY WATER INFRASTRUCTURE DELIVERY TECHNICAL SPECIFICATION PART 1 CIVIL WORKS, UNO.
- MAX. SLUMP = 80mm.

C3. UNLESS NOTED OTHERWISE IN DRAWINGS THE CONCRETE COVER TO REINFORCEMENT SHALL BE AS FOLLOWS;

STRUCTURE	LIQUID FACE (INCL. SPLASH & CONDENSATE ZONES)	SOIL FACE	EXTERIOR ABOVE GROUND
THRUST BLOCK	75	70	–
SLAB, CHAMBER	75	70	50

C4. PROJECT CONTROL TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS 1379. NO ADMIXTURE SHALL BE USED IN CONCRETE WITHOUT THE APPROVAL OF THE SUPERINTENDENT. FLY ASH INCORPORATED WITH CEMENT SHALL COMPLY WITH AS 3582.1 "FINE GRADE". SLAG INCORPORATED WITH CEMENT SHALL COMPLY WITH AS 3582.2.

C5. SIZES OF CONCRETE MEMBERS DO NOT INCLUDE THICKNESS OF APPLIED FINISHES.

C6. NO HOLES OR CHASES OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS WITHOUT THE PRIOR APPROVAL OF THE SUPERINTENDENT.

C7. FORMED SURFACE FINISHES TO BE IN ACCORDANCE WITH AS 3610; –CLASS 2 – INTERNAL AND EXTERNAL SURFACES OF WATER RETAINING STRUCTURES EXCLUDING JOINT AREAS. –CLASS 3 – ALL OTHER SURFACES, PITS, JOINT AREAS AND SURFACES COVERED BY BACKFILL MATERIAL.

C8. ALL CONCRETE STRUCTURES SHALL BE SURVEYED AND ANY VARIATION DOCUMENTED AS 'AS BUILT RECORD' AFTER CONSTRUCTION AND HYDROTESTING.

C9. CONSTRUCTION JOINTS TO COMPLY WITH THE FOLLOWING: EXISTING SURFACE TO BE PREPARED BY SCABBLING OF THE HARDENED CONCRETE TO REMOVE ALL LAITANCE AND SUFFICIENT MORTAR TO EXPOSE THE AGGREGATE TO A DEPTH OF 3 mm. COARSE AGGREGATE WHICH DOES NOT REMAIN FIRMLY EMBEDDED IN THE MORTAR WITH NO UNDERCUTTING SHALL BE REMOVED. ALL REINFORCEMENT TO BE CONTINUOUS ACROSS THE JOINT.

C10. CURING OF ALL CONCRETE SHALL BE ACHIEVED BY KEEPING SURFACES CONTINUOUSLY WET FOR A PERIOD OF 7 DAYS, AND PREVENTION OF LOSS OF MOISTURE FOR A TOTAL OF 14 DAYS FOLLOWED BY A GRADUAL DRYING OUT. CURING OF HORIZONTAL SURFACES MAY BE ACHIEVED BY USING SEALED POLYTHENE SHEETING OVER A WET SURFACE OR BY PONDING. IF ELEMENTS ARE TO BE CURED BY LEAVING FORMWORK IN PLACE, THE FORMWORK SHALL BE KEPT WET CONTINUOUSLY AND EXPOSED SURFACES SHALL BE COVERED. CURING MUST COMMENCE IMMEDIATELY AFTER POURING, SHALL BE CONTINUOUS AND SHALL BE MAINTAINED FOR A MINIMUM OF 7 DAYS. THE CONTRACTOR SHALL SEEK APPROVAL OF ALL CURING METHODS AND MATERIALS FOR ALL CONCRETE ELEMENTS PRIOR TO POURING.

C11. CURING COMPOUNDS MAY BE USED IN LIEU OF WET CURING PROVIDED THAT THE FOLLOWING REQUIREMENTS ARE STRICTLY OBSERVED; ON FORMED SURFACES, THE CONCRETE SURFACE SHOULD BE WETTED IMMEDIATELY AFTER

C12. STRIPPING AND THE COMPOUND APPLIED AS SOON AS THE FREE WATER HAS EVAPORATED. THE COMPOUNDS SHOULD BE APPLIED UNIFORMLY IN AT LEAST TWO APPLICATIONS AT RIGHT ANGLES TO EACH OTHER, SO AS TO ACHIEVE A COMPLETE UNIFORM COVER. DETAILS OF THE PROPOSED CURING COMPOUND SHALL BE SUBMITTED FOR APPROVAL.

C13. DETAILS SHOULD INCLUDE COMPLIANCE WITH AS 3799 AND THE EFFICIENCY INDEX. THE COMPOUND SHOULD BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

C14. STRIPPING OF FORMS AND REMOVAL OF FORMWORK SUPPORTS SHALL COMPLY WITH THE REQUIREMENTS OF AS 3600. PROPOSED FORMWORK STRIPPING TIMES SHALL BE SUBMITTED FOR REVIEW AND APPROVAL PRIOR TO COMMENCEMENT OF WORK.

C15. THE DESIGN, CERTIFICATION, CONSTRUCTION AND PERFORMANCE OF THE FORMWORK AND FALSE WORK IS THE RESPONSIBILITY OF THE SUB–CONTRACTOR AND SHALL COMPLY WITH AS 3610 AND AS 3600. THE FORMWORK SHALL NOT BE DESIGNED TO RELY ON SUPPORT FROM THE PERMANENT STRUCTURE UNLESS PRIOR APPROVAL HAS BEEN GRANTED.

C16. CONCRETE SHALL ONLY BE PLACED WHEN THE AMBIENT TEMPERATURE IS GREATER THAN 5 °C AND LESS THAN 32 °C. THE MAXIMUM CONCRETE TEMPERATURE AT THE TIME OF PLACING SHALL BE 32 °C

C17. DROPPING OF CONCRETE FREELY FROM A HEIGHT EXCEEDING 1.2 m SHALL NOT BE PERMITTED. VIBRATORS SHALL NOT BE USED TO SPREAD CONCRETE.

C18. ALL CONCRETE JOINT SEALANTS SHALL BE APPROVED PRIOR TO THEIR APPLICATION. THEY SHALL BE APPLIED STRICTLY IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

C19. UNLESS NOTED OTHERWISE, ALL CONCRETE EDGES SHALL HAVE A 25x25 CHAMFER AND INSIDE CORNERS SHALL HAVE 25x25 FILLET.

C20. FINISHED CONCRETE SHALL BE A DENSE HOMOGENOUS MASS, COMPLETELY FILLING THE FORMWORK, THOROUGHLY EMBEDDING THE REINFORCEMENT AND FREE OF AIR AND STONE POCKETS. CONCRETE SHALL BE COMPACTED WITH MECHANICAL VIBRATORS.

C21. HYDROPHILIC WATERSTOPS SHALL BE HYDROTITE (CJ –0725 – 3K) OR EQUIVALENT PRODUCT.

REINFORCEMENT

R1. REINFORCEMENT SHALL BE LAPPED ONLY IN THE LOCATIONS SHOWN ON THE DRAWINGS OR AS OTHERWISE APPROVED BY THE STRUCTURAL ENGINEER. MIN LAP TO BE 700mm.

R2. CLOSED TIES/MESH TO BE GRADE 500L DEFORMED WELDED WIRE MESH TO AS/NZS 467

R3. REINFORCEMENT TO BE GRADE 500L DEFORMED WIRE TRENCH MESH TO AS/NZS 4671

R4. WELDING OF REINFORCEMENT IS NOT PERMITTED UNLESS SHOWN ON DRAWINGS OR APPROVED IN WRITING BY THE SUPERINTENDENT. WELDING OF REINFORCEMENT WHERE SHOWN/APPROVED SHALL COMPLY WITH AS 1554.3.

R5. CLEAR COVER TO REINFORCEMENT SHALL BE AS NOTED ON THE DRAWINGS.

R6. BARS SHALL BE TIED AT ALTERNATE INTERSECTIONS. TIE WIRE SHALL NOT PROJECT INTO THE CONCRETE COVER ZONE.

No.	AMENDMENT DESCRIPTION	BY	DATE
11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
09	SWC COMMENTS INCORPORATED	D.T	01/10/24
08	SWC COMMENTS INCORPORATED	G.S	28/08/24
07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24
05	SWC COMMENTS INCORPORATED	G.S	22/05/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23
01	ISSUED TO SYDNEY WATER	G.S	14/04/23

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER _____
W.S.C. _____
CONSTRUCTOR _____
COMPLETED _____
W.A.C. PREPARED _____

DESIGNER _____
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 3 OF 21 SHTS

SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1

A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT

CHAINAGE	EASTING	NORTHING
0.000	293651.255	6226139.996
3.858	293649.586	6226136.518
9.846	293643.865	6226134.746
15.218	293638.790	6226132.987
20.718	293633.541	6226131.345
26.280	293628.163	6226129.925
31.717	293622.837	6226128.830
37.580	293617.039	6226127.960
42.716	293611.940	6226127.346
57.158	293597.671	6226125.120
62.658	293592.251	6226124.183
68.157	293586.893	6226122.945
73.657	293581.606	6226121.430
79.157	293576.369	6226119.751
110.470	293547.127	6226108.553
170.593	293491.089	6226086.768
231.567	293467.095	6226030.713
330.304	293399.959	6225958.313
361.710	293409.925	6225928.530
409.423	293448.964	6225901.099

CHAINAGE	EASTING	NORTHING
457.035	293489.327	6225875.845
459.398	293489.630	6225873.501
469.585	293484.340	6225864.796
481.500	293477.843	6225854.808
493.683	293470.862	6225844.824
510.623	293460.602	6225831.344
518.635	293455.531	6225825.140
537.426	293443.107	6225811.043
557.741	293428.867	6225796.554
576.587	293414.947	6225783.850
613.241	293386.785	6225760.390
619.576	293382.840	6225755.432
664.439	293348.087	6225727.062
688.201	293329.558	6225712.184
703.136	293317.584	6225703.258
715.433	293307.518	6225696.195
740.266	293286.650	6225682.735
760.583	293269.072	6225672.546
794.166	293239.333	6225656.946
803.881	293230.926	6225652.077

CHAINAGE	EASTING	NORTHING
813.336	293223.212	6225646.609
820.457	293217.747	6225642.044
827.206	293212.865	6225637.383
832.373	293209.337	6225633.608
841.252	293203.724	6225626.729
847.138	293200.325	6225621.924
854.929	293196.271	6225615.270
864.077	293192.149	6225607.104
880.815	293185.549	6225591.722
905.599	293175.796	6225568.937
920.343	293168.801	6225555.959
934.314	293160.402	6225544.794
945.373	293152.653	6225536.903
955.410	293144.874	6225530.562
966.155	293135.856	6225524.719
978.812	293124.471	6225519.188
992.414	293111.536	6225514.981
1009.586	293094.720	6225511.505
1025.571	293078.826	6225509.799
1042.108	293062.289	6225509.760

CHAINAGE	EASTING	NORTHING
1058.769	293045.719	6225511.500
1078.360	293026.525	6225515.423
1094.484	293010.974	6225519.683
1108.968	292997.175	6225524.084
1126.548	292980.672	6225530.145
1153.728	292955.662	6225540.785
1179.472	292933.002	6225553.002
1201.124	292914.517	6225564.277
1222.214	292897.175	6225576.280
1241.716	292881.772	6225588.240
1244.241	292879.272	6225587.881
1329.161	292825.933	6225521.803
1514.080	292710.423	6225377.399
1744.498	292600.663	6225174.802
1760.741	292604.052	6225158.917
2077.483	292877.783	6224999.553
2089.197	292881.896	6224988.584
2158.060	292851.858	6224926.619

CHAINAGES (m)	FITTINGS TYPE	EASTING	NORTHING	COMMENTS
1.98	AIR VALVE	293650.42	6226138.25	
192.47	SCOUR VALVE	293482.48	6226066.65	E & N AT TEE LOCATION
235.19	DN500X500 TEE	293433.27	6225791.57	PRV ASSEMBLY
244.19	HYDRANT WITH CV	293422.07	6225790.30	
251.77	STOP VALVE	293416.40	6225785.26	
257.42	HYDRANT WITH CV	293412.15	6225781.54	
261.76	DN500X500 TEE	293408.83	6225778.74	PRV ASSEMBLY
265.30	DN500X200 OFFTAKE WITH FLANGED SV	293396.60	6225768.63	E & N AT TEE LOCATION
500.29	AIR VALVE	293466.86	6225839.56	
501.79	STOP VALVE	293465.93	6225838.38	
503.29	AIR VALVE	293465.02	6225837.19	
611.12	DN710XDN630 TAPER	293388.41	6225761.75	
667.03	SCOUR VALVE	293346.07	6225725.41	E & N AT TEE LOCATION
685.10	DN450X200 OFFTAKE WITH FLANGED SV	293331.94	62256714.09	E & N AT TEE LOCATION
838.81	AIR VALVE	293205.27	6225628.62	
841.25	STOP VALVE	293203.72	6225626.72	
843.70	AIR VALVE	293202.29	6225624.73	

CHAINAGES (m)	FITTINGS TYPE	EASTING	NORTHING	COMMENTS
941.31	DN450X200 OFFTAKE WITH FLANGED SV	293155.49	6225539.79	E & N AT TEE LOCATION
945.37	HYDRANT WITH CV	293152.65	6225536.90	
1078.36	SCOUR VALVE	293026.51	6225515.39	E & N AT TEE LOCATION
1085.72	STOP VALVE	293020.99	6225516.88	
1090.34	AIR VALVE	293016.58	6225518.19	
1461.07	SCOUR VALVE	292743.53	6225418.79	E & N AT TEE LOCATION
1462.78	STOP VALVE	292742.47	6225417.46	
1464.40	SCOUR VALVE	292741.52	6225416.27	E & N AT TEE LOCATION
1764.08	DN630XDN500 TAPER	292606.93	6225157.24	
1766.74	DN375X200 OFFTAKE WITH FLANGED SV	292609.23	6225155.89	E & N AT TEE LOCATION
1924.55	AIR VALVE	292745.61	6225076.49	
2024.49	SCOUR VALVE	292831.98	6225026.21	E & N AT TEE LOCATION
2101.28	HYDRANT WITH CV	292875.69	6224975.74	
2102.78	STOP VALVE	292874.38	6224974.38	
2104.28	HYDRANT WITH CV	292874.38	6224973.03	

No.	AMENDMENT DESCRIPTION	BY	DATE
11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
09	SWC COMMENTS INCORPORATED	D.T	01/10/24
08	SWC COMMENTS INCORPORATED	G.S	28/08/24
07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24
05	SWC COMMENTS INCORPORATED	G.S	22/05/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23
01	ISSUED TO SYDNEY WATER	G.S	14/04/23

SET OUT TABLES

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....

DESIGNER .....
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 4 OF 21 SHTS.

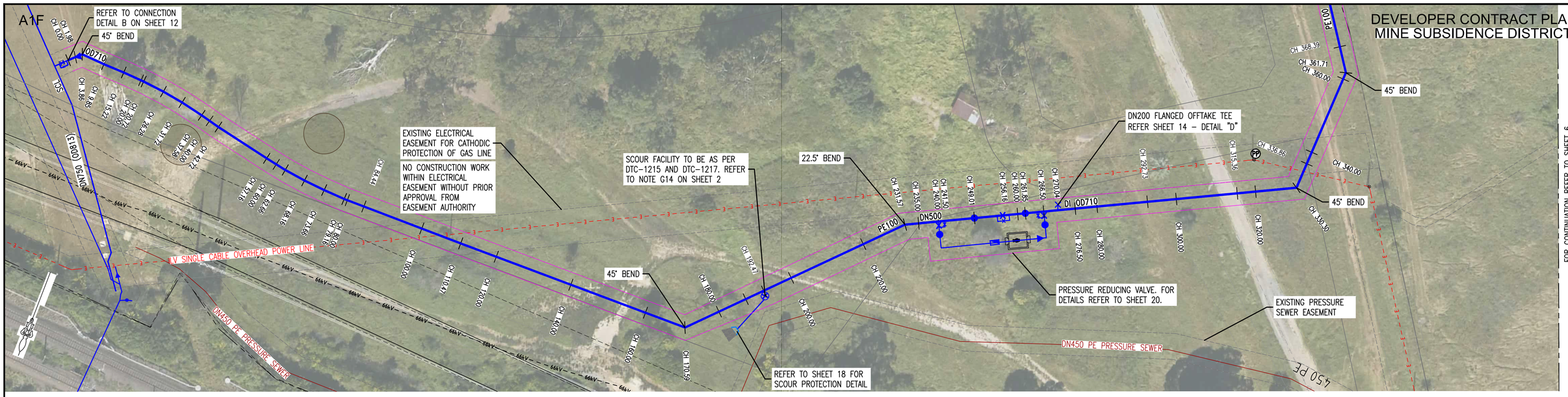
SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1

PLAN DRAWN DATE: 11/12/2024 VERSION: 11 SHEET 4 OF 21 SHEETS

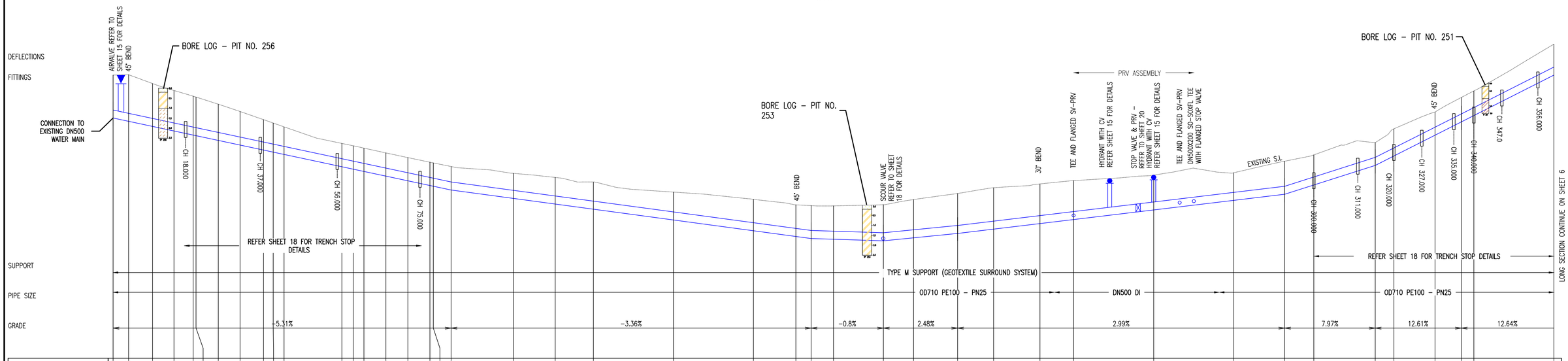
FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD-IN)-VAR1\CASE186560PW-D-4.21.DWG

DESIGNED: T.R DRAFTED: G.S VERIFIED: T.R REVIEWED: S.G APPROVED: G.F ISSUED: 11/12/2024



DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT

PLAN
1:500



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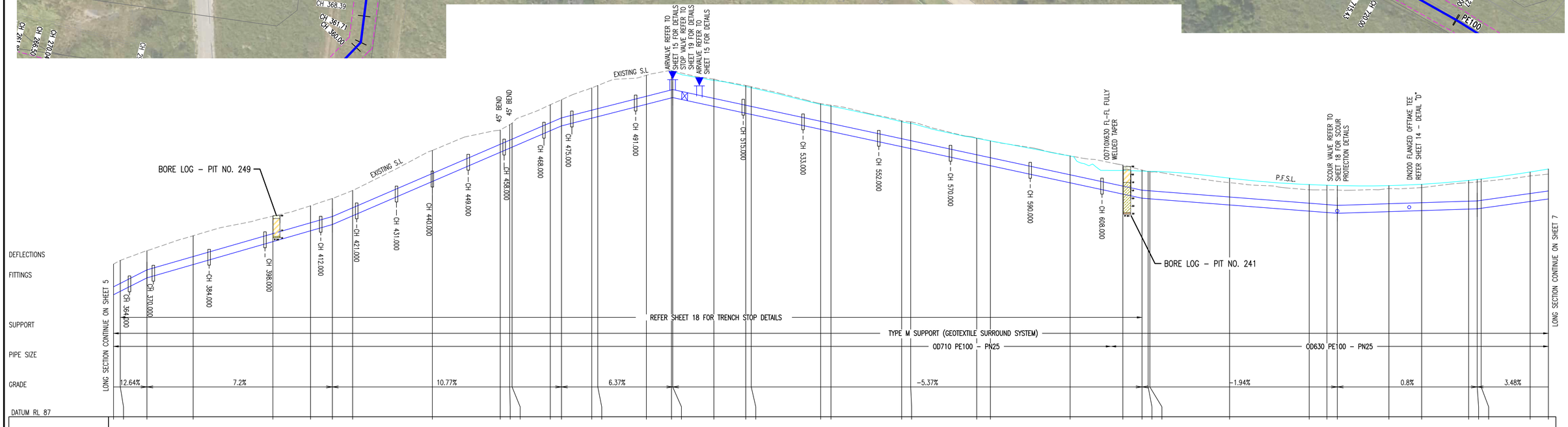
A1F
DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT
45° BEND
OD710
PE100
show offtake
OD710 X OD630 FULLY WELDED TAPER
PE PIPE TO BE HORIZONTALLY DEFLECTED AS SHOWN
OD630
SCOUR FACILITY TO BE AS PER DTC-1215 AND DTC-1217. REFER TO NOTE G14 ON SHEET 2
REFER TO SHEET 18 FOR SCOUR PROTECTION DETAIL
DN200 FLANGED OFFTAKE TEE REFER SHEET 14 – DETAIL "D"
FOR CONTINUATION REFER TO SHEET 5
FOR CONTINUATION REFER TO SHEET 7
PLAN
1:500


BORE LOG – PIT NO. 249
BORE LOG – PIT NO. 241
EXISTING S.L
P.F.S.L.
AIRVALVE REFER TO SHEET 15 FOR DETAILS
STOP VALVE REFER TO SHEET 19 FOR DETAILS
AIRVALVE REFER TO SHEET 15 FOR DETAILS
OD710X630 FL-FL FULLY WELDED TAPER
SCOUR VALVE REFER TO SHEET 18 FOR SCOUR PROTECTION DETAILS
DN200 FLANGED OFFTAKE TEE REFER SHEET 14 – DETAIL "D"
REFER SHEET 18 FOR TRENCH STOP DETAILS
TYPE M SUPPORT (GEOTEXTILE SURROUND SYSTEM)
OD710 PE100 – PN25
OD630 PE100 – PN25
LONG SECTION CONTINUE ON SHEET 5
LONG SECTION CONTINUE ON SHEET 7
DEFLECTIONS
FITTINGS
SUPPORT
PIPE SIZE
GRADE
DATUM RL 87
12.64%
7.2%
10.77%
6.37%
-5.37%
-1.94%
0.8%
3.48%

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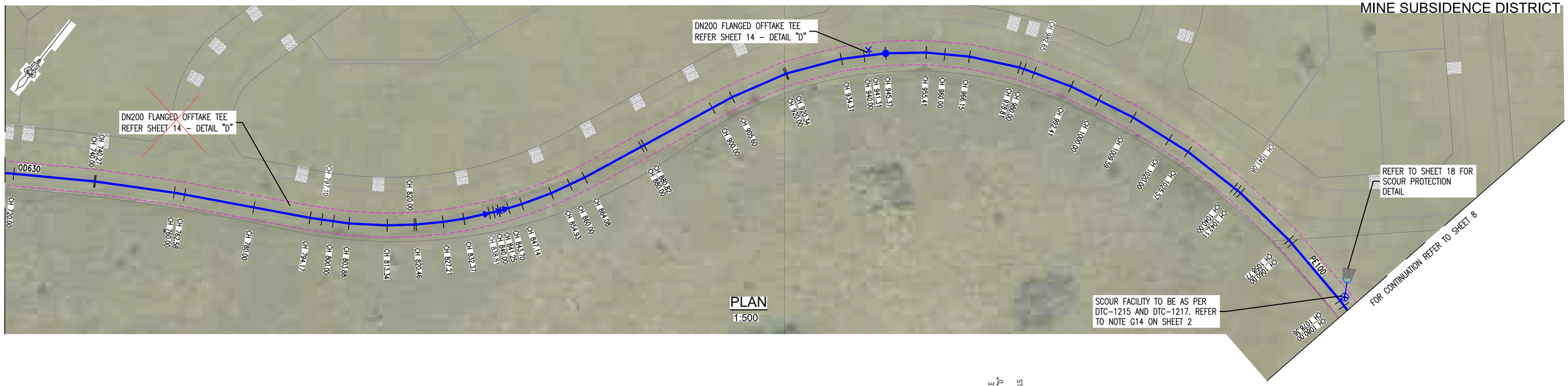
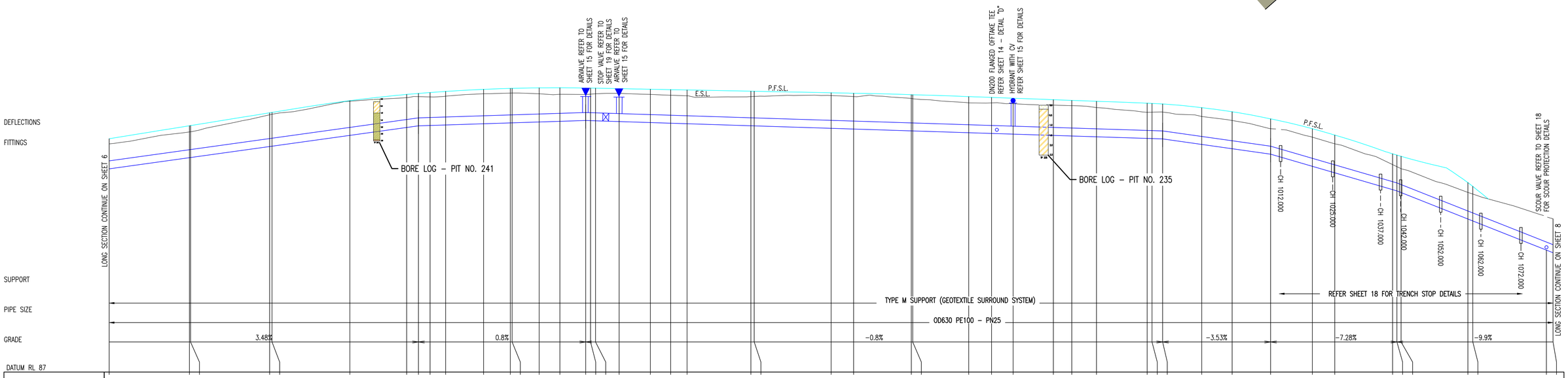
DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT





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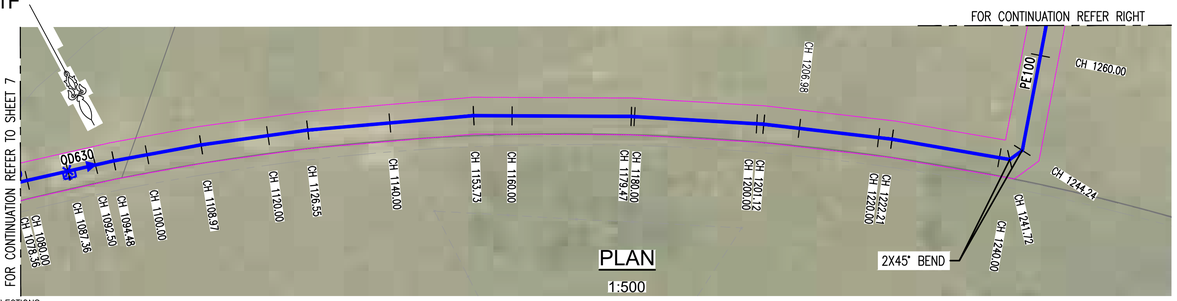
FOR CONTINUATION REFER RIGHT



DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT



DEFLECTIONS

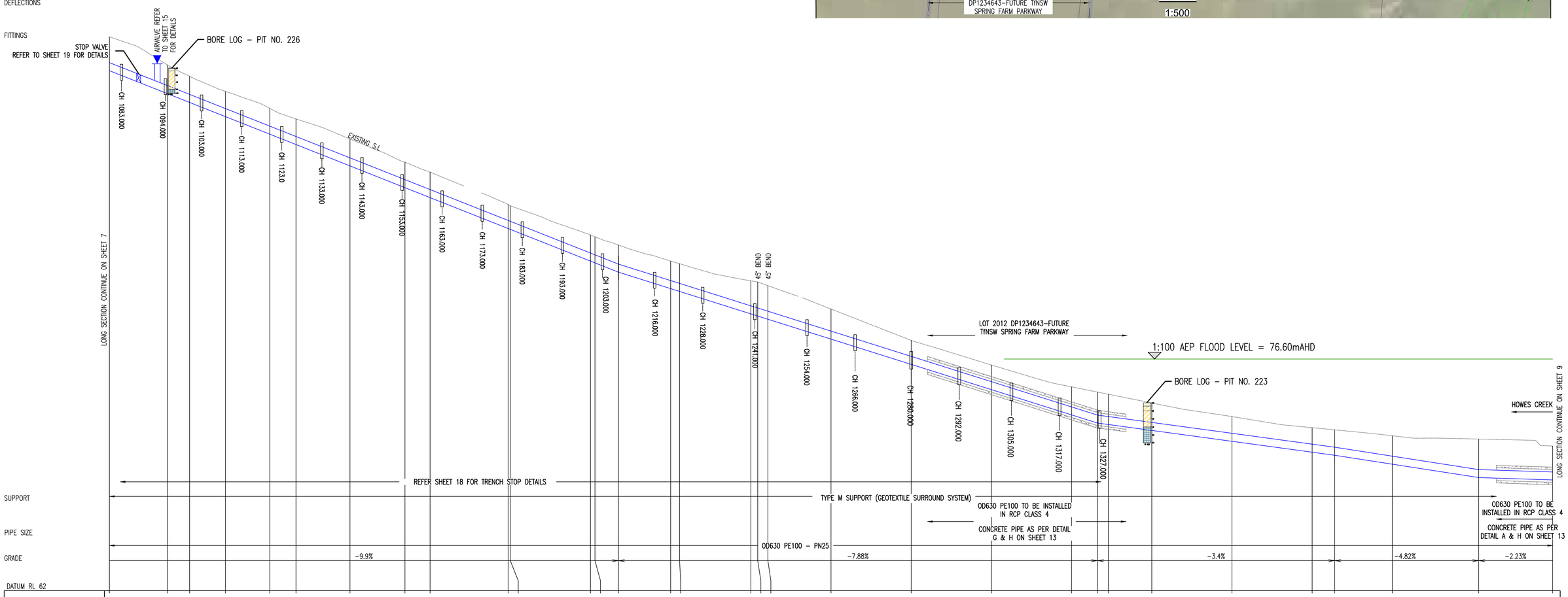
FITTINGS

STOP VALVE
REFER TO SHEET 19 FOR DETAILS

AIRVALVE REFER TO SHEET 15 FOR DETAILS

BORE LOG – PIT NO. 226

LONG SECTION CONTINUE ON SHEET 7



LONG SECTION CONTINUE ON SHEET 9

SUPPORT

PIPE SIZE

GRADE

DATUM RL 62

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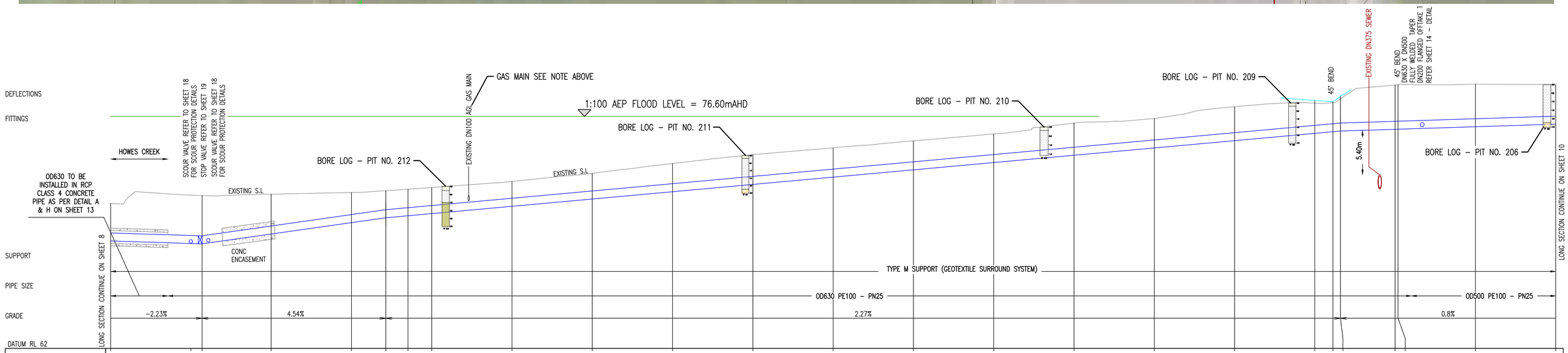
A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT





	DESIGN INVERT	DESIGN SURFACE	DEPTH TO INVERT FROM DESIGN	EXISTING SURFACE	DEPTH TO INVERT FROM EXISTING	CHAINAGE
	68.57			70.50	1.93	1440.000
	68.06			71.520		1454.260
					3.46	1461.07 – 1462.781
	68.842			71.606	2.76	1464.40
	69.75			71.711	1.96	1480.000
	70.137			71.823	1.69	1500.000
	70.262			71.914	1.65	1508.567
	70.397			72.022	1.63	1514.080
	70.851			72.400	1.55	1520.000
	71.305			72.906	1.6	1540.000
	71.759			73.517	1.76	1560.000
	72.213			74.068	1.85	1580.000
	72.668			74.495	1.83	1600.000 – 1601.000
	73.122			74.927	1.8	1620.000
	73.576			75.358	1.78	1640.000
	74.030			76.035	2.01	1660.000
	74.484			76.319	1.83	1680.000
	74.939			77.053	2.11	1700.000
	75.393	77.447	2.05	77.277	1.88	1720.000
	75.495	77.365	1.87	77.324	1.83	1740.000
	75.538	77.702	2.16	77.546	2.01	1744.498 – 1746.392
	75.647			78.408	2.76	1760.000
	75.653			78.426	2.77	1760.741 – 1764.08
	75.807			78.460	2.65	1766.74 – 1780.000
	75.967			78.429	2.46	1800.000

WATER MAIN – LONGITUDINAL SECTION

1:500 HOR
1:125 VER

No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE
04	SWC COMMENTS INCORPORATED	G.S	26/03/24	09	SWC COMMENTS INCORPORATED	D.T	01/10/24				
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23	08	SWC COMMENTS INCORPORATED	G.S	28/08/24				
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23	07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24				
01	ISSUED TO SYDNEY WATER	G.S	14/04/23	06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24	11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
				05	SWC COMMENTS INCORPORATED	G.S	22/05/24	10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24

0 10 20 30 40 50 METRES
SCALE 1:500

0 2.5 5.0 12.5 METRES
SCALE 1:125

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER
W.S.C.
CONSTRUCTOR
COMPLETED
W.A.C. PREPARED
DESIGNER
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 9 OF 21 SHTS.

SYDNEY WATER CORPORATION
FOR DETAILS OF SERVICES SEE SHEET 1

FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD-IN)-VAR1\CASE186560PW-D-9.21.DWG

DESIGNED: T.R *DRAFTED:* G.S *VERIFIED:* T.R *REVIEWED:* S.G *APPROVED:* G.F *ISSUED:* 11/12/2024

PLAN DRAWN DATE: 11/12/2024 VERSION: 11

SHEET 9 OF 21 SHEETS

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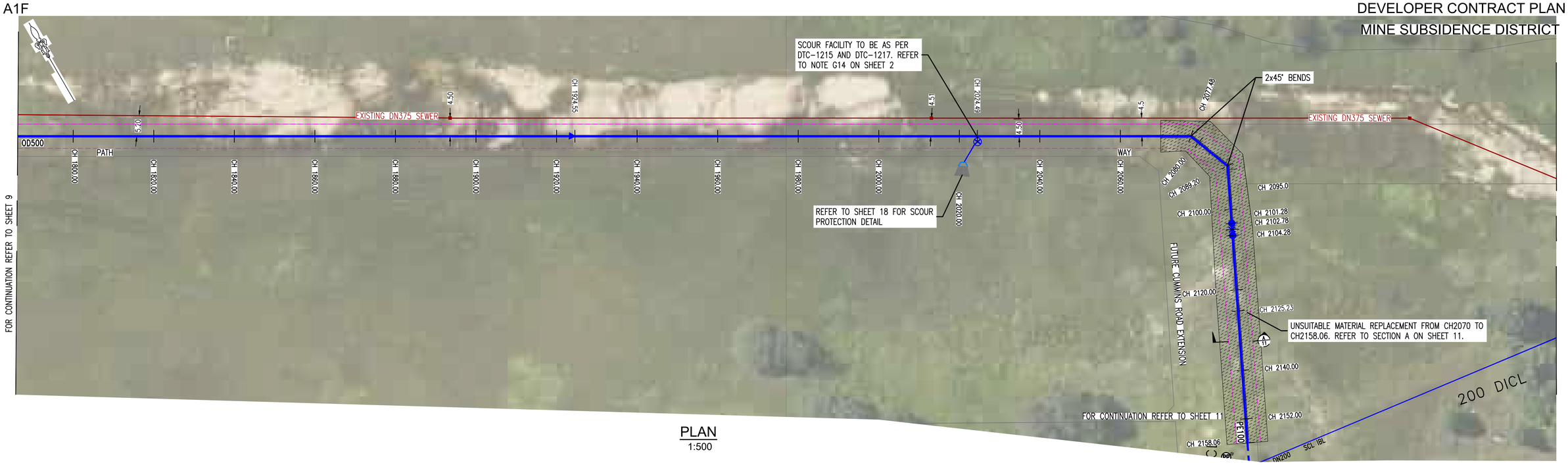
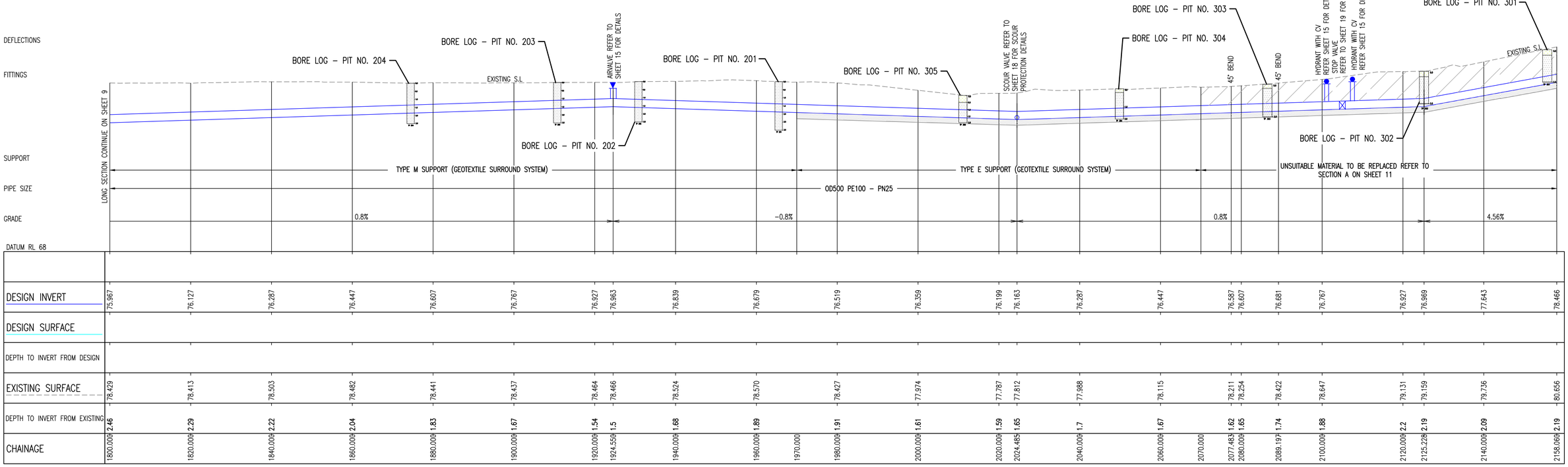
DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT



PLAN
1:500



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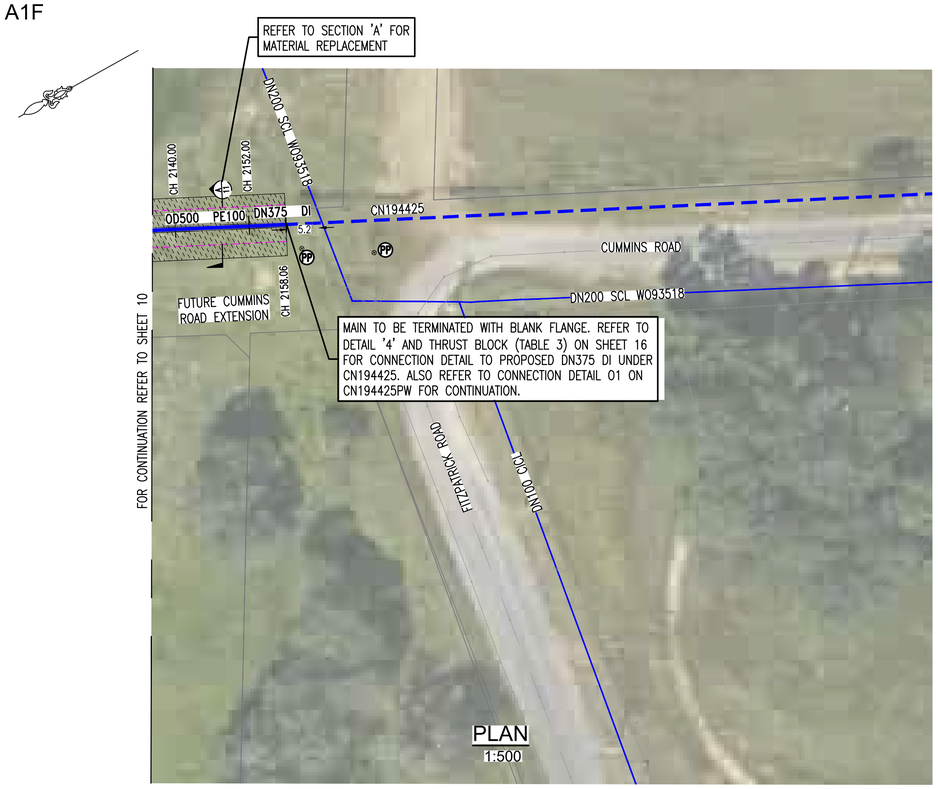
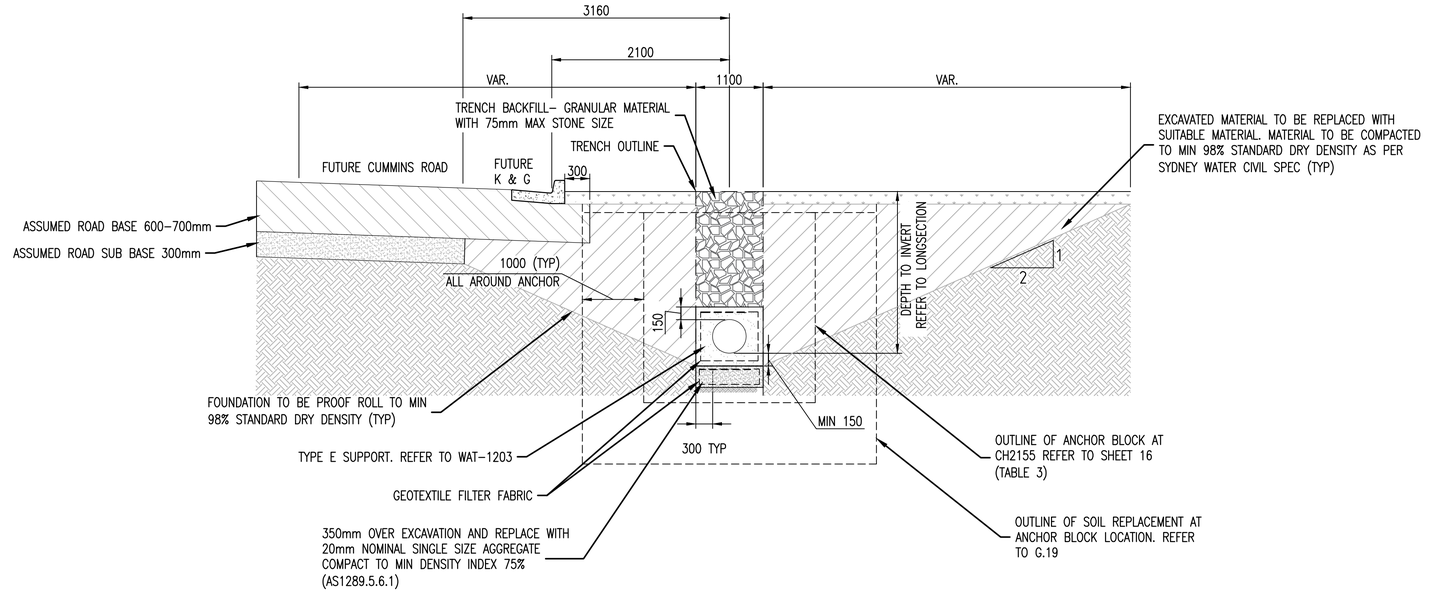
A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT



PLAN
1:500



SECTION A - FUTURE ROAD EXTENSION
SECTION APPLICABLE TO WATER MAIN FROM CH2070.00 TO CH2158.06

1:50

NOTE:

1. UNSUITABLE MATERIAL BETWEEN CH 2070 TO CH 2158.06 TO BE REPLACED WITH SUITABLE MATERIAL.
2. MATERIAL TO BE TESTED AND COMPACTED AS PER SYDNEY WATER CIVIL SPECIFICATION.
3. GEOTECHNICAL ENGINEER LEVEL 1 SUPERVISION WILL BE REQUIRED TO CONFIRM THE SUITABILITY OF THE MATERIAL FOR PIPE LAYING AND THRUST BLOCK.
4. REFER TO LONGSECTION ON SHEET 10 FOR THE EXTENT OF MATERIAL REPLACEMENT.
5. FOR PE TO DI ANCHOR BLOCK AT CH2155 REFER TO DETAIL 4 & TABLE 3. SOIL REPLACEMENT TO EXCEED THE ANCHOR BLOCK BY 1.0m ALL AROUND. REFER TO G.19 FOR SOIL REPLACEMENT/TESTING.

No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE
05	SWC COMMENTS INCORPORATED	G.S	22/05/24	11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24	10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23	09	SWC COMMENTS INCORPORATED	D.T	01/10/24
02	SYDNEY WATER RESUB. - PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23	08	SWC COMMENTS INCORPORATED	G.S	28/08/24
01	ISSUED TO SYDNEY WATER	G.S	14/04/23	07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11& SHEET 17	G.S	05/07/24
				06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24

LONGITUDINAL SECTION

0 1 2 3 4 5 METRES
SCALE 1:50

0 10 20 30 40 50 METRES
SCALE 1:500

0 2.5 5.0 12.5 METRES
SCALE 1:125 VERT

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....
DESIGNER .....

I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 11 OF 21 SHTS

SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1

PLAN DRAWN DATE: 11/12/2024 VERSION: 11 SHEET 11 OF 21 SHEETS

FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD-IN)-VAR1\CASE186560PW-D-11.21.DWG

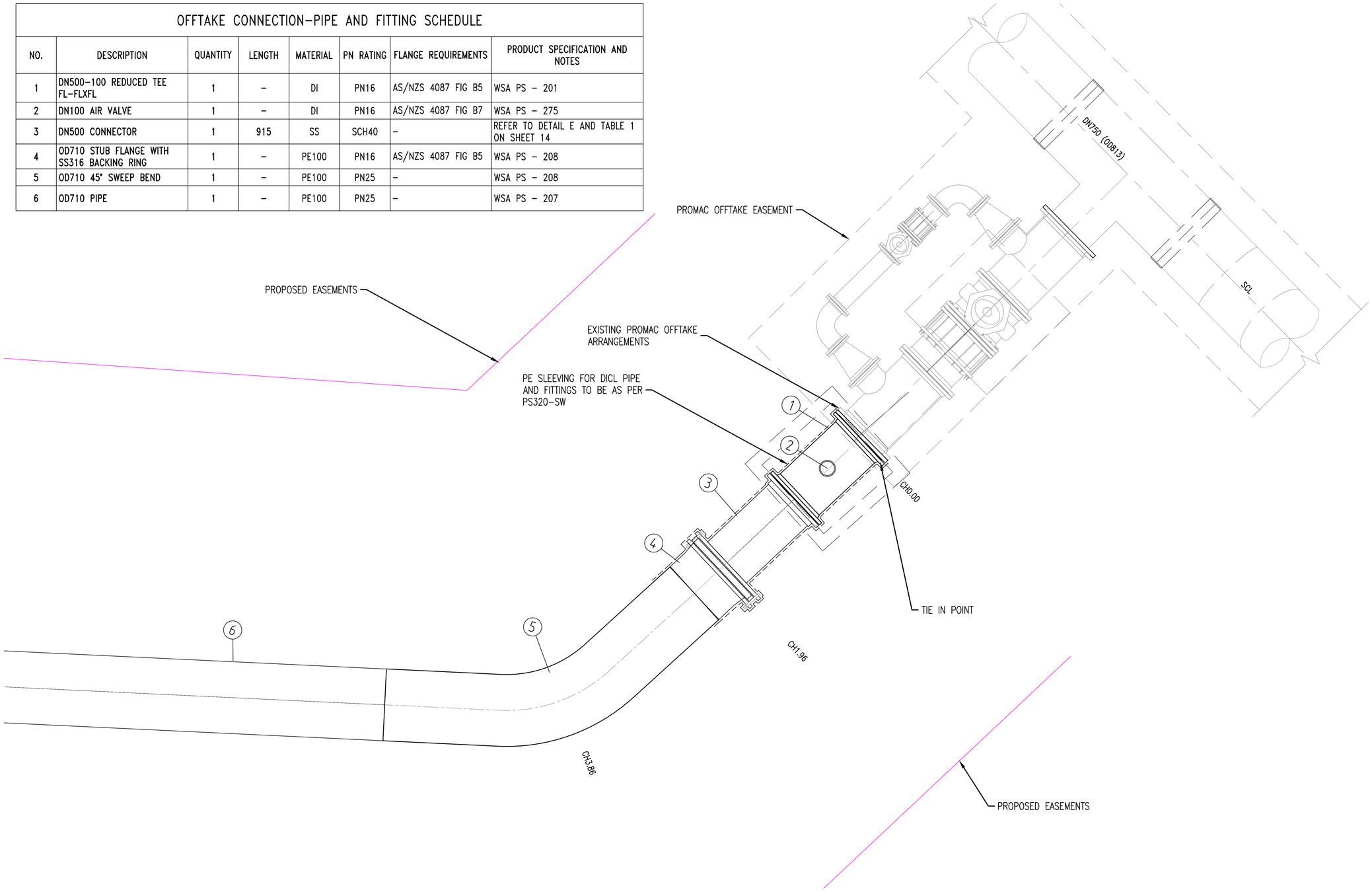
DESIGNED: T.R *DRAFTED:* G.S *VERIFIED:* T.R *REVIEWED:* S.G *APPROVED:* G.F *ISSUED:* 11/12/2024

A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT

OFFTAKE CONNECTION–PIPE AND FITTING SCHEDULE

NO.	DESCRIPTION	QUANTITY	LENGTH	MATERIAL	PN RATING	FLANGE REQUIREMENTS	PRODUCT SPECIFICATION AND NOTES
1	DN500–100 REDUCED TEE FL–FLXFL	1	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 201
2	DN100 AIR VALVE	1	–	DI	PN16	AS/NZS 4087 FIG B7	WSA PS – 275
3	DN500 CONNECTOR	1	915	SS	SCH40	–	REFER TO DETAIL E AND TABLE 1 ON SHEET 14
4	OD710 STUB FLANGE WITH SS316 BACKING RING	1	–	PE100	PN16	AS/NZS 4087 FIG B5	WSA PS – 208
5	OD710 45° SWEEP BEND	1	–	PE100	PN25	–	WSA PS – 208
6	OD710 PIPE	1	–	PE100	PN25	–	WSA PS – 207



DETAIL: B
TIE IN POINT AT CHAINAGE 0.00
SCALE1:20

0 0.4 0.8 1.2 1.6 2.0 METRES
SCALE 1:20

No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE
05	SWC COMMENTS INCORPORATED	G.S	22/05/24	11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24	10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23	09	SWC COMMENTS INCORPORATED	D.T	01/10/24
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23	08	SWC COMMENTS INCORPORATED	G.S	28/08/24
01	ISSUED TO SYDNEY WATER	G.S	14/04/23	07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
				06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER
W.S.C.
CONSTRUCTOR
COMPLETED
W.A.C. PREPARED
DESIGNER
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 12 OF 21 SHTS.

