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Streamlined Biodiversity Development Assessment Report

36 Cabbage Tree Road Bayview 2104

Report prepared by Narla Environmental Pty Ltd

For Opal Health Care

July 2026



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Declarations

I certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the Biodiversity Conservation Act 2016 (BC Act).



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Conflict of Interest

I declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest.



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Glossary

Acronym/ Term	Definition
Accredited Biodiversity Assessor	Individuals accredited by the NSW Department of Climate Change, Energy the Environment and Water (NDCCEEW) to apply the Biodiversity Assessment Method.
APZ	Asset Protection Zone
BAM	The NSW Biodiversity Assessment Method (2020)
BAMC	The NSW Biodiversity Assessment Method Calculator
BC Act	New South Wales Biodiversity Conservation Act 2016
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified.
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity from the impacts of development.
Biodiversity values	The composition, structure and function of ecosystems, including threatened species, populations and ecological communities, and their habitats.
BOS	NSW Biodiversity Offset Scheme
DCCEEW	Department of Climate Change, Energy the Environment and Water
DPE	Department of Planning and Environment (now NDCCEEW)
DPIE	NSW Department of Planning, Industry and Environment (now NDCCEEW)
Ecosystem credit	The class of biodiversity credit that relates to a vegetation type and the threatened species that are reliably predicted by that vegetation type (as a habitat surrogate).
EEC	Endangered Ecological Community
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ha	Hectares
HTE	High Threat Exotic
km	Kilometres
LALC	Local Aboriginal Land Council
LGA	Local Government Area
Locality	A 1,500m buffer area surrounding the Subject Land
m	metres
Native Vegetation	Means any of the following types of plants native to New South Wales: (a) trees (including any sapling or shrub), (b) understorey plants, (c) groundcover (being any type of herbaceous vegetation), (d) plants occurring in a wetland.
NSW	The State of New South Wales
NDCCEEW	NSW Department of Climate Change, Energy the Environment and Water
OEH	Office of Environment and Heritage (now NDCCEEW)
PCT	NSW Plant Community Type
Proposal	The development, activity or action proposed
SAII	Serious and Irreversible Impacts

Acronym/ Term	Definition
SAll entity	Species and ecological communities that are likely to be the subject of serious and irreversible impacts (SAlls)
SBDAR	Streamlined Biodiversity Development Assessment Report
SEPP	State Environmental Planning Policy
Species credit	The class of biodiversity credit that relate to threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
SSDA	State Significant Development Application
Subject Land	The footprint of the proposed development
Subject Property	36 Cabbage Tree Road Bayview 2104 (Lot 121/DP789400)
TEC	Threatened Ecological Community
Threatened species, populations and ecological communities	Species, populations and ecological communities specified in Schedules 1 and 2 of the BC Act 2016
VI	Vegetation Integrity
VIS Plot	Vegetation Integrity Survey Plot

Executive Summary

Narla Environmental Pty Ltd (Narla) was engaged by Principal Healthcare Finance Pty Limited (Opal Healthcare; 'the proponent') to prepare a Streamlined Biodiversity Development Assessment Report (SBDAR) to accompany a State Significant (SSDA) for the proposed development at 36 Cabbage Tree Road Bayview 2104 (Lot 121/DP789400; the Subject Property). The SBDAR will assess the biodiversity impacts of the proposed development in accordance with the requirements of the Biodiversity Conservation Act 2016 and Biodiversity Conservation Regulation 2017. The assessment has been completed as a streamlined assessment in accordance with Appendix L of the Biodiversity Assessment Method (BAM; DPIE 2020a).

The proposed development involves the demolition of existing structures to facilitate the construction of a new residential aged care facility. The project will also include associated soft and hard landscaping, driveways, and other ancillary works. All areas associated with the proposed development are hereafter referred to as the 'Subject Land'.

The proposed development where possible has largely utilised existing dwellings, hardstand and landscaped garden beds containing both native and exotic vegetation. Owing to the proximity of locally native trees, to existing infrastructure however complete avoidance was not possible in order to facilitate the proposed works. Through the implementation of tree sensitive techniques however several significant trees have been proposed for retention which in earlier assessments were originally proposed for removal. This includes trees 17, 19, 23, 24 and 26 which are located along Annam Road. Further discussion were also conducted with Narla, to see if further reiterations could be made to the proposed plans to retain additional trees within the works area. This resulted in the retention of trees 20 and 21 also.

The proposed development is expected to impact one (1) Plant Community Type (PCT): 3234: Hunter Coast Lowland Spotted Gum Moist Forest. The following ecosystem credits are required to be offset in order to mitigate the impacts upon biodiversity as a result of the proposed development:

- Two (2) ecosystem credit for PCT 3234.

This PCT is associated with the Biodiversity Conservation Act listed Endangered Ecological Community (EEC) Pittwater Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion. This EEC is also listed as an 'SAIL entity' within the BioNet Threatened Biodiversity Data Collection (NDCCEEW 2026d). Due to the potential sensitivity of this species to any impact, a determination of whether or not the impacts are serious and irreversible has been undertaken in accordance with Section 9.1 of the BAM (DPIE 2020a).

Two (2) threatened species are required to be assumed present owing to the presence of foraging habitat in the broader locality:

- Two (2) species credits for *Chalinolobus dwyeri* (Large-eared Pied Bat)
- Two (2) species credits for *Vespadelus troughtoni* (Eastern Cave Bat).