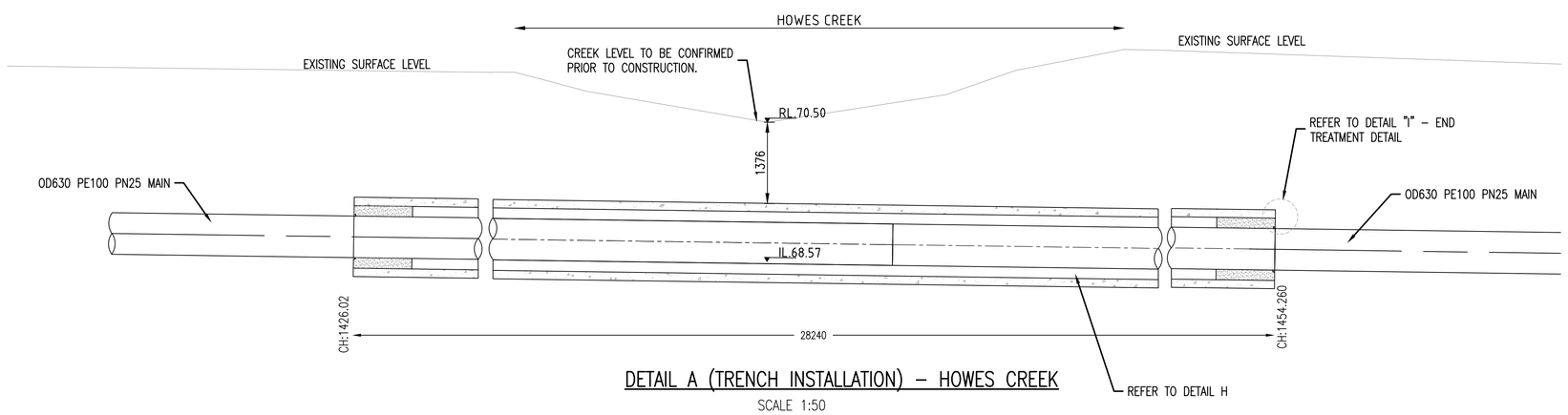
SYDNEY WATER CORPORATION
FOR DETAILS OF SERVICES SEE SHEET 1

PLAN DRAWN DATE: 11/12/2024 VERSION:11

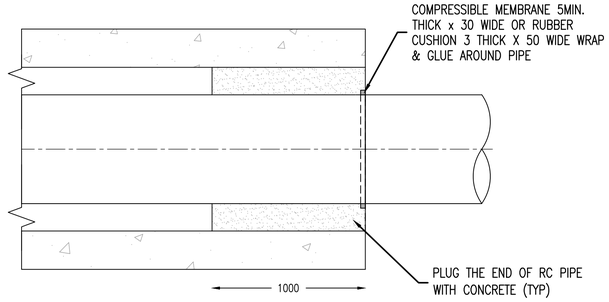
SHEET 12 OF 21 SHEETS

FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD–IN)–VAR1\CASE186560PW–D–12.21.DWG

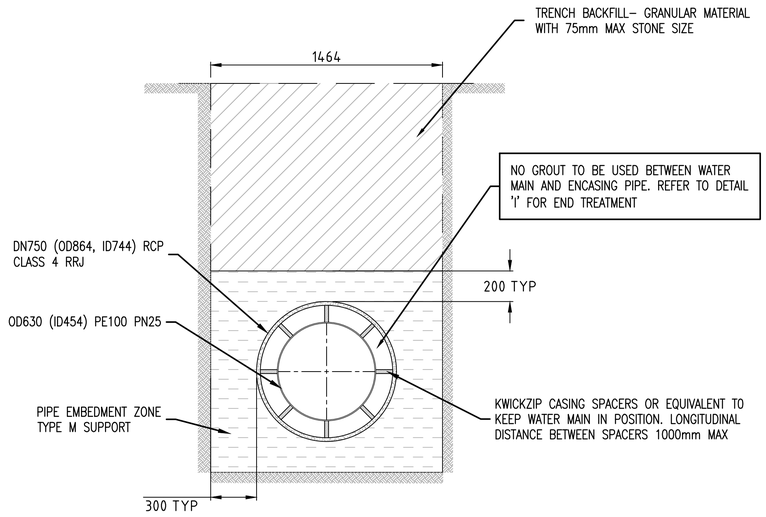
DESIGNED: T.R *DRAFTED:* G.S *VERIFIED:* T.R *REVIEWED:* S.G *APPROVED:* G.F *ISSUED:* 11/12/2024



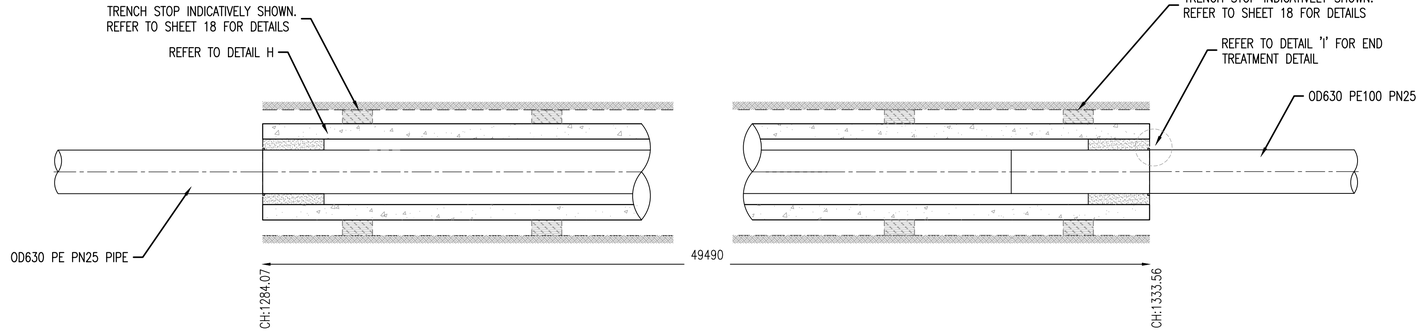
DETAIL A (TRENCH INSTALLATION) – HOWES CREEK
SCALE 1:50



DETAIL 'I' (END TREATMENT DETAIL)
SCALE 1:20



DETAIL H
OD630 PE PN25 INSIDE RCP ID871
VIA TRENCH INSTALLATION
1:20



DETAIL G (SPRING FARM PARKWAY CROSSING) – TRENCH INSTALLATION
SCALE 1:50

AREA OF OVER EXCAVATION TO BE BACKFILLED WITH CEMENT STABILISED SAND TO PS–352_SW. BACKFILL TO BE COMPACTED IN LAYERS NOT EXCEEDING 200mm LOOSE THICKNESS.

No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE
05	SWC COMMENTS INCORPORATED	G.S	22/05/24	11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24	10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23	09	SWC COMMENTS INCORPORATED	D.T	01/10/24
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23	08	SWC COMMENTS INCORPORATED	G.S	28/08/24
01	ISSUED TO SYDNEY WATER	G.S	14/04/23	07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
				06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24

0 1 2 3 4 5 METRES
SCALE 1:50

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....

DESIGNER .....
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

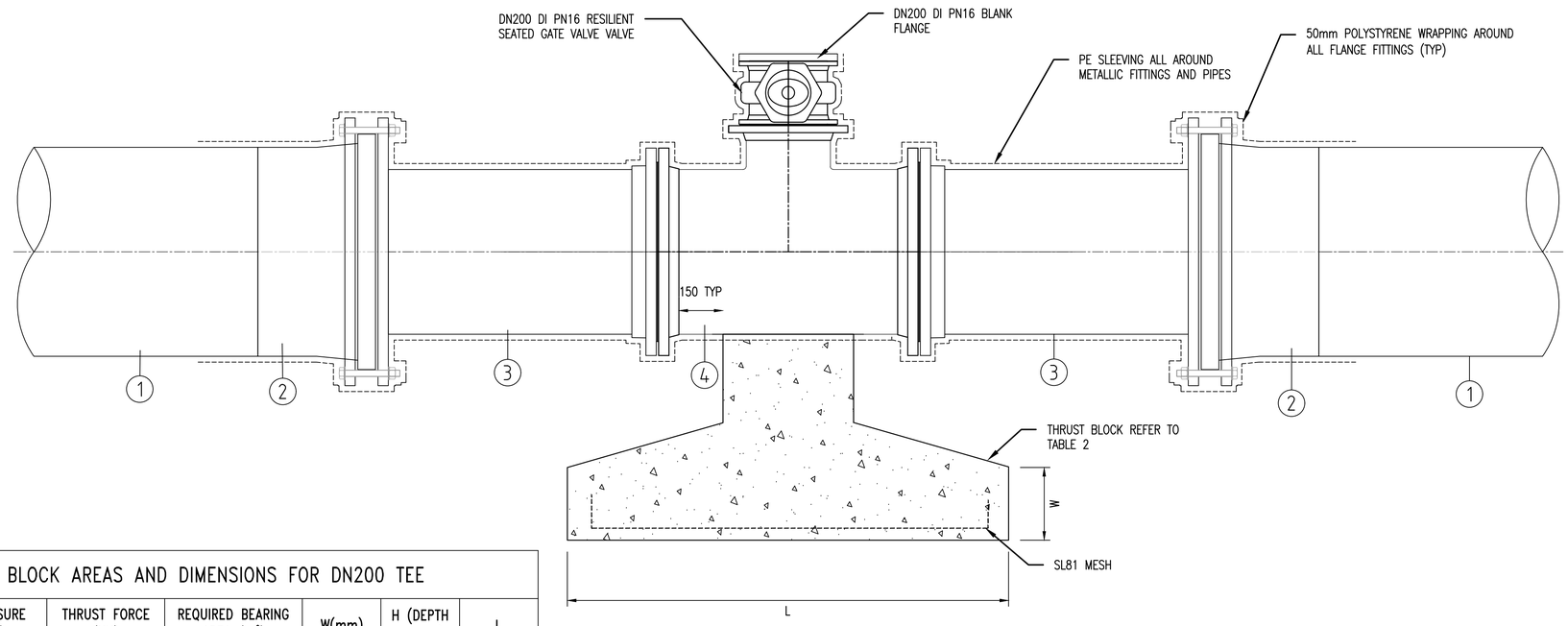
CASE186560PW | SHT 13 OF 21 SHTS.

SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1

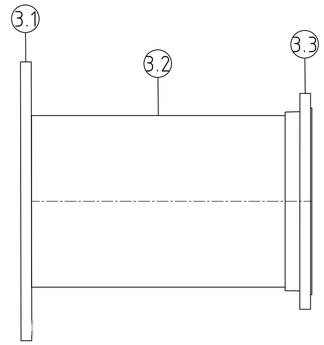
A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT

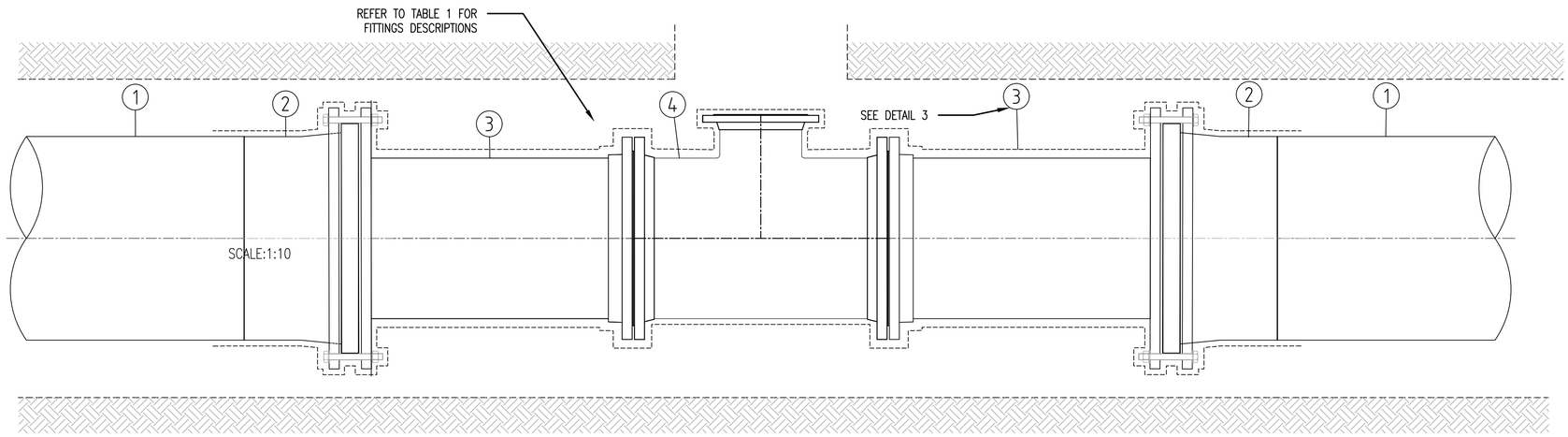


DETAIL 'D' –PLAN VIEW
TYPICAL DN200 OFFTAKE DETAILS
SCALE:1:10

TABLE 2 – THRUST BLOCK AREAS AND DIMENSIONS FOR DN200 TEE							
SOIL BEARING	OD	TEST PRESSURE HEAD(m)	THRUST FORCE (KN)	REQUIRED BEARING AREA (m^2)	W(mm)	H (DEPTH IN mm)	L
50	232	200	83	2.49	350	2500	1000



DETAIL '3' – TYPICAL MK 3 CONNECTION DETAIL



DETAIL 'E' – TYPICAL PE PIPE TO DICL FITTINGS CONNECTION ELEVATION VIEW
SCALE:1:10

TABLE 1 – FITTINGS DESCRIPTIONS FOR PE PIPE CONNECTION TO DI FITTINGS					
1	2	3.1	3.2	3.3	4 (NOTE 1)
PE100 PN25		FLANGE TO AS4087 – FIG B9	SS316 SPOOL – SCH 40 – WT=9.52	FLANGE TO AS4087 – FIGB6	
OD710 PE PN25	PE PN25 STUB FLANGE WITH SS316 BACKING RING	DN700 (PCD=857)	DN550(OD559)	DN500 (PCD=641)	DN500–500X200 FL–FLXFL TEE PN16
OD630 PE PN25	PE PN25 STUB FLANGE WITH SS316 BACKING RING	DN600 (PCD=781)	DN500(OD508)	DN450 (PCD=584)	DN450–450X200 FL–FLXFL TEE PN16
OD500 PE PN25	PE PN25 STUB FLANGE WITH SS316 BACKING RING	DN500 (PCD=673)	DN400(OD406)	DN375 (PCD=495)	DN375–375X200 FL–FLXFL TEE PN16

NOTE 1: THE TEE IS SHOWN FOR TYPICAL DN200 OFFTAKE. THE TEE FOR THE AIR VALVE AND HYDRANT SHOULD HAVE AN OFFTAKE SIZE OF DN250. THE TEE USED AT THE SCOUR FACILITY SHOULD BE A SCOUR TEE WITH DN150 OFF TAKE.

No.	AMENDMENT DESCRIPTION	BY	DATE
11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
09	SWC COMMENTS INCORPORATED	D.T	01/10/24
08	SWC COMMENTS INCORPORATED	G.S	28/08/24
07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24
05	SWC COMMENTS INCORPORATED	G.S	22/05/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23
01	ISSUED TO SYDNEY WATER	G.S	14/04/23

0 0.2 0.4 0.6 0.8 1.0 METRES
SCALE 1:10

WORK AS CONSTRUCTED CERTIFICATION
DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....
DESIGNER .....
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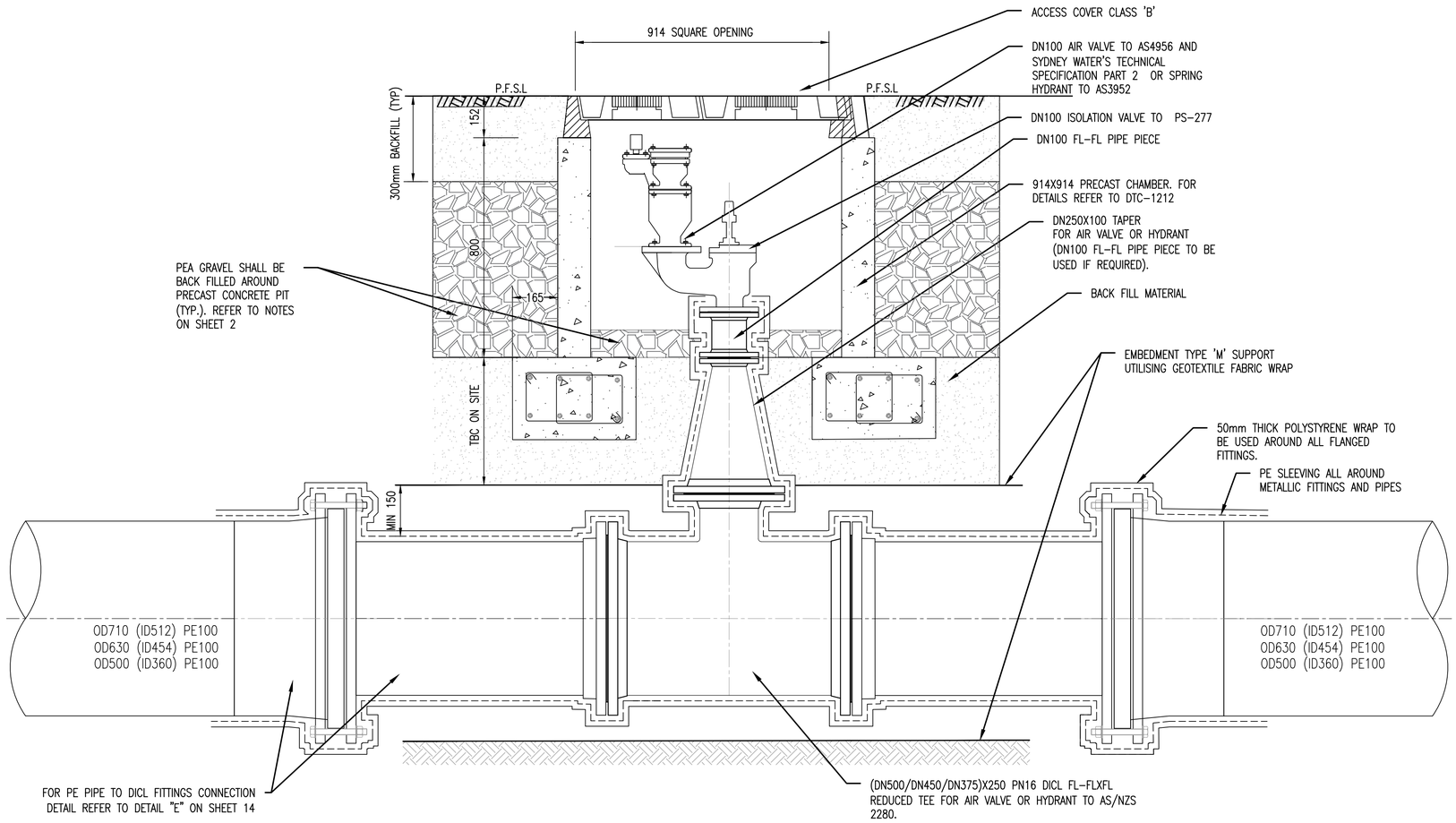
SYDNEY WATER CORPORATION
Sydney WATER
CASE186560PW | SHT 14 OF 21 SHTS.
SYDNEY WATER CORPORATION
FOR DETAILS OF SERVICES SEE SHEET 1

PLAN DRAWN DATE: 11/12/2024 VERSION:11 SHEET 14 OF 21 SHEETS

FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD-IN)-VAR1\CASE186560PW-D-14.21.DWG *DESIGNED:* T.R *DRAFTED:* G.S *VERIFIED:* T.R *REVIEWED:* S.G *APPROVED:* G.F *ISSUED:* 11/12/2024



HYDRANT AND AIR VALVE INSTALLATIONS – FOR DN500/DN450/DN375 WATER MAINS

N.T.S

No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE
05	SWC COMMENTS INCORPORATED	G.S	22/05/24	11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24	10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23	09	SWC COMMENTS INCORPORATED	D.T	01/10/24
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23	08	SWC COMMENTS INCORPORATED	G.S	28/08/24
01	ISSUED TO SYDNEY WATER	G.S	14/04/23	07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
				06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24

WORK AS CONSTRUCTED CERTIFICATION

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CONSTRUCTOR .....
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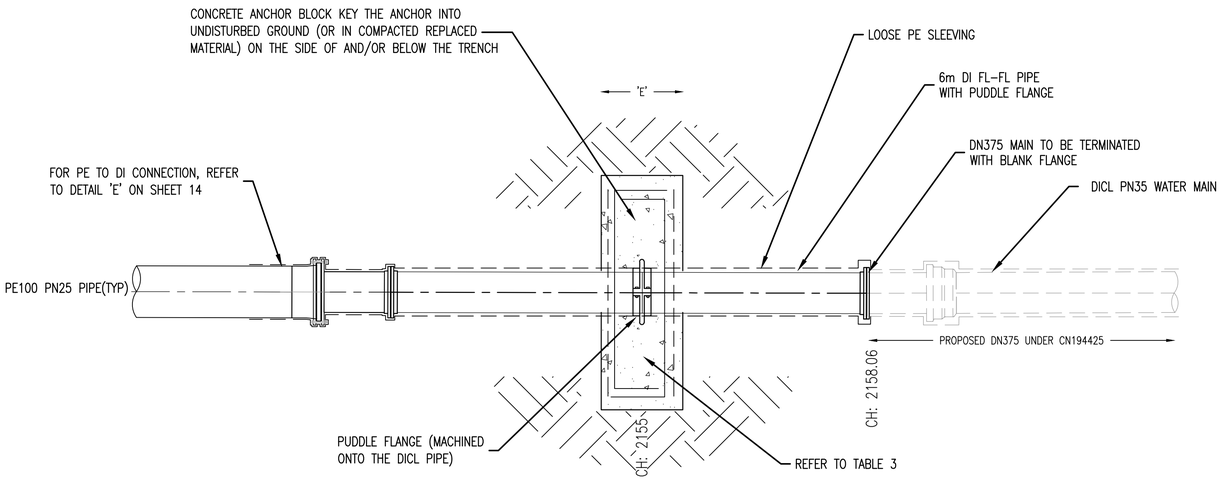
Sydney WATER

SYDNEY WATER CORPORATION

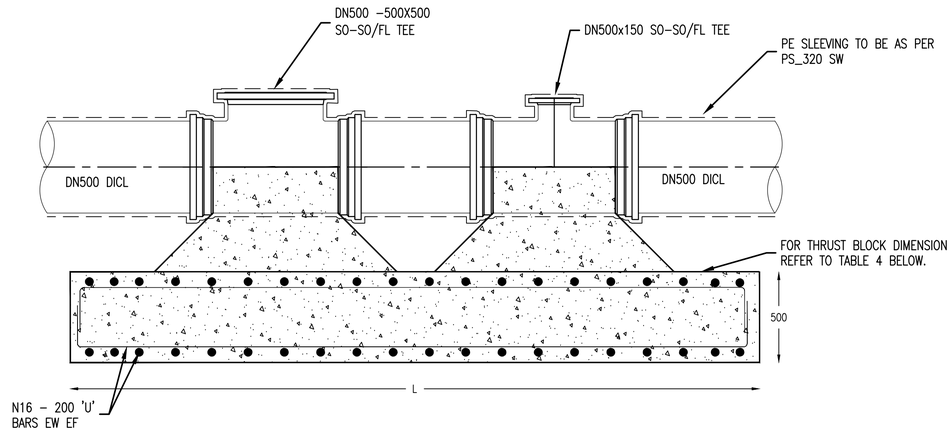
CASE186560PW | SHT 15 OF 21 SHTS.

SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1



DETAIL 4
CONNECTION DETAIL AT CH. 2158
SCALE : NTS



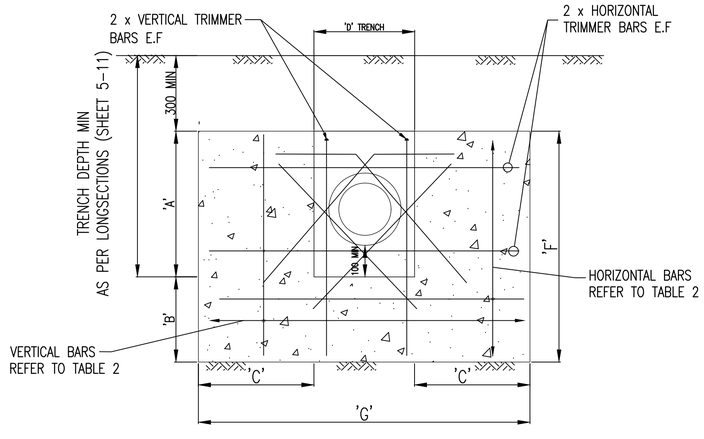
DETAIL 5
COMBINED TEE-THRUST BLOCK
FOR DIMENSION REFER TO TABLE 4
SCALE : NTS

TABLE 1 - ANCHOR BLOCK AND REINFORCEMENT BAR DIMENSIONS FOR PRV PE TO DI ANCHOR BLOCK (200m TEST PRESSURE HEAD)													
DIAMETER	DESIGN FORCE(KN)	ALLOWABLE HORIZONTAL SOIL BEARING PRESSURE(Kpa)	BEARING AREA(m^2)	DIMENSION 'A' (m)	DIMENSION 'B' (m)	DIMENSION 'C' (m)	TRENCH WIDTH DIMENSION 'D' (m)	OVERALL WIDTH DIMENSION 'E' (m)	OVERALL DEPTH DIMENSION 'F' (m)	OVERALL LENGTH DIMENSION 'G' (m)	VERTICAL BARS 'X' (EACH FACE)	HORIZONTAL BARS 'X' (EACH FACE)	CONCRETE GRADE (f'c)
OD710	776.3	50	15.5	2.5	1.5	1.8	1.3	0.6	4.0	4.5	20-N16	15-N16	N32
OD710	776.3	100	7.76	1.8	1.0	1.25	1.3	0.6	2.8	3.4	10-N16	10-N16	N32

TABLE 4 - THRUST BLOCK AREA FOR COMBINED DN500 TEES @ CH 240 AND CH 266.50						
SOIL BEARING	OD	DESIGN PRESSURE HEAD(m)	THRUST FORCE (KN)	REQUIRED BEARING AREA (m^2)	H	L
75	559	200	681	11.4	3000	3800

TABLE 2 - FOR DN500 STOP VALVE ON PRV (SEE SHEET 20) ANCHOR BLOCK DIMENSIONS AND REO BARS DETAILS													
DIAMETER	DESIGN FORCE(KN)	ALLOWABLE HORIZONTAL SOIL BEARING PRESSURE(Kpa)	BEARING AREA(m^2)	DIMENSION 'A' (m)	DIMENSION 'B' (m)	DIMENSION 'C' (m)	TRENCH WIDTH DIMENSION 'D' (m)	OVERALL WIDTH DIMENSION 'E' (m)	OVERALL DEPTH DIMENSION 'F' (m)	OVERALL LENGTH DIMENSION 'G' (m)	VERTICAL BARS 'X' (EACH FACE)	HORIZONTAL BARS 'X' (EACH FACE)	CONCRETE GRADE (f'c)
OD559	491	50	11.78	2.2	1.5	1.45	0.9	0.6	3.7	3.8	18-N16	12-N16	N32
OD559	491	100	5.89	1.8	1	1.15	0.9	0.6	2.8	3.2	10-N16	10-N16	N32

TABLE 3 - FOR DN375 TIE IN POINT TO PROPOSED DN375 DI CN194425 - ANCHOR BLOCK AT CH2155													
DIAMETER	DESIGN FORCE(KN)	ALLOWABLE HORIZONTAL SOIL BEARING PRESSURE(Kpa)	BEARING AREA(m^2)	DIMENSION 'A' (m)	DIMENSION 'B' (m)	DIMENSION 'C' (m)	TRENCH WIDTH DIMENSION 'D' (m)	OVERALL WIDTH DIMENSION 'E' (m)	OVERALL DEPTH DIMENSION 'F' (m)	OVERALL LENGTH DIMENSION 'G' (m)	VERTICAL BARS 'X' (EACH FACE)	HORIZONTAL BARS 'X' (EACH FACE)	CONCRETE GRADE (f'c)
OD500	396	100	4.72	2.0	0.6	0.85	0.9	0.6	2.6	2.6	10-N16	10-N16	N32



DETAIL 6
ANCHOR DETAIL (SECTION VIEW)
SCALE : NTS

No.	AMENDMENT DESCRIPTION	BY	DATE	No.	AMENDMENT DESCRIPTION	BY	DATE
07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24				
06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24				
05	SWC COMMENTS INCORPORATED	G.S	22/05/24				
04	SWC COMMENTS INCORPORATED	G.S	26/03/24				
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23	11	VARIATION 1 - SWC COMMENT ADDRESSED	A.Y	11/12/24
02	SYDNEY WATER RESUB. - PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23	10	VARIATION 1 - PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
01	ISSUED TO SYDNEY WATER	G.S	14/04/23	09	SWC COMMENTS INCORPORATED	D.T	01/10/24
				08	SWC COMMENTS INCORPORATED	G.S	28/08/24

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER . . . . . .
W.S.C. . . . . .
CONSTRUCTOR . . . . . .
COMPLETED . . . . . .
W.A.C. PREPARED . . . . . .

DESIGNER . . . . . .
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

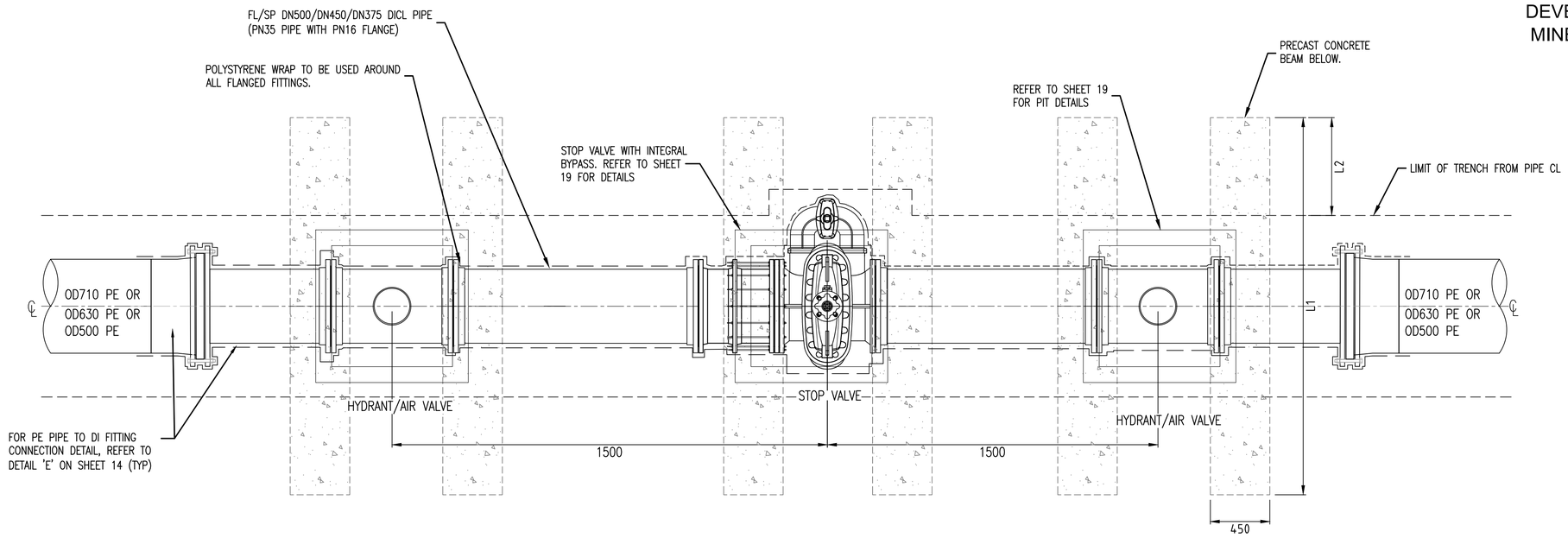
CASE186560PW | SHT 16 OF 21 SHTS.

SYDNEY WATER CORPORATION
FOR DETAILS OF SERVICES SEE SHEET 1

PLAN DRAWN DATE: 11/12/2024 VERSION: 11 SHEET 16 OF 21 SHEETS

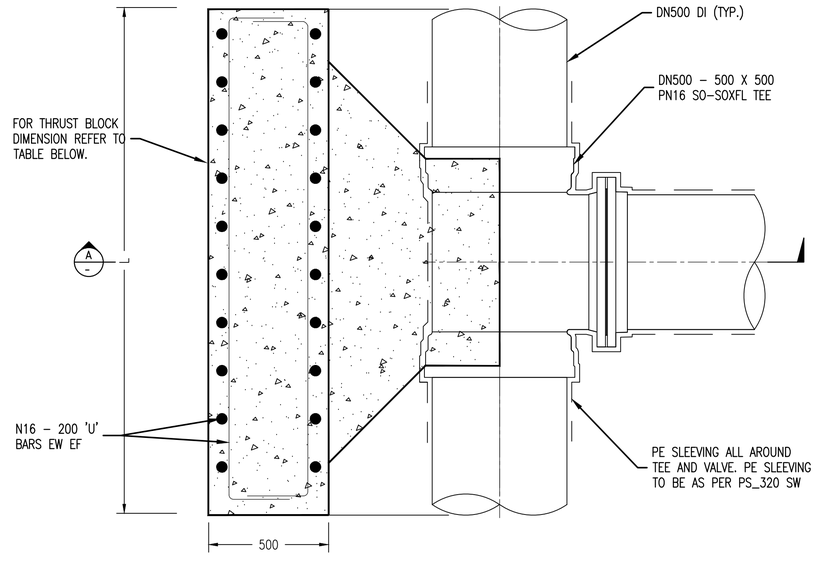
A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT



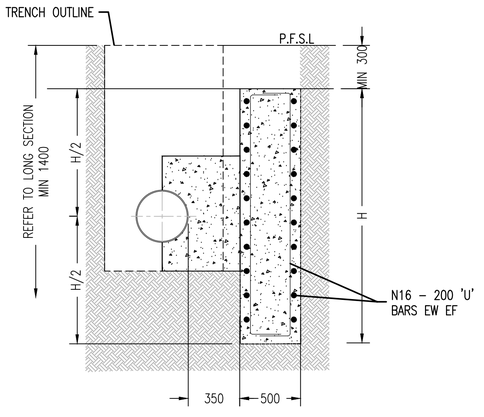
HYDRANT, STOP VALVE, HYDRANT/AIR VALVE ARRANGEMENT (PLAN VIEW)

NTS



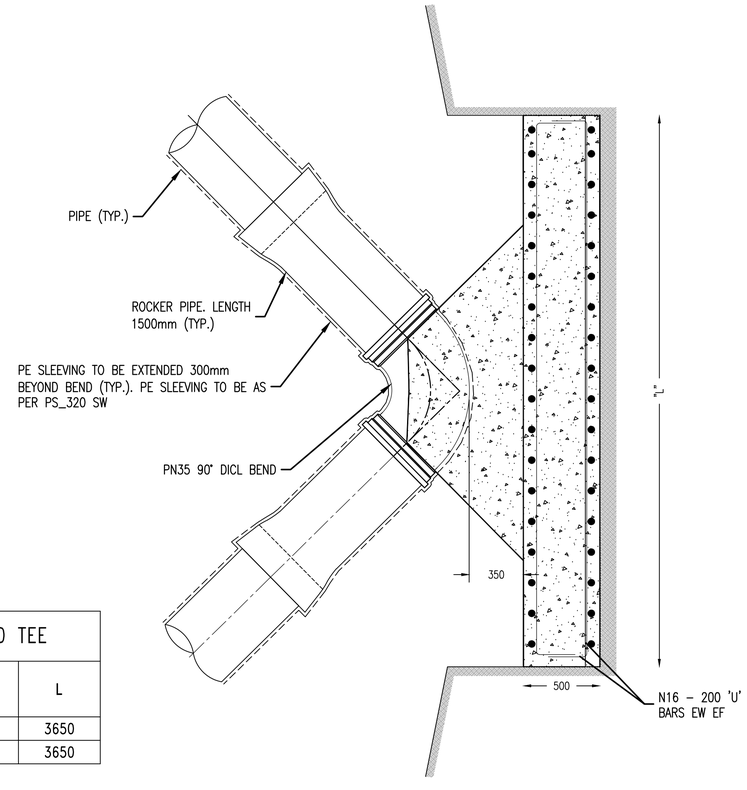
DN500–500x500TEE–THRUST BLOCK (REFER TO TABLE 1)

NTS



BEND THRUST BLOCK SECTION "A"

NTS



BEND THRUST BLOCK–PLAN

NTS

NOTES:
1. THRUST BLOCKS TO BE AT 500mm MINIMUM CLEARANCE FROM OTHER SERVICES (EXISTING OR PROPOSED).
2. THRUST BLOCKS TO BE AT 5000mm CLEARANCE FROM ANY EMBANKMENT.

TABLE 1 – DN500 (OD559) – THRUST BLOCK AREA FOR DN500X500 TEE

SOIL BEARING	DN	DESIGN PRESSURE HEAD(m)	THRUST FORCE (KN)	REQUIRED BEARING AREA (m^2)	H	L
50	500	200	491	14.44	4000	3650
100	500	200	491	7.22	2000	3650

TABLE 2 – DN500 THRUST BLOCK AREA AND DIMENSIONS FOR HORIZONTAL BENDS

BENDS	SOIL BEARING	OD	TEST PRESSURE HEAD(m)	THRUST FORCE (KN)	REQUIRED BEARING AREA (m^2)	H	L
90	75	560	200	697	10.93	2810	3900

No.	AMENDMENT DESCRIPTION	BY	DATE
10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
09	SWC COMMENTS INCORPORATED	D.T	01/10/24
08	SWC COMMENTS INCORPORATED	G.S	28/08/24
07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24
05	SWC COMMENTS INCORPORATED	G.S	22/05/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23
01	ISSUED TO SYDNEY WATER	G.S	14/04/23
11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....

DESIGNER .....
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SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 17 OF 21 SHTS.

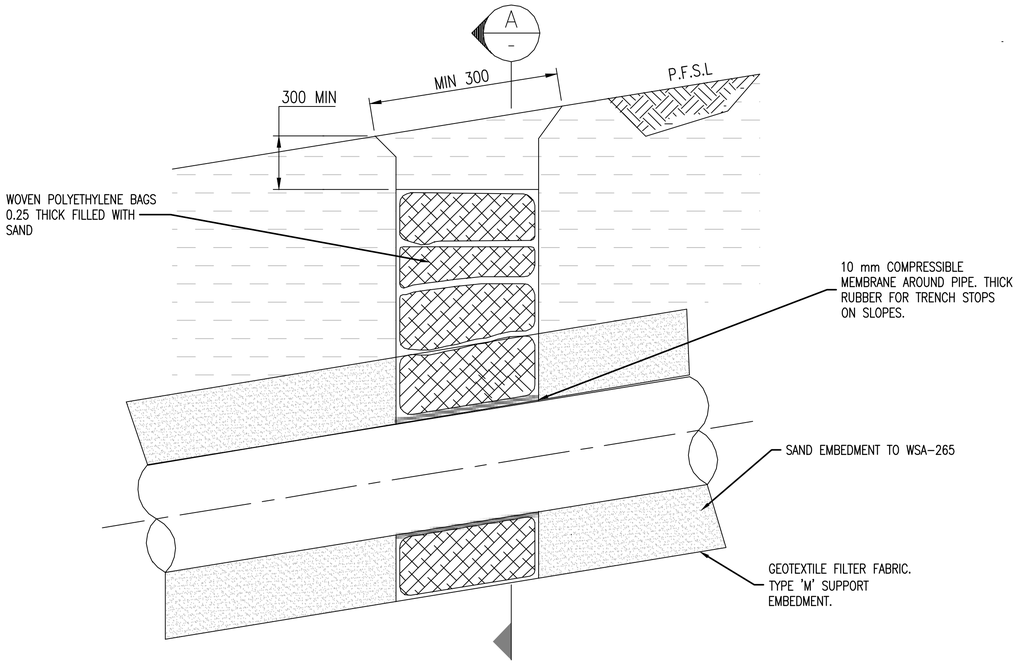
SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1

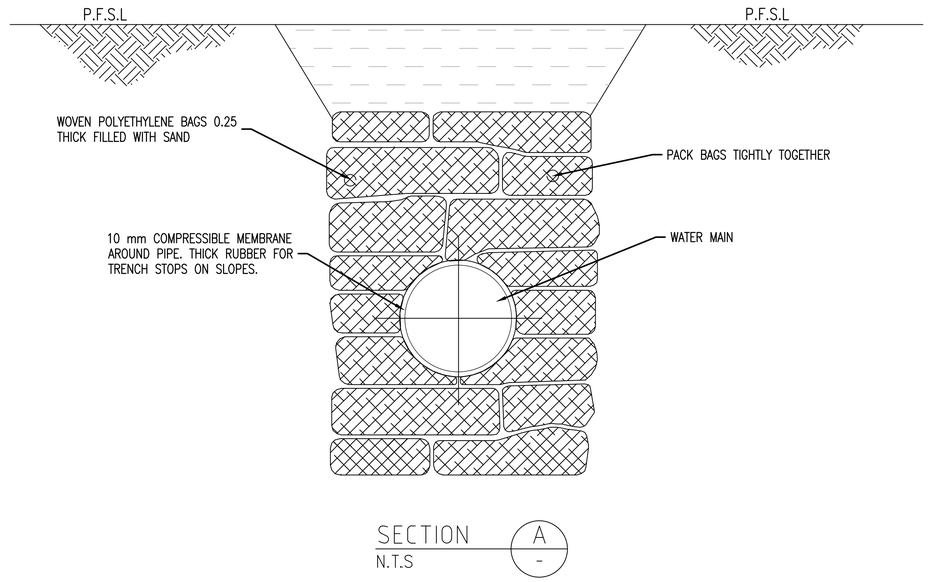
PLAN DRAWN DATE: 11/12/2024 VERSION:11 SHEET 17 OF 21 SHEETS

FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD-IN)-VAR1\CASE186560PW-D-17.21.DWG

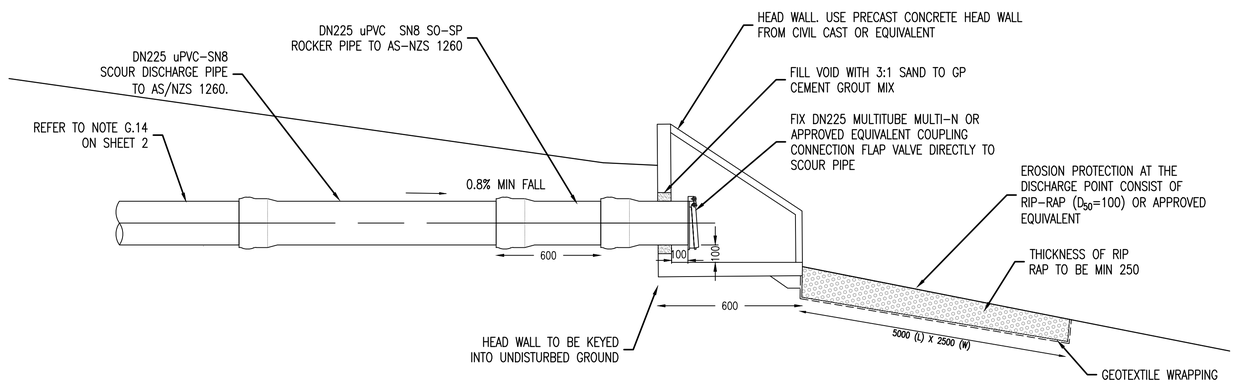
DESIGNED: T.R DRAFTED: G.S VERIFIED: T.R REVIEWED: S.G APPROVED: G.F ISSUED: 11/12/2024



TRENCH STOP DETAIL
N.T.S



SECTION A
N.T.S



SCOUR PROTECTION DETAIL
N.T.S

No.	AMENDMENT DESCRIPTION	BY	DATE
11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
09	SWC COMMENTS INCORPORATED	D.T	01/10/24
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02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23
01	ISSUED TO SYDNEY WATER	G.S	14/04/23

WORK AS CONSTRUCTED CERTIFICATION

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SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 18 OF 21 SHTS.

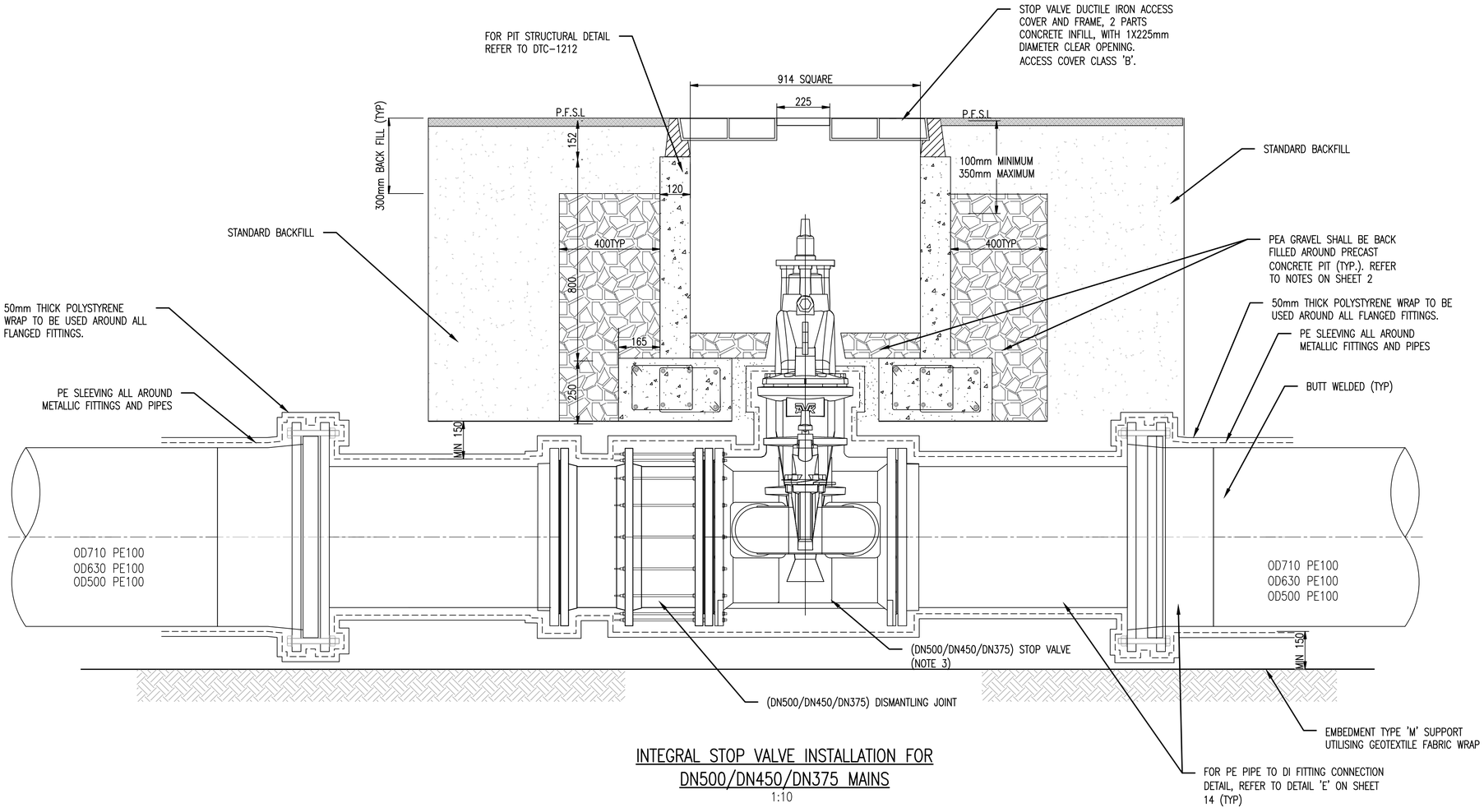
SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1

PLAN DRAWN DATE: 11/12/2024 VERSION:11 SHEET 18 OF 21 SHEETS

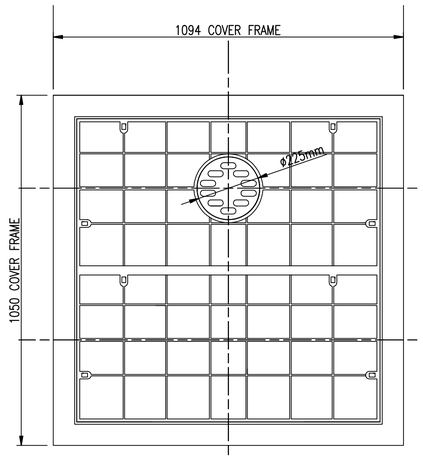
FILE LOCATION: C:\12DS\DATA\SMECSYN\300178115 – MENANGLE PARK_1169\300178115.88\11. CAD\01_DWG\05_SEWER & WATER\W186560(GLENLEE WATER LEAD-IN)-VAR1\CASE186560PW-D-18.21.DWG

DESIGNED: T.R *DRAFTED:* G.S *VERIFIED:* T.R *REVIEWED:* S.G *APPROVED:* G.F *ISSUED:* 11/12/2024



INTEGRAL STOP VALVE INSTALLATION FOR DN500/DN450/DN375 MAINS

1:10



ACCESS COVER FROM CIVIL CAST OR APPROVED EQUIVALENT

1:10

NOTES:

1. METAL ACCESS COVER TO BE TWO PART WITH 1X225mm CLEAR OPENING.
2. ACCESS COVER TO AS3996
3. DN375 STOP VALVE DOES NOT REQUIRE INTEGRAL BYPASS

No.	AMENDMENT DESCRIPTION	BY	DATE
11	VARIATION 1 – SWC COMMENT ADDRESSED	A.Y	11/12/24
10	VARIATION 1 – PIPE MATERIAL AMMENDED TO PE	G.S	01/11/24
09	SWC COMMENTS INCORPORATED	D.T	01/10/24
08	SWC COMMENTS INCORPORATED	G.S	28/08/24
07	SWC COMMENTS INCORPORATED & PW ALIGNMENT AMENDED SEE SHEETS 9,10,11 & SHEET 17	G.S	05/07/24
06	HOWES CREEK CROSSING AMENDED AND BORE LOGS ADDED. SEE SHEETS 8, 9, 10 & 13	G.S	29/05/24
05	SWC COMMENTS INCORPORATED	G.S	22/05/24
04	SWC COMMENTS INCORPORATED	G.S	26/03/24
03	NETWORK COMMENTS INCORPORATED	G.S	07/12/23
02	SYDNEY WATER RESUB. – PRV ADDED CH257.20 & PIPE SIZES AMENDED	G.S	17/11/23
01	ISSUED TO SYDNEY WATER	G.S	14/04/23

0 0.2 0.4 0.6 0.8 1.0 METRES

SCALE 1:10

WORK AS CONSTRUCTED CERTIFICATION	SYDNEY WATER CORPORATION
DEVELOPER	Sydney WATER
W.S.C.	CASE186560PW | SHT 19 OF 21 SHTS.
CONSTRUCTOR	
COMPLETED	SYDNEY WATER CORPORATION
W.A.C. PREPARED	FOR DETAILS OF SERVICES SEE SHEET 1
DESIGNER	
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS	

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SHEET 19 OF 21 SHEETS

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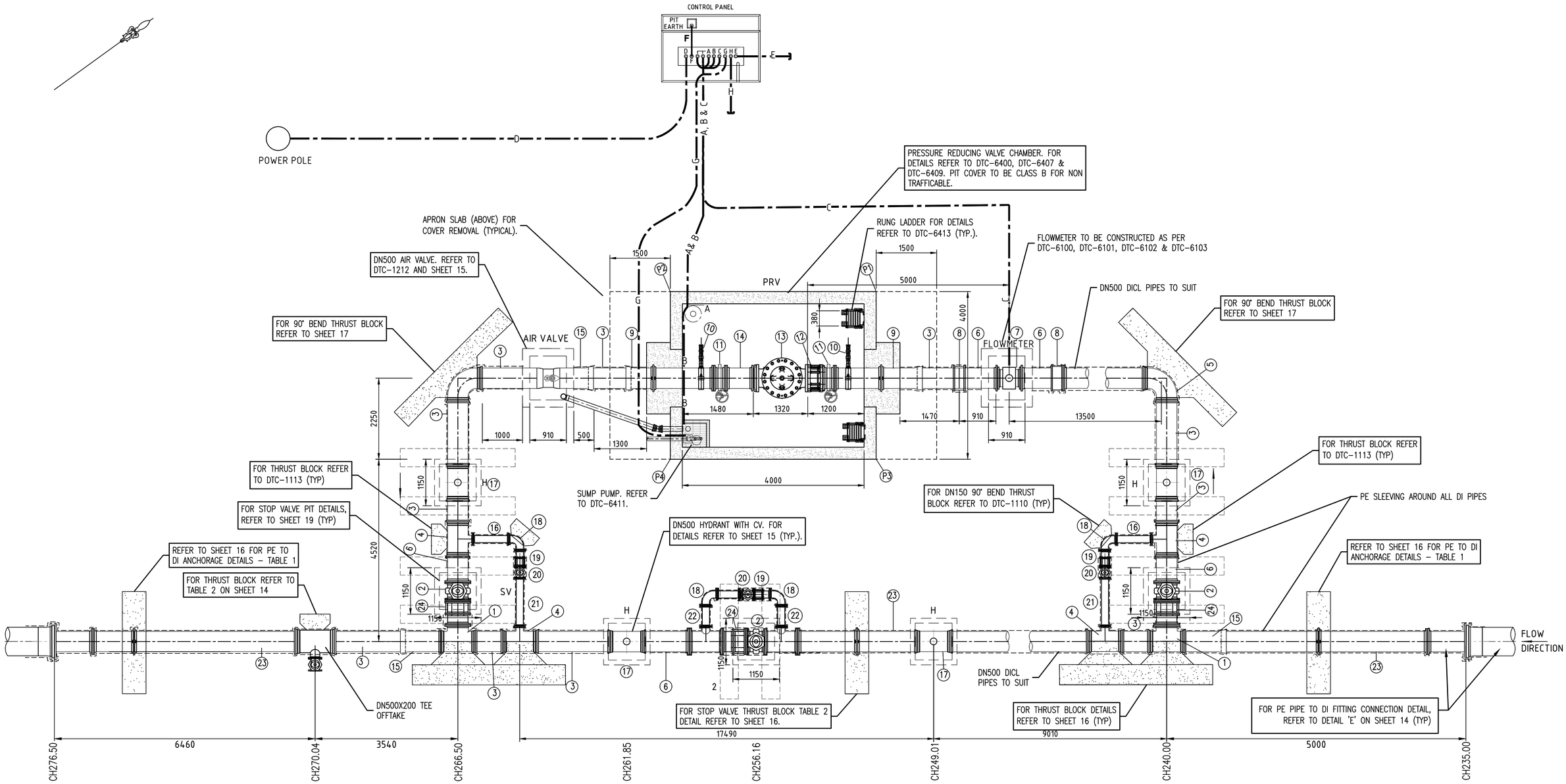

PRESSURE REDUCING VALVE INSTALLATION

1:50

NOTES:

1. ALL ELECTRICAL COMPONENTS MUST MEET THE REQUIREMENT OF SYDNEY WATER TECHNICAL SPECIFICATION – ELECTRICAL.
2. INSTALL A WARNING LABEL STATING "SUMP PUMP TO BE SINGLE PHASE 240V, NO GREATER THAN 250 WATTS" NEAR THE GENERAL POWER OUTLET IN THE CONTROL PANEL.
3. TEMPORARY ELECTRICAL POWER TO BE ARRANGED BY CONTRACTOR. ALL REQUIRED CONDUIT POWER TO BE INSTALLED BY LICENSED ELECTRICAL.
4. PERMANENT ELECTRICAL POWER WILL BE PROVIDED IN THE FUTURE AT THE TIME OF SUBDIVISION WORK.
5. SURVEY MARK AND ASSET LABEL PLATE TO BE FIXED TO VALVE CHAMBER AS PER DTC-6409

PRV PIT SET OUT POINTS		
POINT	EASTING	NORTHING
P1	293443.544	6226018.103
P2	293440.035	6226014.393
P3	293446.565	6226011.535
P4	293443.056	6226015.245

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01	ISSUED TO SYDNEY WATER	G.S	14/04/23

0 1 2 3 4 5 METRES

SCALE 1:50

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....

DESIGNER .....
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SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 20 OF 21 SHTS.

SYDNEY WATER CORPORATION

FOR DETAILS OF SERVICES SEE SHEET 1

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A1F

DEVELOPER CONTRACT PLAN
MINE SUBSIDENCE DISTRICT

PIPE AND FITTING SCHEDULE

NO.	DESCRIPTION	QUANTITY	LENGTH	MATERIAL	PN RATING	FLANGE REQUIREMENTS	PRODUCT SPECIFICATION AND NOTES
1	DN500X500 SO-SOxFL TEE	2	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 201
2	DN500 FL-FL RESILIENT SEATED GATE VALVE	3	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 260
3	DN500 SP-SP SPOOL PIPE	11	TO SUIT	DI	PN35	–	WSA PS – 200
4	DN500X150 SO-SOxFL TEE	4	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 201
5	DN500 90° BEND	2	–	DI	PN35	–	WSA PS – 201
6	DN500 PIPE FL-SP	5	TO SUIT	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 200
7	DN500 FL-FL FLOW METER	1	–	DI	PN16	AS/NZS 4087 FIG B5	SIEMENS FLOWMETER OR ABB FLOW METER
8	DN500 GIBAULT	2	–	DI	PN16	–	WSA PS – 201
9	DN500 FL-SO PIPE WITH PUDDLE FLANGE MACHINED ONTO DICL PIPE.	3	2160	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 200
10	PRESSURE TAPPING	2	–	–	–	–	REFER TO DTC-6408
11	DN500 BUTTERFLY STOP VALVE	2	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 263
12	DN500 FL-FL DISMANTLING JOINT – THRUST TYPE	1	–	SS 316	PN16	AS/NZS 4087 FIG B5	WSA PS – 201
13	DN500 PRESSURE REDUCING VALVE	1	1320	DI	PN16	AS/NZS 4087 FIG B5	SINGER – MODEL – S106
14	DN500 FL-FL SPOOL PIPE	1		DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 200
15	DN500 SO-SP SPOOL PIPE	3		DI	PN35		WSA PS – 200
16	DN150 FL-FL SPOOL PIPE	2	1000	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 200
17	DN500x80 HYDRANT TEE	4	–	DI	PN16	–	WSA PS – 267
18	DN150 FL-FL 90 DEGREE BEND	4	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 201
19	DN150 FL-FL DISMANTLING JOINT – THRUST TYPE	3	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 201
20	DN150 FL-FL GATE VALVE RESILIENT SEATED	3	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 260
21	DN150 FL-FL SPOOL PIPE	2	1194	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 200
22	DN150 FL-FL SPOOL PIPE	2	1000	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 200
23	DN500 FL-SP PIPE WITH PUDDLE FLANGE MACHINED ONTO DICL PIPE.	3	TO SUIT	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 200
24	DISMANTLING JOINT THRUST TYPE	3	–	DI	PN16	AS/NZS 4087 FIG B5	WSA PS – 201

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0 0.4 0.8 1.2 1.6 2.0 METRES
SCALE 1:20

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....

DESIGNER .....
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

SYDNEY WATER CORPORATION

Sydney WATER

CASE186560PW | SHT 21 OF 21 SHTS.

SYDNEY WATER CORPORATION
FOR DETAILS OF SERVICES SEE SHEET 1

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Appendix D Community notification letter

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Endeavour Energy
ABN 11 247 365 823
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 E Biodiversity Assessment Report (BAR)

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Biodiversity Assessment Report

Menangle Park Zone Substation

Prepared by: Jack Tatler
Report date: August 2025



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
Final v1.0	Jade Minto	Jack Tatler (BAAS21006)	30 April 2025
Final v2.0	Jade Minto	Jack Tatler (BAAS21006)	5 May 2025
Final v3.0	Ethan Dean	Jack Tatler (BAAS21006)	3 June 2025
Final v4.0	Jack Tatler (BAAS21006)	-	20 August 2025

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)*
Jade Minto	-	Ecologist	Report updates	*BBioCon*
Ethan Dean	-	Ecologist	Field survey, report updates	*BBioCon*

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.

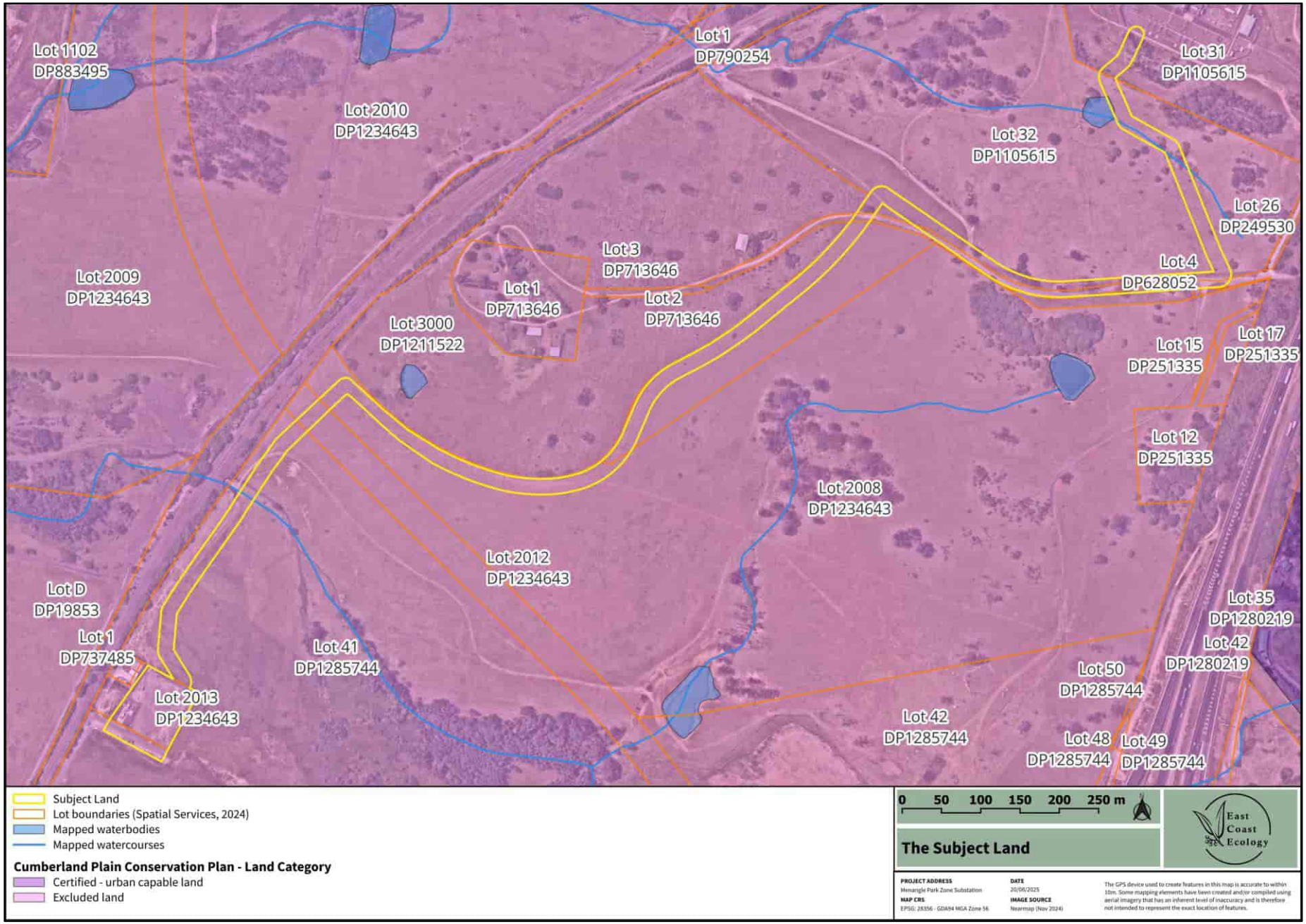


Figure 1. The location of the Subject Land.

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.

Six (6) priority weeds for the South East region (DPI, 2025) were identified within the Subject Land:

- *Asparagus asparagoides* (Bridal Creeper)
- *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. Part of the Subject Land was 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.

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 and the 30th of May 2025 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 068257) 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

Table 2. Weather conditions taken from the nearest weather stations (station 068257) in the lead up and during the field survey (BOM, 2025).

Timing/activities	Date	Day	Temperature		Rainfall (mm)
			Min	Max	
Lead up to the survey	23/05/2025	Friday	16.1	20.1	72.8
	24/05/2025	Saturday	8.0	20.9	9.8
	25/05/2025	Sunday	7.3	18.1	0

Timing/activities	Date	Day	Temperature Min	Temperature Max	Rainfall (mm)
	26/05/2025	Monday	5.2	18.3	0
	27/05/2025	Tuesday	11.4	17.7	12.0
	28/05/2025	Wednesday	6.7	19.3	0
	29/05/2025	Thursday	7.5	18.5	0
Additional vegetation mapping, flora survey and fauna habitat survey	30/05/2025	Friday	4.8	20.8	0

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.

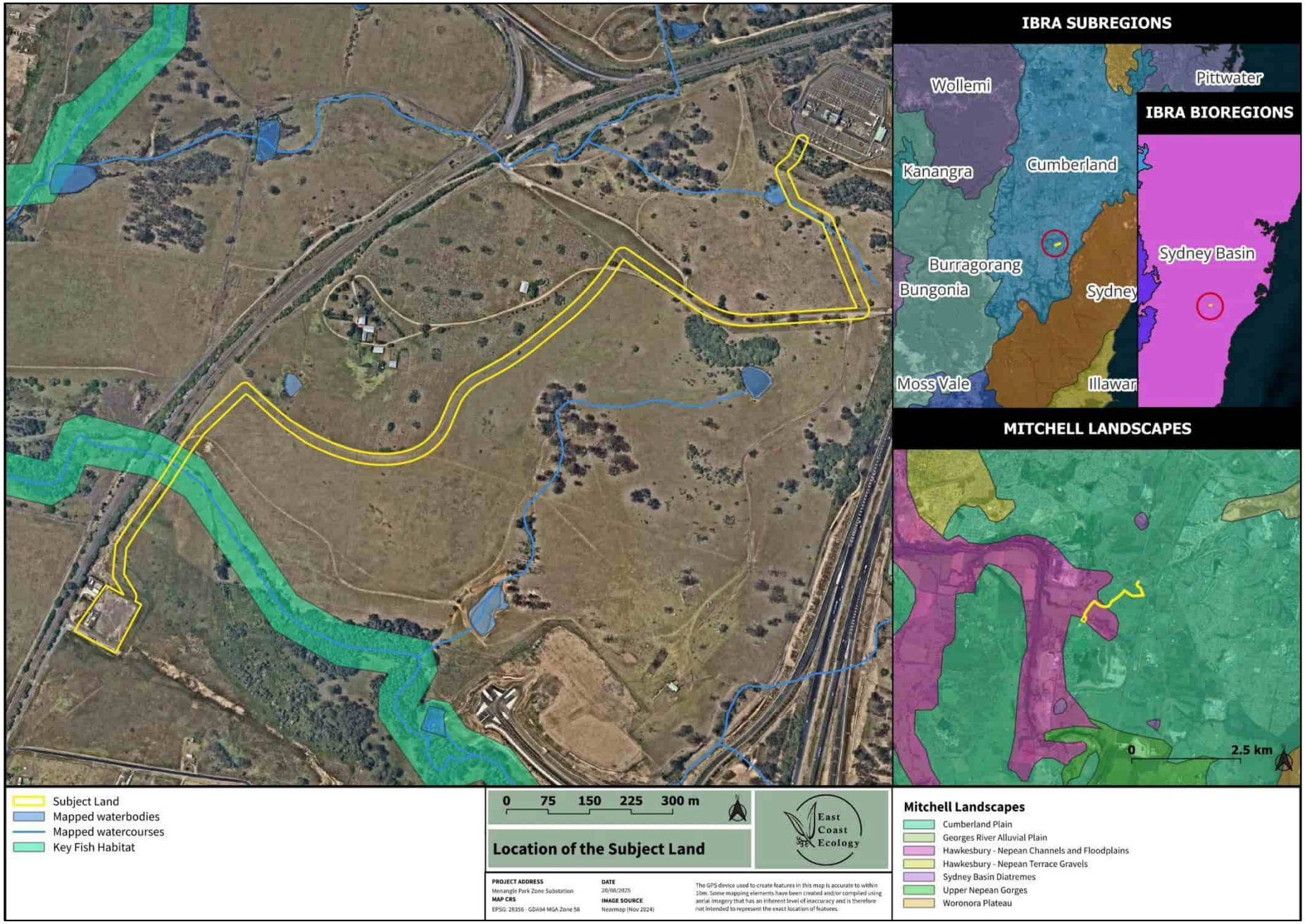


Figure 2. The location of Subject Land within the broader context.

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 3**. Native vegetation assigned to PCT 3320 was stratified into two vegetation zones based on varying condition classes:

- Vegetation zone 1: PCT 3320 (canopy)
- Vegetation zone 2: PCT 3320 (poor condition grassland), and
- Vegetation zone 3: PCT 3320 (degraded).

The vegetation zones within the Subject Land are detailed in **Table 4** - **Table 6** and displayed in **Figure 4**. Vegetation zone 2 was in very poor condition but owing to scattered native groundcover species the precautionary principle was applied and it was classified as PCT 3320.

Table 3. Vegetation identified within the Subject Land.

PCT ID	PCT Scientific Name	Area within the Subject Land	
		Feeder Route	Zone Substation
3320	Cumberland Shale Plains Woodland	4.07ha	0ha
	Total Area	**4.07ha**	

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.

4.1.3 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.

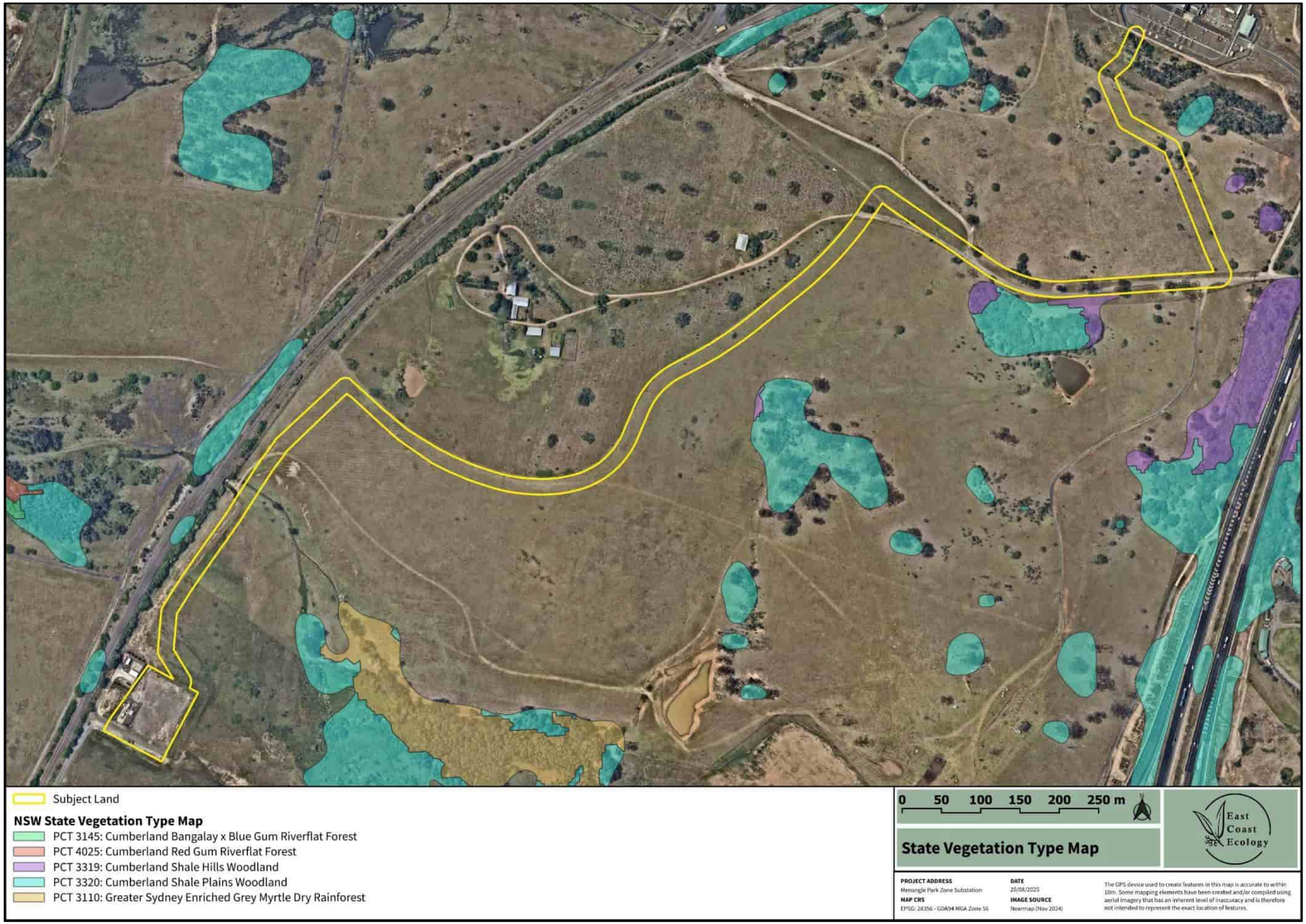


Figure 3. Vegetation communities surrounding the Subject Land.

Table 4. 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)	**Feeder Route**	**Zone Substation**
	0.16ha	0ha
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 *E. 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.		
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 5. 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)	**Feeder Route**	**Zone Substation**
	3.87ha	0ha
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.		
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**)	

Table 6. Description of vegetation zone 3: PCT 3320 (degraded) within the Subject Land.

PCT 3320: Cumberland Shale Plains Woodland (vegetation zone 3)		
		
Vegetation Formation	Grassy woodlands	
Extent within Subject Land (approximate)	**Feeder Route**	**Zone Substation**
	0.05ha	0ha
Description of vegetation zone 3: PCT 3320 (canopy) within the Subject Land		
The vegetation within vegetation zone 3 was in a degraded condition although native species were identified within each stratum. This vegetation zone was characterised by a canopy of *Eucalyptus crebra* and *Acacia implexa* dominating the mid-storey and entering the canopy in some cases. Other native species included *Indigofera australis*, *Acacia falcata*, *Clematis glycinoides*, *Imperata cylindrica*, *Lomandra longifolia* and *Dichondra repens*. A high cover of *Olea europaea* subsp. *cuspidata* is responsible for the degraded condition of this vegetation zone, as well as *Araujia sericifera* and *Asparagus asparagoides*.		
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**)	

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. Vegetation zone 3 consisted of characteristic canopy, shrub and ground cover species detailed in the Final Determination.

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. Although a higher diversity of native species was recorded in vegetation zone 3, the patch is fragmented by easements, hardstand, roads and rail lines and is unlikely to be >5ha. Moreover, no large or hollow-bearing trees were identified within or immediately surrounding the Subject Land. The mid-storey and ground layer had a high cover of weeds although some patches that were not shaded by African Olive were dominated by a low diversity of native species. Given the small size, and degraded and fragmented state of vegetation zone 3, it was not determined to form part of the EPBC Act listed community.

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.

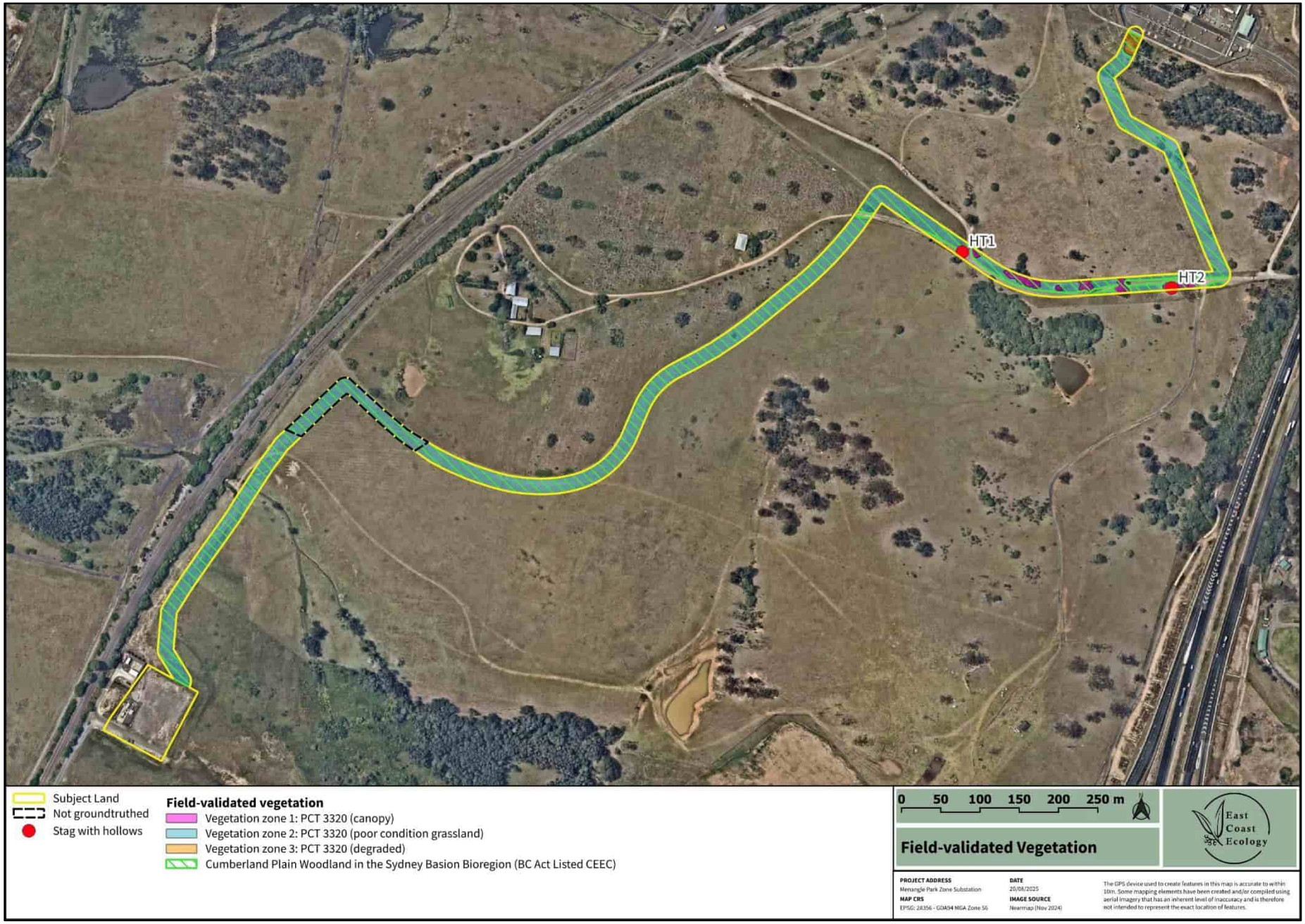


Figure 4. Field-validated vegetation communities.

5. RESULTS: THREATENED SPECIES

5.1 Threatened Flora

Database searches revealed 10 threatened flora have been recorded within a ~5km radius of the Subject Land (**Table 7**).

Table 7. 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
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 8**).

Table 8. 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	-	V	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 9**.

5.2.1 Threatened Fauna Habitat

Details of the threatened fauna habitat recorded within the Subject Land are included in **Table 9**. 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. These watercourses were chocked with exotic vegetation however some native ground covers were scattered throughout (**Photo 1**). These watercourses are unlikely to provide habitat for threatened fauna species owing to the 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 9. 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.
Soft-fruit-bearing trees/shrubs	Present. African Olive and Blackberry
Dense shrubbery and leaf litter	Absent.

Habitat component	Subject Land
Tree hollows	Present – 2 stags with 1 x small (HT1), 3 x medium, 1 x large and 1 x extra large (HT1) 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 10**). These species do not breed in Australia.

Table 10. 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.

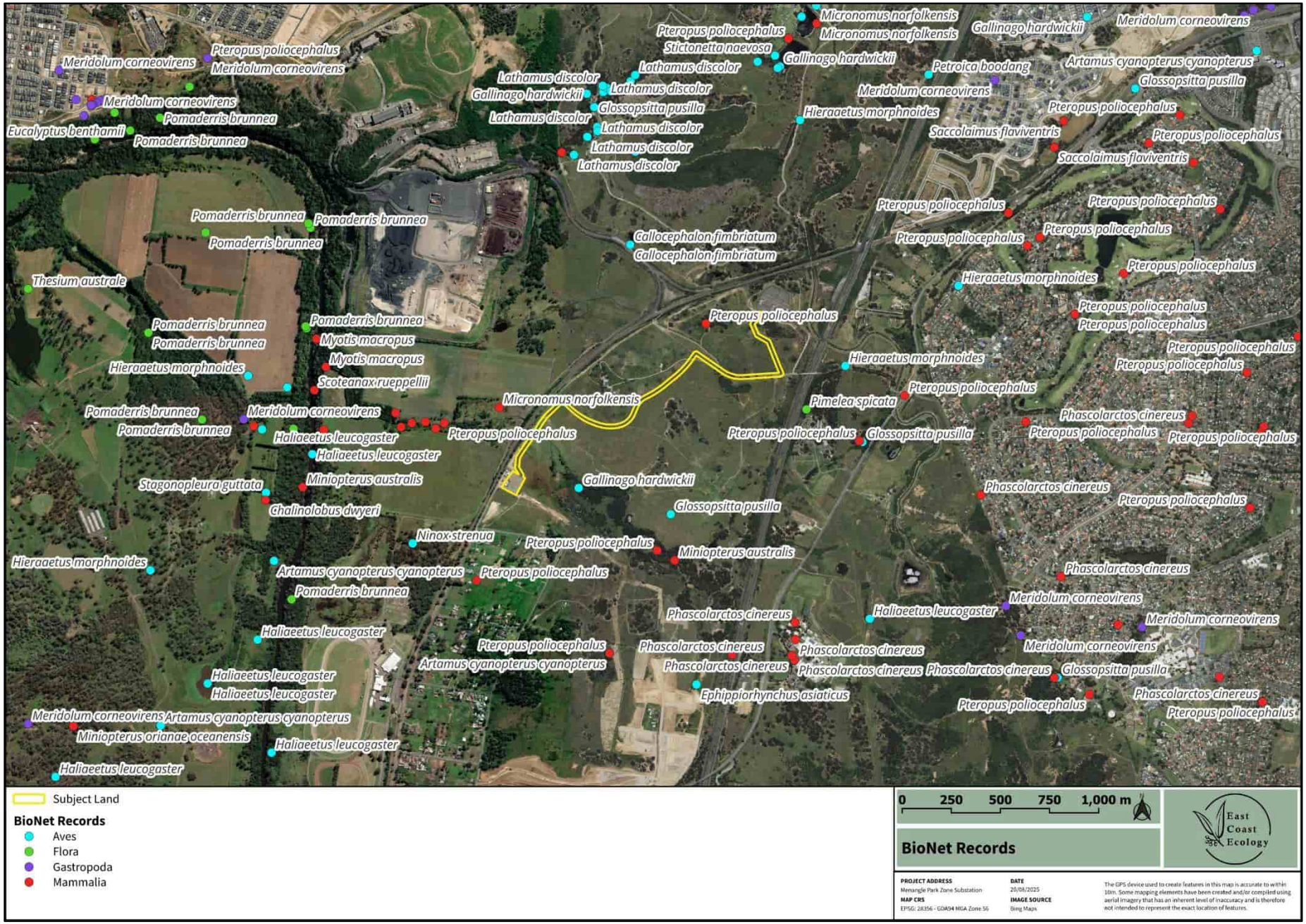


Figure 5. Threatened species records (historical) within proximity to the Subject Land.

6. IMPACT SUMMARY

6.1 Impacts to Plant Community Types

The primary direct ecological impact of the activity is clearing of native vegetation. Up to 4.07ha of PCT 3320: Cumberland Shale Plains Woodland will be impacted by the proposed activity, this is a conservative estimate assuming complete disturbance within the Subject Land. PCT 3320 will be removed during trenching along the Feeder route and may be impacted by machinery traversing through the Subject Land. 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 could result in impacts to up to 4.07ha of the BC Act listed community along the Feeder route. 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 predominantly 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 up to 4.07ha of degraded understorey vegetation along the Feeder route 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 11**.

Table 11. 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

Potential Indirect Impact	Nature, extent and duration
	activity. The site assessment recorded environmental and priority weeds both within and adjacent to the Subject Land.
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 some 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.

Potential Indirect Impact	Nature, extent and duration
Trampling of threatened flora species	No impacts are expected to occur outside of the Subject Land.
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.

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. Hollow-bearing tree 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 12**.

Table 12. 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	Seek approval before removing any vegetation (except for safety clearances of electrical assets as defined in MMI 0013) (EE, 2024)..	Prior to construction	Endeavour Energy/ Contractor
B02		Check the work package documents for any identified significant trees and approval documentation if removal of vegetation is required. Significant trees are protected under local government legislation or on a Significant Tree Register (EE, 2024).	Prior to construction	Endeavour Energy/ Contractor
B03		Field surveys to be conducted over the area not ground-truthed 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
B04		Pre-clearing surveys and final pre-clearing checks will be undertaken to avoid impacting protected fauna.	Prior to construction	Endeavour Energy/ Contractor
B05		Follow the environmental assessment process and seek approval before removing vegetation unless the removal is for safety clearances of electrical assets as defined in MMI 0013 (EE, 2024).	Prior to construction	Endeavour Energy/ Contractor
B06		Engage qualified personnel (e.g. arborists) to carry out vegetation works in accordance with the relevant standards, including pruning in accordance with AS 4373 (EE, 2024).	Prior to construction	Endeavour Energy/ Contractor

ID	Impact	Mitigation measure	Timing and duration	Responsibility
B07		Manage the generation of mulch in accordance with EMS 0004– Managing Vegetation Near Electrical Infrastructure and Pest, Weed and Disease Mitigation. This includes not applying mulch to environmentally sensitive areas if it has been generated outside of these areas (EE, 2024).	During construction	Endeavour Energy/ Contractor
B08		Install protection methods around significant trees and vegetation that could be damaged on your work site including barrier fencing (EE, 2024).	During construction	Endeavour Energy/ Contractor
B09		Minimise disturbance to the roots in the Tree Protection Zone. If damage to the tree's root system is unavoidable, contact your Environmental Representative or seek an arborist assessment before starting the works (EE, 2024).	During construction	Endeavour Energy/ Contractor
B10		Avoid disturbing previously undisturbed areas by using established access tracks to the worksite (EE, 2024).	During construction	Endeavour Energy/ Contractor
B11		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.	During construction	Endeavour Energy/ Contractor

ID	Impact	Mitigation measure	Timing and duration	Responsibility
		▪ Protocols to manage weeds, pathogens and pest species		
B12	Direct impacts to threatened species	Avoid disturbing habitat such as hollow bearing trees, intact vegetation and drainage lines (EE, 2024).	Detailed design	Endeavour Energy/ Contractor
B13		Adhere to controls provided by land managers (e.g. NPWS) and employ measures to protect existing vegetation and threatened plant species e.g. use existing access tracks, minimise clearing and disturbance, barricade protected vegetation, clearly designate areas for storage (EE, 2024).	During construction	Endeavour Energy/ Contractor
B14	Invasion and spread of pests, weeds and diseases	Pests, weeds and diseases will be managed in accordance with the Hygiene Protocol for Mitigating the Spread of Pests, Noxious Weeds and Diseases in company standard EMS0004- Managing Vegetation Near Electrical Infrastructure and Pest, Weed and Disease Mitigation (EE, 2024).	During construction	Endeavour Energy/ Contractor

8. CONCLUSION

The proposed activity may impact up to 4.07ha of heavily modified PCT 3320: Cumberland Shale Plains Woodland associated with BC Act listed EEC, Cumberland Plain Woodland in the Sydney Basin Bioregion along the Feeder route. No native vegetation or habitat will be impacted within the Zone Substation. The removal of native trees and hollow-bearing stags will be avoided, wherever possible. No threatened species were considered likely to occur within the Subject Land 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

Australian Standard 4970 (2009) Protection of Trees on Development Sites

Biodiversity Conservation Regulation (2017)
https://www.legislation.nsw.gov.au/#/view/regulation/2017/432

Bureau of Meteorology (BOM) Daily Weather Observations. Available from: www.bom.gov.au.

Bureau of Meteorology (BOM) (2024) Groundwater Dependent Ecosystem GDE Atlas Home: Water Information

Commonwealth of Australia (2013a) Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (awe.gov.au) Environment Protection and Biodiversity Conservation Act 1999.

Department of Climate Change Energy the Environment and Water (DCCEEW) (2025) Protected Matters Search Tool.

Department of Environmental Conservation (DEC) (2004) Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft), New South Wales Department of Environment and Conservation, Hurstville, NSW.

Department of the Environment and Energy (2018) Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Subregions)

Department of Planning and Environment (DPIE) (2020a) Biodiversity Assessment Method

Department of Planning and Environment (DPIE) (2020b) Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method

Department of Primary Industries (DPI) (2013) Policy and guidelines for fish habitat conservation and management.

Department of Primary Industries (DPI) (2016) Fish Communities and Threatened Species Distributions of NSW

Department of Primary Industries (DPI) (2024a) Freshwater Threatened Species Distributions Maps

Department of Primary Industries (DPI) (2024b) Key Fish Habitat Maps – Hawkesbury-Nepean

Department of Primary Industries (DPI) (2024) Priority weeds for Greater Sydney
https://weeds.dpi.nsw.gov.au/WeedBiosecurities?AreaId=3

Endeavour Energy (2024) Environmental Guidelines Handbook

Landcom (2004) Managing Urban Stormwater: Soils and Construction 'The Blue Book', Volume 1, Fourth Edition, New South Wales Government, ISBN 0-9752030-3-7

Mitchell (2002) NSW Ecosystems Study: Background and Methodology (Unpublished)

NSW Department of Climate Change Energy the Environment and Water (NSW DCCEEW) (2024a) BioNet. The website of the Atlas of NSW Wildlife http://www.bionet.nsw.gov.au/

NSW Department of Climate Change Energy the Environment and Water (NSW DCCEEW) (2024b) BioNet. Threatened Biodiversity Data Collection

NSW Department of Climate Change Energy the Environment and Water (NSW DCCEEW) (2024c) BioNet. Vegetation Classification System

NSW Department of Climate Change Energy the Environment and Water (NSW DCCEEW) (2024d) NSW State Vegetation Type Map https://datasets.seed.nsw.gov.au/dataset/nsw-state-vegetation-type-map

NSW Department of Climate Change Energy the Environment and Water (NSW DCCEEW) (2024e) Soil Landscapes http://espade.environment.nsw.gov.au

NSW Government (2017) NSW Legislation: Biodiversity Conservation act 2016 No 63, Schedule 4: Key Threatening Processes https://www.legislation.nsw.gov.au/acts/2016-63.pdf

NSW Scientific Committee (2009) Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing – final determination

PlantNET (2023) The NSW Plant Information Network System, Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au

Threatened Species Scientific Committee (2009). Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. Department of the Environment, Water, Heritage and the Arts. Canberra, ACT: Department of the Environment, Water, Heritage and the Arts.

Transport for NSW (Transport) (2024a), Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects. Available at: Biodiversity Management Guideline (nsw.gov.au)

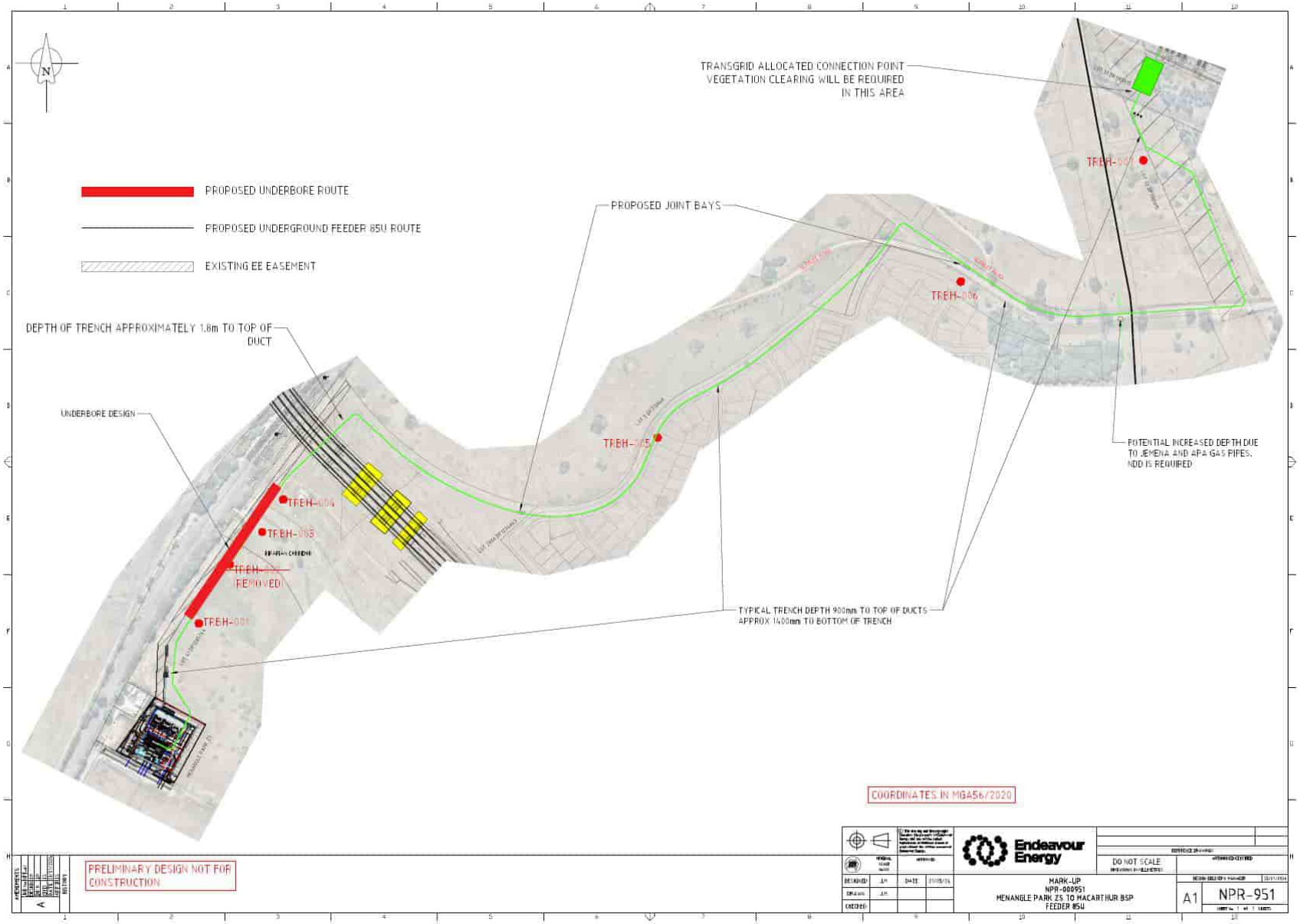
APPENDICES

Appendix A. Menangle Park Zone Substation Preliminary Design (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.

Appendix A. Menangle Park Zone Substation Preliminary Design (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.
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.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
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 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.	854	Low. Habitat for this species is substantially degraded and it was not detected during the field survey.
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	36	Low. Habitat for this species is substantially degraded and it was not detected during the field survey.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			area. It also occurs at Walcha on the New England Tableland and in far eastern Gippsland in Victoria.		
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 woodland on shale-sandstone transition soils or shale soils.	34	Low. Habitat for this species is substantially degraded and the nearest record is >4km from the Subject Land.
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.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
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.
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	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.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			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.		
Calidris canutus	-	V	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 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	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			
			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.
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	1	Low. There is no potential 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			
			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 .		
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 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.	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.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
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 Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	50	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records on BioNet.
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	1	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			
			heath and inland riparian forest, from the sub-alpine zone to the coastline.		
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 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.	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.
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	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.,

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			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.		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.
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.,

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
					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.
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.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
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.
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	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.,

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			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.		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 of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	15	Low. There is no suitable habitat for this species within the Subject Land.
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,	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.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
			from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.		
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 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.	12	Low. There is no suitable habitat for this species within the Subject Land.
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	1	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			
			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.		
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.
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. Native tree removal will be avoided where possible.
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.	1	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			
			Has a strong preference for shale-influenced transitional landscapes and has not been confirmed outside such habitats.		
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 very wide range, with and without trees; appears to defend an aerial territory.	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.
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.

Scientific name	Status		Distribution and habitat	Number of records (BioNet)	Likelihood of occurrence
	BC Act	EPBC Act			
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 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.	2	Low. There is no suitable habitat for this species within the Subject Land and there are no nearby records in BioNet.

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 4.07ha 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 4.07ha 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. Native tree removal will be avoided where possible. 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 F Geotechnical Investigation (Alliance, 2024)

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Geotechnical Investigation Report

Project

NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 85U
Glenlee Road, Menangle Park NSW

Prepared for

Endeavour Energy

Date

4 November 2024

Report No

18255-GR-1-1



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1 INTRODUCTION

This report presents the findings of a geotechnical investigation carried out by Alliance Geotechnical Pty Ltd (Alliance) for Endeavour Energy Pty Ltd (the Client) for the proposed Menangle Park ZS to Macarthur BSP Feeder 85U at Glenlee Road, Menangle Park NSW (the Site). The investigation was carried out in general accordance with Estimate No. 18255-10772, dated 15 August 2024.

The objectives of the geotechnical investigation were to assess the surface and subsurface conditions and provide a geotechnical investigation report with comments and recommendations with the following:

- Existing geotechnical subsurface and groundwater conditions.
- Thermal Resistivity test results.
- Geotechnical design parameters of encountered site soils for retention design.
- Excavation conditions and methodologies
- Temporary batter slopes and retention structures

The investigation comprised the drilling of six boreholes, in-situ testing with the Dynamic Cone Penetrometer (DCP) and Perth Sand Penetrometer (PSP) adjacent to the borehole locations, and sampling of site soils for Thermal Resistivity (TR) testing, followed by engineering analysis and reporting. Details of the field investigation are presented in this report, together with comments and recommendations for the proposed development.

2 PROPOSED WORKS

Alliance received a request for quotation (RFQ) from Jarrod Marshall on 25 July 2024. The RFQ included a concept plan of the alignment along with a brief geotechnical and environmental scope.

Based on the provided documents and further communications with the client, it is understood that the client is proposing to install a cable system from Menangle Park ZS to Macarthur BSP Feeder 85U, with an overall alignment of approximately 2km long. The majority of the alignment is to be installed by conventional trenching methods at approximately 1.2m depth, with the exception of a proposed under bored section required to cross below an unnamed tributary of the Nepean River that passes through the south-western portion of the site at nominally 2.5m depth.

The geotechnical investigation was requested by Endeavour Energy to characterise the site's surface and subsurface conditions, and to obtain Thermal Resistivity (TR) test data of site soils at proposed cable depths.

3 ALIGNMENT LOCATION DESCRIPTION & REGIONAL GEOLOGY

3.1 Alignment Location Description

The proposed feeder alignment starts at Menangle Park ZS, generally following an upward slope in the northeast direction towards the Macarthur BSP and crossing five lots. The project site is situated in undulating, hilly terrain, with an elevation difference of approximately 45 metres between the two substations.

From Menangle Park ZS, the feeder alignment begins in Lot 41 DP 1285744 and runs parallel to the adjacent train tracks to the west, crosses a local creek connected to the Nepean River, and then continues along local grass tracks, following the hill's contour. The alignment then enters Lot 2008 DP 1234643 and Lot 32 DP 1105615, following the fence line boundary with Lot 3 DP 713646 until it intersects with and runs along Glenlee Road. At the intersection with the access gate to Lot 2008 DP 1234643, the alignment shifts into Lot 32 DP 1105615 towards a downhill slope to terminate at Macarthur BSP.

The approximate site location with approximate alignment is shown in Figure 1. Selected site photographs are presented in Appendix A.

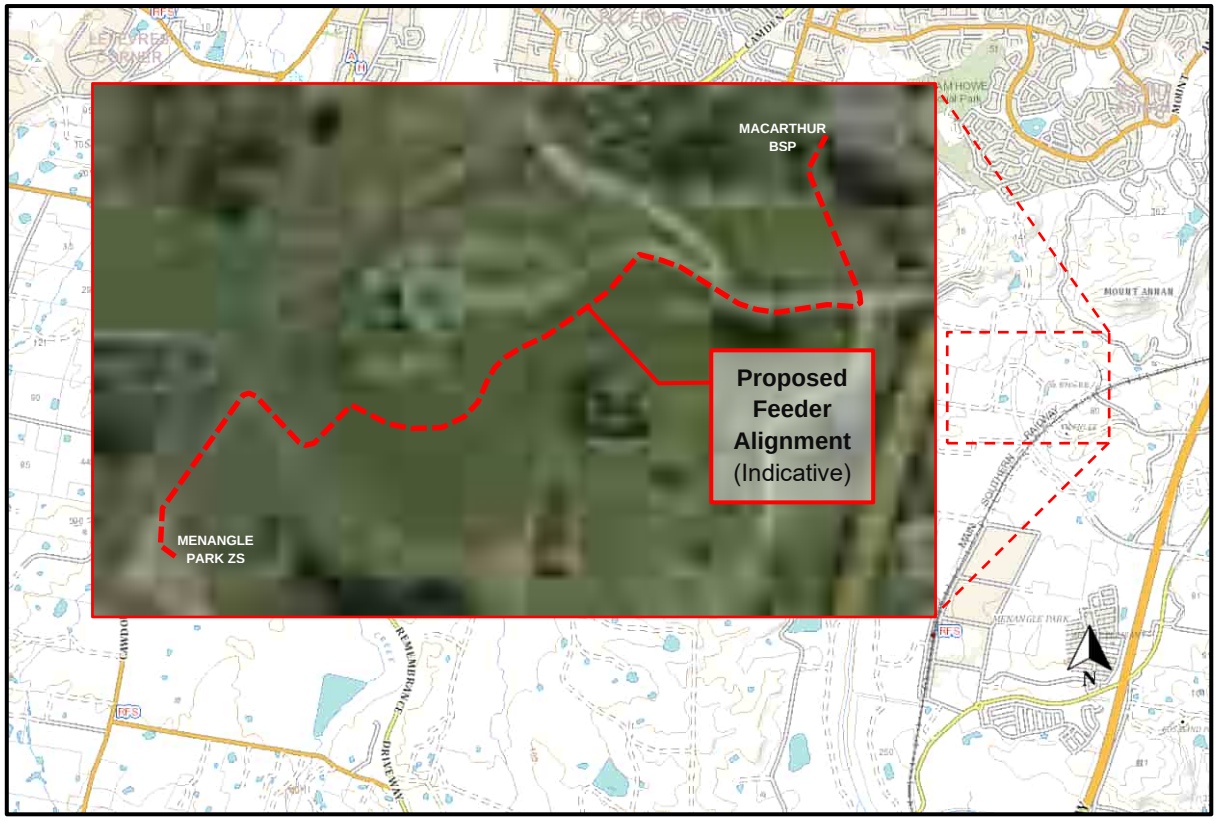


Figure 1 – Site Location & Aerial Image (extracted from MinView)

3.2 Regional Geology

The New South Wales Seamless Geology dataset, version 2.4 [Digital Dataset], published by the Geological Survey of New South Wales, indicates that the site is predominantly underlain by Bringelly Shale, consisting of *shale, carbonaceous claystone, laminite, lithic sandstone, and rare coal*. Alluvium, comprising *unconsolidated grey to brown to beige humic (±)micaceous silty clay, quartz-(±)lithic silt, fine- to medium-grained quartz-rich to quartz-lithic sand, and polymictic pebble to cobble gravel (as sporadic lenses)* is

indicated in the southwest corner of the alignment, associated with the creek that passes through that part of the site.

The findings of this investigation are consistent with the above geological setting and assumptions. The indicative location of the proposed alignment overlaying NSW Seamless Geology map with 10m contours are presented in Figure 2 below.

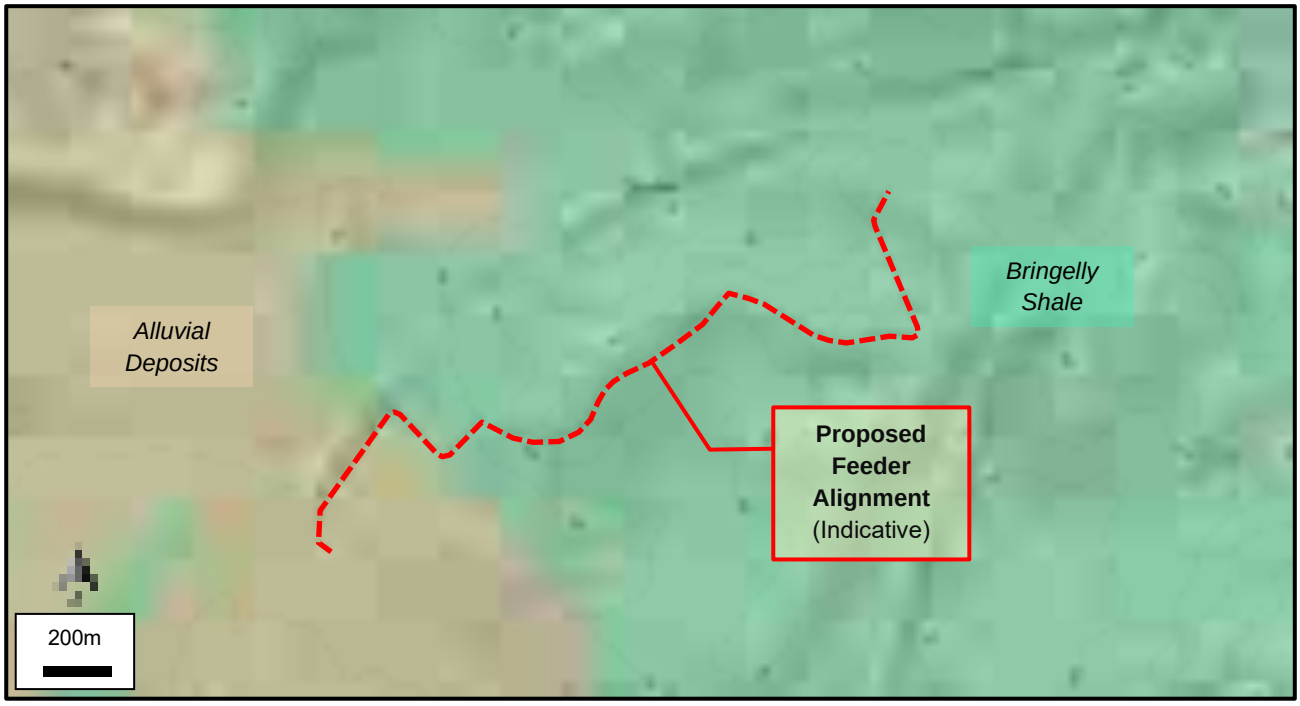


Figure 2 - Site Location with NSW Seamless Geology and 10m Contours.

4 FIELDWORK

4.1 Methods

The geotechnical investigation was undertaken by Alliance on the 19th and 24th of September 2024. Preliminary borehole locations were provided by the client, which were then checked against available Before You Dig Australia (BYDA) plans and cleared by a subcontracted service locator of underground and overhead services prior to drilling.

- An initial site walkover was carried out by an Experienced Geotechnical Engineer from Alliance to assess site access and confirm service clearances.
- Six (6) boreholes were drilled using Alliance's ute-mounted drilling rig.
- Boreholes were advanced through the soil profile using 110mm diameter solid flight augers fitted with a tungsten carbide (TC) bit to target depths or prior refusal on bedrock.
    - Boreholes TRBH-001 and TRBH-005-007 had a target depth of 2m below ground level (BGL), and boreholes TRBH-003-004 had a target depth of 5m BGL. TRBH-006 was terminated upon refusal at 1.3m BGL.
    - Borehole TRBH-002 was omitted from the investigation scope by the client.
    - Standard Penetrometer tests were conducted initially at 1.0-1.5m depth, then at nominally 1.5m intervals.

  - Dynamic Cone Penetrometer (DCP) and Perth Sand Penetrometer (PSP) tests were undertaken adjacent to borehole locations to determine the near-surface soil consistency / relative density.
  - Undisturbed samples were collected at cable depths for Thermal Resistivity (TR) testing except in TRBH-006 where undisturbed sampling was not possible, hence a bulk sample was retrieved.
  - On completion, the boreholes were backfilled with drilling spoil and made flush with the surrounding surface.
- Borehole drilling was supervised by a geotechnical engineer from Alliance, and the encountered soil profiles were documented in accordance with AS1726-2017 *Geotechnical Site Investigations.*
- Selected site photographs taken during the fieldwork are presented in Appendix A.

4.2 Borehole Details

A summary of the geotechnical investigation depths, surveyed borehole coordinates, and reduced levels (RL) are presented in Table 1 below. The coordinates are based on the GDA2020 coordinate system. Surveyed coordinates were found using a GNSS Trimble Rover with an estimated horizontal accuracy of 0.01m and estimated vertical accuracy of 0.02m.

Table 1 - Summary of Surveyed Investigation Locations

ID	Easting	Northing	Surface RL m AHD	Termination Depth m BGL
TRBH-001	292624.37	6225374.95	70.86	3.0
TRBH-003	292704.46	6225494.72	71.51	5.0
TRBH-004	292731.25	6225525.44	71.11	5.0
TRBH-005	293192.35	6225602.64	101.79	2.0
TRBH-006	293581.26	6225800.01	105.55	1.3
TRBH-007	293810.07	6225950.33	102.17	2.0

4.3 Subsurface Conditions

Summarised descriptions of the encountered subsurface geotechnical units are provided in Table 2, and a summary of the subsurface material profiles in each borehole are provided in Table 3. Reference to the individual borehole log sheets should be made for a full description of the subsurface conditions encountered at each borehole.

Table 2 - Summary of Subsurface Materials

Geotechnical Unit	Material Description	Apparent Fill Compaction / Soil Consistency/Density / Rock Strength
Unit 1: Topsoil	Variably SAND / CLAY / Silty CLAY, medium grained sands, low to medium plasticity clays, brown, dark brown	-
Unit 2A: Granular Alluvium	SAND / Clayey SAND, medium to coarse grained, brown, grey.	Very Loose to Medium Dense
Unit 2B: Cohesive Alluvium	CLAY / Silty CLAY / Sandy CLAY, medium to high plasticity, fine to medium grained sands, brown, grey.	Soft to Very Stiff
Unit 3: Residual Soil	CLAY / Silty CLAY, variably low to high plasticity, brown, red, grey.	Stiff to Very Stiff
Unit 4: Bedrock	Sandstone, fine grained, grey and red brown, highly weathered.	Inferred Very Low to Low Strength

Table 3 – Summary of Encountered Subsurface Profiles

Geotechnical Unit	Apparent Fill Compaction/ Soil Consistency	Depths encountered (m BGL)					
		TRBH-001	TRBH-003	TRBH-004	TRBH-005	TRBH-006	TRBH-007
Unit 1	-	0.0 – 0.1	0.0 – 0.1	0.0 – 0.1	0.0 – 0.1	0.0 – 0.1	0.0 – 0.1
Unit 2A	Very Loose to Loose	0.1 – 1.1	-	3.8 – 5.0[1]	-	-	-
	Medium Dense	1.1 – 2.6	-	-	-	-	-
Unit 2B	Soft to Firm	-	0.1 – 1.3; 3.8 – 5.0[1]	0.1 – 0.6	-	-	-
	Stiff to Very Stiff	-	1.3 – 3.8	0.6 – 3.8	-	-	-
Unit 3	Stiff to Very Stiff	2.6 – 3.0[1]	-	-	0.1 – 2.0[1]	0.1 – 1.0	0.1 – 2.0[1]
Unit 4	Inferred Very Low to Low Strength	-	-	-	-	1.0 – 1.3[2]	-

Notes:
1: Termination at target depth.
2: TC bit refusal

The approximate borehole locations are indicated on the Geotechnical Investigation Plan (Drawing 18255-GR-1-1-B) in Appendix B.

The borehole logs are provided in Appendix C and should be read in conjunction with the attached Explanatory Notes which explain the terms, abbreviations, and symbols used, together with the interpretation and limitation of the logging procedure.

4.4 Groundwater

Groundwater seepage was encountered during borehole drilling in TRBH-001, TRBH-003 and TRBH-004 where a localised ground water table was encountered. Groundwater was not encountered in the other borehole locations. Groundwater depth observations are summarised in Table 4.

Table 4 – Summary of Observed Groundwater Seepage Levels

Borehole ID	Groundwater Level (m BGL)
TRBH-001	1.0
TRBH-003	1.5
TRBH-004	0.6
TRBH-005	Not encountered
TRBH-006	Not encountered
TRBH-007	Not encountered

It should be noted that groundwater seepage can be dependent and may fluctuate based on seasonal and climatic conditions or relative water levels prevalent in the nearby creeks within and surrounding the vicinity. It should also be noted that groundwater seepage may occur along joints, bedding planes, and soil/rock interface and may vary across the site and its vicinity.

5 LABORATORY TESTING

5.1 Thermal Resistivity (TR) Testing

Thermal Resistivity (TR) Testing was carried out on five undisturbed (U75) soil samples and one remoulded bulk sample, collected from investigation boreholes. The TR tests were carried out in Alliance's NATA-accredited laboratory in accordance with ASTM D5334-22, AG-01 and AS1289.2.1.1.

Thermal resistivity testing was carried out at variable moisture conditions on undisturbed and remoulded samples. Undisturbed sampling was not feasible at BH01 or at 3.0m in BH02 as shallow extremely weathered siltstone bedrock was encountered at the proposed sampling depth. Test results are summarised in Table 5 and laboratory test certificates are presented in Appendix D.

Table 5 – Summary of Thermal Resistivity Test Results

Sample Source (m BGL)	Material	FMC[2] (%)	OMC[3] (%)	Moulded Moisture (%)	Thermal Resistivity (m.K/W) at Target Moisture Contents			
					0% Moisture	3% Moisture	5% Moisture	OMC/ Moulded Moisture
TRBH-001 1.2-1.5	SAND	13	-	11.8	1.19	0.761	0.625	0.418
TRBH-003 3.0-3.3	CLAY	18	-	18.4	1.272	1.169	1.016	0.448
TRBH-004 3.0-3.3	CLAY	28.5	-	29.8	1.47	1.42	1.311	0.675
TRBH-005 1.2-1.5	CLAY	11.1	-	10.8	1.45	1.044	0.903	0.604
TRBH-006 1.0-1.3[1]	SAND[3]	19	20.9	-	1.541	1.385	1.151	0.705
TRBH-007 1.2-1.5	Silty CLAY	18	-	17.6	1.242	0.986	0.901	0.614

Notes:
1: Remoulded sample
2: Field Moisture Content
3: Optimum Moisture Content
4: Sandstone, recovered as sand

6 COMMENTS & RECOMMENDATIONS

6.1 Geotechnical Design Parameters

Based on the subsurface materials encountered and in-situ testing carried out during the investigation, the preliminary geotechnical design parameters are provided in Table 6 below.

Table 6 – Recommended Preliminary Geotechnical Design Parameters

Material	Soil Consistency / Density, Rock Strength	γ [1] (kN/m³)	c_u [2] (kPa)	c' [3] (kPa)	Φ' [4] (degrees)	K_a [5]	K_0 [6]	K_P [7]	E [8] (MPa)	ϑ [9]
Unit 2A: Granular Alluvium	Very Loose	16	0	0	27	0.38	0.55	2.66	5	0.3
	Loose	18	0	0	30	0.33	0.50	3.00	10	0.3
	Medium Dense	19	0	0	32	0.31	0.47	3.25	35	0.3
Unit 2B: Cohesive Alluvium	Soft	16	12	2	22	0.45	0.63	2.20	2.5	0.3
	Firm	17	25	2	24	0.42	0.59	2.37	8	0.3
	Stiff to Very Stiff	18	50	5	26	0.39	0.56	2.56	15	0.3
Unit 3: Residual Soil	Stiff	18	50	5	26	0.39	0.56	2.56	15	0.3
	Very Stiff	19	100	7	28	0.36	0.53	2.77	30	0.3
Unit 4: Bedrock	Inferred Very Low Strength	22	-	50	28	-	-	-	75	0.3

Notes:
1: Material in-situ weight, based on visual assessment (±10 %)
2: Undrained Cohesion/shear strength, assuming normally consolidated clay (±10 %).
3: Effective Cohesion, assuming normally consolidated clay (±10 %).
4: Effective Friction Angle (±2˚) assuming drained conditions; may be dependent on defect conditions.
5: Active earth pressure.
6: Earth pressure at rest.
7: Passive earth pressure.
8: Young's Modulus
9: Poisson's Ratio

6.2 Excavation Conditions

The following recommendations should be read in conjunction with the latest version of "Excavation Work – Code of Practice" prepared by Safework NSW.

Excavations for the proposed asset installation are anticipated to have a maximum excavation depth of approximately 1.5m BGL for the majority of the alignment, and about 2.5-3m BGL for the underbore launch and retrieval pits. Excavations to these depths are expected to encounter minor topsoil, alluvial clays and sands and residual clays. Sandstone bedrock is likely to be encountered in the vicinity of TRBH-006 and may be encountered elsewhere along the alignment within proposed trench excavation depths.

Excavations through topsoil, alluvial and residual soils is expected to be readily achievable using conventional earthworks equipment such as a tracked excavator fitted with a toothed or trenching bucket. Ripping tynes

fitted to a larger sized excavator may be required to excavate through very low strength sandstone, and a rock hammer attachment may be required to excavate low strength or better sandstone if encountered below investigation borehole depths.

Generally, the ground vibration Peak Particle Velocity (PPV) should be limited to 5mm/s at property boundaries and 3mm/s adjacent to sensitive properties. Low vibration equipment should be used near all site boundaries where vibrations could impact on adjacent building footings and structures. A dilapidation survey of any nearby structures/services (within the zone of influence of the proposed excavation works) is recommended to be undertaken by a structural engineer prior to the commencement of any site excavations. The report should include precise measurements of any existing defects and cracks presented with relevant photos.

Groundwater seepage was recorded in borehole TRBH-001 at a depth of 1m BGL, and in boreholes TRBH-003 and TRBH-004 at depths of 1.5m and 0.6m BGL, respectively. As such, groundwater inflow should be anticipated in trench excavations in the south-western portion of the site, and in underbore launch and receival pits. Where groundwater inflow is slow, it is anticipated that conventional sump-and-pump methods should be sufficient to manage inflow and maintain a dry excavation, in conjunction with temporary surface drainage lines cut into excavation benches/batters as required. If strong groundwater inflow is encountered when excavating underboring pit locations, the use of steel sheet piles driven below the depth of excavation may be considered to reduce water ingress into the excavation.

6.3 Temporary Retention and Batter Slopes

The proposed excavations can be undertaken by adopting unsupported batter slopes provided that the batter slopes in the soils do not extend below the ‘zone of influence’ of any adjacent structures and infrastructure (i.e. a 30° line for granular materials and a 45° line for cohesive material drawn from horizontal to the foundation level of any adjacent structure and infrastructure). Based on the properties of the materials encountered, the recommended maximum temporary batter slopes are presented below in Table 7.

Table 7 - Maximum Dry Excavation Batter Slopes (Temporary)

Material	Temporary Batter Slope (H:V) [1&2]
Very Loose to Loose Sand	2.5:1
Medium Dense Sand	1.5:1
Soft to Firm Clay	2:1
Stiff to Very Stiff Clay	1:1
Very Low Strength or better Sandstone	0.75:1[3]

Notes:
1: Surcharge loads must be kept clear of the crest of temporary batters.
2: Excavations can be benched using the above ratios, provided that vertical cuts are kept to a maximum of 1.5m height.
3: Subject to verification by a suitably qualified geotechnical engineer on site.

A geotechnical engineer should be engaged to inspect any excavation deeper than 1.5m in depth to ensure that the excavation is safe to work within. Excavations deeper than 1.5m depth should be backfilled within the same day that they have been excavated unless inspected by a geotechnical engineer.

Where temporary batter slopes at the above maximum ratios are not preferred or cannot be accommodated due to site constraints, it is recommended to support the excavation using a shoring box or similar temporary retaining system. Any temporary or permanent retaining wall or shoring system should be designed in

accordance with AS4678 and other relevant standards and guidelines, by an appropriately qualified person. Recommended parameters for the design of temporary retention structures are provided in Table 6 above.

7 LIMITATIONS

Alliance has prepared this report for the site located at Glenlee Road, Menangle Park NSW in accordance with Alliance's fee proposal and Terms of Engagement. This geotechnical report has been prepared for Endeavour Energy for this project and for the purposes outlined in this report. This report cannot be relied upon for other projects, other parties on this site or any other site.

The borehole and in-situ and laboratory test results provided in this report are indicative of the subsurface conditions at the site only at the specific sampling and testing locations, and to the depths excavated at the time of the investigation. Subsurface conditions can change significantly due to geological and human processes. Where variations in conditions are encountered further geotechnical advice should be sought from Alliance.

8 REFERENCES

Colquhoun G.P., Hughes K.S., Deyssing L., Ballard J.C., Folkes C.B, Phillips G., Troedson A.L. & Fitzherbert J.A. 2021. New South Wales Seamless Geology dataset, version 2.4 [Digital Dataset]. Geological Survey of New South Wales, Department of Regional NSW, Maitland.

AS1726-2017 – Geotechnical Site Investigations.

APPENDIX A – Selected Site Photographs



Photo 1 – View to the southwest of the location of borehole TRBH-005.



Photo 2 – View to the east of the location of borehole TRBH-003.



Photo 3 – Residual CLAY from SPT test, recovered from borehole TRBH-005.

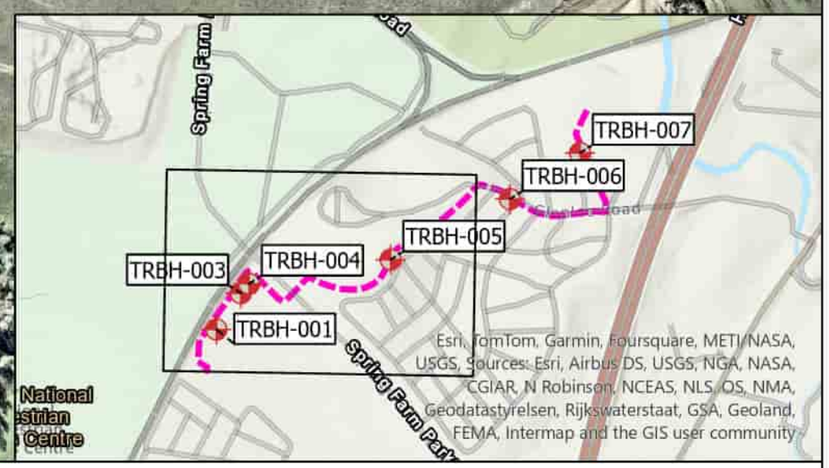


Photo 4 – Alluvial CLAY from SPT test, recovered from borehole TRBH-004.

APPENDIX B – Geotechnical Investigation Plan (Drawing 18255-GR-1-1-B)

TRBH-001
TRBH-003
TRBH-004
TRBH-005

Legend
- Approximate Proposed Alignment
- Borehole Locations



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Site Plan Scale 1:2,500 on A3

Client Name:	Endeavour Energy	N 0 30 60 Metres	Figure Number:	18255-GR-1-1-B
Project Name:	NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 85U		Figure/Drawing Date:	26/09/2024
Project Location	Glenlee Road, Menangle Park NSW		Report Number:	18255-GR-1-1

TRBH-007

TRBH-006

TRBH-005

TRBH-004

TRBH-003

TRBH-001

Spring Farm Road

Spring Farm Parkway

National Equestrian Centre

Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS, Esri, Geoscience Australia, NASA, NGA, USGS

Legend

- Approximate Proposed Alignment
- Borehole Locations

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Site Plan Scale 1:2,500 on A3

Client Name:	Endeavour Energy	N 0 30 60 Metres	Figure Number:	18255-GR-1-1-B
Project Name:	NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 85U		Figure/Drawing Date:	26/09/2024
Project Location	Glenlee Road, Menangle Park NSW		Report Number:	18255-GR-1-1

APPENDIX C – Explanatory Notes and Borehole Logs

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Explanatory Notes
Drill & Excavation Logs

General

Information obtained from site investigations is recorded on log sheets. Soils and very low strength rock are commonly drilled using a combination of solid-flight augers with a Tungsten-Carbide (TC) bit. Descriptions of these materials presented on the “Borehole Log” are based on a combination of regular sampling and in-situ testing. Rock coring techniques commences once material is encountered that cannot be penetrated using a combination of solid-flight augers and Tungsten-carbide bit. The "Cored Borehole Log" presents data from drilling where a core barrel has been used to recover material - commonly rock.

The "Excavation – Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits or trenches.

The heading of the log sheets contains information on Project Identification, Hole or Test Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The scale is presented in the depth column as metres below ground level.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is included in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures, and geological unit. Material description and classifications are based on Australian Standard Geotechnical Site Investigations: AS 1726 - 2017 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

Drilling

Drilling, Casing and Excavating

Drilling methods deployed are abbreviated as follows

Abbreviation	Method
AS	Auger Screwing
ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
BH	Backhoe
E	Excavator
HA	Hand Auger
HQ	HQ core barrel (~63.5 mm diameter core) *
HMLC	HMLC core barrel (~63.5 mm diameter core) *
NMLC	NMLC core barrel (~51.9 mm diameter core) *
NQ	NQ core barrel (~47.6 mm diameter core) *
RR	Rock Roller
WB	Wash-bore drilling

* Core diameters are approximate and vary due to the strength of material being drilled.

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage. It is introduced to assist with the drill process, in particular, when core drilling. The introduction of drill fluid/water does not allow for accurate identification of water seepages.

Drilling Penetration/Drill Depth

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

Abbreviation	Description
VE	Very Easy
E	Easy
F	Firm
H	Hard
VH	Very Hard

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

Groundwater inflow water level

Samples/Tests

Samples collected and testing undertaken are abbreviated as follows

Abbreviation	Test
ES	Environmental Sample
DS	Disturbed Sample
BS	Bulk Sample
U50	Undisturbed (50 mm diameter)
C	Core Sample
SPT	Standard Penetration Test
N	Result of SPT (*sample taken)
VS	Vane Shear Test
IMP	Borehole Impression Device
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test
HB	Hammer Bouncing

Excavation Logs

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added. Photos are recommended.

Material Description – Soil

Material Description - In accordance with AS 1726-2017

Classification Symbol - In accordance with the Unified Classification System (AS 1726-2017).

Abbreviation	Typical Name
GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands, gravelly sands, little or no fines.
SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
SM	Silty sand, sand-silt mixtures.
SC	Clayey sands, sand-clay mixtures.
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL	Organic silts and organic silty clays of low plasticity. *
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, clastic silts.
CH	Inorganic clays of high plasticity, fat clays.
OH	Organic clays of medium to high plasticity, organic silts. *
Pt	Peat and other highly organic soils. *

* Additional details may be provided in accordance with the Von Post classification system (1922).

Organic Soils – Identification using laboratory testing:

Material	Organic Content - % of dry mass
Inorganic	<2
Organic Soil	<2 ≤ 25
Peat	> 25

Organic Soils – Descriptive terms for the degree of decomposition of peat:

Term	Decomposition	Remains	Squeeze
Fibrous	Little or none	Clearly recognizable	Only water No solid
Pseudo-fibrous	Moderate	Mixture of fibrous and amorphous	Turbid water < 50% solids
Amorphous	Full	Not recognizable	Paste > 50% solids

Particle Characteristics – Definitions are as follows:

Fraction	Component (& subdivision)		Size (mm)
Oversize	Boulders		> 200
	Cobbles		> 63 ≤ 200
Coarse grained soils	Gravel	Coarse	> 19 ≤ 63
		Medium	> 6.7 ≤ 19
		Fine	> 2.36 ≤ 6.7
	Sand	Coarse	> 0.6 ≤ 2.36
		Medium	> 0.2 ≤ 0.6
		Fine	> 0.075 ≤ 0.21
Fine grained soils	Silt		0.002 ≤ 0.075
	Clay		< 0.002

Secondary and minor soil components

In coarse grained soils – The proportions of secondary and minor components are generally estimated from a visual and tactile assessment of the soils. Descriptions for secondary and minor soil components in coarse grained soils are as follows.

Designation of components	Percentage fines	Terminology (as applicable)	Percentage accessory coarse fraction	Terminology (as applicable)
Minor	≤ 5	Trace clay / silt	≤ 5	Trace sand / gravel
	> 5 ≤12	With clay / silt	> 5 ≤12	With sand / gravel
Secondary	> 12	Silty or clayey	> 30	Sandy or gravelly

Descriptions for secondary and minor soil components in fine grained soils are as follows.

Designation of components	Percentage coarse grained soils	Terminology (as applicable)
Minor	≤ 5	Trace sand / gravel / silt / clay
	> 5 ≤12	With sand / gravel / silt / clay
Secondary	> 30	Sandy / gravelly / silty / clayey

Plasticity Terms - Definitions for fine grained soils are as follows:

Descriptive Term	Range of Liquid Limit for silt	Range of Liquid Limit for clay
Low Plasticity	≤ 50	≤ 35
Medium Plasticity	N/A	> 35 ≤50
High Plasticity	> 50	> 50

Particle Characteristics

Particle shape and angularity are estimated from a visual assessment of coarse-grained soil particle characteristics. Terminology used includes the following:

Particle shape – spherical, platy, elongated,

Particle angularity – angular, sub-angular, sub-rounded, rounded.

Moisture Condition – Abbreviations are as follows:

D	Dry, looks and feels dry.
M	Moist, No free water on remoulding.
W	Wet, free water on remoulding.

Moisture content of fine-grained soils is based on judgement of the soils moisture content relative to the plastic and liquid limit as follows:

MC < PL	Moist, dry of plastic limit.
MC ≈ PL	Moist, near plastic limit.
MC > PL	Moist, wet of plastic limit.
MC ≈ LL	Wet, near liquid limit.
MC > LL	Wet of liquid limit.

Consistency - of cohesive soils in accordance with AS 1726-2017, Table 11 are abbreviated as follows:

Consistency Term	Abbreviation	Indicative Undrained Shear Strength Range (kPa)
Very Soft	**VS**	< 12
Soft	**S**	12 ≤ 25
Firm	**F**	25 ≤ 50
Stiff	**St**	50 ≤ 100
Very Stiff	**VSt**	100 ≤ 200
Hard	**H**	≥ 200
Friable	**Fr**	-

Density Index (%) of granular soils is estimated or is based on SPT results. Abbreviations are as follows:

Description	Abbreviation	Relative Density	SPT N
Very Loose	**VL**	< 15%	0 - 4
Loose	**L**	15 - 35%	4 - 10
Medium Dense	**MD**	35 - 65%	10 - 30
Dense	**D**	65 - 85%	30 - 50
Very Dense	**VD**	> 85%	> 50

Structures – Fissuring and other defects are described in accordance with AS 1726-2017 using the terminology for rock defects

Origin – Where practicable an assessment is provided of the probable origin of the soil, e.g. fill, topsoil, alluvium, colluvium, residual soil.

MATERIAL DESCRIPTION - ROCK

Material Description – In accordance with AS 1726-2017

Rock Naming – Where possible conventional geological names are used within the logs. Engineering properties cannot be inferred directly from the rock names in the table, but the use of a particular name provides an indicative range of characteristics to the reader. Lithological identification of rock is provided to appreciate the geology of an area, to correlate geological profiles seen in boreholes or to distinguish boulders from bedrock.

Grain Size – Grain size is done in accordance with AS1726-2017 as follows:

For sedimentary rock:

Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mmto 0.6mm
Fine grained	Mainly 0.06mm to 0.2mm

For igneous and metamorphic rock:

Coarse grained	Mainly greater than 2 mm
Medium grained	Mainly 0.6mm to 2mm
Fine grained	Mainly less than 2mm

Colour - Rock colour is described in the moist condition.

Texture and Fabric

Frequently used terms:

Sedimentary Rock	Metamorphic Rock	Igneous
Bedded	Banded	Amorphous
Cross-bedded	Cleaved	Crystalline
Folded	Folded	Flow banded
Graded	Foliated	Folded
Interbedded	Gneissose	Lineated
Laminated	Lineated	Massive
Massive	Schistose	Porphyritic

Bedding and fabric:

Description	Spacing
Very Thickly Bedded	> 2m
Thickly Bedded	0.6m to 2m
Medium Bedded	0.2m to 0.6m
Thinly Bedded	60mm to 200mm
Very Thinly Bedded	20mm to 60mm
Thickly Laminated	6mm to 20mm
Thinly Laminated	< 6mm

Degree of development:

Massive	No layering or fabric. Rock is homogeneous.
Indistinct	Layering or fabric just visible, There is little effect on strength properties.
Distinct	Layering or fabric obvious. The rock may break more easily parallel to the fabric.

Features, inclusions, and minor components - Features, inclusions and minor components within the rock material shall be described where those features could be significant such as gas bubbles, mineral veins, carbonaceous material, salts, swelling minerals, mineral inclusions, ironstone or carbonate bands, cross-stratification, or minerals the readily oxidise upon atmospheric exposure.

Moisture content - Where possible descriptions are made by the feel and appearance of the rock using one according to following terms:

Dry	Looks and feels dry.
Moist	Feels cool, darkened in colour, but no water is visible on the surface.
Wet	Feels cool, darkened in colour, water film or droplets visible on the surface.

The moisture content of rock cored with water may not be representative of its in-situ condition.

Durability – Descriptions of the materials durability such as tendency to develop cracks, break into smaller pieces or disintegrate upon exposure to air or in contact with water are provided where observed.

Rock Material Strength – The strength of the rock material is based on uniaxial compressive strength (UCS). The following terms are used:

Term / Abbreviation		Description	UCS (MPa)	Point Load Strength Index (MPa)
Very Low	**VL**	Crumbles under firm blow with sharp end of pick, can be peeled with a knife; too hard to cut a triaxial by hand; 30mm pieces can be broken by hand.	0.6 – 2	0.03 – 0.1
Low	**L**	Easily scored with a knifed; indentations 1-3mm show with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	2 – 6	0.1 – 0.3
Medium	**M**	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.	6 – 20	0.3 – 1
High	**H**	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.	20 – 60	1 – 3
Very High	**VH**	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	60 – 200	3 – 10
Extremely High	**EH**	Specimen requires many blows with geological pick to break into intact materials; rock rings under hammer.	> 200	> 10

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical logs as follows:

D	Diametral Point Load Test
A	Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown. Point Load Strength Index test results are presented as $I_{s\,(50)}$ values in MPa.

Weathering – Weathering classification assists in identification but does not imply engineering properties. Descriptions are as follows:

Term / Abbreviation		Description
Residual Soil	**RS**	Material has soil properties. Mass structure and material texture and fabric of original rock not visible, but the soil has not been significantly transported.
Extremely Weathered	**EW**	Material has soil properties. Mass structure, material texture and fabric of original rock are still visible.
Highly Weathered	**HW**	Material is completely discoloured, significant decrease in strength from fresh rock.
Moderately Weathered	**MW**	Material is `completely discoloured, little or no change of strength from fresh rock.
Slightly Weathered	**SW**	Partly stained or discoloured, little or no change to strength from fresh rock.
Fresh	**FR**	No signs of mineral decomposition or colour change.

Alteration – Physical and chemical changes of the rock material due to geological processes by fluids at depth at pressures and temperatures above atmospheric conditions. Unlike weathering, alteration shows no relationship to topography and may occur at any depth. When altered materials are recognized, the following terms are used:

Term / Abbreviation				Description
Extremely Altered		**XA**		Material has soil properties. Structure, texture, and fabric of original rock are still visible. The rock name is replaced with the name of the parent material, e.g., Extremely Altered basalt. Soil descriptive terms are used.
Highly Altered	**Distinctly altered**	**HA**	**DA**	The whole of the rock material is discoloured. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be higher or lower due to loss of minerals or precipitation of secondary minerals in pores.
Moderately Altered	**Distinctly altered**	**MA**	**DA**	The whole of the rock material is discoloured. Little or no change of strength from fresh rock. The term 'Distinctly Altered' is used where it is not practicable to distinguish between 'Highly Altered' and 'Moderately Altered'. Distinctly Altered is defined as follows: - The rock may be highly discoloured; - Porosity may be higher due to mineral loss; or may be lower due to precipitation of secondary minerals in pores; and - Some change of rock strength.
Slightly Altered		**S**		Rock is slightly discoloured. Little or no change of strength from fresh rock.

Alteration is only described in the context of the project where it has relevance to the civil and structural design.

Defect Descriptions

General and Detailed Descriptions – Defect descriptions are provided to suit project requirements. Generalized descriptions are used for some projects where it is unnecessary to describe each individual defect in a rock mass, or where multiple similar defects are present which are too numerous to log individually. The part of the rock mass to which this applies is delineated.

Detailed descriptions are given of defects judged to be particularly significant in the context of the project. For example, crushed seams in an apparently unstable slope. As a minimum, general descriptions outlining the number of defect sets within the rock mass and their broad characteristics are provided where it is possible to do so.

Defect Type – Defect abbreviations are as follows:

BP	Bedding parting	**SSM**	Sheared seam	**DB**	Drilling break
JT	Joint	**CS**	Crushed seam	**HB**	Handling break
SS	Shear surface	**SM**	Infilled seam		
SZ	Sheared zone	**EWS**	Extremely weathered seam		

Sheared surfaces, sheared zones, sheared seams, and crushed seams are generally faults in geological terms.

Defect Orientation

For oriented core: The dip and dip direction are recorded as a two-digit and three-digit number separated by a slash, are collected e.g., 50°/240° and there is not core loss that could obscure core orientation. If alternative measurements are made, such as dip and strike or dip direction relative to magnetic north this shall be documented.

For non-oriented core: The dip is recorded as a two-digit number, e.g., 10°. In vertical boreholes the dip is generally measured relative to the horizontal plan. If the borehole is inclined the dip is generally measured from the core axis.

Surface Roughness – Defect surface roughness is described as follows:

VR	**Very rough**	Many large surface irregularities with amplitude generally more than 1 mm.
RO	**Rough**	Many small surface irregularities with amplitude generally less than 1 mm.
SO	**Smooth**	Smooth to touch. Few or no surface irregularities.
PO	**Polished**	Shiny smooth surface
SK	**Slickensided**	Grooved or striated surface, usually polished.

Surface Shape – Defect surface roughness is described as follows:

PL	**Planar**	The defect does not vary in orientation.
CU	**Curved**	The defect has a gradual change in orientation
UN	**Undulating**	The defect has a wavy surface.
ST	**Stepped**	The defect has one or more well defined steps
IR	**Irregular**	The defect has many sharp changes of orientation

Defect Infilling – Common abbreviation as follows:

Ca	Calcite	**Fe**	Iron Oxide	**Qz**	Quartz
Cy	Clay	**MS**	Secondary mineral	**X**	Carbonaceous

Defect Coatings and Seam Composition - Coatings are described using the following terms:

CN	**Clean**	No visible coating.
SN	**Stained**	No visible coating but surfaces are discoloured.
VN	**Veneered**	A visible coating of soil or mineral, too thin to measure; may ne patchy.
CO	**Coating**	A visible coating up to 1 mm thick. Soil in-fill greater than 1 mm shall be described using defect terms (e.g., infilled seam). Defects greater than 1 mm aperture containing rock material great described as a vein.

Defect Spacing, Length, Openness and Thickness – Described directly in millimetres and metres. In general descriptions, half order of magnitude categories is used, e.g. joint spacing typically 100 mm to 300 mm, sheared zones 1m to 3m thick.

Depending on project requirements and the scale of observation, spacing may be described as the mean spacing within a set of defects, or as the spacing between all defects within the rock mass. Where spacing is measured within a specific set of defects, measurements shall be made perpendicular to the defect set.

Where significant, the nature of the defect end condition is recorded in the context of the scale of the exposure.

Block Shape – Where it is considered significant, block shape should be described using terms given in Table 23, AS 1725:2017.

Stratigraphic Unit – Geological maps related to the project are used for the designation of lithological formation name and, where possible geological unit name, e.g., Bringelly Shale, Potts Hill Sandstone Member.

Core Loss – Core loss occurs when material is lost during the drilling process It is shown at the bottom of the run unless otherwise indicated where core loss is known.

Total Core Recovery – The percentage of rock recovered excluding core loss per core run.

Defect Spacing – The spacing of successive defects or the mean spacing for relatively broken core.

Fracture Index – Which is the number defects per metre of core.

Rock Quality Designation (RQD) – The percentage of sound core pieces of 100mm or greater per core run and is calculated using Deere et al. (1989) method.

Rock Classification System – For design purpose, Sydney Rock Mass Classification System (Pells et al. 1998, 2019) is adopted.

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BH No: TRBH-001
Sheet: 1 of 1
Job No: 18255

Borehole Log

Client: Endeavour Energy
Project: NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 854
Location: Glenlee Road, Menangle Park

Started: 19/09/2021
Finished: 19/09/2021
Borehole Size: 110 mm

Rig Type: TDLR800 | **Hole Location** 292624E, 6225375N | **Driller:** SK | **Logged:** MB
RL Surface: 72.86m | **Contractor:** Alliance | **Bearing:** --- | **Checked:** AT

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	PSP per 150mm (2 4 9 18)	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT						-	TOPSOIL: SAND, medium grained, dark brown, trace silt, trace rootlets.		0.0-0.1 ES1	M	-	TOPSOIL
						SW	SAND, medium to coarse grained, brown, grey.					ALLUVIAL
			72.5	0.5					0.2-0.3 ES2		L	
									0.5-0.6 ES3			
			72.0	1.0			At 0.9m: becoming fine grained, trace subrounded ironstone gravel.				VL	
	▼ GW at 1.0m									W	MD	
			71.5	1.5		SW	SAND, medium to coarse grained, grey mottled red orange, trace clay, trace medium to coarse subrounded to rounded gravel.		1.2-1.5 TR			
							At 1.5m: becoming SAND with clay.		SPT 7, 8, 12 N=20 PP>500kPa			
			71.0	2.0			At 1.7m: becoming Clayey SAND.					
						SW	SAND, medium to coarse grained, dark grey, with clay, trace fine to coarse subrounded to rounded ironstone gravel.					
			70.5	2.5								
						CH	CLAY, high plasticity, grey mottled orange brown, with fine grained sand.		SPT 4, 7, 9 N=16 PP=140, 190, 420kPa		VSt	RESIDUAL
			70.0	3.0								
							Target depth. Borehole TRBH-001 terminated at 3m					
			69.5	3.5								
			69.0	4.0								
			68.5	4.5								
			68.0	5.0								
			67.5	5.5								

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BH No: TRBH-003
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Job No: 18255

Borehole Log

Client: Endeavour Energy
Project: NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 854
Location: Glenlee Road, Menangle Park

Started: 24/09/2024
Finished: 24/09/2024
Borehole Size: 110 mm

Rig Type: TDLR800 | **Hole Location** 292704E, 6225495N | **Driller:** MA | **Logged:** MB
RL Surface: 71.51m | **Contractor:** Alliance | **Bearing:** --- | **Checked:** AT

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	DCP per 150mm (2 4 9 18)	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT						-	TOPSOIL: Silty CLAY, medium plasticity, brown, trace rootlets.		0.0-0.1 ES1	MC < PL	-	TOPSOIL
						-	Silty CLAY, medium plasticity, brown.		0.1-0.2 ES2		St	ALLUVIAL
			71.0	0.5						MC ~ PL		
							At 0.6m: becoming brown and grey brown, clay with silt.		0.5-0.6 ES3	MC > PL	S - F	
						-	CLAY, medium to high plasticity, dark grey, trace subrounded gravel, trace fine to medium grained sand.					
			70.5	1.0					SPT 2, 4, 4 N=8			
						CI-CH	CLAY, medium to high plasticity, brown, trace subrounded gravel.				St	
	▼ GW at 1.5m		70.0	1.5								
						CH	CLAY, high plasticity, grey mottled orange brown, with fine ironstone gravel.			MC ~ PL		
			69.5	2.0								
			69.0	2.5					SPT 3, 5, 7 N=12			
							At 2.8m: with fine to coarse grained sand, trace subrounded gravel.					
			68.5	3.0					3.0-3.3 TR			
									3.3 PP=180, 140, 180kPa		VSt	
			68.0	3.5								
						CH	Sandy CLAY, high plasticity, grey mottled orange brown, with fine to coarse subrounded to subangular ironstone gravel.				F	
			67.5	4.0								
			67.0	4.5					SPT 2, 3, 3 N=6			
			66.5	5.0								
							Target depth. Borehole TRBH-003 terminated at 5m					
				5.5								

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BH No: TRBH-004
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Job No: 18255

Borehole Log

Client: Endeavour Energy
Project: NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 854
Location: Glenlee Road, Menangle Park

Started: 24/09/2024
Finished: 24/09/2024
Borehole Size: 110 mm

Rig Type: TDLR800 | **Hole Location** 292731E, 6225525N | **Driller:** MA | **Logged:** MB
RL Surface: 71.11m | **Contractor:** Alliance | **Bearing:** --- | **Checked:** AT

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	DCP per 150mm (2 4 9 18)	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT			71.0			-	TOPSOIL: Silty CLAY, medium plasticity, brown, trace rootlets.		0.0-0.1 ES1	MC < PL	-	TOPSOIL
						CI	CLAY, medium plasticity, grey mottled orange brown, trace fine subangular to subrounded gravel. At 0.3m: becoming dark brown mottled orange and grey, with subangular gravel.		0.1-0.2 ES2		S - F	ALLUVIAL
				0.5								
	GW at 0.63m		70.5						0.5-0.6 ES3		St	
							At 0.8m: becoming high plasticity.					
				1.0		CH	CLAY, high plasticity, grey mottled orange brown, with fine grained sand, with fine subrounded to subangular gravel.		SPT 0, 1, 0 N=1	MC ~ PL		SPT possibly undertaken on material from borehole wall collapse. Please refer to DCP instead.
			70.0									
				1.5			At 1.6m: becoming dark brown with grey and orange.					
			69.5									
				2.0								
			69.0									
				2.5		CH	CLAY, high plasticity, grey mottled orange brown, trace fine gravel.		SPT 2, 4, 5 N=9			
			68.5				At 2.8m: trace fine to medium subrounded to subangular ironstone gravel.					
				3.0					3.0-3.3 TR			
			68.0						3.3 PP=100, 160, 180kPa			
				3.5								
			67.5			CH	Sandy CLAY, high plasticity, grey mottled orange brown, fine to medium grained sand, with fine to medium subrounded to subangular ironstone gravel.					
				4.0					SPT 2, 2, 3 N=5			
			67.0									
				4.5		SC	Clayey SAND, fine to coarse grained, orange brown mottled grey, high plasticity clay, trace subrounded ironstone gravel.			M	L	
			66.5									
				5.0								
			66.0				Target depth. Borehole TRBH-004 terminated at 5m					
				5.5								

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BH No: TRBH-005
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Job No: 18255

Borehole Log

Client: Endeavour Energy
Project: NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 854
Location: Glenlee Road, Menangle Park

Started: 19/09/2021
Finished: 19/09/2021
Borehole Size: 110 mm

Rig Type: TDLR800 | **Hole Location** 293192E, 6225603N | **Driller:** SK | **Logged:** MB
RL Surface: 103.79m | **Contractor:** Alliance | **Bearing:** --- | **Checked:** AT

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	DCP per 150mm (2 4 9 18)	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT	Not Encountered		103.79	0.0		-	TOPSOIL: Silty CLAY, low to medium plasticity, dark brown.	17	0.0-0.1 ES1	MC < PL	-	TOPSOIL
						CL-CI	CLAY, low to medium plasticity, brown.	10	0.1-0.2 ES2		St	RESIDUAL
			103.5					9				
				0.5				7	0.5-0.6 ES3			
			103.0				At 0.7m: trace fine grained sand.	8				
				1.0				9				
								13			VSt	
							At 1.1m: becoming brown with pale grey, with fine grained sand.	22				
			102.5						1.2-1.5 TR			
				1.5								
			102.0			CH	Silty CLAY, high plasticity, pale brown mottled orange, trace fine grained sand.		SPT 6, 7, 8 N=15			
				2.0								
							Target depth. Borehole TRBH-005 terminated at 2m					
			101.5									
				2.5								
			101.0									
				3.0								
			100.5									
				3.5								
			100.0									
				4.0								
			99.5									
				4.5								
			99.0									
				5.0								
			98.5									
				5.5								

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BH No: TRBH-006
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Borehole Log

Client: Endeavour Energy
Project: NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 854
Location: Glenlee Road, Menangle Park

Started: 19/09/2021
Finished: 19/09/2021
Borehole Size: 110 mm

Rig Type: TDLR800 **Hole Location** 293581E, 6225800N **Driller:** SK **Logged:** MB
RL Surface: 107.55m **Contractor:** Alliance **Bearing:** --- **Checked:** AT

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	DCP per 150mm (2 4 9 18)	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT	Not Encountered		107.5			-	TOPSOIL: CLAY, low plasticity, dark brown, trace rootlets.	17	0.0-0.1 ES1	MC < PL	-	TOPSOIL
						CL-CI	CLAY, low to medium plasticity, brown, with fine grained sand.	13	0.1-0.2 ES2		St - VSt	RESIDUAL
			107.0	0.5				8 9	0.5-0.6 ES3			
			106.5	1.0		-	SANDSTONE, grey and red brown, inferred very low to low strength, highly weathered.	9 17		-	-	BEDROCK
			106.0	1.5			Refusal on inferred low to medium strength sandstone. Borehole TRBH-006 terminated at 1.3m					
			105.5	2.0								
			105.0	2.5								
			104.5	3.0								
			104.0	3.5								
			103.5	4.0								
			103.0	4.5								
			102.5	5.0								
				5.5								

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BH No: TRBH-007
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Job No: 18255

Borehole Log

Client: Endeavour Energy
Project: NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 854
Location: Glenlee Road, Menangle Park

Started: 19/09/2021
Finished: 19/09/2021
Borehole Size: 110 mm

Rig Type: TDLR800 | **Hole Location** 293810E, 6225950N | **Driller:** SK | **Logged:** MB
RL Surface: 104.17m | **Contractor:** Alliance | **Bearing:** --- | **Checked:** AT

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	DCP per 150mm (2 4 9 18)	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT	Not Encountered		104.0	0.0		-	TOPSOIL: Silty CLAY, low to medium plasticity, dark brown, trace rootlets.	13 16 13	0.0-0.1 ES1	MC < PL	-	TOPSOIL
						CI-CH	Silty CLAY, medium to high plasticity, red brown, trace fine grained sand.		0.1-0.2 ES2		VSt	RESIDUAL
			103.5	0.5				9 8	0.5-0.6 ES3		St	
			103.0	1.0			At 1.2m: becoming high plasticity.	5 7 9 8	1.2-1.5 TR			
			102.5	1.5				9 9	SPT 6, 7, 17 N=24		VSt	
			102.0	2.0			Target depth. Borehole TRBH-007 terminated at 2m					
			101.5	2.5								
			101.0	3.0								
			100.5	3.5								
			100.0	4.0								
			99.5	4.5								
			99.0	5.0								
				5.5								

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Dynamic Cone Penetrometer (DCP) and Perth Sand Penetrometer (PSP) Test Report

Client	Endeavour Energy	**Report Number**	18255-GR-1-1
Project Name	NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 85U	**Project Number**	18255
Project Location	Glenlee Road, Menangle Park	**Date Tested**	19/09/2024 and 24/09/2024
Test Method	AS 1289.6.3.2		

Borehole ID	**TRBH-001**		**TRBH-003**	**TRBH-004**		**TRBH-005**	**TRBH-006**	**TRBH-007**
Test Number	**DCP-01**	**PSP-01**	**DCP-03**	**DCP-04**	**DCP-04A**	**DCP-05**	**DCP-06**	**DCP-07**
Surface Material	-	-	-	-	-	-	-	-
Approximated RL (mBGL)	Surface level	Surface level	Surface level	Surface level	Surface level	Surface level	Surface level	Surface level
Date tested	19/09/2024	24/09/2024	19/09/2024	19/09/2024	24/09/2024	19/09/2024	19/09/2024	19/09/2024
0.00 – 0.15	2	3	8	2	2	17	17	13
0.15 – 0.30	3	2	7	3	2	10	13	16
0.30 – 0.45	2	2	4	2	1	9	8	13
0.45 – 0.60	2	2	3	3	4	7	9	9
0.60 – 0.75	2	1	2	4	6	8	9	8
0.75 – 0.90	4	0	1	4	6	9	17, HB	5
0.90 – 1.05	2	1	0	7	8	13		7
1.05 – 1.20	9	5	2	9	8	22, HB		9
1.20 – 1.35	20	10	4	10	9			8
1.35 – 1.50	15, HB	8, HB	7	10	9			9
1.50 – 1.65			8		10			9

Notes: This test report is intended to be read in conjunction with the geotechnical report by Alliance Geotechnical (ref:18255 GR-1-1).

APPENDIX D – Laboratory Test Certificates

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Thermal Resistivity with 4 Point Dry Out Curve

Test Method: ASTM D5334-22, AG-01, AS1289.2.1.1

Report Number:	18255-1	Sample Date:	19/09/2024
Sample Number:	39598A	Test Date:	17/10/2024
Issue Number:	1	Report Date:	18/10/2024

Reason for Reissue:	N/A
Client Name:	Alliance Geotechnical
Project Name:	NPR-000061 Menangle Park
Sample Location:	TRBH-001, Depth: 1.2m-1.5m
Material Description:	SAND; fine to coarse, brown-grey, trace gravel
Report Remarks:	Thermal Needle Diameter 2.4mm
	Length 100mm Needle Insertion: Pushed
Sampling Method:	Sampled by client
Tested by:	SP

Specimen Details					
MDD	-	Target Density Ratio	-	Moulded Density Ratio	N/A
OMC	-	Target Moisture Ratio	-	Moulded Moisutre Ratio	N/A
FMC	13 %	Achieved Dry Denisty	1.875 t/m3	Moulded Moisture	11.8 %

Results	1	2	3	4
Moisture Content *(% Dry Weight)*	0.0	3.1	5.2	11.8
Wet Density *(t/m^3)*	1.875	1.933	1.972	2.097
Starting Temperature *(°C)*	19.826	23.393	26.513	23.292
Conductivity (W/mK)	0.8372	1.314	1.601	2.394
Resistivity *(Km/W)*	1.19	0.761	0.625	0.418

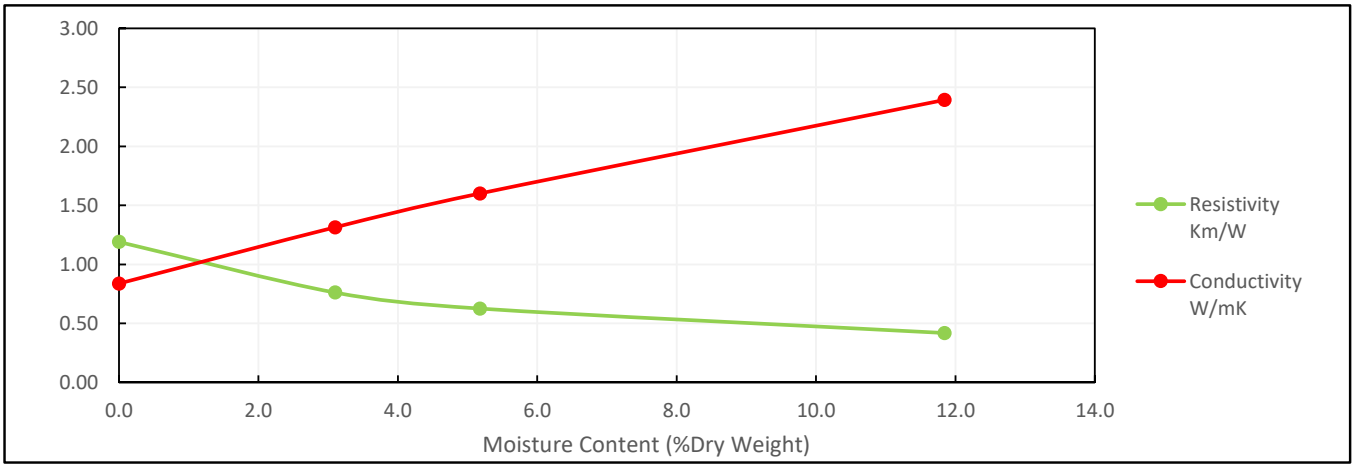

Figure 1 - *Thermal Dry Out Curve* *Sample ID: 39598A*

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Accredited for compliance with ISO/IEC 17025 - Testing
NATA Accredited Laboratory Number: 15100

Approved Signatory:

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Thermal Resistivity with 4 Point Dry Out Curve

Test Method: ASTM D5334-22, AG-01, AS1289.2.1.1

Report Number:	18255-2	Sample Date:	19/09/2024
Sample Number:	39663A	Test Date:	17/10/2024
Issue Number:	1	Report Date:	21/10/2024

Reason for Reissue:	N/A
Client Name:	Alliance Geotechnical
Project Name:	NPR-000061 Menangle Park
Sample Location:	TRBH-003, Depth: 3.0m-3.3m
Material Description:	CLAY; high plasticity, grey mottled orange-brown, with sand, with gravel
Report Remarks:	Thermal Needle Diameter 2.4mm Length 100mm Needle Insertion: Pushed
Sampling Method:	Sampled by client
Tested by:	SP

Specimen Details					
MDD	-	Target Density Ratio	-	Moulded Density Ratio	N/A
OMC	-	Target Moisture Ratio	-	Moulded Moisutre Ratio	N/A
FMC	18 %	Achieved Dry Denisty	1.661 t/m3	Moulded Moisture	18.4 %

Results	1	2	3	4
Moisture Content *(% Dry Weight)*	0.0	3.0	5.4	18.4
Wet Density *(t/m^3)*	1.661	1.711	1.751	1.966
Starting Temperature *(°C)*	20.292	22.675	25.269	22.643
Conductivity (W/mK)	0.786	0.855	0.984	2.233
Resistivity *(Km/W)*	1.272	1.169	1.016	0.448

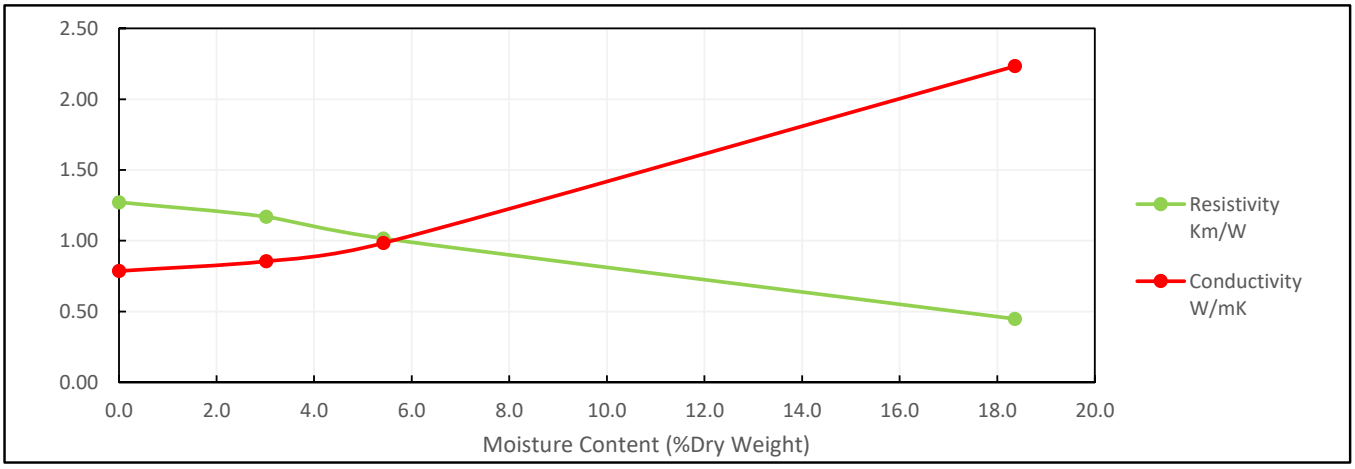

Figure 1 - *Thermal Dry Out Curve* *Sample ID: 39663A*

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Thermal Resistivity with 4 Point Dry Out Curve

Test Method: ASTM D5334-22, AG-01, AS1289.2.1.1

Report Number:	18255-2	Sample Date:	19/09/2024
Sample Number:	39663B	Test Date:	17/10/2024
Issue Number:	1	Report Date:	21/10/2024

Reason for Reissue:	N/A
Client Name:	Alliance Geotechnical
Project Name:	NPR-000061 Menangle Park
Sample Location:	TRBH-004, Depth: 3.0m-3.3m
Material Description:	CLAY; high plasticity, grey mottled orange-brown, trace gravel
Report Remarks:	Thermal Needle Diameter 2.4mm
	Length 100mm Needle Insertion: Pushed
Sampling Method:	Sampled by client
Tested by:	SP

Specimen Details					
MDD	-	Target Density Ratio	-	Moulded Density Ratio	N/A
OMC	-	Target Moisture Ratio	-	Moulded Moisutre Ratio	N/A
FMC	28.5 %	Achieved Dry Denisty	1.396 t/m3	Moulded Moisture	29.8 %

Results	1	2	3	4
Moisture Content *(% Dry Weight)*	0.0	2.9	6.0	29.8
Wet Density *(t/m^3)*	1.396	1.436	1.479	1.812
Starting Temperature *(°C)*	19.805	22.637	25.1	22.808
Conductivity (W/mK)	0.68	0.704	0.763	1.481
Resistivity *(Km/W)*	1.47	1.42	1.311	0.675

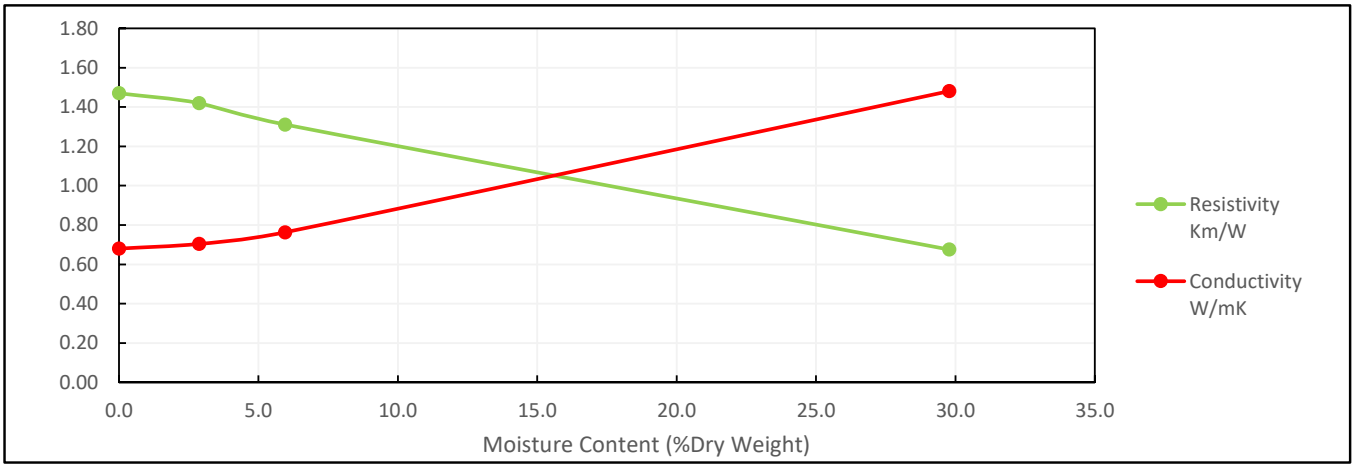

Figure 1 - *Thermal Dry Out Curve* *Sample ID: 39663B*

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Thermal Resistivity with 4 Point Dry Out Curve

Test Method: ASTM D5334-22, AG-01, AS1289.2.1.1

Report Number:	18255-1	Sample Date:	19/09/2024
Sample Number:	39598B	Test Date:	17/10/2024
Issue Number:	1	Report Date:	18/10/2024

Reason for Reissue:	N/A
Client Name:	Alliance Geotechnical
Project Name:	NPR-000061 Menangle Park
Sample Location:	TRBH-005, Depth: 1.2m-1.5m
Material Description:	CLAY; low to medium plasticity, brown-pale grey, with fine sand
Report Remarks:	Thermal Needle Diameter 2.4mm
	Length 100mm Needle Insertion: Pushed
Sampling Method:	Sampled by client
Tested by:	SP

Specimen Details					
MDD	-	Target Density Ratio	-	Moulded Density Ratio	N/A
OMC	-	Target Moisture Ratio	-	Moulded Moisutre Ratio	N/A
FMC	11.1 %	Achieved Dry Denisty	1.819 t/m3	Moulded Moisture	10.8 %

Results	1	2	3	4
Moisture Content *(% Dry Weight)*	0.0	3.2	5.1	10.8
Wet Density *(t/m^3)*	1.819	1.878	1.912	2.015
Starting Temperature *(°C)*	19.941	23.941	26.603	22.944
Conductivity (W/mK)	0.689	0.958	1.107	1.655
Resistivity *(Km/W)*	1.45	1.044	0.903	0.604

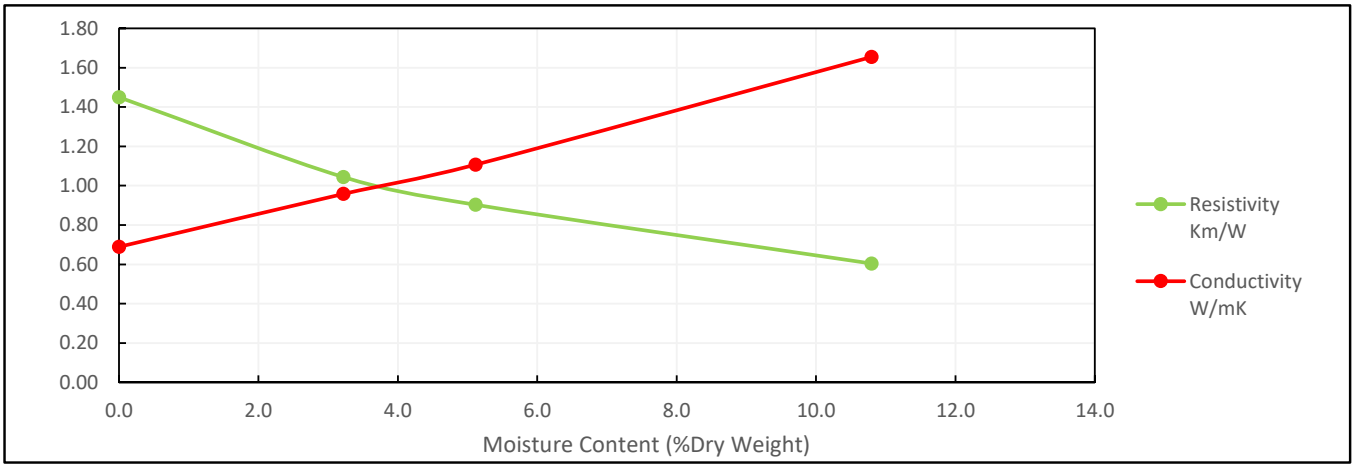

Figure 1 - *Thermal Dry Out Curve* *Sample ID: 39598B*

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Approved Signatory:

Thermal Conductivity Report

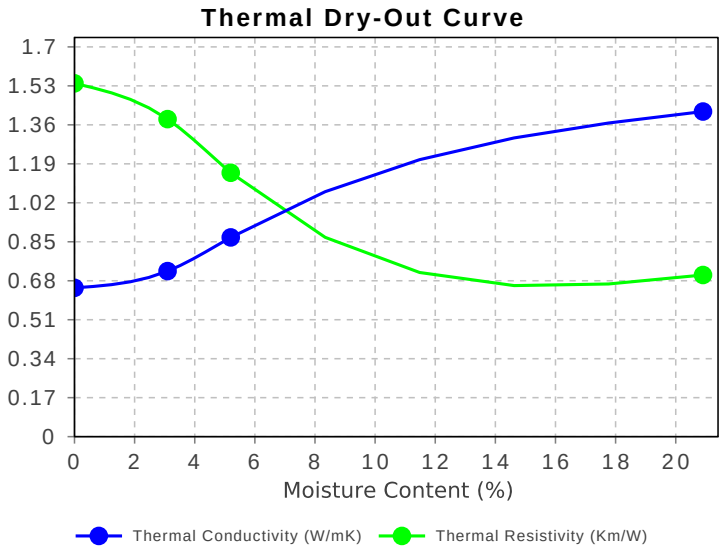
Alliance Geotechnical Pty Ltd
10 Welder Road Seven Hills NSW 2147
PO Box 275, Seven Hills NSW 1730
Phone: 1800 288 188
Email: brett@allgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brett Bellingham
Conformance Testing Manager
NATA Accredited Laboratory Number: 15100

Report Number: **18255-1**
Issue Number: 1
Date Issued: 18/10/2024
Client: Alliance Geotechnical Pty Ltd
8 to 10 Welder Rd, Seven Hills NSW 2147
Contact: Monica Baduria
Project Number: 18255
Project Name: NPR-000061 Menangle Park
Project Location: Glenlee Road, Menangle Park
Work Request: 39598
Sample Number: 24-39598C
Date Sampled: 19/09/2024
Dates Tested: 24/09/2024 - 18/10/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: In accordance with the test method
Sample Location: **TRBH-006 , Depth: 1.0m-1.3m**

Determination of Thermal Conductivity (ASTM D5334)	
Specimen Type	Remoulded
Maximum Dry Density (t/m^3)	1.656
Optimum Moisture Content (%)	20.9
Method of Compactive Effort	Standard
Target Density Ratio (%)	100
Target Moisture Ratio (%)	100
Achieved Density Ratio (%)	99
Achieved Moisture Ratio (%)	100
Field Moisture Content (%)	19
Placement Moisture Content (%)	21
Material Retained on 37.5 mm (%)	0
Material Retained on 19 mm (%)	0
Oversize Material Included	N/A
Diameter of Needle (mm)	3.5
Length of Needle (mm)	120
Method of Needle Insertion	Pushed
Type of Grease Used	Thermal



Sample Remoulding				
Point	OMC	2	3	Zero
Target Moisture Content (%)	20.9	5	3	0
Mass of Soil (g)	3334.0	2931.0	2873.0	2786.0
Wet Density (t/m^3)	1.98	1.74	1.71	1.66
Dry Density (t/m^3)	1.64	1.66	1.66	1.66
Average Specimen Diameter (mm)	104	101	98	97
Average Specimen Length (mm)	201	198	196	196
Time (s)	300.0	300.0	300.0	300.0
Start Temperature (^{o}C)	19.15	22.25	23.42	21.39
Thermal Conductivity (W/mK)	1.42	0.87	0.72	0.65
Thermal Resistivity (Km/W)	0.705	1.151	1.385	1.541

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Results relate only to the items tested/sampled.

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Thermal Resistivity with 4 Point Dry Out Curve

Test Method: ASTM D5334-22, AG-01, AS1289.2.1.1

Report Number:	18255-1	Sample Date:	19/09/2024
Sample Number:	39598D	Test Date:	17/10/2024
Issue Number:	1	Report Date:	18/10/2024

Reason for Reissue:	N/A
Client Name:	Alliance Geotechnical
Project Name:	NPR-000061 Menangle Park
Sample Location:	TRBH-007, Depth: 1.2m-1.5m
Material Description:	Silty CLAY; high plasticity, red-brown, trace fine sand
Report Remarks:	Thermal Needle Diameter 2.4mm
	Length 100mm Needle Insertion: Pushed
Sampling Method:	Sampled by client
Tested by:	SP

Specimen Details					
MDD	-	Target Density Ratio	-	Moulded Density Ratio	N/A
OMC	-	Target Moisture Ratio	-	Moulded Moisutre Ratio	N/A
FMC	18 %	Achieved Dry Denisty	1.683 t/m3	Moulded Moisture	17.6 %

Results	1	2	3	4
Moisture Content *(% Dry Weight)*	0.0	2.7	5.5	17.6
Wet Density *(t/m^3)*	1.683	1.729	1.776	1.979
Starting Temperature *(°C)*	19.97	23.342	26.884	23.401
Conductivity (W/mK)	0.805	1.014	1.11	1.628
Resistivity *(Km/W)*	1.242	0.986	0.901	0.614

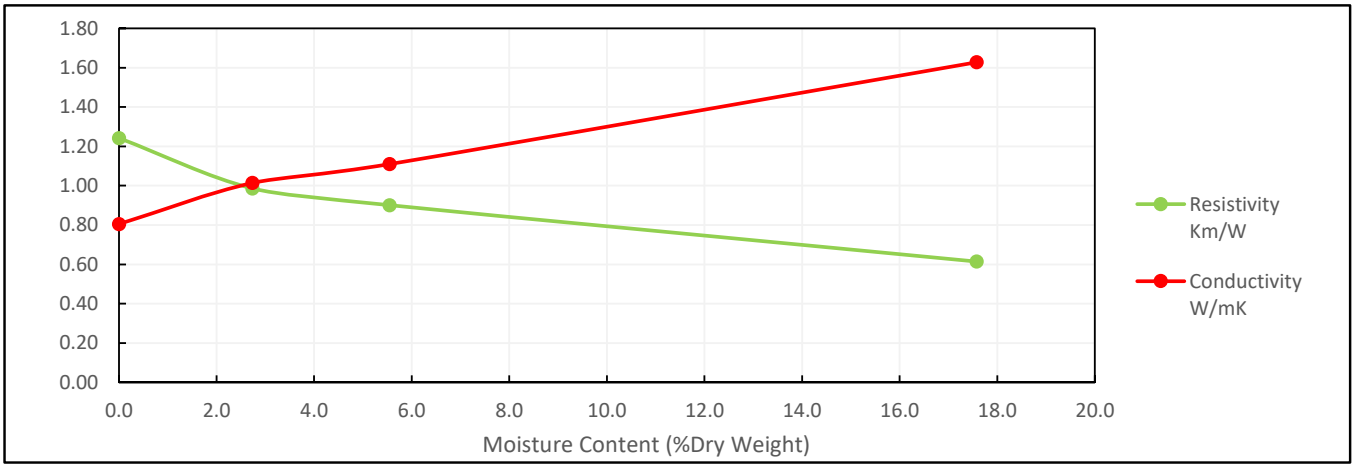

Figure 1 - *Thermal Dry Out Curve* *Sample ID: 39598D*

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Approved Signatory:

Appendix G Contamination and Waste Classification Report, GeoEnviro (2018)

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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
Email: geoenviro@exemail.com.au

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
PO Box 1543, Macquarie Centre. North Ryde, NSW 2113
ABN: 62 084 294 762
Tel: (02) 9679 8733
Fax: (02) 9679 8744
Email: geoenviro@exemail.com.au

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,

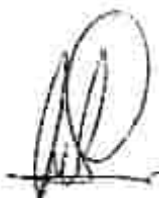
Re Contamination and Waste Classification Report
Proposed Menangle Zone Substation
Part Lot 2 in DP 737485, Fitzpatrick Street, Menangle Park

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.

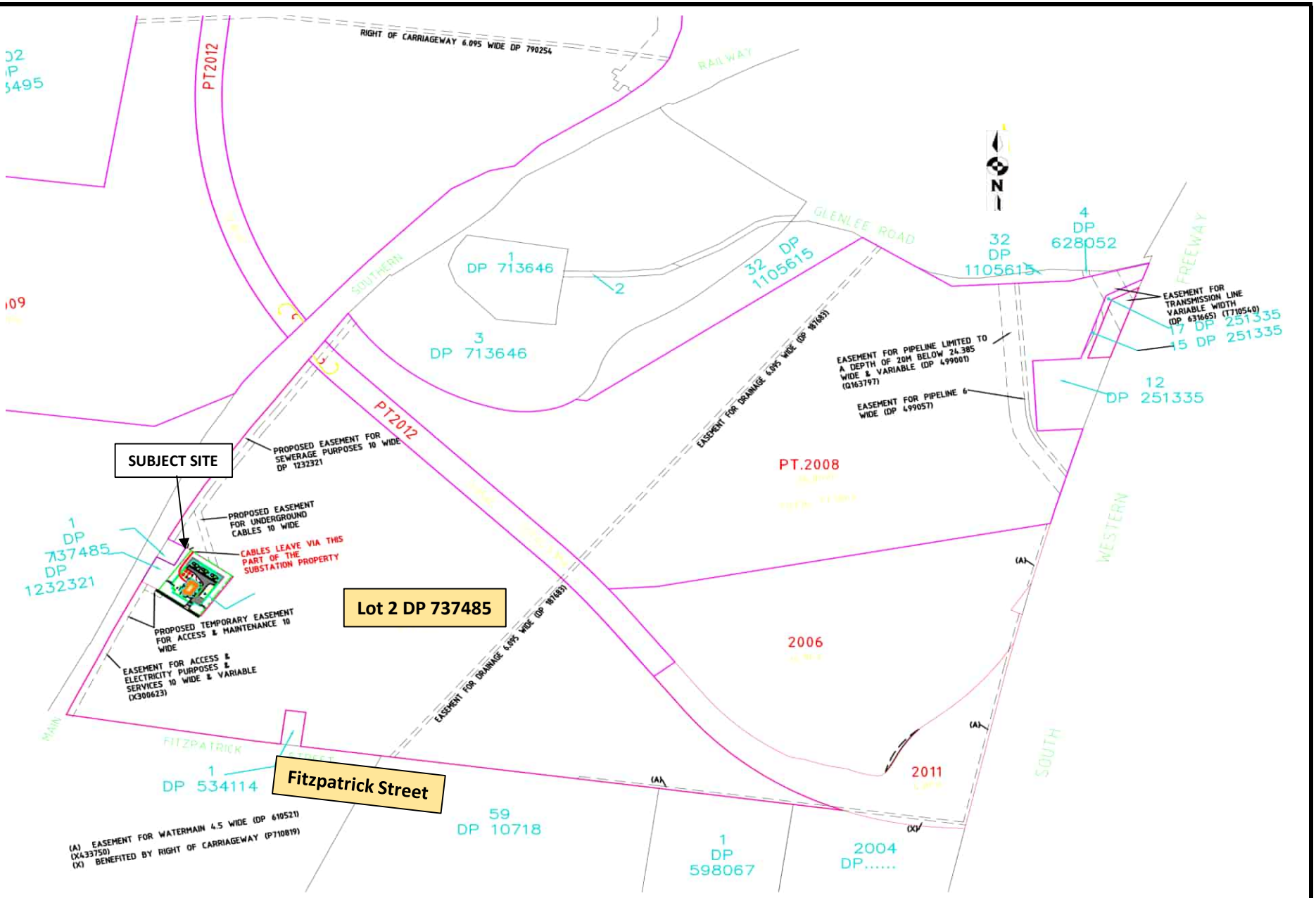
Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

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.

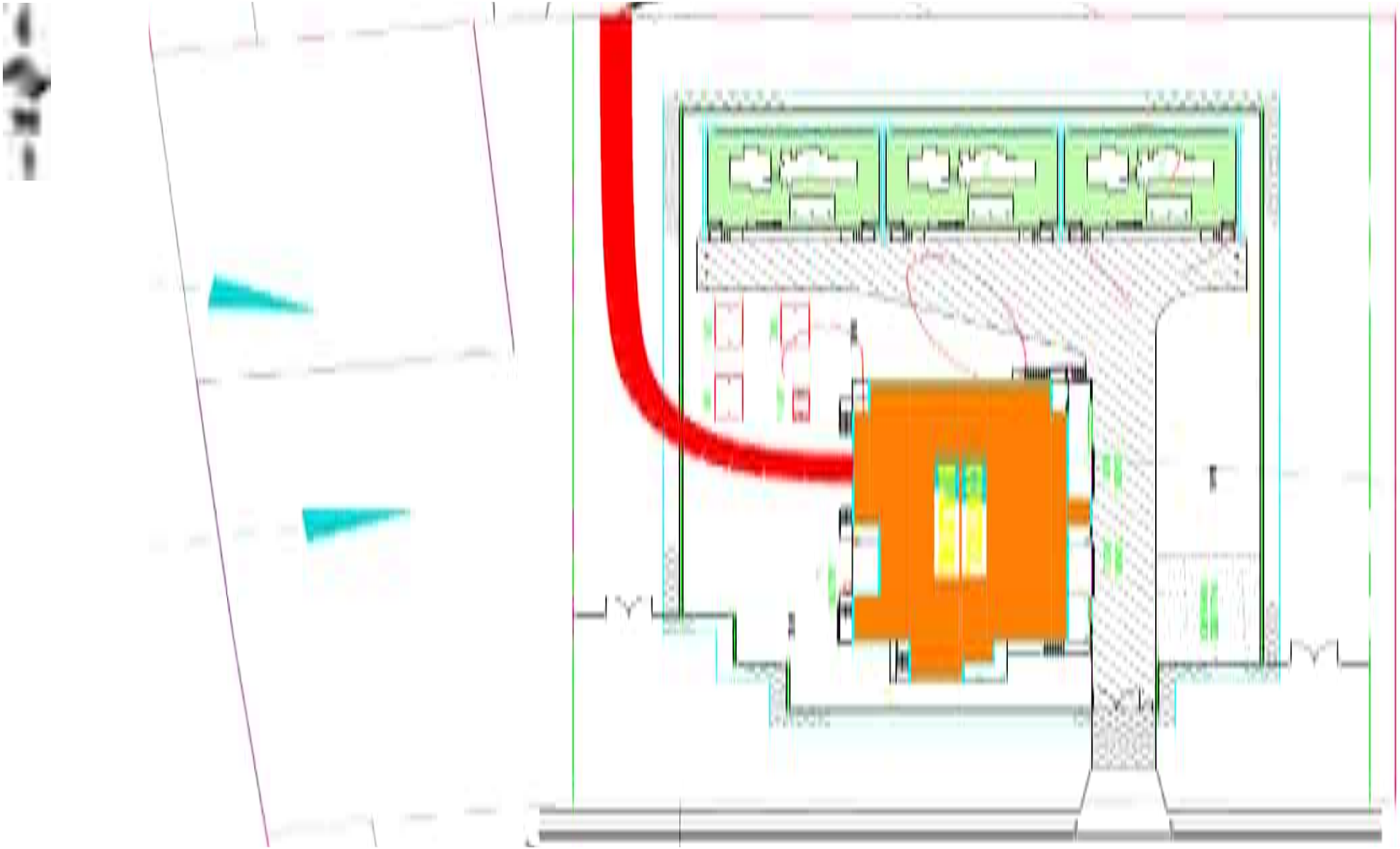
The statements presented in these documents are intended to advise you of what should be your realistic expectations of this report, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level 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

1. *"Geotechnical Investigation Report – Proposed Menangle Zone Substation, Lot 2 DP 737485", GeoEnviro Consultancy Pty Ltd reference JC17313A-r1 dated January 2018*
2. *1:100,000 Soil Landscape Map of Wollongong/Port Hacking – Soil Conservation Service of NSW; Sheet 9029-9129*
3. *1:100,000 Geological Map of Wollongong/Port Hacking – Geological Series Sheet 9029-9129 (Edition 1) 1985*
4. *Australian & New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Australian and New Zealand Conservation Council and National Health and Medical Research Council, 1992.*
5. *Assessment of Orchard and Market Garden Contamination - Contaminated Sites Discussion Paper, NSW EPA 1999.*
6. *Health Based Soil Investigation Levels, National Environmental Health Forum Monographs Soil Series No. 1 – 1996*
7. *National Environment Protection (Assessment of Site Contamination) Measure 1999 (including updated Schedule B1 – 2013*
8. *Guidelines for Assessment Service Station-sites – NSW EPA 1994*
9. *Guidelines for the NSW Auditor Scheme, NSW EPA*
10. *Part 1 – Classifying Waste – 2014, NSW DEC*
11. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 – ANZECC.*
12. *Department of Land and Water Conservation – "Site Investigation for Urban Salinity".2002*
13. *Salinity Code of Practice – Western Sydney Regional Organisation of Councils Ltd – 2002*
14. *What do all the numbers mean? A guide for the interpretation of soil test results. – Department of Conservation and Land Management, 1992*
15. *Acid Sulphate Soil Manual – NSW Acid Sulphate Soil Management Advisory Committee August 1998*



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



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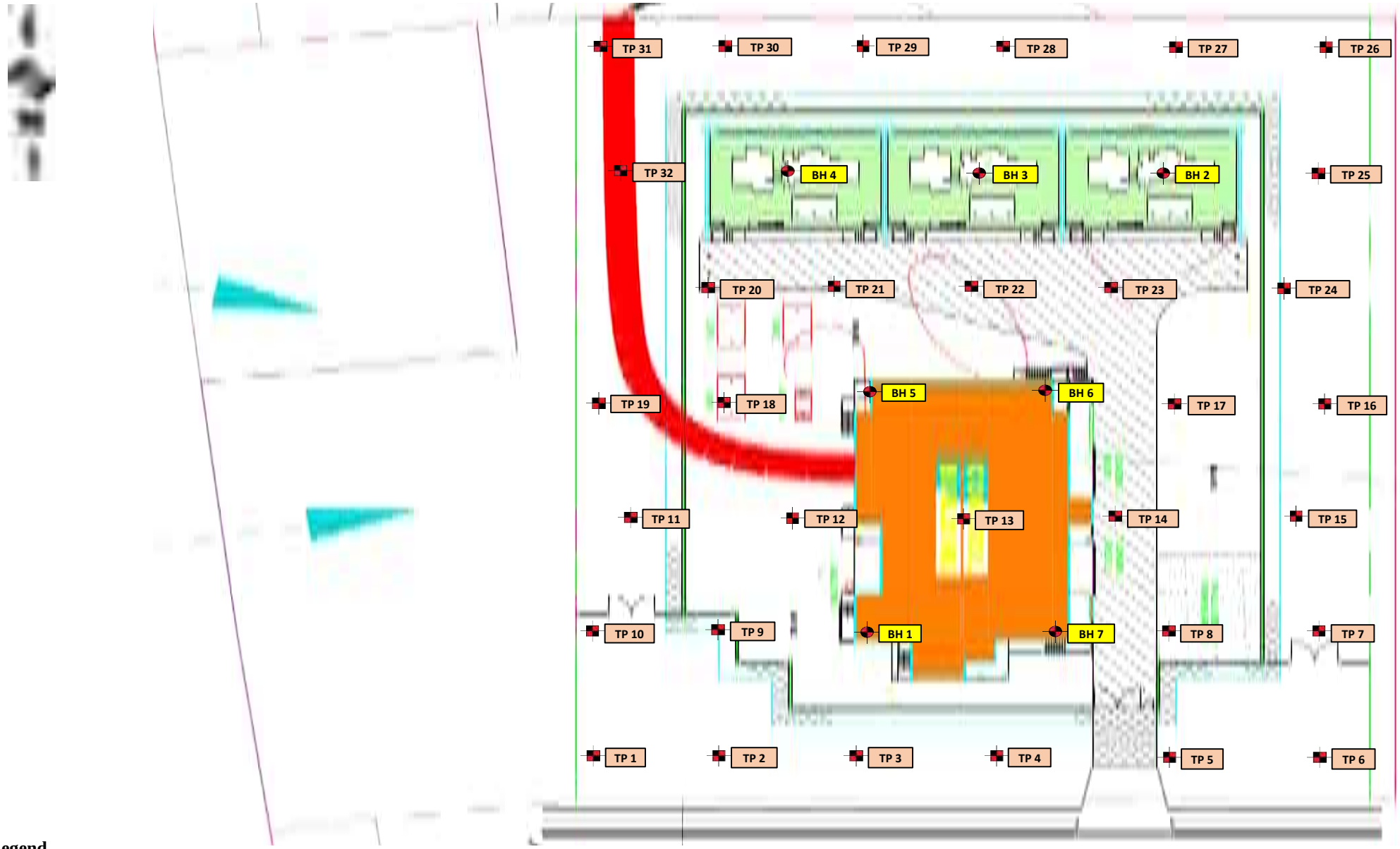
Drawn By: SG	Date: 08/01/2017	**Brewster Murray Pty Ltd**	
Checked By: SL	Date: 08/01/2017	**Proposed Menangle Zone Substation**	
Revision By:	Date:	**Proposed Site Layout**	
Scale: Proportional	A3	**Project No: JC17313A**	**Drawing No: 2**



Legend

- Test Pit
- Borehole

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**	
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

Prepared By: SL 2/02/2018
Checked By:__SG___Date:2/02/2018

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

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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

GeoEnviro Consultancy

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

GeoEnviro Consultancy

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

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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

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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

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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

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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

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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	
							Sandy Silty Clay: Medium plastiucity, grey and brown	M-W			
		▼		4.0					H	600	Seepage encountered at 4.0m
			N=22 6,11,11								
				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							

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

Borehole Report

Client: Brewster Murray Pty Ltd
Project: Proposed Menangle Zone Substation
Location: Fitzpatrick Street, Menangle

Job no: JC17313A
Date: 1/12/17
Logged by: SG

Drill Model and Mounting: Hanjn 8D
Hole Diameter: 100 mm

Slope: 90 deg
Bearing: -

R.L. Surface:
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		CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands	M	Vst -H		
TC-BIT				10.0		CI-CH	Silty Clay: Medium plasticity, grey and brown, with fine to medium grained ironstone bands, trace Siltstone bands	M	Vst -H		
				11.0							
				12.0							
				13.0							
				14.0			Siltstone/Sandstone: Brown, extremely to distinctly weathered, low strength				
				15.0			End BH 1 at 14.6m				
				16.0							

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

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				Silty Sandy Clay: Medium plasticity, grey and brown	M	H	400-500	
		▼		3.0							Groundwater encountered at 3.0m upon completion
						CI-CH	Silty Clay: Medium to high plasticity, grey and brown, with fine grained ironstone gravel	MC= PL (D-M)			
				4.0							
			N=19 5,8,11						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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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 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
				4.0		CI	Silty Clay: Medium plasticity, grey and brown, with fine to coarse grained ironstone gravel	M			Seepage encountered at 3.6m
			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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Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
Tel: (02) 96798733 Fax: (02) 96798744

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		
				1.0		SC	Sandy Clay: Medium plasticity, grey and brown, with ironstone gravel	M	St	150	
		▼	3 1,1,1								Groundwater encountered at 1.2m on Day 3, 5 and 14 after investigation
				2.0							
		▼					Sandy Silty Clay: Medium plasticity, brown and grey, with fine to coarse grained ironstone gravel	M			
		▼	N=21 9,10,11	3.0					H	>600	Groundwater at 2.4m after 2hrs of drilling Seepage encountered at 2.8m
				4.0							
			N=22 5,11,11								
				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			SC	Sandy Clay: Low to medium plasticity, grey brown	M	VSt	210	
				2.0							
			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	
				4.0							
			N=24 3,12,12						H	520- 550	
				5.0							
			N=24 8,12,12						H	>600	
				6.0							
				7.0							
							End BH 7 at 7.0m				
				8.0							

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Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia
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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		
				1.0							
			N=6 2,2,4					M-W			
		▼				SC	Clayey Sand: Fine to medium grained, grey and brown	M			Groundwater encountered at 1.5m on Day 3, 5 and 14 after investigation
				2.0							
						SC	Sandy Clay: Medium plasticity, grey and brown, trace of ironstone gravel	M			
			N=19 4,9,10						H	420-	
				3.0		CI	Silty Clay: Medium plasticity, grey brown, with fine to medium grained ironstone gravel	M		500	
				4.0							
			N=22 5,9,13						H	500	
				5.0							
			N=24 7,12,12						H	550	
				6.0							
				7.0							
							End BH 7 at 7.0m				
				8.0							

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)

Find us on

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.

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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.
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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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PLAN FORM 2

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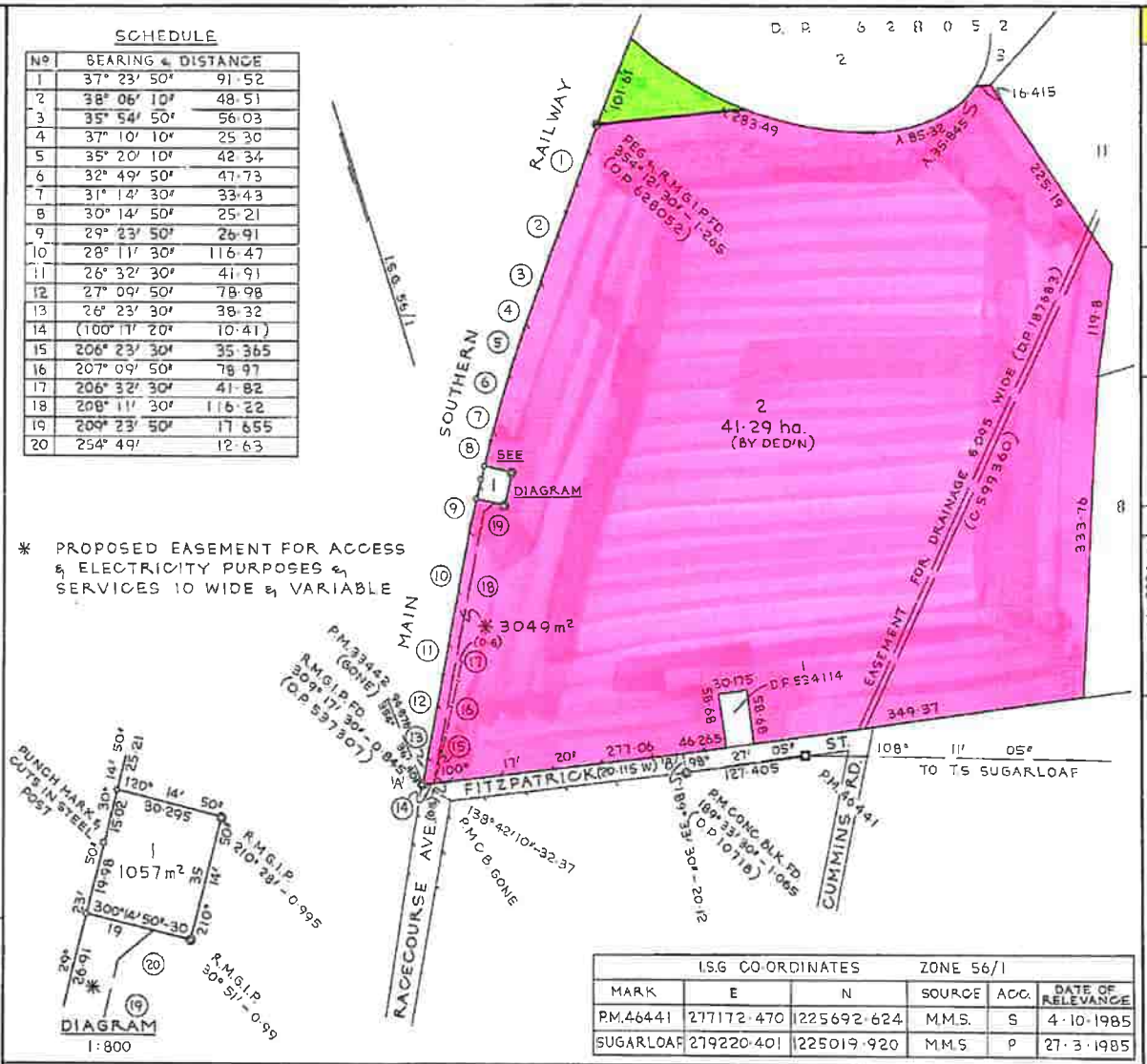
Signatures and seals only.

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° 17′ 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

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 – NOT A 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 City: CAMPBELLTOWN

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. (LTD. DEL. BOX 889T) 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

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 249 of the Metropolitan Water, Sewerage and Drainage Act, 1924, as amended, Hunter District Water, Sewerage, and Drainage Act, 1925, 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.

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

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123/25492 F.B. 6769 R.E.

D.P. 737485

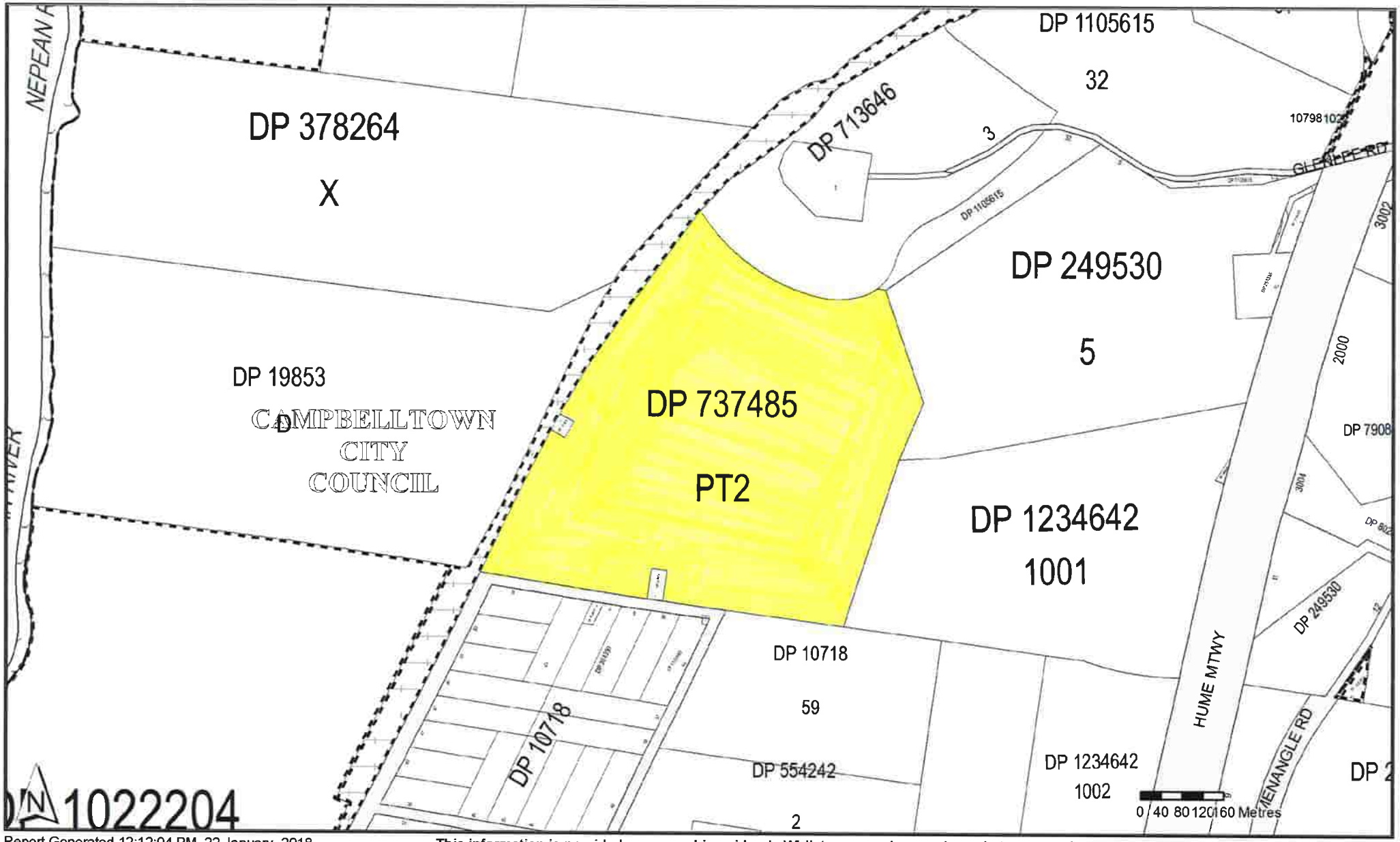
Req:R986598 /Doc:DP 0737485 P /Rev:25-Jun-1992 /Sts:OK.OK /Pgs:ALL /Prt:22-Jan-2018 11:13 /Seq:1 of 1
Ref:PSH-GROLLY-JC17313A /Src:H

LAND REGISTRY SERVICES

Cadastral Records Enquiry Report : Lot 2 DP 737485

Ref : NOUSER

Locality : MENANGLE PARK
Parish : MENANGLE
LGA : CAMPBELLTOWN
County : CUMBERLAND



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PLAN FORM 2

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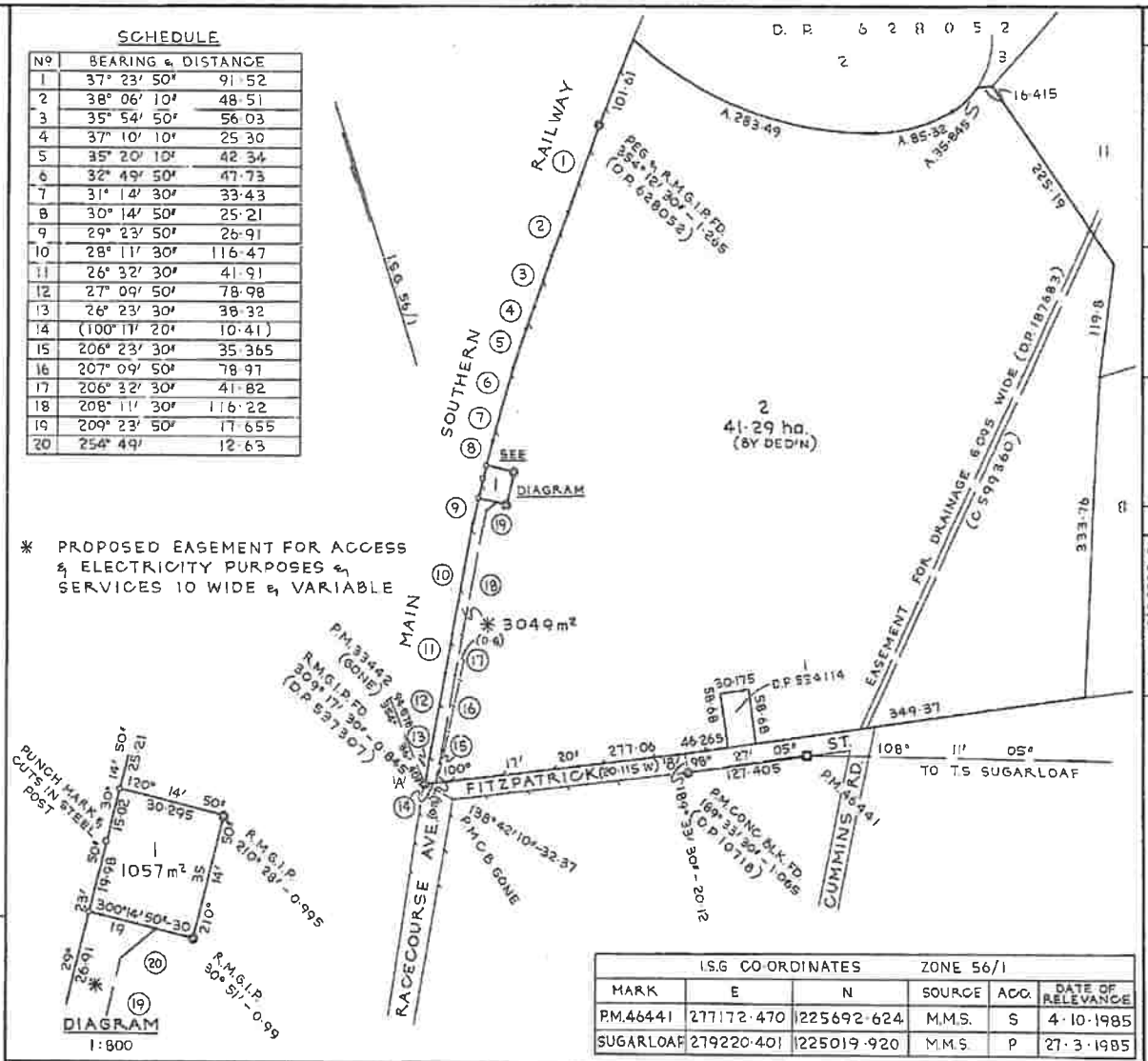

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Lengths are in metres.

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Locality: MENANGLE PARK

Parish: MENANGLE

County: CUMBERLAND

This is sheet 1 of my plan in sheets.

ALAN WILLIAM SIMPSON
M.W.S. & D.B. (LTD DEL BOX 889T)

22·9·1986

Signature

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 242 of the Metropolitan Water, Sewerage and Drainage Act, 1924, as amended, Illinois District Water, Sewerage, and Drainage Act, 1925, 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 areas of operations of the Metropolitan Water Sewerage and Drainage Board and the Illinois District Water Board.

*Delete if inapplicable.

A.F.D.

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

SURVEYOR'S REFERENCE 1224807 86/592

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123/25492 F.B. 6769 R.E.

D.P. 737485

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

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

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glossary and metadata

Greater Sydney Region

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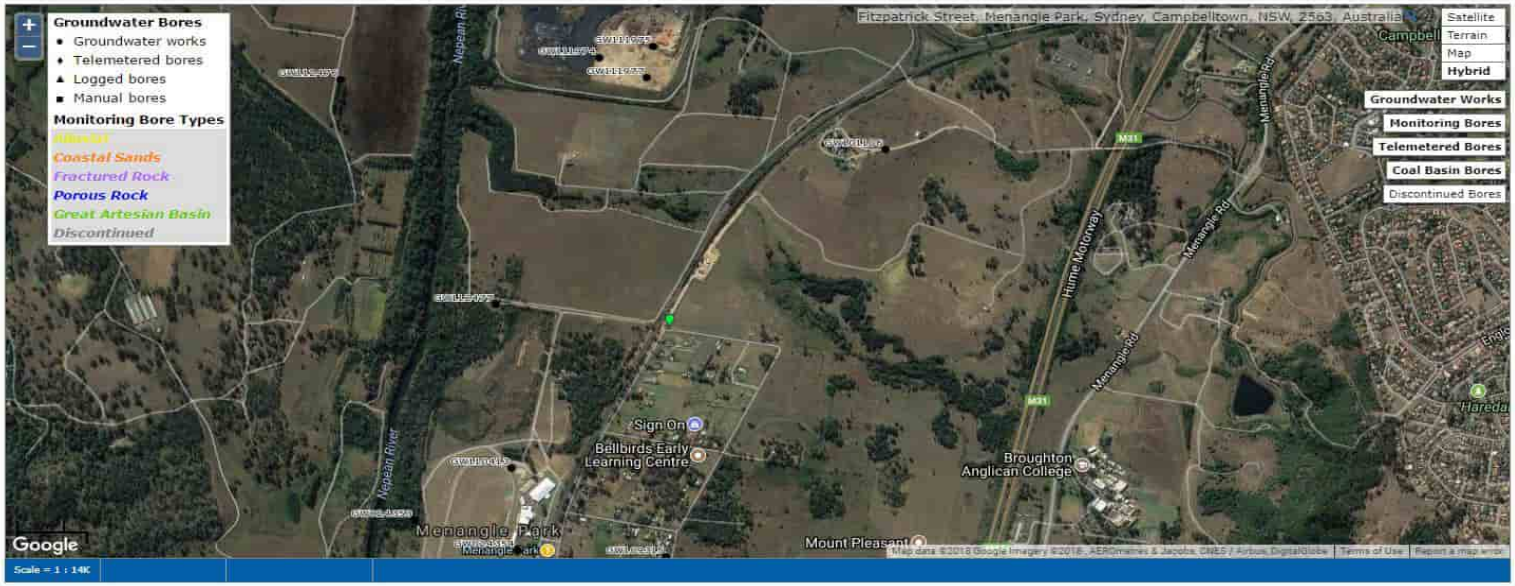
All data times are Eastern Standard Time

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: **Final Depth:** 280.00 m
Completion Date: 07/03/1997 **Drilled Depth:** 280.00 m

Contractor Name: SOUTHERN TABLELANDS DRILLING
Driller: Roger Charles Ritchie
Assistant Driller:

Property: N/A **Standing Water Level:** 17.000
GWMA: - **Salinity:**
GW Zone: - **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 **CMA Map:**
River Basin: - Unknown **Grid Zone:** **Scale:**
Area/District:

Elevation: 0.00 m (A.H.D.) **Northing:** 6225747.0 **Latitude:** 34°05'19.1"S
Elevation Source: Unknown **Easting:** 293207.0 **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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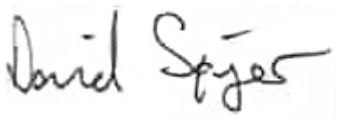
Asbestos Approved By
Analysed by Asbestos Approved Identifier: Lulu Scott, Lucy Zhu
Authorised by Asbestos Approved Signatory: Lulu Scott

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:

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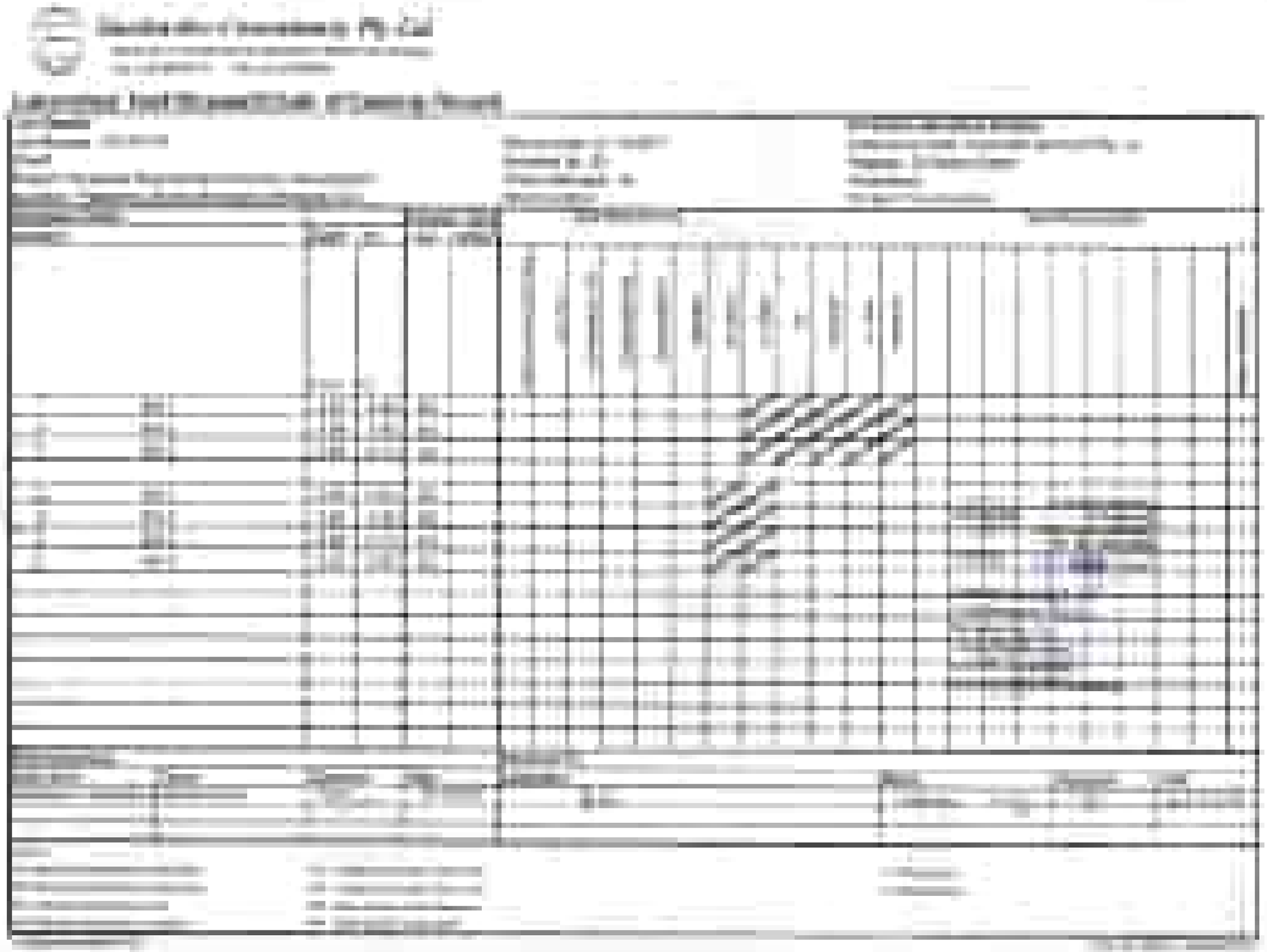
Sample ID	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticidesin soil	PCBsin Soil	Acid Extractable metalsin soil	pH1:5 soil:water	Electrical Conductivity1:5 soil:water	Chloride, Cl1:5 soil:water	Sulphate, SO41:5 soil:water	Resistivity in soil*	sPOCAS field test	Asbestos 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.





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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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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

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.

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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	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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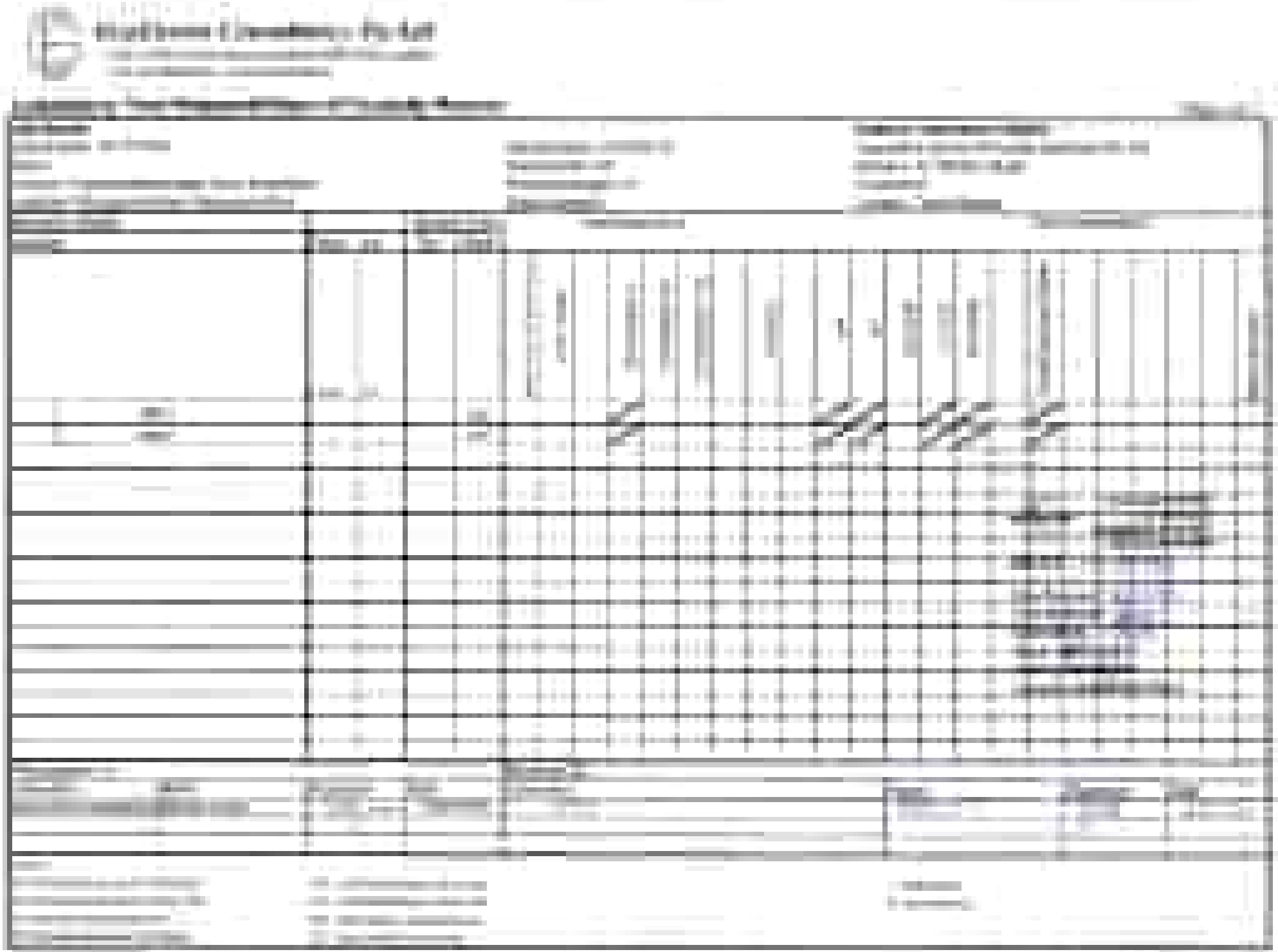
Sample ID	vTRH(C6-C10)/BTEXN in Water	svTRH (C10-C40) in Water	PAHsin Water	OCP in water	PCBs in Water	HM in water - dissolved	pH	Electrical Conductivity	Total Dissolved Solids(grav)	Chloride, Cl	Sulphate, SO4	Resistivity
MW1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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.



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

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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)

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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

	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	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

	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	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)

	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	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

	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	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	60	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)

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

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	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 Aboriginal Objects Due Diligence Assessment

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Menangle Park Zone Substation and Feeder 85U

Aboriginal Heritage Due Diligence Assessment

Prepared for JBS&G on behalf of Endeavour Energy

Campbelltown Local Government Area

August 2025

Ref. 2427

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1 Introduction

1.1 Background

Endeavour Energy is preparing a Review of Environmental Factors (REF) for proposed works including the removal of the temporary 66/11kV mobile substation at the Menangle Park Zone Substation and construction of a new permanent 66/11kV 35 MVA substation. The proposal is located within the suburb of Menangle Park in the Campbelltown Local Government Area (LGA), within the Menangle Park Urban Release Area (MPURA). The proposal constitutes the 'study area' for this assessment and is shown on Figure 1.

The new substation will be supplied by two 66Kv feeders; the existing feeder 85P, and a new feeder 85U from Macarthur Bulk Supply Point. Installation of the new feeder would involve mechanical trench excavation with underboring of an approximately 200 metre long section underneath Howes Creek. The new substation will support future growth in the MPURA and Greater Macarthur Growth Area, securing an adequate long-term electricity supply for current and future residential and commercial customers by providing a new diversified 33kV electricity supply into the area. The site layout plan is provided in Figure 2.

Kelleher Nightingale Consulting Pty Ltd (KNC) was engaged by JBS&G on behalf of Endeavour Energy to undertake an Aboriginal heritage due diligence assessment of the study area. The assessment aimed to identify if Aboriginal objects were likely to be located in the study area and if so, whether the proposed works were likely to harm those objects. This assessment has been conducted in accordance with the Heritage NSW *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (Department of Environment, Climate Change and Water (DECCW), 2010).

1.2 Aboriginal heritage due diligence assessment process

The due diligence assessment process is a step by step method designed to give proponents a baseline level of information outlining opportunities and constraints related to Aboriginal heritage. The relevant steps are:

- Determining if the activity will disturb the ground surface or any culturally modified trees (Step 1)
- Database search: Aboriginal heritage information management system (AHIMS) and known information sources (Step 2a)
- Landscape assessment (Step 2b)
- Impact avoidance assessment (Step 3)
- Desktop assessment and visual inspection (Step 4).

The *Due Diligence Code of Practice* specifies that if the initial assessment process identifies that Aboriginal objects will be or are likely to be harmed, then further investigation and impact assessment is required (Step 5). The process involves "taking *reasonable and practical measures* to determine whether your actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm" (DECCW, 2010:4).

1.3 Due Diligence Assessment Summary

Assessment under the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* did not identify any extant Aboriginal sites, objects or areas of Aboriginal archaeological potential within the study area.

The assessment identified two destroyed Aboriginal archaeological sites, Menangle Park Feeder Isolated Find 01 (MPFIF 01) (AHIMS 52-2-4497) and Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01) (AHIMS 52-2-4529) within the study area. Both sites have been destroyed under Aboriginal Heritage Impact Permit (AHIP) C0005561 and are not a constraint for the current Due Diligence assessment.

Landform and disturbance assessment found that historic and contemporary land use has led to high levels of disturbance throughout the study area corridor, related to construction of the Macarthur Substation, Glenlee Road, Menangle Park Zone Substation, the Sydney Water Pump Station pipeline and historic and contemporary agricultural landuse associated with the Glenlee estate property. Landforms directly adjacent to Howes Creek would not be impacted by the works with the proposed 200 metre section of underboring under the creek. The remainder of the study area displays low to no potential for intact Aboriginal archaeology and no identified Aboriginal objects.

Existing AHIPs C0000393, 4894 and 5401 partially overlap the majority of the current study area (refer Figure 6). Endeavour Energy should confirm with the AHIP holders that the proposed works may be completed under these permits prior to commencing works.

Based on the results of this assessment there are no archaeological constraints to the proposal and according to the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* the proposed works can therefore proceed with caution.



Figure 1. Location of study area

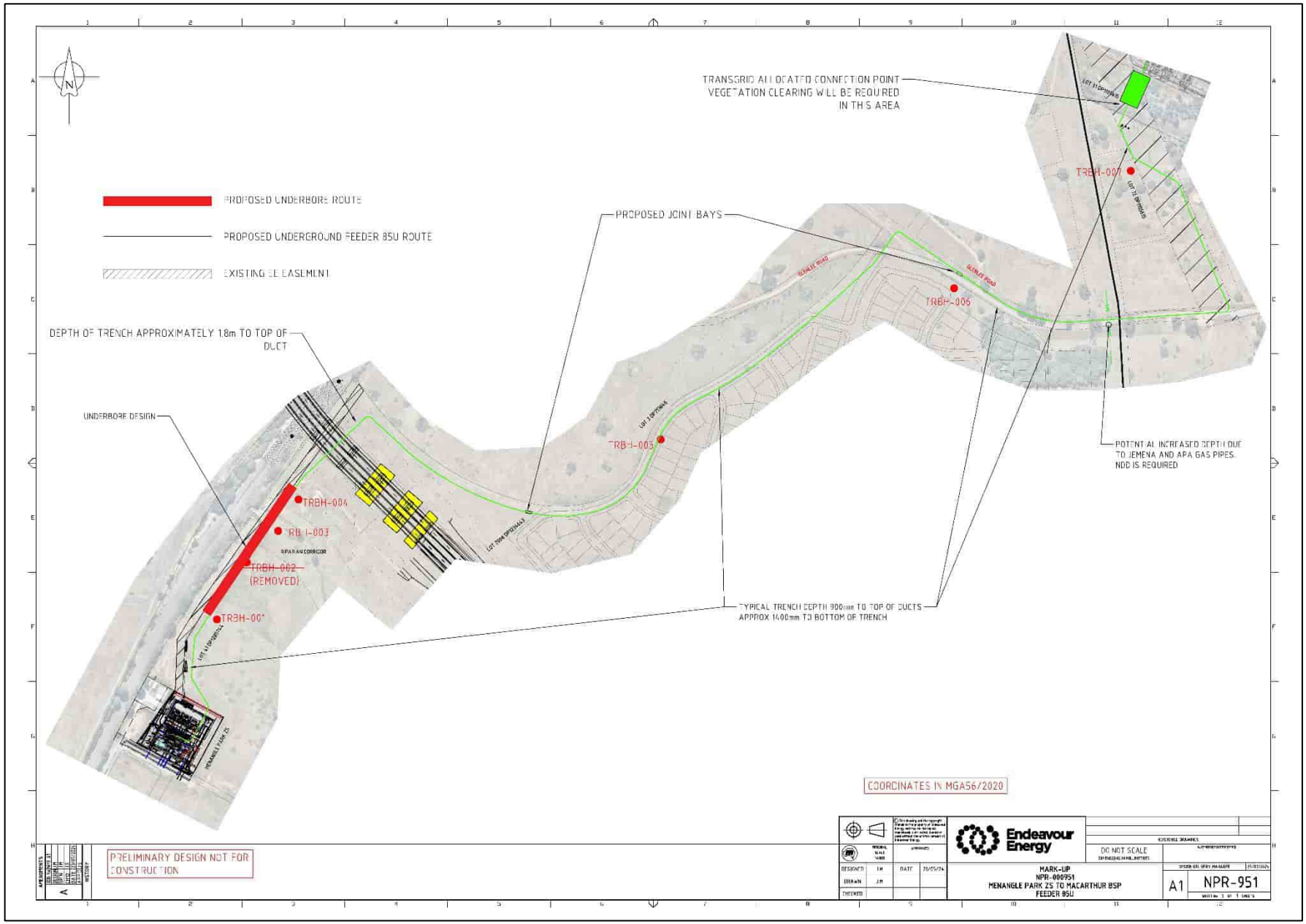

Figure 2. Site layout plan

2 Assessment Process

2.1 Identify if the proposed activity will disturb the ground surface

The proposed works will involve open trenching and launch/receival pits for the underbore, which would impact the ground surface and have the potential to impact on any Aboriginal objects or Aboriginal heritage items that may be present. Some level of ground disturbance is unavoidable for the proposal as a whole. As a result, the due diligence process progressed to the next step.

2.2 Database searches and known information sources

2.2.1 AHIMS web service

The Aboriginal Heritage Information Management System (AHIMS) is a database operated by Heritage NSW and regulated under section 90Q of the *National Parks and Wildlife Act 1974*. AHIMS contains information and records pertaining to registered Aboriginal archaeological sites (Aboriginal objects, as defined under the Act) and declared Aboriginal places (as defined under the Act) in NSW. A search of AHIMS was conducted on 2 June 2025 to identify registered (known) Aboriginal sites or declared Aboriginal places within or adjacent to the study area (AHIMS Client Service ID: 1010154). The AHIMS search results are attached as Appendix A and discussed below.

The AHIMS Web Service database search was conducted within the following coordinates (GDA 94, Zone 56):

Eastings:	291569 – 294534
Northings:	6224457 - 6226765
Buffer:	0 metres (search area included an extensive buffer)

The AHIMS search results showed:

41	**Aboriginal sites are recorded in or near the above location**
0	**Aboriginal places have been declared in or near the above location**

The distribution of recorded Aboriginal sites within these coordinates is shown on Figure 3. The frequencies of site types within the AHIMS database search area are listed in Table 1.

Table 1. Site features and context from AHIMS database search

Site Context	Site Feature	Number	*Frequency (%)*
Open	Artefact	38	*92.8*
	Artefact; Potential Archaeological Deposit (PAD)	1	*2.4*
	Potential Archaeological Deposit (PAD)	1	*2.4*
	Modified Tree (Carved or Scarred)	1	*2.4*
Total		***41***	***100***

AHIMS results indicate that nine of these sites have been destroyed and one has been partially destroyed. The AHIMS results, the nature of previously recorded sites and previous archaeological investigations in the area are discussed further in section 2.2.3.

2.2.2 Other heritage register searches

A search was undertaken of the following statutory and non-statutory heritage registers for Aboriginal heritage items:

- State Heritage Register and State Heritage Inventory
- Campbelltown Local Environmental Plan 2015
- Section 170 Heritage and Conservation Registers
- National Heritage List
- Commonwealth Heritage List
- Australian Heritage Database (Register of the National Estate – Non-statutory archive)
- Australian Heritage Places Inventory (Register of the National Estate – Non-statutory archive).

No Aboriginal archaeological sites or Aboriginal heritage items were recorded on these databases within the study area.

The State Heritage Registered historic property known as ‘Glenlee’ (SHR #00009) is located adjacent to the study area on the western side of the central portion of the alignment. The property is a rare surviving early 19th century pastoral holding, comprising a large 3,000 acre block granted to William Howe in 1818, with Glenlee homestead built in 1823. The property is located outside of the current study area extent and is not listed for Aboriginal heritage values, although the listing notes the area close to the house may have archaeological potential associated with its occupation and use by the Dharawal Aboriginal people prior to and immediately after European settlement.

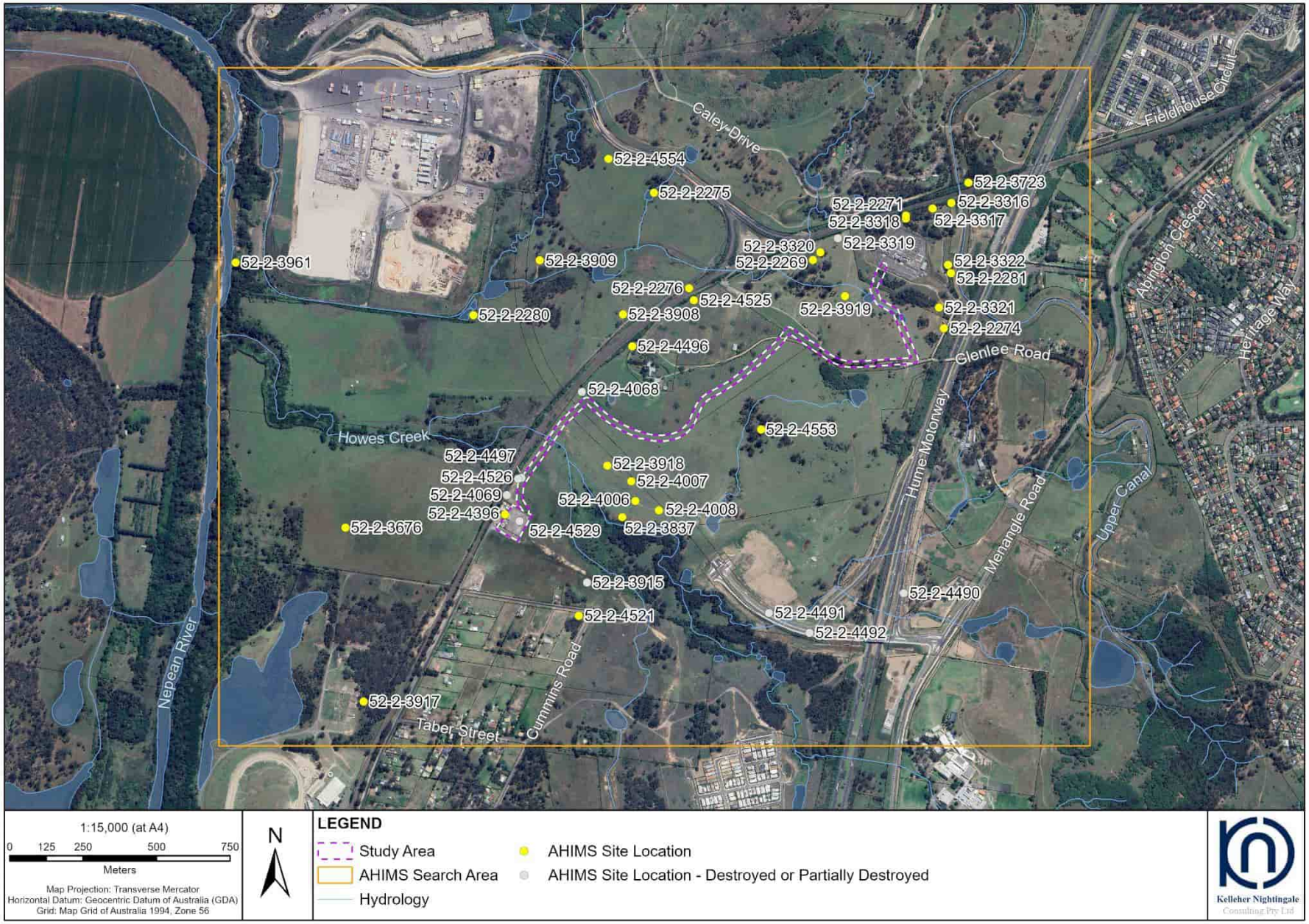

Figure 3. AHIMS Search Results

2.2.3 Previously recorded sites within the study area

There are two previously recorded AHIMS sites located within the study area boundary. Both sites have been destroyed under AHIP C0005561.

Menangle Park Feeder Isolated Find 01 (MPFIF 01) – AHIMS 52-2-4497
Site MPFIF 01 (AHIMS 52-2-4497) was located within the southern end of the current study area approximately seven metres southwest of the proposed underbore launch/retrieval pit on the southern side of Howes Creek. The site consisted of an isolated artefact identified on the slope of a raised, artificial embankment created by Sydney Water wastewater works adjacent to the Main Southern Railway. The artefact comprised a backed medial flake fragment of silcrete. Visibility at the site was high due to recent excavation however no other objects were identified. The artefact was located in a severely disturbed context. The site was subsequently destroyed under AHIP C0005561 issued for Endeavour Energy infrastructure works. The assessment context of the site is discussed further in section 2.2.5.

Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01) – AHIMS 52-2-4529
Site MPS AS 01 (AHIMS 52-2-4529) was located at the southern extent of the current study area within the Menangle Park Zone Substation area. The artefact site was registered by Artefact Heritage as part of investigations for the Menangle Park Zone Substation. Two positive test squares from the Niche 2013 investigation (see section 2.2.5) were located within Artefact's study area and these were registered as a new site. The site card noted that they formed part of a wider site extent (i.e. MPRP 8, see below) extending outside of the substation assessment area. No surface artefacts were identified. This AHIMS recording formed part of the wider confirmed extent of previously identified site MPRP 8 and was not considered to be a separate archaeological deposit. The site was subsequently included on AHIP C0005561 issued for Endeavour Energy infrastructure works and has been destroyed. The assessment context of the site is discussed further in section 2.2.5.

2.2.4 Previously recorded sites in the vicinity of the study area

Five further previously recorded sites were recorded in close proximity to the study area.

MPSW-AS1-13 – AHIMS 52-2-4069
Site MPSW-AS1-13 (AHIMS 52-2-4069) was located 30 metres west of the current study area at the southern end. The site comprised a low density subsurface archaeological deposit identified during test excavation as part of the Menangle Park Wastewater Servicing Project assessment. The site comprised six silcrete and two tuff artefacts located on an upper terrace adjacent to the south bank of Howes Creek. The artefacts were spread over approximately 170m. The assemblage included complete and broken flakes and one bifacial core. The site was assessed as of low scientific significance and has been destroyed under AHIP C0000393. The artefacts have since been reburied in a different location (see 52-2-4396 below). The assessment context of the site is discussed further in section 2.2.5.

MP - Reburial – 2017 – AHIMS 52-2-4396
The MP - Reburial – 2017 – (AHIMS 52-2-4396) site registration comprises the reburial of objects found at MPSW-IA1-13 and MPSW-AS1-13 during test excavation. AHIP C0000393 was issued to Sydney Water in 2014 for the Menangle Park Wastewater Servicing Project and stipulated that all artefacts recovered by the associated test program be reburied. The reburial location is within the Sydney Water SPS 1185 Pump Station site immediately east of the railway line, three metres northwest of the current study area. Artefacts were reburied in the southeastern corner of the site (within the pump station fence) and the reburial location registered on AHIMS. The reburial location is not within the current study area.

Menangle Park Feeder Artefact Scatter – 01 - AHIMS 52-2-4526
Site Menangle Park Feeder Artefact Scatter (AHIMS 01 - 52-2-4526) was located five metres northwest of the southern end of the current study area. The site comprised an open artefact scatter recorded on a raised, artificial embankment created by Sydney Water wastewater works adjacent to the Main Southern Railway. Two silcrete artefacts were identified in a disturbed exposure: one grey proximal flake fragment and one distal flake fragment. The site was recorded approximately 11 metres west of MPF IF 01. The site is within the Sydney Water AHIP C0000393 area and has been destroyed. The assessment context of the site is discussed further in section 2.2.5.

MPRP 8 Menangle Park Rezoning Project 8 – AHIMS 52-2-3915
Site MPRP 8 Menangle Park Rezoning Project 8 (AHIMS 52-2-3915) was originally recorded as an isolated find of an FGS flake on a sandy alluvial terrace/lower slope south of Howes Creek. The area had been affected by erosion, soil movement, stock movement, and localised small areas of sand mining. The AHIMS registered coordinate for the site was placed at this location, approximately 275 metres south east of the current study area. The wider landform was assessed by HLA in 2007 who recorded numerous artefacts over an area of approximately 30m x 100m including chert and quartz flakes, a hammerstone, a chert core, and a flake from volcanic material. The artefacts were all identified on the sandy alluvial part of the landform, visible in areas of erosion. Subsurface potential was considered to be high. The site was also associated with an identified Aboriginal cultural area.

The lower slope/terrace landform was later subject to archaeological test excavation by Niche (2013b, Transect 3). The test squares excavated in the vicinity of the previously recorded surface artefacts did not contain any further archaeological material and soils in the vicinity were typical of the Blacktown soil landscape. Further to the northwest, testing demonstrated intact archaeological deposit within the deep alluvial sands at the terrace boundary, with artefacts recovered between 25-95cm depth. Artefacts were mostly silcrete, followed by chert, quartz and volcanic. Unmodified debitage accounted for the majority of the assemblage however two cores were recovered of chert and silcrete, along with a broken silcrete flake tool. A pair of artefacts recovered from one square at the base of the slope was recorded as a grinding dish and grinding stone with a residue of yellow ochre. This site also incorporates an area of cultural significance as identified by Aboriginal stakeholders. Deposits associated with this site continued to the east along the creek corridor and are comparable with those identified at the northern end of Transect 2 (Niche 2013b). The assessed site extent was subsequently updated following further work by KNC in 2019, extending across the broad alluvial landform south of Howes Creek between the Main Southern Railway and the Hume Motorway.

A portion of MPRP 8 was subsequently included in the CHAR assessment and AHIP application for Stage 1 of the Dahua Menangle Park development (KNC 2020a) and incorporated in that AHIP. Partial salvage of the site was undertaken in October 2020 under AHIP 4648 in accordance with the AHIP conditions. Recently issued AHIP 5401 for further bulk earthworks and vegetation management for the Menangle Park development also incorporates a large section of the site extent across the southern side of Howes Creek, with the remaining site area contained within a Conservation Zone. The site extent in proximity to the current study area is largely contained within these two AHIP areas. A small portion of the initially-mapped wider MPRP 8 site extent overlaps the current study area at the Menangle Park Zone Substation. This portion of the site extent has been subject to severe levels of disturbance and is now located within a hardstand/bitumen covered area. It is not expected that any archaeological deposit associated with the site extends within this area.

MPSW-IA1-13 - AHIMS 52-2-4068

Site MPSW-IA1-13 was an isolated find identified during test excavation as part of the Menangle Park Wastewater Servicing Project assessment. The site consisted of a single silcrete medial flake fragment located on a mid slope landform south of Glenlee House overlooking Howes Creek. The site was assessed as of low scientific significance and AHIP C0000393 was subsequently issued for the site. The artefact has since been reburied in a different location (see 52-2-4396) and the site is listed as destroyed.

2.2.5 Previous archaeological investigations

Comprehensive archaeological investigations have been previously conducted within and surrounding the study area for the Menangle Park Urban Release Area (MPURA), including various stages of land releases, proposed residential developments and associated infrastructure projects. These have ranged from archaeological survey through test excavation and the formulation of management recommendations and strategies for conservation of Aboriginal heritage values as part of the ongoing development of the area. These archaeological investigations have resulted in the identification of two registered AHIMS sites within the current study area and several within 200 metres of the study area. AHIMS registered sites are shown on Figure 3. Relevant archaeological background for the study area and the registered AHIMS sites are discussed below.

Macarthur Substation, Menangle Park

An Aboriginal and historic archaeological assessment was completed prior to the construction of the Macarthur Substation and associated infrastructure at Menangle Park (Heritage Concepts 2006). The assessment included a review of background information, consultation with the Tharawal Local Aboriginal Land Council and an archaeological field survey. The assessment area was generally bound by the Main Southern Railway in the north and west, The Hume Highway in the east and Glenlee Road in the south, located within the portion of the current study area north of Glenlee Road. The area encompassed the headwaters of an unnamed west flowing creek and the crest and western slopes of a saddle landform that formed part of a ridgeline connecting Mount Annan in the north and Menangle Sugarloaf in the south. The assessment area was situated in an area determined to have moderate archaeological potential based on the regional model for the Cumberland Plain. The area had been extensively modified and cleared as a result of past agricultural land use practices related to market gardening and farming. Site types predicted to occur within the assessment were predominantly open artefact scatters; however it was also suggested that the potential occurrence and distribution of any Aboriginal sites within the assessment area would be dependent on the level of modern land use disturbance and development across the area.

The archaeological survey identified six previously unrecorded isolated surface artefacts (AHIMS 52-2-3316-52-2-3321) and three areas of potential archaeological deposit. Artefacts identified consisted of broken flakes, predominantly made from silcrete while one quartz artefact was also identified. The survey also inspected a tree with a bark removal scar (AHIMS 52-2-2281), recorded during a previous archaeological investigation and subsequently reregistered the site (AHIMS 52-23322). The previously unrecorded Aboriginal archaeological sites were generally located on a spur line south of the Main Southern Railway corridor; with one site located on the crest of a small rise that overlooked a confluence of the creek. The artefacts were located along vehicle tracks or areas of erosion and it was concluded that “it is unlikely that any of the artefact encountered on the surface have retained the integrity of their original depositional contest”

(Heritage Concepts 2006: 50). Ground surface visibility was assessed as very poor due to vegetation, limited to vehicle tracks and areas of erosion. The survey area had been cleared in the past with predominantly young regrowth. The area had been subject to variable levels of disturbance from past land use including grazing, cultivation and ploughing. It was recommended that a testing program be undertaken within the three PADs identified by the assessment and artefact collection at the six isolated find spots. A Consent to Destroy Permit was also recommended.

Menangle Park West Sand Deposit – Test Excavation and Archaeological Assessment
The Howes Creek corridor on the western side of the railway tracks was assessed in 2009 as part of an Environmental Impact Assessment for the proposed extraction of soil and sand in an area adjacent to the Nepean River (JMCHM 2009). Previous modelling by JMCHM 2004 had identified the area as displaying a mixture of Zone 1 (high archaeological potential) and Zone 2 (moderate archaeological potential). A more in-depth review of land use history was undertaken as part of the updated assessment and revised downward the amount of land previously identified as displaying high potential. Analysis of historical aerial photography also indicated that the area had been extensively and repeatedly cultivated. Test excavation was undertaken across the area.

A total of 24 test pits, each measuring 1m^2 and 1 metre deep, were excavated mechanically in three spits. Pits were aligned along five approximate transects designated A to E running north-south across the test area. Three additional test pits were excavated in areas where higher artefact densities were identified, and a further three pits were excavated but not sieved. In total, 30 pits were dug. A total of 183 'lithic' items were recovered: of these, 168 were stone artefacts, with the remaining fifteen comprising crenate fracture pieces of artefactual raw material, non-diagnostic fragments and two possible manuport pebbles (JMCHM 2009:29). The assemblage was mostly silcrete (n=102, 55.7%) but also included a moderate proportion of silicified tuff (n=38, 20.8%) and quartz (n=25, 13.7%). Quartzite (n=15), petrified wood (n=2) and a single hornfels artefact were also recovered.

Artefacts were recovered from 16 test pits, with only four pits containing more than ten artefacts. The absence of lithics from almost half of the test pits was considered unusual given the presence of a 4th order stream. Results were interpreted as indicating three site foci: in pit A1 in the northwest corner of the study area, in pits C6, C6a and C7 south of Howes Creek, and pits D6, D6a, D6b and D7 also south of Howes Creek. The two latter foci may have been part of a continuous scatter around the lower slope above the creek (JMCHM 2009:29). Artefact types included six cores, six backed artefacts, three bipolar pieces, and a white quartz retouched scraper tool, with the remainder of the assemblage comprising mixed debitage. Half of the cores and backed artefacts, the scraper, and the three bipolar artefacts were found in pit D6 or adjacent pits, indicating the site focus in this area. There was some relationship between artefact density, landform, soil type and distance from water.

The more intensive site focus was found to be on the sandy deposits south of Howes Creek, with this area assessed as displaying good archaeological potential. Moderate archaeological potential was ascribed to lower-density deposits in the north western and south eastern portions of the investigation area, on the sandy loams and pale sands. The remainder of the area was considered to display low archaeological potential and it was noted that the top 20-30cm of deposit across the area had been affected by previous cultivation. Management recommendations for the area were based on the updated archaeological zoning following the results of the test excavation. It was recommended that a s90 AHIP be sought for the soil and sand extraction, with provision for salvage of the area of good archaeological potential south of the creek. The remainder of the area required no archaeological mitigation.

Camden Gas Project
In 2007 HLA Envirosciences undertook further work in the Menangle Park area for the Camden Gas Project. The assessment included desktop review of previous assessments, Aboriginal community consultation and an archaeological field survey of the locations of proposed surface wells, gas lines and access tracks across Spring Farm and Menangle Park. Field survey identified a total of 25 Aboriginal archaeological sites, four of which were considered to be duplicates or additions to previous recordings. Of the remaining 21 new sites, thirteen were recorded at Spring Farm and eight were recorded at Menangle Park. Three sites (M2 - AHIMS 52-2-4006, M3 – AHIMS 52-2-4007 and M4 - AHIMS -52-2-4008) were located along an access track north of Howes Creek approximately 150 metres southeast of the current study area. Site M2 and M3 comprised low density artefact scatters of quartz and silcrete eroding out of the farm track. M4 consisted of an isolated silcrete flake identified on the same farm track with a background of natural ironstone. The three sites were considered to be in secondary context, likely moved downslope from the Blacktown Soil Landscape via erosion from a level area above the track. The disturbed context of these artefacts is a result of the erosional characteristics of sloping landforms within the Blacktown Soil Landscape and indicates the low potential for archaeological integrity to remain within these soils.

Aboriginal Heritage Impact Assessments – Menangle Park Urban Release Area
A large portion of the current study area was assessed during investigations for the MPURA by Niche Environment and Heritage in 2013. A series of Aboriginal Heritage Impact Assessments was completed as part of the rezoning process (Niche 2013a). The MPURA was divided into a number of Precincts which were assessed individually for their Aboriginal heritage, with Precinct 100 and Precinct 300 located within the current study area. The assessment included a review of previous studies and development of a predictive model for each Precinct. In general, the MPURA model considered that "the most likely areas to contain Aboriginal archaeological deposits within the MPURA are areas of low disturbance

within 200m of water […] on flat land and on slopes between 1 and 11.1 degrees... Where this land coincides with the Theresa Park soil landscape there is a higher likelihood for that area to contain contextualised Aboriginal archaeological sites of significant density which in turn increases the likelihood for those Aboriginal archaeological sites to be of moderate to high scientific archaeological significance" (Niche 2013a:20-21). Howes Creek was also identified as a key landscape feature associated with Aboriginal objects, with elevated landforms near the creek considered to have high potential for subsurface deposits.

Menangle Park Subdivision and Infrastructure Project – CHAR and Test Excavation – transect 3 and transect 8 within current study area

An Aboriginal Cultural Heritage Assessment Report (CHAR) and test excavation were subsequently undertaken by Niche in late 2013 (Niche 2013b, 2013c). The CHAR study area comprised 238ha of lands owned by UrbanGrowth NSW and included the majority of the current study area. Part of the assessment process included correcting erroneous site locations registered on AHIMS and submitting site card updates, as well as registering previously recorded (but not registered) archaeological sites within the project area. Archaeological sensitivity mapping was reviewed and the study area divided into zones of good potential (zone 1), moderate potential (zone 2), and low potential (zone 3), as per JMCHM (2010). Based on this sensitivity mapping the zones present within the current study area comprise zone 2 and zone 3, with no areas of good potential present.

Test excavation under the *Code of Practice for the Archaeological Investigation of NSW* (DECCW, 2010b) was conducted to sample landforms within Zone 1 and Zone 2 landscapes. Test areas were selected to sample a range of environmental and cultural factors, including soil landscape, distance to water, slope gradient/landform and disturbance history. Excavations were undertaken in 2013 with the participation of registered Aboriginal stakeholders. A total of 103 test pits (50cm x 50cm each) were excavated across six transects within the MPURA area. Test pits were spaced between 25m and 50m apart along transects to effectively sample the areas. Excavated depths ranged from 0.1m to 1.45m with a variety of soil profiles described. A total of 100 artefacts were recovered, mostly from Transects 2 and 3 and five artefacts from a single pit on Transect 7. Transects 1, 6 and 8 contained no artefacts. Overall artefact densities ranged from 0 to 15/0.25m^2 (extrapolated to 60/m^2), a moderate to high subsurface artefact density. No artefacts were recovered further than 350m from a permanent or temporary source of water and no artefacts were recovered from pits placed on slopes with a gradient greater than 4 degrees (Niche 2013b:54). Notable finds included a grinding dish and top-stone with ochre residue.

Transects 3 and 8 were located partially within the current study area boundary. Transect 3 ran approximately north west to south east, parallel to the southern side of Howes Creek east of the railway. This transect crossed the southern end of the current study area. A total of 26 test pits were excavated, comprising 21 pits and five extensions. This transect sampled the lower edge of the hillslope where it met the alluvial terraces and flats associated with Howes Creek. Elevation ranged from 74-80m with slopes from 0-4 degrees. Pits 317 and 318 were located in the vicinity of previously recorded surface site MPRP 8, while pits 306, 307 and 308 fell within the area identified by registered stakeholders as displaying Aboriginal cultural significance. In total, the sample area was 6.5m^2. The test area was situated along the boundary between the Blacktown and Theresa Park soil landscapes and variation was evident in the soil profiles. Test pits along the alluvial flat were deep and sandy, with pale brown sands transitioning to a darker olive brown sand towards the base. Soil profiles became shallower moving up slope away from the creek with increasing clay content, moving to the silty clay loams more typical of Blacktown soils. Severe disturbance was evident in some squares (e.g. pit 317) due to localised sand extraction. A total of 29 artefacts were recovered from testing at Transect 3, mostly silcrete (n=20), followed by chert (n=4), quartz (n=3) and 2 volcanic. Unmodified debitage accounted for the majority of the assemblage (n=24), however two cores were recovered of chert and silcrete, along with a broken silcrete flake tool. A pair of artefacts recovered from pit 308 was recorded as a grinding dish and grinding stone with a residue of yellow ochre. In general, artefact distribution was dispersed and of low density. No clear site focus was evident. The highest single point density was at pit 302, which contained 5 artefacts. Artefacts were recovered from depths between 25-95cm from the ground surface, and no artefacts were recovered in the upper part of the soil profile across the tested area. No subsurface deposit was identified in the vicinity of previously recorded surface artefacts at MPRP 8. Two test squares were located within the current study area at 301 and 310, with no artefacts identified at 301 and one flake identified at 310 (located within the existing Menangle Park Zone Substation area).

Transect 8 was located across the steeper ridge slopes north of Glenlee Road above a first order drainage line, crossing the northern portion of the current assessment area with one test square (803A) located within the current boundary. Ten test pits were excavated, with soils identified as relatively shallow and somewhat eroded. Deposit depths ranged from 15-35cm deep and comprised a brown silty clay topsoil with a high frequency of gravel overlying a reddish brown or yellowish brown clay B Horizon. Test pits were not aligned along the transect, instead being placed individually on flat areas of microtopography across the slopes. Elevation ranged from 80-125m AHD with slopes between 4-9.2 degrees. No artefacts were recovered from any test squares at Transect 8.

Higher artefact densities and deeper (potentially older) soil profiles were described for pits excavated within the Tal landscape on the southern side of Howes Creek. These areas were considered to display greater archaeological potential and sensitivity than those excavated on the shale hillslopes, which comprise the majority of the current study area.

Artefacts were present in 65% of test pits excavated in alluvial geological landscapes and in only 5% of test pits excavated in the Bringelly Shale geological landscape (Niche 2013c:25). Overall, the alluvial terraces and terrace/slope interface were considered to be the most sensitive landforms within the MPURA. Updated sensitivity mapping was undertaken based on the findings of the test excavation, landform parameters including slope gradient and distance to water, and an artefact density analysis. This mapping places the current study area predominantly within areas of 'Low Archaeological Sensitivity and Significance' and 'Low Potential for Intact Archaeology', with a small portion at the southern end within an area of 'Moderate Archaeological Sensitivity and Significance'. This Moderate area has since been disturbed by construction of the Menangle Park Zone Substation.

MPURA Aboriginal archaeological test excavation (KNC 2019)
Archaeological assessment for the Dahua MPURA project began in late 2017 and included comprehensive review of previous investigations. Preliminary field inspections were undertaken to locate previously recorded sites and identify areas for the proposed test excavation under the *Code of Practice* (DECCW 2010b). During these inspections, one new site was recorded: MPURA North IF 1 (AHIMS 52-2-4553) comprised an isolated find of a silcrete flake located in a treed area surrounding a drainage line on the slopes running south from the Glenlee Road ridgeline. The drainage line had been partially modified, running southwest to a farm dam before joining Howes Creek approximately 500m away. The treed area was previously identified as an archaeologically sensitive 'Zone 2' area by Niche (2013c). The area was found to be highly disturbed and has been used for rubbish disposal and dumping. Large areas of sheet erosion were also evident as well as vehicle tracks. Potential for associated subsurface deposit within the treed area was low.

It was confirmed that the majority of the study area had previously been subject to extensive archaeological field survey and that test excavation programs had taken place across large portions of the MPURA. Test excavation was recommended at two portions of the assessment area that had not been subject to previous testing, based on the presence of identified archaeological sites and lack of existing information. Additional testing for the majority of the study area was not required due to existing data. Test excavation was subsequently undertaken in July-August 2018. The two investigation areas were named 'Menangle Park North' and 'Menangle Park South'. Menangle Park North was located approximately 300 metres northwest of the current study area and is discussed below. Menangle Park South was located further away, approximately two kilometres south of the current study area.

Testing at Menangle Park North comprised excavation in five areas, including in the vicinity of previously recorded surface sites GL12 and MPRP 2. Test squares ('TS') were aligned along transects positioned to sample various landform elements in the investigation area. Transect 1 (MPN1) was positioned on a lower slope/alluvial flat in an area of remnant vegetation immediately south of the creekline. Five test squares were excavated, recovering three artefacts from TS1 and one from TS2. Artefacts from TS1 included two distal flake fragments with backing and an angular fragment, all found between 15-25cm deep. The single quartzite angular fragment was recovered from 30-40cm depth in TS2. Soil profiles were relatively deep (<65cm) and sandy, with pale brown sands overlying a pale, bleached stratum above yellow sandy clay. Sands became coarser with depth. The influence of the nearby creek was apparent with a small amount of alluvial silt and well-rounded Fe/Mn nodules increasing in size and frequency down the profile and forming a hard pan in TS4 and TS5. This area was previously identified by Artefact Heritage as a PAD and testing confirmed that archaeological deposit is present in the western part of the treed area. Mean artefact density across the test area was 3.2/m^2 with a high point at TS1 which displayed an extrapolated density of 12/m^2 at this location. Given its landform context the deposit identified at MPN1 was considered to form part of existing site MPRP 2.

Testing at area MPN2 aimed to investigate the northern part of the very gentle slope containing previously identified site MPRP 2. Six test squares were aligned along the edge of a treed area north of a vehicle track leading west to the coal washery. Five of the six squares were found to contain artefacts (total n=17). The highest density (n=6) was in TS6 at the northern end of the transect, followed by three each in the adjoining TS7 and TS8 and four in TS9. TS11 at the southern end of the transect contained a single artefact. Artefacts were predominantly silcrete of varying colours, one MGS and one quartzite. All were unmodified debitage apart from one backed silcrete distal flake fragment from TS9. Soils in this area were shallower (<30cm), comprising grey to grey-brown silty clay loams above yellowish brown clay B horizons. Test squares showed bioturbation from insect and tree root activity with several large roots and former root channels evident. Mean artefact density across the test area was 11.3/m^2 with the high point being TS6 which displayed an extrapolated density of 24/m^2 at this location. Given its landform context and the continuation of recorded artefacts upslope, the deposit identified at MPN2 is considered to form part of existing site MPRP 2.

MPN3 comprised three test squares (TS12-14) located on a well-defined spur crest/knoll landform to the north west of MPN2 which offered extensive views to the south. All three squares were found to contain archaeological deposit. Artefacts included a quartzite proximal fragment, two silcrete angular fragments (one backed), a backed angular fragment of quartzite and a heavily worked multidirectional dark grey silcrete core. Deposit on the hill crest was shallow (<20cm), comprising reddish brown fine silty loam above a compact plastic red clay B horizon. All artefacts were recovered from the upper 10cm of the deposit. Some historical disturbance was evident in the deeper (28cm) middle test square (TS13), with glass, glazed ceramic and other rubbish to 20cm depth. Fragments of historical shaped sandstone were also identified in TS13. Mean artefact density across the test area was 6.7/m^2 with the high points being TS12 and TS14 which displayed an extrapolated density of 8/m^2 at these locations. Given the presence of artefacts and the distinctive landform, the area was designated as site MPURA North AFT 1 (AHIMS 52-2-4554).

MPN4 was positioned to test the landform associated with previously recorded site GL 12. Eleven test squares were aligned along two transects on either side of the first order drainage line. Squares on the eastern side of the drainage line were found to be shallow (<20cm) deposits of uniform stiff yellow-brown silty clay loam to clay loam above plastic yellow clay B horizons. No artefacts were recovered from these squares. Squares to the west of the drainage line tended to be deeper (c.25-30cm) and displayed friable grey-brown silty clay loam with increasing clay content and fine Fe/Mn inclusions above compact red-brown light clay to clay. Bioturbation was evident throughout.

One artefact was recovered from the western squares, comprising a grey silicified tuff core with three negative scars and 0% cortex, at 15cm depth in TS21 just south of the dam. Mean artefact density across the test area was low at just 0.4/m^2 with the high point being TS21 which displayed an extrapolated density of 4/m^2 at this location. The additional artefact found at MPN4 is part of the same context as GL 12 (located on the western side of the eroded drainage gully below the dam wall) and is considered to form part of that site.

MPN5 comprised seven test squares positioned on a transect running approximately north-south through the MPRP 2 site area. The aim of testing at this locale was to identify if the site had a subsurface component as well as the recorded surface artefacts. Squares were positioned running up the unformed vehicle track and gentle slope to the north of the recorded site location. Four test squares were found to contain artefacts (total n=15) with the highest density at TS31 (n=11). Artefacts were predominantly silcrete (n=12) along with one example each of quartz, chert and petrified wood. Artefacts mostly comprised unmodified debitage, however a silcrete flake with usewear was found at TS27 while high density square TS31 contained a small (exhausted) silcrete core with two negative flake scars and two backed artefacts.

Soils were generally shallow (<20cm) grey-brown to yellow-brown silty clay loams with scattered fine Fe/Mn flecking above yellow-brown plastic clays. Deeper deposit was evident on the southern part of the transect in TS31 and TS32 closer to the creek. There was some evidence for subsurface disturbance at the northern part of the transect near the old haul road, with a shallow fill layer of redeposited coal fragments and black shale in the upper 10cm however this was localised. There was also evidence for agricultural disturbance and former cultivation of the paddock with long furrows across the ground surface in many areas. No deeper alluvial or sandy soils were evident, with the test squares displaying profiles more typical of the Blacktown soil landscape. Mean artefact density across the test area was 8.6/m^2 with the high point being TS31 which displayed an extrapolated density of 44/m^2 at this location. The additional artefacts identified at MPN5 formed part of previously recorded site MPRP 2.

Menangle Park Site-Wide Bulk Earthworks & Vegetation Clearance Aboriginal Cultural Heritage Assessment Report
KNC were engaged by Dahua to assist in the preparation of an Aboriginal cultural heritage assessment report (CHAR) for the wider MPURA study area, with specific impact assessment related to proposed site-wide bulk earthworks and vegetation clearing activities under Development Application (DA) 3574/2019/DA-CW (KNC 2025). The CHAR was prepared to support the application for an AHIP, building on the results of previous assessments and consultation regarding the proposal including background research, field survey and the test excavation program. The assessed area contains the majority of the current study area extent.

Background research and previous archaeological assessment identified thirteen extant sites and four previously destroyed sites wholly or partially located within the site-wide bulk earthworks and clearing area and three Aboriginal cultural areas within the wider study area. Sites included open artefact scatters, isolated finds and subsurface archaeological deposit of varying density and integrity. The transition between the elevated alluvial terraces and adjoining slopes was identified as an area of particular interest, given the intact and higher density deposits identified along this liminal zone. Areas of low disturbance were identified to retain higher archaeological potential than those adversely affected by previous landuse. Flatter areas were stated to contain higher density or more intact deposit, with artefacts identified on the slopes being frequently out of context or forming part of shallow, eroded deposits as evidenced by the absence of artefacts recovered during previous test excavation of areas of slope across the MPURA.

Significance of sites within the impact area was determined due to their proximity to a major permanent watercourse (Nepean River) and the permanent tributary of Howes Creek, the confirmed presence of subsurface archaeological deposit, previous assessment as an area of high sensitivity, and through identification of moderately intact soils relatively unaffected by modern landuse and environmental factors. The transition between the elevated alluvial terraces and adjoining slopes was identified as an area of particular interest at site MPRP 8, given the intact and higher density deposits identified along this liminal zone. The site extent of MPRP 8 was located partially within the current study area at the now disturbed Menangle Park Zone Substation, continuing to the east within the less disturbed portion of the higher level Tertiary low relief sandy alluvial terrace south of Howes Creek.

Aboriginal archaeological sites within the wider study area were considered by Dahua in relation to the design and planning of the development, with four Conservation Areas established which intersected with known Aboriginal sites and cultural areas. Thirteen extant Aboriginal archaeological sites were situated at least partially within the proposed impact area. Archaeological significance of the identified Aboriginal sites was defined by the information exhibited by each site and ranged from low to moderate-high. A mitigation program was proposed, including archaeological salvage to be undertaken where at least moderately significant Aboriginal archaeology would be impacted by the proposed works. Surface artefact collection was also recommended for all sites prior to impact.

An AHIP application was made for Aboriginal objects within the boundaries of the site-wide earthworks and clearing area and included provision for impact mitigation through archaeological salvage excavation and community surface collection. The AHIP was issued in May 2025 for a duration of five years (AHIP 5401). Large portions of the current study area are within the boundaries of this AHIP (Figure 6).

Spring Farm Parkway Stages 1 and 2– Survey, Test Excavation and CHAR

A portion of the current study area was assessed for its Aboriginal cultural heritage values during investigations for the proposed Spring Farm Parkway, a 6.1 kilometre long link road to service existing and future residential land releases including Spring Farm, Elderslie, Menangle Park and Mount Gilead. An investigation was undertaken by Artefact Heritage in September 2017 and included an archaeological field survey (Artefact 2017a and 2017b). Review of background information identified seven previously registered sites within the Parkway study area, with four more within the immediate vicinity. Within Menangle Park, the Parkway study area crosses from north west to south east, following the northern bank of Howes Creek before joining the Hume Highway. The Parkway study area incorporated a narrow corridor south of the Glenlee estate property that continues south from the railway corridor, passing along the eastern side of the Menangle Park Zone Substation location. Portions of this corridor are within the current study area alignment.

The field survey described four areas of PAD (SFMP PAD-01 to SFMP PAD-04). PAD-01 and PAD-02 were located on gently sloping landforms in proximity to the Howes Creek tributary. PAD-03 and PAD-04 were located on the alluvial flat/slope interface north of Howes Creek, just to the west of the Hume Highway. Previously recorded sites were revisited and reassessed, including MPRP 2 where additional artefacts were recorded, and the cluster of recordings south of Glenlee House which were subsequently described as a 'site complex'. These included sites M2, M3 and M4 (AHIMS 52-2-4006-4008) and 'Menangle Park AGL' (AHIMS 52-2-3837). Menangle Park AGL was identified by test excavation undertaken by Biosis in 2011 in the vicinity of a proposed gas infrastructure corridor. Testing was limited to 15 50cmx50cm test squares, which recovered a total of 12 artefacts. Artefacts comprised silcrete and quartz flakes and flaked fragments. No further archaeological work was recommended in the area following the test excavation program. For the Parkway project, Artefact Heritage recommended further investigation of the identified PADs via test excavation under the *Code of Practice*.

KNC undertook test excavation and preparation of a CHAR for Stage 1 of the project in 2018 (KNC 2018a), comprising the part of the project corridor containing SFMP PAD-03 and SFMP PAD-04, along with SFMP PAD-05 (identified to the east of the Hume Highway during an addendum assessment). PAD 3 was located approximately 240 metres west of the Hume Motorway corridor on a gently south sloping landform bound by a steep south sloping spurline to the north and an unnamed tributary of Howes Creek to the south. The test area was located to the south east of Transect 7 previously excavated by Niche (2013b). Seventeen 50x50cm test squares were excavated along four transects.

Soil profiles were typical Blacktown soils, characterised by silty loams over orange-brown clay B horizons of varying depth. No deep deposits or alluvial sands were encountered. Squares showed concentrations of Fe/Mn nodules at the transition between A and B horizons, indicating repeated waterlogging. A total of four artefacts were recovered from four test squares, giving a very low extrapolated site artefact density of 0.96/m^2. All artefacts were recovered from the upper 20cm of the deposit and comprised two silcrete flakes and a medial fragment and one quartz flake. The low artefact density, limited range of artefact types and dispersed spatial distribution of artefacts indicated a low potential to retrieve additional archaeological information from the site. The newly identified site was named Spring Farm Parkway AFT 1 (AHIMS 52-2-4491).

Excavation at neighbouring PAD 4 took place to the southeast on the opposite side of the creek tributary. Twenty-one 50x50cm test squares were excavated on a gently west sloping landform which overlooked the junction of two unnamed tributaries of Howes Creek, 90 metres west of the Hume Highway. Soil profiles showed some variation with distance from the creek, with those closer to the watercourse being slightly deeper with an increased presence of Fe/Mn in the deposit. Again, no deep deposits or alluvial sands were encountered. Two artefacts were recovered from the upper 20cm of deposit in two test squares, a quartz proximal fragment and a silcrete angular fragment. Mean artefact density across the tested area extrapolated to 0.4/m^2. Due to the presence of artefacts at the PAD, it was reclassified/renamed Spring Farm Parkway AFT 2 (AHIMS 52-2-4492). Significance assessment undertaken for the CHAR determined both sites to display low archaeological significance. The identified sites were not a focal point for the creation of stone artefacts and the artefacts were considered to represent isolated events which had been disturbed by natural processes or past land use practices.

It was considered unlikely that further investigation could contribute to an understanding of Aboriginal landscape use in the region. It was recommended that an AHIP be sought for the sites and for the land within the project area. AHIP 4894 was subsequently issued for construction of the project in May 2022 for a duration of ten years. Portions of the southern half of the current study area are located within the boundaries of this AHIP (Figure 6). Results from the Spring Farm Parkway program indicate that deposits identified in the Blacktown soils along Howes Creek tend to be of lower density and are more representative of 'background scatter' and low frequency discard events as people moved through the landscape. Despite their superficial similarity, the elevated landforms immediately north of the Howes Creek corridor displayed shallower soil profiles with little sand content and few Aboriginal objects.

Menangle Park Water Infrastructure

Additional investigations have been undertaken in recent years as part of infrastructure planning and development for water, wastewater and electrical services to the MPURA. These have led to the identification of additional archaeological sites within generally narrow investigation corridors, including investigations undertaken for the Menangle Park Wastewater Services project (AECOM 2014). The project included the construction of a pumping station approximately 200 metres north of the Menangle Park Village and a narrow corridor adjacent to the southern boundary of the Main Southern Railway extending from Beersheba Parade in the south to the intersection of Menangle Road and Glen Alpine Drive in the north. This narrow corridor runs immediately adjacent to the southern end of the current study area.

The investigations included an archaeological survey and test excavation. The survey identified disturbance areas associated with the Howes Creek flood plain and an area where olive groves had been cleared within the Glenlee estate. A test excavation program was undertaken and comprised 42 test pits, of which five contained artefacts. The artefacts were primarily recovered from test pits that were located across an area of 170 metres within the upper terrace landform on the southern side of Howes Creek and were subsequently registered as MPSW-AS1-13 (AHIMS 52-2-4069), located 30 metres west of the current study area. The artefacts recovered at MPSW-AS1-13 comprised five silcrete and two IMT unmodified flakes or flaking debitage and one silcrete multiplatform core. The artefacts were generally less than 25 millimetres with the largest artefact consisting of a silcrete flaked piece with a maximum dimension of 35 millimetres. None of the artefacts retained cortex. The site was assessed as having low archaeological significance and possibly impacted by flooding events. A single silcrete medial flake was recovered during the test excavation on a mid slope landform on the northern side of Howes Creek, registered as MPSW-IA1-13 (AHIMS 52-2-4068), located 100 metres northeast of the current study area. MPSW-IA1-13 was assessed as exhibiting low archaeological significance and likely to be in a disturbed context. An AHIP for the Menangle Park Wastewater Services project (AHIP C0000393) was issued on 1 July 2014 and artefacts recovered from the test excavation were reburied within the Sydney Water Pump Station site. The reburial location was registered on AHIMS as 'MP-Reburial-2017' (52-2-4396). MPSW-IA1-13 was subsequently destroyed under the AHIP.

Menangle Park Zone Substation and Feeder

Archaeological assessment was required for a proposal by Endeavour Energy to establish a new mobile interim Menangle Park Zone Substation to service the initial Menangle Park electricity load growth (Artefact 2018). This required a new underground electricity network transmission feeder connection between the Transgrid Macarthur Bulk Supply Point and the new Zone Substation. A portion of this assessment area follows the southern end of the current study area alignment and crosses the current study area at the northern extent, south of the Macarthur Substation. The proposal included installation of the Menangle Park Zone Substation, a mobile zone substation located approximately 200 metres north of the Menangle Park Village and an associated underground electricity line connecting the substation to the Macarthur Bulk Supply Point, running adjacent to the southern boundary fence of the Main Southern Railway. Several sections of the feeder corridor overlapped or were immediately next to the corridor of the Menangle Park Wastewater Services project (AECOM 2014). The project area traversed the floodplain adjacent to Howes Creek and lower slopes of a spur that descended to the west from the ridgeline connecting Mount Annan and Menangle Sugarloaf.

The investigations identified two sites within and immediately adjacent to the current study area at the southern end, located along an artificial embankment created by works associated with the Menangle Park Wastewater Services project. This included Menangle Park Feeder Isolated Find 01 (AHIMS 52-2-4497) which is located within the current study area, containing one backed silcrete medial flake fragment and Menangle Park Feeder Artefact Scatter 01 (AHIMS 52-2-4526), located 5 metres northeast of the current study area, consisting of two silcrete flake fragments. The investigations also identified two isolated artefacts (Menangle Park Feeder Isolated Find 02 and 03 - AHIMS 52-2-4496 and 52-2-4525) within the Glenlee estate. Menangle Park Feeder Isolated Find 02 consisted of a silcrete multiplatform core identified within an area of disturbance associated with the Menangle Park Wastewater Services project works. Menangle Park Feeder Isolated Find 03 was a silcrete proximal fragment located within an erosion scour adjacent to an existing fence line that appeared to have been subject to past disturbance.

The artefacts recovered by a test excavation undertaken for the Menangle Urban Release Area project within the substation investigation area and previously registered as part of MPRP 8, were reregistered as Menangle Park Subdivision Artefact Scatter 01 (AHIMS 52-2-4529), located within the current study area. This AHIMS recording forms part of the wider confirmed extent of previously identified site MPRP 8 and was not considered to be a separate archaeological deposit. An AHIP for the Menangle Park Zone Substation and Feeder project (AHIP C0005561) was issued on 21 January 2020 for a duration of two years. The AHIP authorised harm to three sites including the two sites located within the current study area (MPS AS 01 and Menangle Park Feeder Isolated Find 01), which have subsequently been destroyed. The results of this investigation indicates that landforms associated with Howes Creek may contain Aboriginal objects, however when in proximity to the railway line these landforms have been subject to high levels of ground disturbance, with sites most likely to occur as isolated objects or low density artefact scatters within a disturbed context.

Artefact Heritage subsequently undertook an assessment for the current proposal in early 2024 (Artefact 2024). The assessment comprised register searches, background information review and environmental assessment along with a visual inspection. No Aboriginal objects or archaeological sites were identified within the current study area as a result of the assessment.

Review of existing archaeological data (AHIMS sites and previous investigations) identified the same archaeological context as the current assessment, with two destroyed sites within the study area and the presence of existing AHIPs. The visual inspection noted high levels of disturbance associated with existing infrastructure and around Howes Creek, and noted that Aboriginal archaeological deposit would be more likely in areas with less land use impact. Additional assessment was recommended.

Summary and Implications for Study Area

A review of the database searches and associated background information identified two previously registered Aboriginal archaeological sites, Menangle Park Feeder Isolated Find 01 (MPFIF 01) (AHIMS 52-2-4497) and Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01) (AHIMS 52-2-4529) within the current study area. Both sites have been destroyed under AHIP C0005561 and are no longer extant.

Four further Aboriginal archaeological sites were registered in proximity to the current study area, including MPSW-AS1-13 (AHIMS 52-2-4069), MP - Reburial – 2017 (AHIMS 52-2-4396), MPSW-IA1-13 (AHIMS 52-2-4068) and Menangle Park Feeder Artefact Scatter – 01 (AHIMS 52-2-4526). MP - Reburial – 2017 consists of an artefact reburial site located adjacent to the current study area within the Sydney Water SPS 1185 Pump Station. Sites MPSW-AS1-13, MPSW-IA1-13 and Menangle Park Feeder Artefact Scatter – 01 have both been destroyed under AHIP C0005561 and are no longer extant.

Previously identified Aboriginal archaeological sites within proximity of the study area generally consist of artefact scatters and isolated finds, with one culturally modified (scarred) tree identified >200 metres east of the current study area. Aboriginal archaeological sites in the vicinity of the assessment area have mostly consisted of isolated artefacts or low density artefact scatters identified within disturbed contexts. Past test excavation programs undertaken within the sloping landforms of the Bringelly Shale geological landscape have identified a very low archaeological potential within these landforms. Better archaeological integrity is encountered within the alluvial terrace landforms south of Howes Creek where impacts from land use disturbance has been limited (e.g. site MPRP 8). Archaeological evidence suggests that whilst Aboriginal objects are known to occur in and near the study area, the likelihood of intact subsurface deposit will vary significantly based on the level of environmental and anthropomorphic disturbance. The current study area has been subject to a high level of land use disturbance, leading to a low likelihood of any intact archaeological deposit remaining within the study area.

2.3 Landscape Assessment

The *Due Diligence Code of Practice* identifies several landscape features that were often used by Aboriginal people in the past and consequently are often associated with Aboriginal objects, provided that the landscape has not been significantly disturbed. An evaluation of landscape features within the study area aids in assessing whether Aboriginal archaeology is likely to exist.

The study area is located within the suburb of Menangle Park and traverses several landforms characterised by gentle to moderate slopes, ridges, and the Nepean River Floodplain around the Howes Creek portion of the study area (Figure 4). The study area is located within the suburb of Menangle Park and traverses several landforms characterised by gentle to moderate slopes, ridges, and the low-lying Nepean River Floodplain (Figure 4). Original vegetation within the study area has been cleared, with the area now covered in exotic pasture grasses. Some areas of remnant native vegetation and regrowth are present along the Howes Creek watercourse to the east of the current study area and in isolated stands outside of the study area. The vegetation communities mapped for these areas include Cumberland Plain Woodland (both Shale Hills and Shale Plains variants) and Greater Sydney Enriched Grey Myrtle Dry Rainforest.

The study area is located on the southeastern margin of the Cumberland Plain, a large, low lying and gently undulating physiographic region of the Sydney Basin. The formation of the Sydney Basin began between 300 to 250 million years ago when river deltas gradually replaced the ocean that had extended as far west as Lithgow (Pickett and Alder 1997). The oldest, Permian layers of the Sydney Basin consist of marine, alluvial and deltaic deposits that include shales and mudstone overlain by coal measures.

The underlying geology of the study area consists of three primary units (Figure 5). The higher ground and slopes underlying the northern part of the study area are composed of Bringelly Shale (Rwb), a late Triassic deposit from the Wianamatta Group. Bringelly Shale is generally composed of shale, carbonaceous claystone, laminate, rare coal and tuff. Small occurrences of an unnamed Wianamatta sandstone member consisting of fine- to medium-grained quartz lithic sandstone are also found in the underlying geology, thought to be indicative of channel deposits on the Triassic coastal plain (Sherwin & Holmes 1986). Quaternary Alluvium (Qal) was deposited in association with fluvial activity along major creeks during the Pleistocene and Holocene epochs. Quaternary Alluvium borders the Howes Creek watercourse located towards the southern end of the study area, comprising quartz and other lithic fluvial sand, silt, and clay. The elevated ground at the southern extent of the study area was originally an alluvial landform, forming an older high level Tertiary terrace comprising Tertiary Alluvium (Tal). Raw materials suitable for artefact manufacture occur widely across the Cumberland Plain, in the form of rock outcrops, large cobbles and various river gravels, with cobbles, pebbles and clasts deposited across the landscape by the complex network of stream channels.

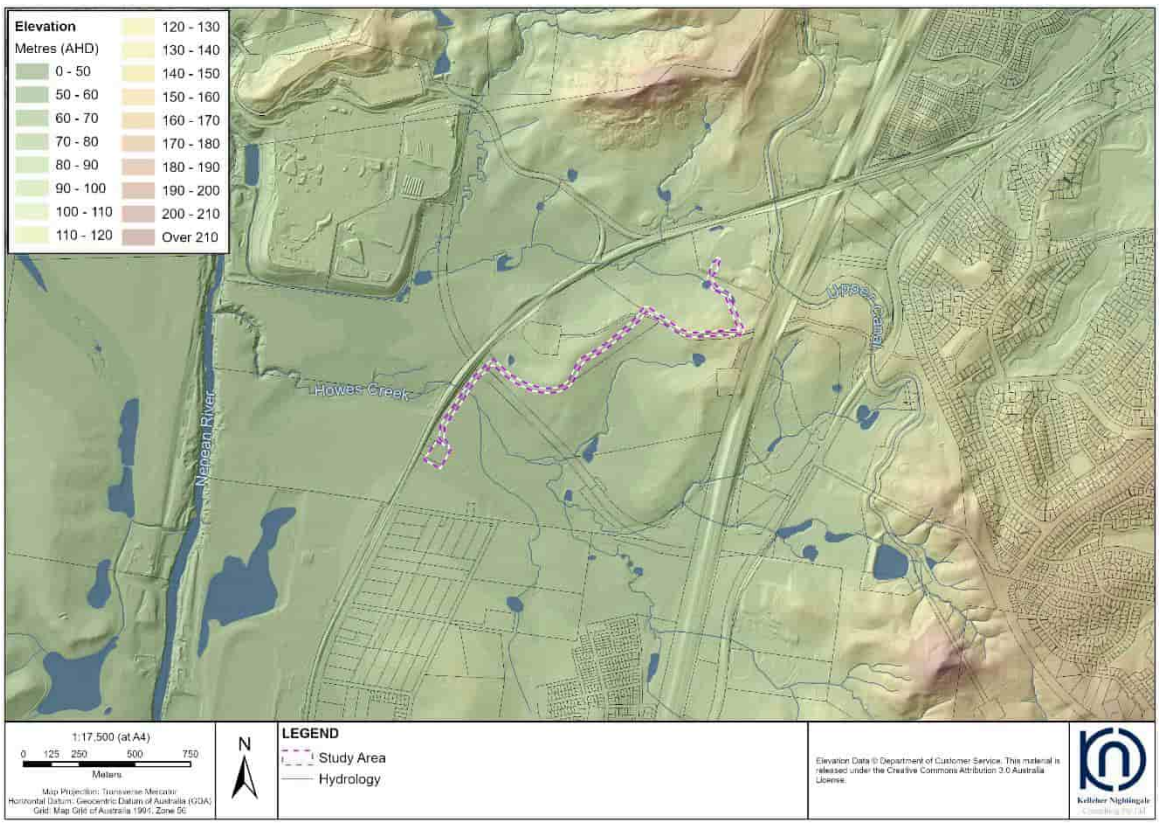

Figure 4. Topography of the study area

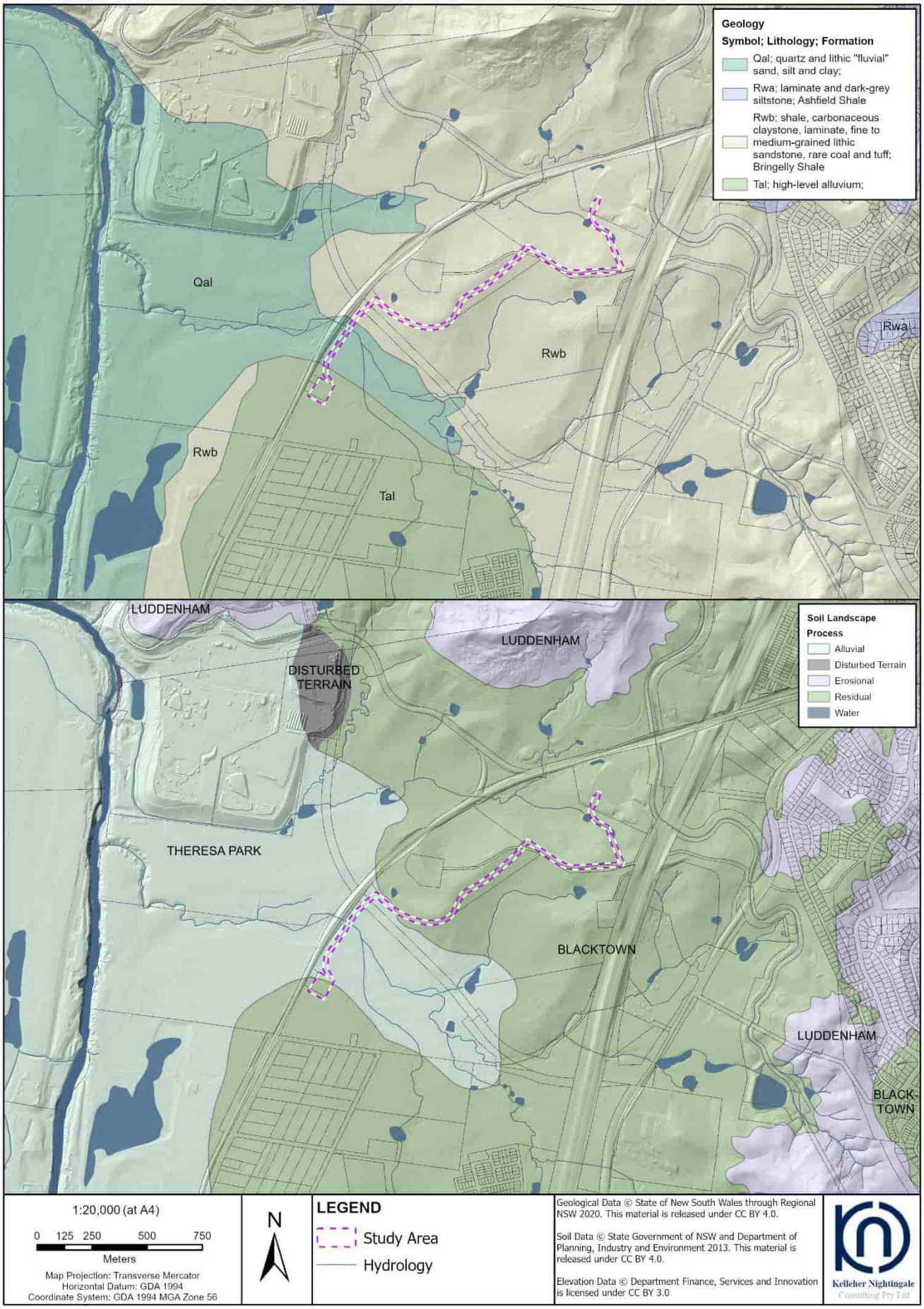

Figure 5. Geology and soils of the study area

Two soil landscapes occur within the study area which are closely related to underlying geology, hydrology and topography. Residual soils of the Blacktown soil landscape occur across the majority of the study area (Figure 5). Blacktown soils developed in situ from the underlying Bringelly Shale and are generally shallow to moderately deep and are characteristic of the gently undulating terrain across the Wianamatta Group on the Cumberland Plain (Hazelton and Tille 1990:27). The archaeological characteristics of these soils are well documented across the Cumberland Plain. In open (cleared of trees) sloping context these soils develop erosional (as opposed to colluvial) characteristics which are not conducive to the survivability of significant archaeological deposit. The sloping nature of the ground in the majority of the current study area is therefore not especially conducive to archaeological integrity.

Soils derived from the underlying alluvial geology (both Qal and Tal) are of the Theresa Park soil landscape. Theresa Park soils are highly variable and include poorly structured red to orange silty loams, brown loams, and sandy loams (Hazleton and Tille 1990). Soils generally contain significant amounts of fine sand. The erodibility of these soils is moderate, although the surface sands are generally stable when not subjected to concentrated flows or flood events. Soils are moderately deep to deep on floodplains and near terrace edges, while those along drainage lines are shallow to moderately deep. Archaeologically, these soils are conducive to artefact survivability, with the depth of sand bodies and alluvial terrace soils lending itself to the possibility of deep, stratified sites. However the occurrence of these soils within the dynamic environment of active floodplains means their integrity is highly variable.

Geotechnical investigation of the study area alignment was undertaken by Alliance Geotechnical (2024). Six boreholes were drilled to characterise the surface and subsurface conditions of the project area and to obtain Thermal Resistivity test data of soils at the proposed cable depths. Borehole locations are shown on maps included as Appendix B. Results of this investigation generally correlate with the known soil landscapes identified within the study area. Boreholes TRBH-005, TRBH-006 and TRBH-007 were located within the Bringelly Shale geological landscape and Blacktown soil landscape. These boreholes identified a silty clay deposit at the surface, reaching clay after 10cm depth at TRBH-005 and TRBH-006 while TRBH-007 continued as silty clay until the target depth of the borehole was reached at 2 metres. TRBH-006 encountered sandstone bedrock at 1 metre depth, correlating with the known potential for small occurrences of an unnamed Wianamatta sandstone member to occur within this landscape. The shallow depth of clay encountered within these boreholes reflects the erosional context of this portion of the study area located on sloping landforms and indicate the limited potential for intact archaeological deposit to remain.

Borehole TRBH-004 was located on the northern side of Howes Creek and TRBH-003 was located immediately south of Howes Creek. These locations were mapped within the Quaternary Alluvium geological landscape, close to the border with Bringelly Shale and within the Theresa Park soil landscape. The soils encountered within these boreholes were more reminiscent of Bringelly Shale, containing silty clay from the surface with clay present from 10cm depth at TRBH-004 and from 80cm depth at TRBH-003 with ironstone gravels. This likely reflects the location of these boreholes close to the border between Quaternary Alluvium and Bringelly Shale.

Borehole TRBH-001 was located approximately 150 metres southwest of Howes Creek, also mapped within the Quaternary Alluvium geological landscape and the Theresa Park soil landscape. This borehole revealed a deposit more characteristic of an alluvial landscape, comprising a sand deposit from the surface with a change to clayey sand at 1.7 metres, sand returning at 2 metres before reaching residual clay at 2.6 metres depth. Sub-rounded to rounded ironstone gravel was present from 90cm depth with increasing gravel roundness with depth. This result reflects the expectation of a deep sandy deposit within the alluvial terrace and correlates with the soils identified during test excavation programs within this area. These test programs have also identified high levels of land use disturbance and impacts of flooding within the upper portion of this sandy deposit, resulting in a very low density archaeological deposit with low potential for archaeological integrity where disturbance levels are high. No boreholes were located within the Tertiary Alluvium geological landscape at the southern end of the study area. These results indicate that the majority of the study area alignment is located within archaeologically unfavourable Bringelly Shale landforms containing shallow clay depths. The more archaeologically favourable alluvial landscapes located within a small portion of the study area south of Howes Creek have been subject to higher levels of disturbance, compromising the potential for intact archaeological deposit to remain at this location.

Hydrology within the study area is predominantly characterised by drainage lines and creeks that flow to the Nepean River which is located approximately one kilometre to the west. Howes Creek crosses the southern end of the study area, a third order watercourse and permanent tributary of the Nepean River. The natural hydrology of the watercourse has been impacted by construction of the railway line, with the creek flowing through a culvert beneath the railway. A minor tributary is located within the northern portion of the study area between Glenlee Road and the existing Macarthur Substation facility. The natural hydrology of this tributary has been interrupted by construction of online farm dams. The changing hydrology of the area has been remarked upon in previous assessments - it was noted during the Niche test excavation that a drainage depression in the east “forms an area of limited surface water with a shallow water table and may represent a past creek line which has since silted up. The drainage depression may hold surface water after periods of heavy rain or be associated with swamp vegetation” (Niche 2013b:56).

Land use within the study area has continued to be rural or semi-rural in nature. The study area is predominantly used as pasture with introduced grasses present in paddocks throughout the study area, with some areas subject to high levels of infrastructure-related disturbance including the Macarthur Substation, Glenlee Road, the Main Southern Railway, the Menangle Park Zone substation and feeder, the artificial embankment associated with the Sydney Water pumping station pipeline and the Howes Creek Bridge. Other historic land use disturbance includes tree clearing, online farm dam construction and cultivation, with an olive tree orchard previously located immediately adjacent to the current study area within the Glenlee Estate property (removed post-2014). Nine acres of orchard were also declared in the 1822 Muster for Glenlee, however the location of this is unknown and was likely outside of the current property extent.

An analysis of disturbance across the wider Menangle Park Urban Release Area as part of previous cultural heritage investigation identified varying levels of landscape disturbance in the area associated with buildings, roads, the Main South Railway, market gardens, poultry farms, BMX tracks, rubbish tips, formed tracks, dams, drains and other excavations, orchards, areas of vegetation clearance and cultivation, and areas disturbed by machinery (Jo McDonald Cultural Heritage Management (JMCHM) 2010:4-5). Natural processes of disturbance within the study area include erosion, colluvial movement on slopes and fluvial activity which occur as a result of the topography, hydrology, geology and soils within the landscape context. Overall land use disturbance within the study area is moderate, with localised areas of high to severe disturbance.

The study area is located in proximity to landform features (within 200 metres of waterways; ridgelines) which are often associated with Aboriginal occupation/activity as determined by the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010a). Based on the landscape assessment, the study area has the potential to retain Aboriginal objects and archaeological deposit in contexts where the ground has not been subject to significant disturbance.

2.4 Impact Avoidance

Background research did not identify any previously recorded extant Aboriginal objects in the current study area. The former site extent of MPRP 8 (AHIMS 52-2-3915) partially overlaps the southern end of the study area at the Menangle Park Zone Substation. Due to existing severe disturbance, it is not expected that any archaeological deposit extends within this area.

Landscape assessment identified the presence of landforms considered archaeologically sensitive by Heritage NSW under the *Due Diligence Code of Practice* (study area is in proximity to waterways and ridgelines). Activities associated with the proposed works would impact the ground surface to some degree and therefore have the potential to harm Aboriginal objects which may be present. Some level of ground disturbance to archaeologically-sensitive landforms is unavoidable for the proposal as a whole. As a result, the due diligence process progressed to the next step.

2.5 Desktop Assessment

The desktop review and assessment combined the results of heritage register searches, previous investigations and landscape assessment. Background research has confirmed that no extant Aboriginal archaeological sites occur within the study area. Two Aboriginal archaeological sites (Menangle Park Feeder Isolated Find 01 (MPFIF 01) - AHIMS 52-2-4497 and Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01) - AHIMS 52-2-4529) were previously located within the current study area however have since been destroyed under AHIP C0005561 and are not a constraint for the current Due Diligence assessment. Four Aboriginal archaeological sites were registered in close proximity to the current study area, including MPSW-AS1-13 (AHIMS 52-2-4069), MPSW-IA1-13 (AHIMS 52-2-4068), MP - Reburial – 2017 (AHIMS 52-2-4396), and Menangle Park Feeder Artefact Scatter – 01 (AHIMS 52-2-4526). MP - Reburial – 2017 consists of an artefact reburial site located adjacent to the current study area within the Sydney Water SPS 1185 Pump Station. Sites MPSW-AS1-13, MPSW-IA1-13 and Menangle Park Feeder Artefact Scatter – 01 have been destroyed under AHIP C0005561 and are no longer extant. The site extent of MPRP 8 (AHIMS 52-2-3915) partially overlaps the southern end of the study area at the Menangle Park Zone Substation. Due to existing disturbance, it is not expected that any archaeological deposit extends within this area.

The desktop assessment identified the potential for Aboriginal sites to occur in the form of open context artefact scatters, isolated artefacts and PADS within the study area, especially on elevated landforms located in close proximity to waterways, particularly the Howes Creek watercourse and on elevated ridgelines. Previously recorded sites of this type have been recorded in the general vicinity of the study area. The combination of topography and the Blacktown soil landscape found within the majority of the study area is generally not conducive to the survivability of archaeological deposit in open contexts, being prone to erosional characteristics within sloping landform contexts. The portion of the study area located within the more favourable Theresa Park soil landscape has been subject to higher levels of disturbance from land use, existing infrastructure and flood effects, resulting in a low potential for intact archaeological deposit to occur. Overall, disturbance levels across the study area are generally moderate to high and are associated with use of the study area corridor for agriculture, electricity and water related utilities and road infrastructure. Native vegetation has been cleared within the study area.

A favourable landscape assessment (waterways and ridgelines) and the presence of known Aboriginal archaeological sites within the local area necessitated a visual inspection of the study area as the next step of the Due Diligence process, to evaluate the findings of the desktop assessment.

2.6 Visual Inspection

The study area was inspected and assessed on the 30th May 2025 by Georgia Blanch and Cristany Milicich (KNC). The visual inspection aimed to identify Aboriginal objects or sites and assess the potential of the archaeologically sensitive landforms identified within the study area to contain Aboriginal objects.

No Aboriginal objects or areas of archaeological potential were identified within the study area. Several areas within the assessment boundary were located within unfavourable landform contexts or areas subject to high levels of disturbance by existing infrastructure. In many cases the environment within the study area was modified with little to no intact original soil. These areas are not conducive to artefact survivability and do not display archaeological potential.

The inspection commenced in the northern portion of the study area, south of the Macarthur Substation facility (Plate 1). The alignment follows a southwest direction from the substation within a vegetated area with a sloping, disturbed and modified ground surface identified. No old growth or mature native vegetation was present, with invasive weed species including Lantana and Narrow Leaf Cotton Bush identified. Small patches of ground surface exposures within the vegetated area were inspected with fill materials comprising plastic, brick, ceramic and glass fragments identified. Several blocks and fragments of lithic sandstone was also present on the ground surface (Plate 2), likely redeposited from the adjacent substation area during earthmoving for construction. At the southern extent of this portion of the alignment the ground surface becomes low-lying and swampy, associated with a drainage tributary. This portion of the study area was highly disturbed with no Aboriginal objects or areas of archaeological potential identified.

Inspection of the study area alignment then continued in a southeast direction towards the ridge crest at the intersection between Glenlee Road and a farm road (Plates 3 and 4). This portion of the study area follows the existing transmission alignment and was characterised by moderate to steep slopes descending from the ridge. The alignment crosses a drainage tributary modified by the construction of online farm dams. Ground visibility was limited with a few exposures adjacent to the existing power poles and within areas subject to hare burrowing activity. These exposures were inspected with soils identified as a reddish brown silty clay with some angular gravels resulting from slope wash. No Aboriginal objects or areas of archaeological potential were identified in this part of the study area.



Plate 1. View to southeast at northern extent of study area. Alignment extends down the slope through vegetated area. Existing Macarthur substation at left.



Plate 2. Redeposited blocky fragments of lithic sandstone on ground surface within study area south of Macarthur substation.



Plate 3. View to southwest between Macarthur substation and Glenlee Road, gentle slope descending from ridge crest. Online farm dam visible at left.



Plate 4. View to southeast along alignment towards Glenlee Road. Alignment follows existing power lines to the ridge crest at Glenlee Road in background.

Inspection of the study area alignment continued to the west along Glenlee Road. The road extends west along moderate to gentle slopes descending from the ridge crest. The study area follows the alignment of the existing disturbed road corridor and includes the verge on both sides. Several exposures were present within the road verge, with soils consisting of a reddish brown silty clay with mixed gravels ranging from small angular gravels to rounded cobbles (Plate 6). It is likely that these gravels are within a disturbed context resulting from construction of the road. The soils in this section of the study area were modified, truncated and highly disturbed by the existing roadway. A mature native tree was located next to the intersection between Glenlee Road and a farm road. This tree was inspected with no evidence of cultural modification (carved or scarred) identified. A small, bedded drainage gully composed of friable sandstone was located on the northern side of the road, running parallel with the road. Disturbance was evident within the verge on the southern side of Glenlee Road with signs indicating an existing buried gas pipeline (Plate 7). No Aboriginal objects or areas of archaeological potential were identified. The southern verge of Glenlee Road within the current study area is partially covered under existing AHIP 5401 (Figure 6).

The study area alignment then extends to the southwest along gentle to moderate slopes descending from a ridge to the northeast, following the boundary of the Glenlee estate property (Plate 8). The area was considered to display low archaeological potential, with Sydney Water earthworks in progress during the time of the visual inspection. This portion of the study area is covered under two existing AHIPs: 5401 and 4894 (Figure 6).



Plate 5. View to west from ridge crest along Glenlee Road. The study area follows the alignment of the existing road, descending along gentle to moderate slopes from trees in background.



Plate 6. View to southwest from Glenlee Road. Exposure within road verge containing a reddish brown silty clay soil.



Plate 7. View to southwest from Glenlee Road. Signs indicate location of existing buried gas pipelines within verge on southern side of road.



Plate 8. View west across study area, alignment follows the Glenlee estate fenceline. Current Sydney Water earthworks in progress within study area. Area covered under existing AHIPs 5401 and 4894.

Inspection of the southern end of the study area began at the Menangle Park Zone Substation. Disturbance was identified within the proposed substation area at the existing mobile substation, containing a large bitumen covered area of hardstand, with fencing and structures (Plate 9). This bitumen covered area was the location of previously registered site (now destroyed) Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01) (AHIMS ID 52-2-4529). The location of previously registered artefact reburial site MP - Reburial – 2017 (AHIMS ID 52-2-4396) was identified and confirmed to be within the existing Sydney Water compound to the west of the proposed substation area, outside of the current assessment extent (Plate 10).

The alignment continued north from the substation along the low-lying floodplain. The ground surface in this area was undulating with two old fence lines running northeast to southwest across the study area. An artificial embankment was located at the southern extent of this area adjacent to the Sydney Water compound. The alignment continued to the northeast, following the alignment of an artificial drainage embankment adjacent to the railway line. Existing buried water infrastructure was identified in this portion of the study area (Plate 11). The launch/retrieval pits on the northern and southern side of Howes Creek for the proposed underboring section of the alignment under were inspected and with no areas of archaeological potential identified. The alignment extends southeast from the northern launch/retrieval pit before continuing northeast to the Glenlee estate property boundary. No Aboriginal objects, Aboriginal archaeological sites or areas of archaeological potential were identified within this portion of the study area. The majority of the southern portion of the study area is covered under three existing AHIPS: AHIP C0000393, AHIP 5401 and AHIP 4894 (Figure 6).



Plate 9. View to northwest at proposed location for Menangle Park Zone Substation. Disturbance from existing mobile substation including road, large bitumen covered area, fencing and structures.



Plate 10. View to northwest at Sydney Water compound, location of registered artefact reburial site MP - Reburial – 2017 (AHIMS ID 52-2-4396). Location confirmed to be outside of current study area extent.



Plate 11. View northwest towards Howes Creek. Alignment follows artificial embankment on left. Proposed launch/retrieval pit for underboring south of fenceline. Existing buried water infrastructure visible on left. Area partially covered under existing AHIPs C0000393, 5401 and 4894.



Plate 12. View northeast at Howes Creek. Study area alignment runs to the right of existing bridge, proposed for underboring. Launch/retrieval pit located approximately 35 metres north of creek. Alignment continues to the northeast along hillslope bordering the Glenlee estate property boundary. Area partially covered under existing AHIPs C0000393, 5401 and 4894.

In summary, the visual inspection did not identify any Aboriginal objects or archaeological sites within the study area. The study area was either located in low lying areas, sloping landforms and/or had been heavily modified by existing landuse activities including construction of Glenlee Road, electricity and water related infrastructure, dam construction and cultivation practices. The majority of the study area is located under three current AHIPS: C0000393, 5401 and 4894 (Figure 7). No areas of subsurface potential were identified.

3 Statutory Requirements

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

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

Aboriginal objects are protected under section 86 of the Act. It is an offence to harm or desecrate an Aboriginal object, either knowingly [section 86 (1)] or unknowingly [section 86 (2)]. An Aboriginal heritage impact permit (AHIP) issued under section 90 (1) of the Act is required for any activity which will harm an Aboriginal object or declared Aboriginal place.

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

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

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

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

4 Summary and Recommendations

The study area was assessed under the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010a). No Aboriginal objects, archaeological sites or areas of archaeological potential were identified within the study area as a result of the due diligence assessment.

Two previously registered sites located within the study area (AHIMS 52-2-4497 and AHIMS 52-2-4529) have been destroyed under AHIP C0005561 and are no longer extant. One artefact reburial site was identified directly adjacent to the study area (MP - Reburial – 2017; AHIMS 52-2-4396) within the Sydney Water SPS 1185 Pump Station (Figure 3). The site is located outside of the study area boundary and will not be impacted by the proposal.

Landform and disturbance assessment found that contemporary land use has led to high levels of disturbance within the study area due to road construction, existing water and electricity-related infrastructure and agriculture. No areas of archaeological potential were identified within the study area.

Existing AHIPs C0000393, 4894 and 5401 partially overlap the majority of the current study area (refer Figure 6). These existing AHIPs allow impact to Aboriginal objects within their respective boundaries, provided that works are undertaken in accordance with the AHIP conditions. Endeavour Energy should confirm with the AHIP holders that the proposed works may be completed under these permits prior to commencing works.

Based on the results of this assessment there are no archaeological constraints to the proposal and according to the Heritage NSW *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* the proposed works can therefore proceed with caution.

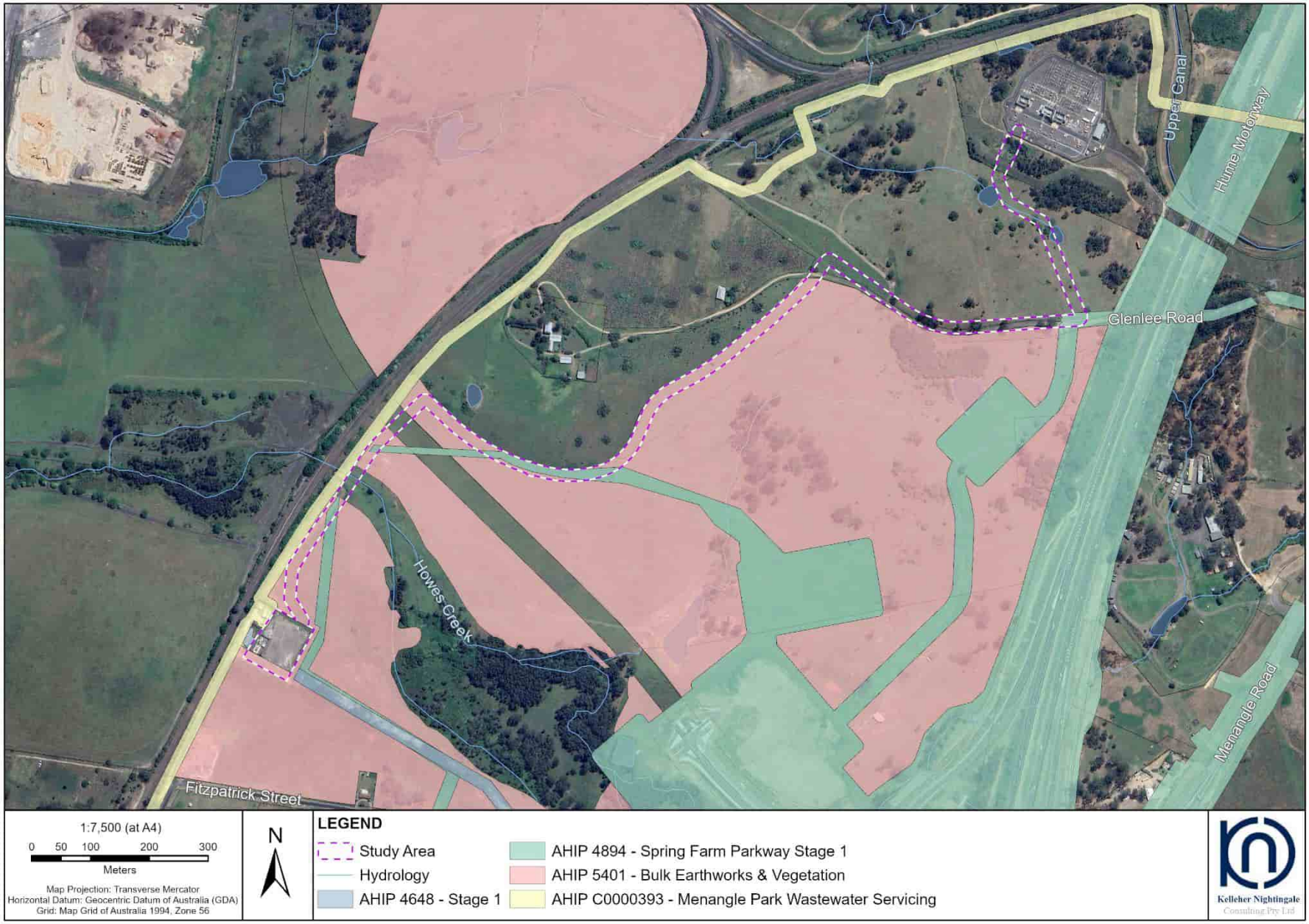

Figure 6. Existing AHIPS in relation to the current study area

References

AECOM, 2014. Menangle Park Wastewater Services: Aboriginal Cultural Heritage Assessment Report. Report to Sydney Water.

Alliance Geotechnical, 2024. Menangle Park ZS to Macarthur BSP Feeder 85U Glenlee Road, Menangle Park NSW: Geotechnical Investigation Report. Report to Endeavour Energy.

Artefact Heritage Services Pty Ltd (Artefact), 2017a. Spring Farm Link Road: Stage 1 and 2: PACHCI 2 Aboriginal Heritage Assessment. Report to Roads and Maritime Service.

Artefact, 2017b. Spring Farm Parkway: Stage 1 and 2: Addendum PACHCI Stage 2 Aboriginal Heritage Assessment. Report to Roads and Maritime Service.

Artefact, 2018. Menangle Park Zone Substation and Feeder: Aboriginal Due Diligence Assessment. Report to Endeavour Energy.

Artefact, 2024. Aboriginal Heritage Due Diligence Report – Menangle Park Zone Substation and Feeder 85U. Report to JBS&G.

Department of Environment, Climate Change and Water NSW (DECCW), 2010a. *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. Part 6 National Parks and Wildlife Act 1974. Department of Environment, Climate Change and Water NSW, Sydney NSW.

DECCW, 2010b. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. Part 6 National Parks and Wildlife Act 1974. Department of Environment, Climate Change and Water NSW, Sydney NSW.

Hazelton, P.A and Tille, P.J., 1990. *Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet*. Soil Conservation Service of NSW, Sydney.

Heritage Concepts, 2006. Aboriginal and Historic Archaeological Assessment of the proposed Macarthur Substation, Menangle Park. Report prepared for Maunsell Australia Pty Ltd on behalf of TransGrid.

HLA Envirosciences Pty Ltd, 2007. Camden Gas Project Stage 2 Concept Plan, Spring Farm and Menangle Park Project Areas: Aboriginal Heritage Assessment. Report to AGL Gas Production (Camden) Pty Ltd.

JMCHM, 2009. Test Excavation and Archaeological Assessment of Aboriginal PAD #52-2-3676: Proposed Soil & Sand Extraction at Menangle Park West, NSW. Report to Harvest Scientific Services and Landcom.

JMCHM, 2010. Archaeological Assessment of Indigenous Heritage Issues: Menangle Park Draft Structure Plan. Report prepared for APP Corporation Pty Ltd on behalf of Landcom and Campbelltown City Council.

Jo McDonald Cultural Heritage Management Pty Ltd (JMCHM), 2004. Additional archaeological assessment of Indigenous heritage issues Menangle Park rezoning. Report to APP Corporation Pty Ltd on behalf of Campbelltown City Council and Landcom.

Kelleher Nightingale Consulting Pty Ltd (KNC), 2018. Spring Farm Parkway: Aboriginal Cultural Heritage Assessment. Report to Roads and Maritime Services.

KNC, 2019. Menangle Park Master Plan: Archaeological Assessment – Test Excavation Report. Report to Dahua.

KNC, 2020a. Menangle Park Stage 1 DA: Aboriginal Cultural Heritage Assessment. Report to Dahua.

KNC, 2025. Menangle Park Site-Wide Bulk Earthworks & Vegetation Clearance: Aboriginal Cultural Heritage Assessment Report. Report to Dahua.

Niche Environment and Heritage (Niche), 2013a. Aboriginal Heritage Impact Assessment - DA04 (Precinct 100, 200, 300, 400 & supporting infrastructure). Report prepared for UrbanGrowth NSW.

Niche, 2013b. Archaeological Report: Menangle Park Subdivision and Infrastructure Project. Report prepared for SMEC Urban and UrbanGrowth NSW.

Niche, 2013c. Aboriginal Cultural Heritage Assessment: Menangle Park Subdivision and Infrastructure Project. Report prepared for SMEC Urban and UrbanGrowth NSW.

Pickett, J. and Alder, J., 1997. Layers *of Time: the Blue Mountains and their Geology*. Department of Mineral Resources: Sydney.

Sherwin, L. and G. Holmes (Eds), 1986. *Geology of the Wollongong and Port Hacking 1:100,000 Sheets 9029, 9129*. NSW Geology Survey, Sydney NSW.

Appendix A AHIMS Extensive Search Results

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 2427
Client Service ID : 1010154

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
52-2-3676	MenParkWestPAD	GDA	56	292000	6225200	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Ms.Elizabeth White					Permits	3137	
52-2-4496	Menangle Park Feeder Isolated Find 02 (MPFIF 02)	GDA	56	292976	6225817	Open site	Valid	Artefact : -		
	Contact	Recorders	Artefact Heritage and Environment - Pyrmont,Ms.Alyce Haast					Permits		
52-2-4492	Spring Farm Parkway AFT 2	GDA	56	293579	6224842	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor,Mr.Matthew Kelleher,M					Permits	4894	
52-2-3320	Mt Annan Macarthur Sub Station 5	GDA	56	293616	6226137	Open site	Valid	Artefact : 1		
	Contact Searle	Recorders	Niche Environment and Heritage,Heritage Concepts,Ms.Clare Anderson					Permits		
52-2-3917	MPRP 10 Menangle Park Rezoning Project 10	GDA	56	292062	6224608	Open site	Valid	Artefact : 1		
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,AECOM Australia Pty Ltd - Sydney,Ms.Norr					Permits		
52-2-4006	M2 2007	GDA	56	292987	6225291	Open site	Valid	Artefact : 1		
	Contact	Recorders	Niche Environment and Heritage,Ms.Clare Anderson					Permits	5401	
52-2-4497	Menangle Park Feeder Isolated Find 01 (MPFIF 01)	GDA	56	292599	6225369	Open site	Destroyed	Artefact : -		104277
	Contact	Recorders	Artefact Heritage and Environment - Pyrmont,Ms.Alyce Haast,Mr.Matthew Kelleher					Permits	4564	
52-2-3909	MPRP 2 Menangle Park Rezoning Project 2	GDA	56	292661	6226110	Open site	Valid	Artefact : -		
	Contact	Recorders	AECOM Australia Pty Ltd - Sydney,Ms.Norma Richardson,Mr.Matthew Kelleher,Kell					Permits	5401	
52-2-3918	MPRP 11 Menangle Park Rezoning Project 11	GDA	56	292891	6225411	Open site	Valid	Artefact : 3		
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,AECOM Australia Pty Ltd - Sydney,Ms.Norr					Permits	5401	
52-2-4068	MPSW-IA1-13	GDA	56	292805	6225662	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Mr.Geordie Oakes,Mr.Matthew Kelleher,Kelleher Nightingale Consulting Pty Ltd (G					Permits	3723	
52-2-4008	M4 2007	GDA	56	293067	6225259	Open site	Valid	Artefact : 1		
	Contact	Recorders	Niche Environment and Heritage,Ms.Clare Anderson,Mr.Matthew Kelleher,Kelleher					Permits	5401	
52-2-2281	GL16	AGD	56	293956	6225876	Open site	Valid	Artefact : 1		
	Contact	Recorders	Doctor.Julie Dibden,Heritage Concepts					Permits		
52-2-3723	CG-IA-16	GDA	56	294120	6226374	Open site	Valid	Artefact : 1		
	Contact	Recorders	Ms.Renee Regal					Permits		
52-2-3318	Mt Annan Macarthur Sub Station Site 3	GDA	56	293907	6226252	Open site	Valid	Artefact : 1		
	Contact Searle	Recorders	Niche Environment and Heritage,Heritage Concepts,Ms.Clare Anderson					Permits		
52-2-3321	Mt Annan Macarthur Sub Station Site 6	GDA	56	294020	6225949	Open site	Valid	Artefact : 1		
	Contact Searle	Recorders	Niche Environment and Heritage,Heritage Concepts,Ms.Clare Anderson,Mr.Matthe					Permits	4577	
52-2-2276	GL11	GDA	56	293169	6226015	Open site	Valid	Artefact : 1		
	Contact	Recorders	Doctor.Julie Dibden,Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor					Permits		
52-2-4396	MP - Reburial - 2017	GDA	56	292543	6225245	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Geordie Oakes					Permits		
52-2-4490	Spring Farm Parkway IF 1	GDA	56	293900	6224977	Open site	Destroyed	Artefact : -		

Report generated by AHIMS Web Service on 02/06/2025 for Matthew Kelleher for the following area at Datum :GDA, Zone : 56, Eastings : 291569.0 - 294534.0, Northings : 6224457.0 - 6226765.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 41

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 2427
Client Service ID : 1010154

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor,Mr.Matthew Kelleher,I					Permits	4894	
52-2-4525	Menangle Park Feeder Isolated Find 03 (MPFIF 03)	GDA	56	293186	6225974	Open site	Valid	Artefact : -		
	Contact	Recorders	Artefact Heritage and Environment - Pyrmont,Artefact Heritage and Environment -					Permits		
52-2-2275	GL12	GDA	56	293050	6226340	Open site	Valid	Artefact : 1		
	Contact	Recorders	Doctor,Julie Dibden,Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor					Permits	5401	
52-2-3837	Menangle Park AGL	GDA	56	292942	6225236	Open site	Valid	Artefact : 12, Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Biosis Pty Ltd - Wollongong,Mr.Paul Howard					Permits	5401	
52-2-4491	Spring Farm Parkway AFT 1	GDA	56	293441	6224910	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor,Mr.Matthew Kelleher,I					Permits	4894	
52-2-3319	Mt Annan Macarthur Sub Station 4	GDA	56	293676	6226185	Open site	Destroyed	Artefact : 1		104277
	Contact Searle	Recorders	Niche Environment and Heritage,Heritage Concepts,Ms.Clare Anderson,Mr.Matthe					Permits	4564	
52-2-3322	Mt Annan, Macarthur Sub Station - 7	GDA	56	294051	6226094	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	Contact Searle	Recorders	Heritage Concepts,Mr.Matthew Kelleher,Kelleher Nightingale Consulting Pty Ltd (G					Permits		
52-2-3908	MPRP 1 Menangle Park Rezoning Project 1	GDA	56	292945	6225926	Open site	Valid	Artefact : 12		
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,AECOM Australia Pty Ltd - Sydney,Ms.Norr					Permits	5401	
52-2-2269	GL14	GDA	56	293591	6226111	Open site	Valid	Artefact : 2		
	Contact	Recorders	Doctor,Julie Dibden,Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor					Permits		
52-2-4007	M3 2007	GDA	56	292973	6225358	Open site	Valid	Artefact : 1		
	Contact	Recorders	Niche Environment and Heritage,Ms.Clare Anderson					Permits	5401	
52-2-3919	MPRP 12 Menangle Park Rezoning Project 12	GDA	56	293700	6225988	Open site	Valid	Artefact : 1		
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,AECOM Australia Pty Ltd - Sydney,Ms.Norr					Permits		
52-2-4069	MPSW-AS1-13	GDA	56	292549	6225311	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Mr.Geordie Oakes,Mr.Matthew Kelleher,Kelleher Nightingale Consulting Pty Ltd (G					Permits	3723	
52-2-2274	GL15	AGD	56	293932	6225688	Open site	Valid	Artefact : 1		
	Contact	Recorders	Doctor,Julie Dibden					Permits		
52-2-2280	GL10	AGD	56	292331	6225733	Open site	Valid	Artefact : 5		
	Contact	Recorders	Doctor,Julie Dibden					Permits		
52-2-4526	Menangle Park Feeder Artefact Scatter 01	GDA	56	292587	6225366	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Artefact Heritage and Environment - Pyrmont,Artefact Heritage and Environment -					Permits		
52-2-3915	MPRP #8 Menangle Park Rezoning Project 8	GDA	56	292822	6225013	Open site	Partially Destroyed	Artefact : 1		
	Contact	Recorders	Kelleher Nightingale Consulting Pty Ltd,AECOM Australia Pty Ltd - Sydney,Ms.Norr					Permits	4648,4894,5401	
52-2-4529	Menangle Park Subdivision Artefact Scatter 01 (MPS AS 01)	GDA	56	292593	6225222	Open site	Destroyed	Artefact : -		104277

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Page 2 of 3

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 2427
Client Service ID : 1010154

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	Artefact Heritage and Environment - Pyrmont,Ms.Alyce Haast,Mr.Matthew Kelleher					Permits	4564	
52-2-2271	GL 16-14	AGD	56	293803	6226072	Open site	Valid	Artefact : 1		
	Contact	Recorders	Doctor.Julie Dibden					Permits		
52-2-4553	MPURA North IF 1	GDA	56	293415	6225534	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Matthew Kelleher,Kelleher Nightingale Consulting Pty Ltd (Generic users)					Permits	5401	
52-2-4554	MPURA North AFT 1	GDA	56	292895	6226455	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Matthew Kelleher,Kelleher Nightingale Consulting Pty Ltd (Generic users)					Permits	5401	
52-2-3316	Mt Annan, Macarthur Sub Station Site - 1	GDA	56	294062	6226305	Open site	Valid	Artefact : 1		
	Contact Searle	Recorders	Heritage Concepts					Permits	4303	
52-2-3317	Mt Annan, Macarthur Sub Station Site - 2	GDA	56	293998	6226286	Open site	Valid	Artefact : 1		
	Contact Searle	Recorders	Heritage Concepts					Permits		
52-2-4521	Fitzpatrick Site 1	GDA	56	292794	6224900	Open site	Valid	Artefact : -		
	Contact	Recorders	Biosis Pty Ltd - Wollongong,Mrs.Samantha Keats					Permits		
52-2-3961	Glenlee Isolated Find 1 2007 (Glenlee IF 1 2007)	GDA	56	291626	6226102	Open site	Valid	Artefact : 1		
	Contact	Recorders	Ms.Vanessa Hardy,Cultural Heritage Connections Pty Ltd					Permits		

**** Site Status**
Valid - The site has been recorded and accepted onto the system as valid
Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.
Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground
Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 02/06/2025 for Matthew Kelleher for the following area at Datum :GDA, Zone : 56, Eastings : 291569.0 - 294534.0, Northings : 6224457.0 - 6226765.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 41

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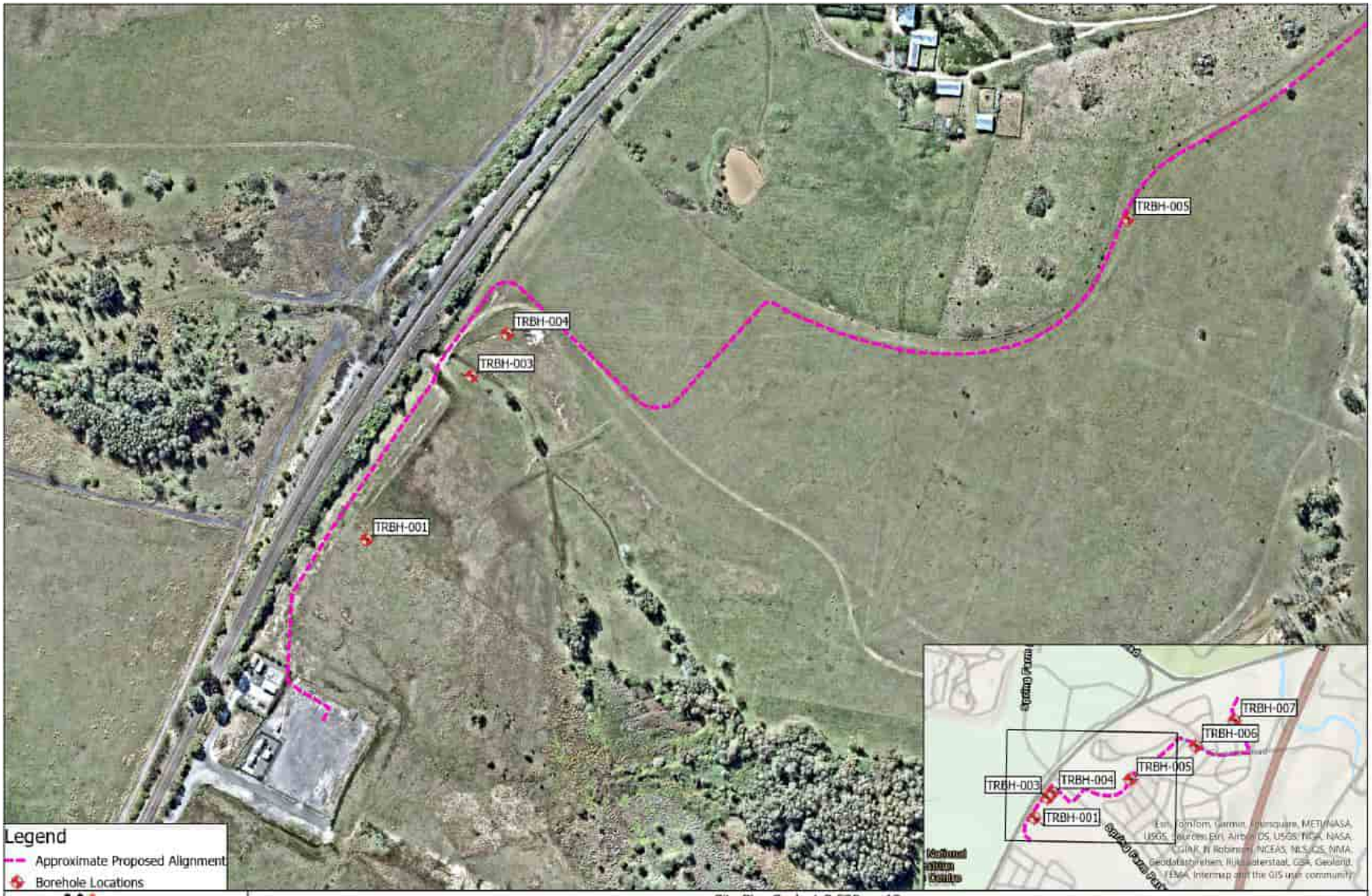
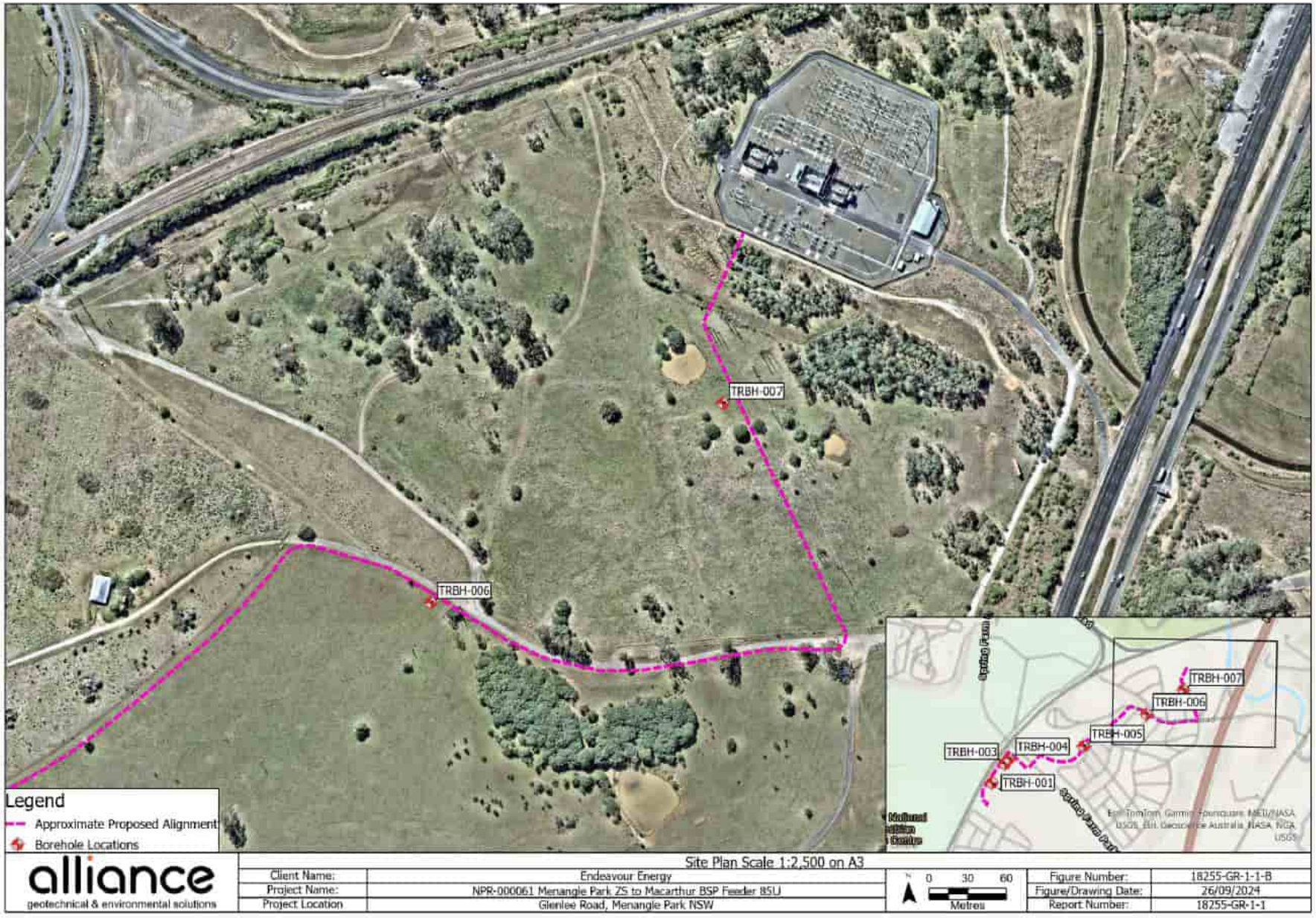
Appendix B Geotechnical Investigation Plan (Alliance Geotechnical 2024)


TRBH-001
TRBH-003
TRBH-004
TRBH-005
TRBH-006
TRBH-007
Legend
Approximate Proposed Alignment
Borehole Locations
alliance
geotechnical & environmental solutions
Site Plan Scale 1:2,500 on A3
Client Name: Endeavour Energy
Project Name: NPR-000061 Menangle Park ZS to Macarthur BSP Feeder 85U
Project Location Glenlee Road, Menangle Park NSW
0 30 60
Metres
Figure Number: 18255-GR-1-1-B
Figure/Drawing Date: 26/09/2024
Report Number: 18255-GR-1-1


TRBH-007
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TRBH-004
TRBH-003
TRBH-001
Legend
Approximate Proposed Alignment
Borehole Locations
alliance
geotechnical & environmental solutions
Site Plan Scale 1:2,500 on A3
Client Name: Endeavour Energy
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Project Location Glenlee Road, Menangle Park NSW
0 30 60
Metres
Figure Number: 18255-GR-1-1-B
Figure/Drawing Date: 26/09/2024
Report Number: 18255-GR-1-1

Appendix J Statement of Heritage Impacts

©JBS&G Australia Pty Ltd

25th August 2025

Roweena D'Souza
Principal – Assessment and Approvals
JBS&G
Level 1, 50 Margaret Street, Sydney, NSW
rdsouza@jbsg.com.au

Dear Roweena

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 & gate lodge [Glenlee] (#00009).

Artefact's original report of April 2025 has been updated as there has been a minor route change. Artefact received updated plans on the 9th of August 2025 and have updated the SOHI accordingly.

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 the suburb of 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.

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 feeder route which has been planned to avoid this item.

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 & gate lodge	SHR	No. 00009	State
	Campbelltown LEP 2015	No. I00009	State
	RNE	No. 3277	State
	NTAR	No. 7769	State



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. Soon after arrival at Sydney Cove, 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.

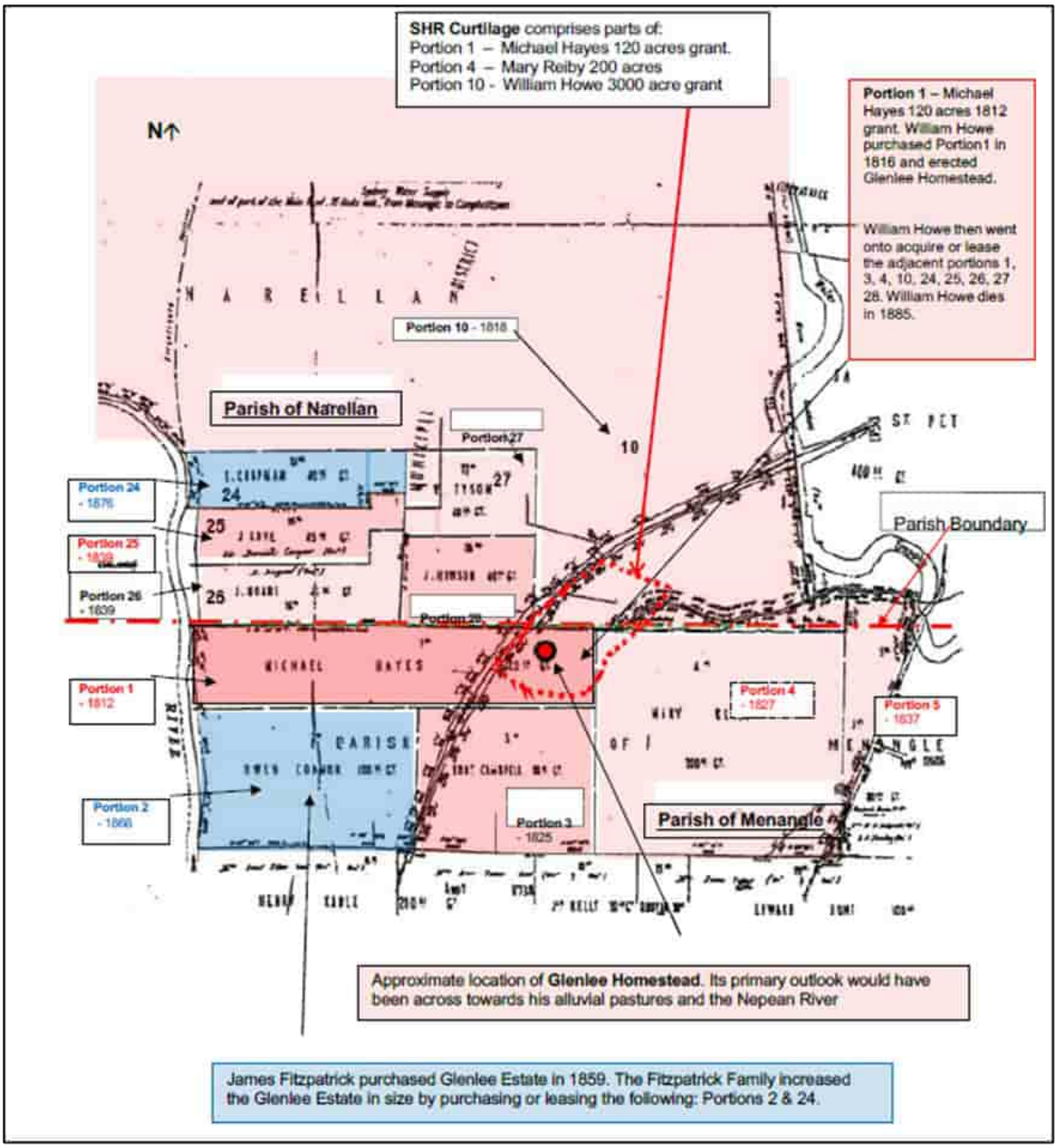

Figure 3: The Glenlee Estate (Source: Kass, 2020)

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.

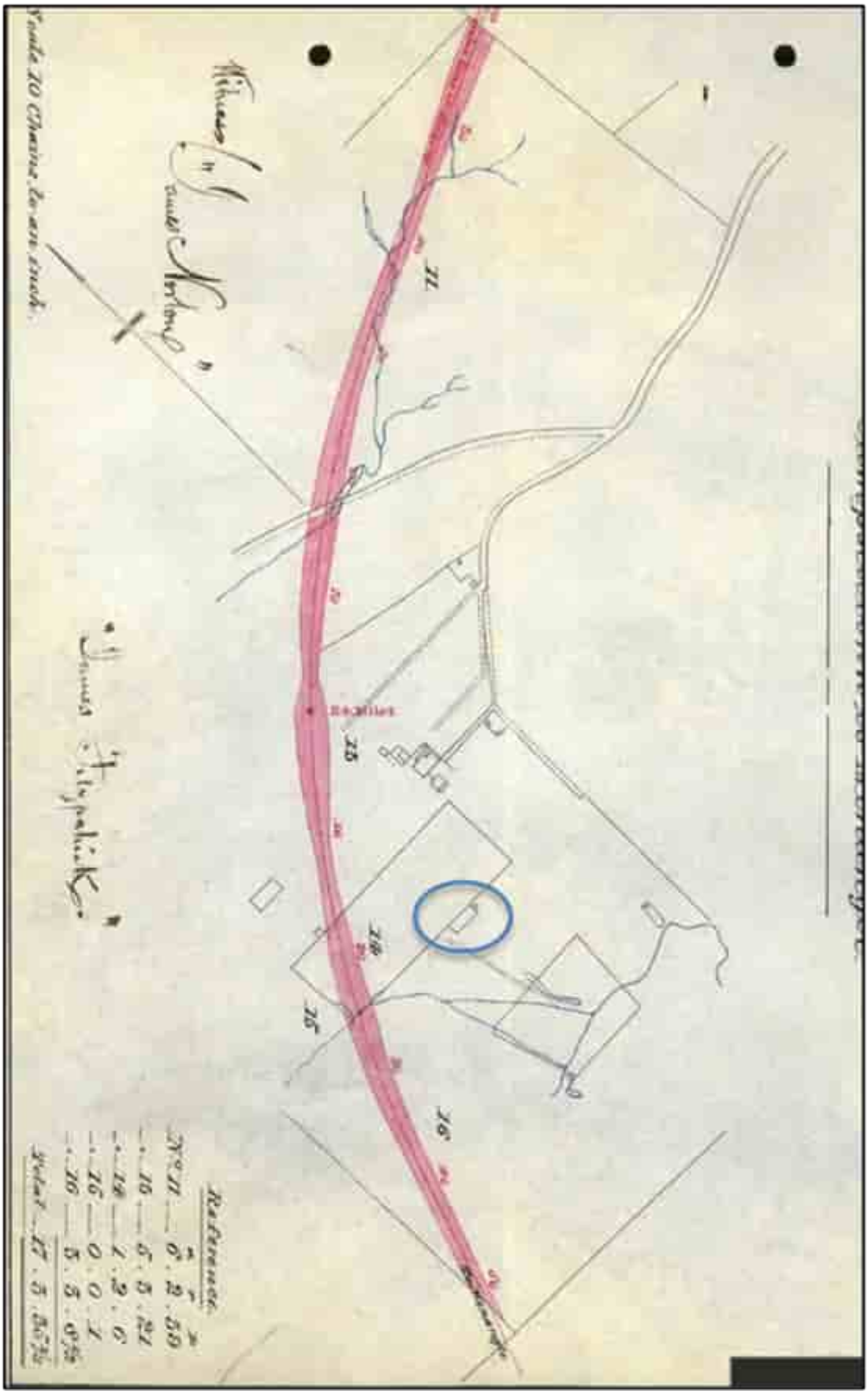

Figure 4: Railway survey plan with the location of the field and hut highlighted (Source: Old System Deed, Book 80 No 475 1862)

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.

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.

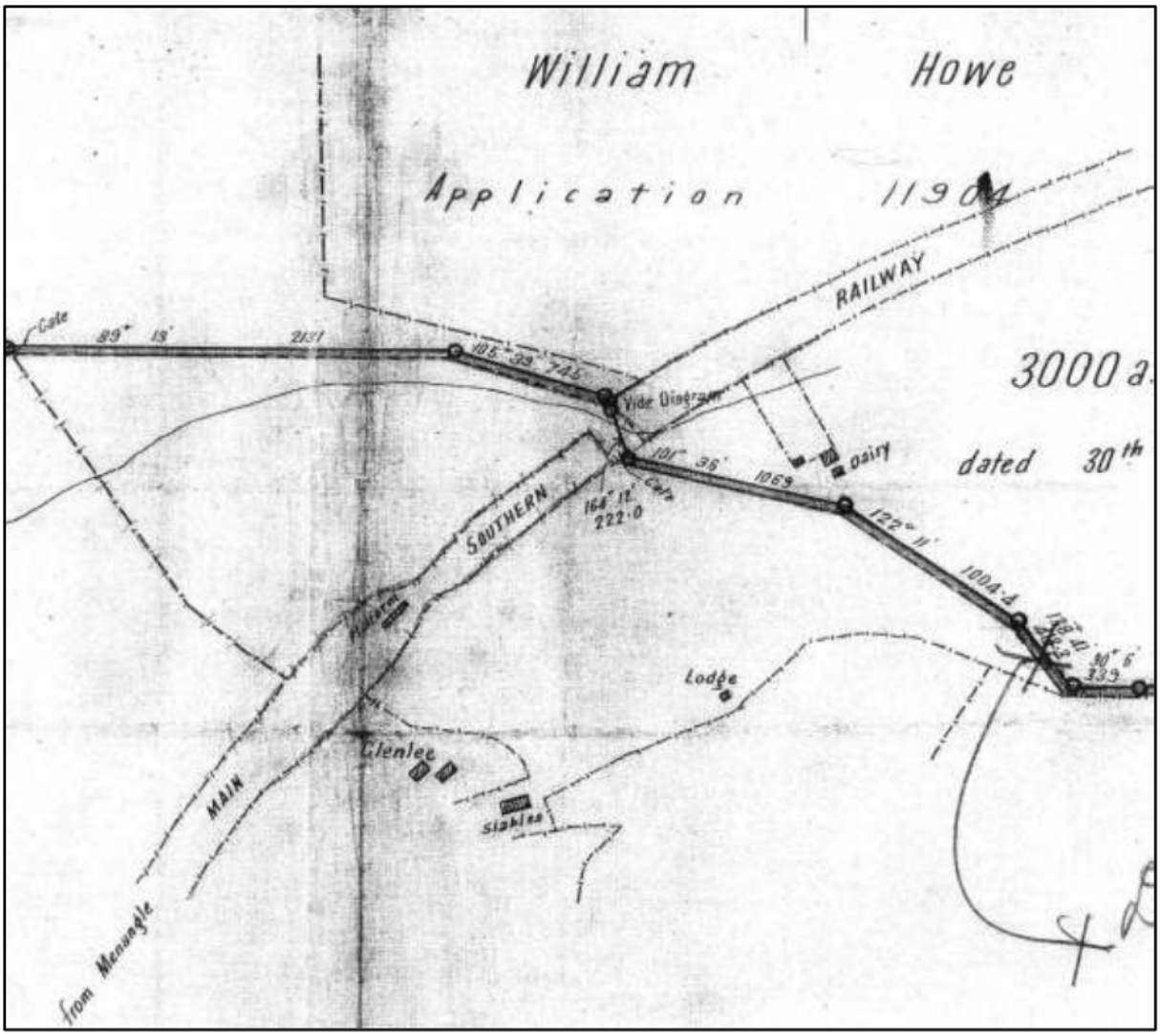

Figure 5: Extract from a 1907 plan showing some of the buildings at Glenlee (Source: Kass, 2020)

[28] This road was abandoned by the 1960s.

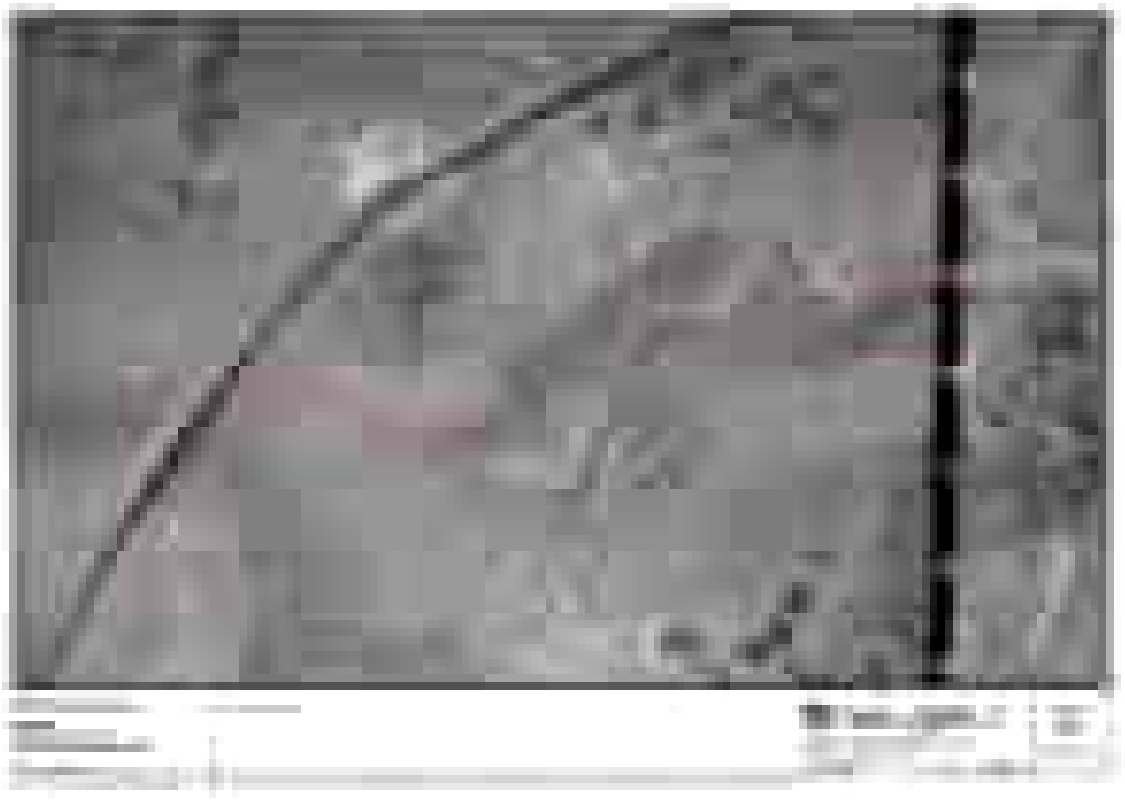

Figure 6: Aerial image of Glenlee, dated 30th April 1945, showing no structures in the immediate vicinity of the proposed feeder route (Source: Geoscience Australia)

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.

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

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)

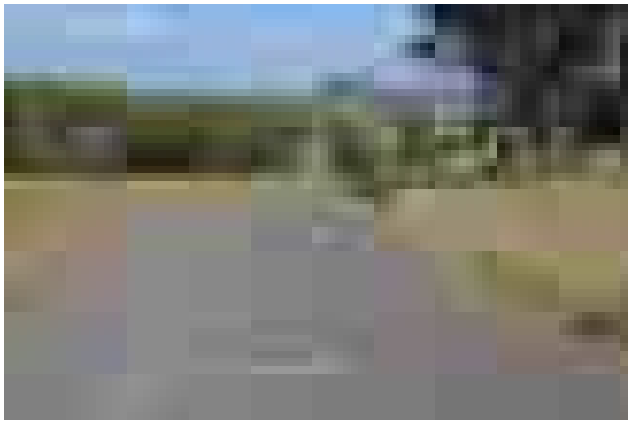

Figure 8: Eroding asphalt on Glenlee Road

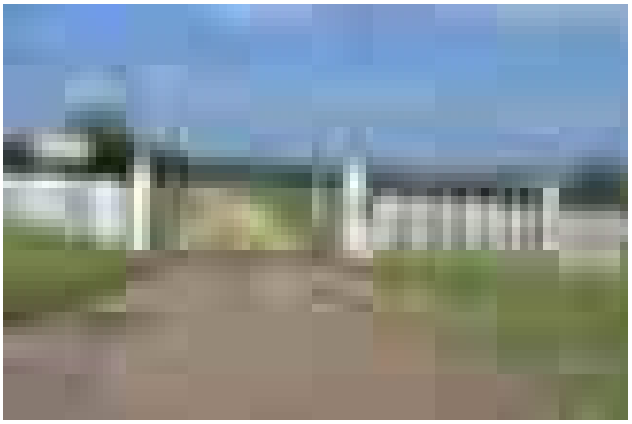

Figure 9: Gate of Glenlee property, noting poor condition of road



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)



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

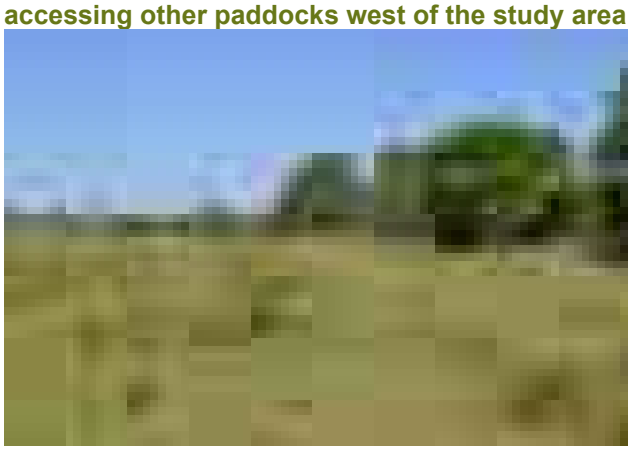

Figure 16: South view of the existing Menangle Park Zone Substation



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)

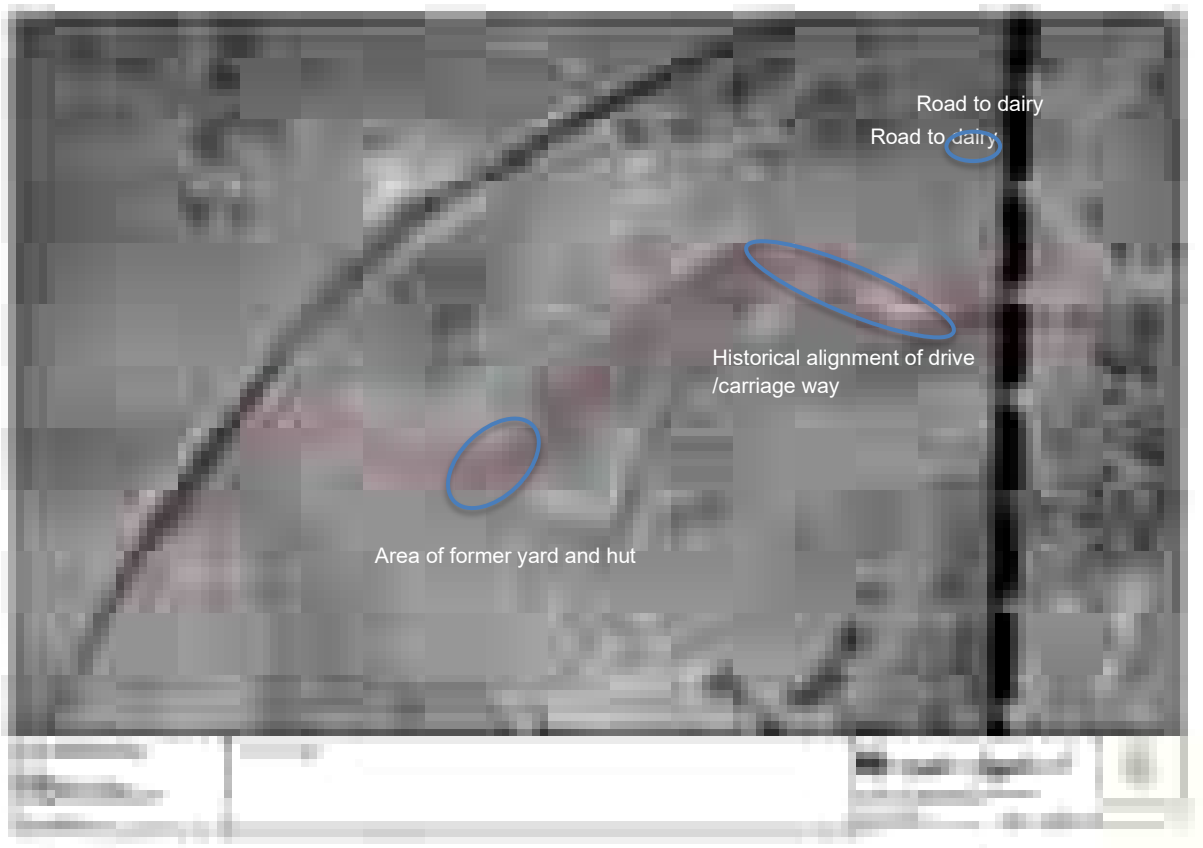

Figure 20: Location of areas of archaeological potential

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 farms, as well as the administration and control of this convict population, through the magistrates

[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.

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.

Historical phase	Events	Archaeological potential	Archaeological research potential
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 aerial 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.

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 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
- All works must remain outside the SHR curtilage of Glenlee (SHR & LEP #00009). A surveyor should be engaged to clarify the curtilage during works, if required

References

"Advertising" Evening News (Sydney, NSW : 1869 - 1931) 13 January 1885.

"Advertising" The Daily Telegraph (Sydney, NSW : 1883 - 1930) 10 April 1891.

“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.

“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.

Australian Town and Country Journal. “Glenlee.—A Well Managed Farm.” April 5, 1905.

Campbell, J. F. "The Wild Cattle of the Cowpastures and the Village of Cawdor." *Journal of the Royal Australian Historical Society* 14, 1 (1928).

Casey & Lowe Pty. “Glenlee, Outbuildings, Gardens & Gatehouse, Menangle Park Revised Historical Archaeological Assessment.” Report to Tropman & Tropman Architects, 2021.

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.

Dyster, B. "The Depression of the 1840s in New South Wales." In Australian Dictionary of Biography. Australian National University: National Centre of Biography, 2022.

Heritage NSW 2024

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.

Heritage NSW, 2022. “Glenlee, outbuildings, garden & gatelodge”. *SHI database no. 5045216.*

Higgenbotham, Edward. “Glenlee House, Menangle Road, Campbelltown, NSW: Site Survey of Archaeological Remains.” Produced for Peter Thorp and Associates by E. Higginbotham, 1985.

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.

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, 2020.

Margaret Steven, 'Macarthur, John (1767–1834)', Australian Dictionary of Biography, National Centre of Biography, Australian National University,1967.

Primary Application No 11904, Historical Land Records Viewer.

Raymond, Michael. “A History of Glenlee Menangle Road, Campbelltown.” Unpublished manuscript. Heritage NSW Library, 1978.

Vivienne Parsons, 'Howe, William (1777–1855)', Australian Dictionary of Biography, National Centre of Biography, Australian National University, 1966.

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.

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