Whilst these species are listed as 'SAIL Entities' within the BioNet Threatened Biodiversity Data Collection (NDCCEEW 2026d), the threshold for impacts to these species to be considered potentially 'Serious and Irreversible' are impacts to breeding habitat. As no such habitat was present within or immediately surrounding the Subject Land, this threshold was not met and therefore impacts for these species was assessed as foraging habitat only.

One (1) additionally threatened species, was also required to be offset owing to a nest being located in proximity to the Subject Land, on the other side of Annam Road:

- One (1) species credit for *Lophoictinia isura* (Square-tailed Kite).

This species is not listed as being at risk of SAIL (NDCCEEW 2026d).

In order to further minimise potential impacts of the proposal on local biodiversity values, a series of mitigation and management measures have been identified, which are to be implemented as part of any Construction Environmental Management Plan (CEMP) produced for the site. This includes landscaping efforts incorporating vegetation representative of PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest with all trees proposed for removal to be replaced at a 2:1 ratio with locally sourced, native species representative of this community within the Subject Property and for construction activities where noise is considered likely to exceed current parameters to be minimised during the breeding period of Square-tailed Kites (September to January).

1. Introduction

1.1 Overview

This Streamlined Biodiversity Development Assessment Report (SBDAR) is submitted to the Department of Planning, Housing and Infrastructure (DPHI) on behalf of Principal Healthcare Finance Pty Limited (Opal Healthcare) in support of a SSDA (SSD-77240466) for a 177 bed residential aged care facility (RACF) at 36-42 Cabbage Tree Road, Bayview (the Subject Property; **Figure 1**). This SBDAR will assess the biodiversity impacts of the proposed development in accordance with the requirements of the Biodiversity Conservation Act 2016, Biodiversity Conservation Regulation 2017 and BAM (DPIE 2020a).

This SBDAR assesses the biodiversity impacts of the development in accordance with the requirements of the Biodiversity Conservation Act 2016 (BC Act), Biodiversity Conservation Regulation 2017 and Biodiversity Assessment Method (BAM; DPIE 2020a). Narla have produced this report in order to assess any potential impacts associated with the SSDA and recommend appropriate measures to mitigate any potential ecological impacts in line with the requirements of the consent authority. The assessment has been completed in accordance with Appendix L of the BAM (DPIE 2020a).

1.2 The Proposed Development

The proposed development will comprise the following:

- Demolition of the existing aged care building and driveway on the site;
- Construction of a three-storey residential aged care facility, accommodating:
 - 177 beds,
 - Basement parking,
 - Ground floor ancillary facilities;
- Construction of a community room, to be located on the Aveo Bayview Gardens Retirement Living (Aveo BGRL) site;
- Construction of a new driveway, to be located on the Aveo BGRL site;
- Torrents Title subdivision of the Opal Healthcare Bayview site from Aveo BGRL;
- Associated amenities and landscaping works;
- Augmentation of, and connection to, existing utilities as required.
- For a detailed project description, refer to the Environmental Impact Statement prepared by Beam Planning.

The proposed development encompasses an area of approximately 0.69 ha. All areas associated within the proposed development will hereafter be referred to collectively as the 'Subject Land' (**Figure 1**).

1.3 Secretary's Environmental Assessment Requirements

This report has been prepared to respond to the SEARS for SSD-77240466. Specifically, this report has been prepared to respond to those SEARS summarised in **Table 1**.

Table 1. SEARS requirements as they relate to biodiversity.

Requirement	Response
Biodiversity Assess any biodiversity impacts associated with the development in accordance with the Biodiversity Conservation Act 2016 and the Biodiversity Assessment Method 2020, including the preparation of a Biodiversity Development Assessment Report (BDAR), unless a waiver is granted, or the site is on biodiversity certified land. If the development is on biodiversity certified land, provide information to identify the site (using associated mapping) and demonstrate the proposed development is consistent with the relevant biodiversity measure conferred by the biodiversity certification.	Streamlined BDAR Prepared.

1.4 Assessment Methods Applied

This SBDAR will be prepared as a site-based 'Streamlined assessment module – small area development that requires consent' as the proposed works do not exceed the area clearing threshold for small area developments as outlined in the BAM (DPIE 2020a). The minimum lot size for the Subject Property is 700m² and the total Subject Land is 0.69ha.

Table 2. Area limits for application of small area development threshold. Bold indicates the threshold relevant to this report.

Minimum lot size associated with the property	Maximum area limit for application of the small area development module
Less than 1ha	≤1ha
Less than 40ha but not less than 1ha	≤2ha
Less than 1000ha but not less than 40ha	≤5ha
1000ha or more	≤10ha

1.5 Site Location and Description

The Opal HealthCare Bayview site comprises a ~6,000sqm portion of the current Aveo BGRL site at 36-42 Cabbage Tree Road, legally described at Lot 121 in DP 789400. The Subject Property is irregular in shape, bound by Annam Road to the east, and the Aveo BGRL site to the north, west, and south.

The Subject Property is situated within a suburban landscape located within the suburb of Bayview in the Northern Beaches Local Government Area (LGA; **Figure 2**) and is located within the boundaries of the Metropolitan Local Aboriginal Land Council (LALC). It has an area of approximately 8.02ha and is neighboured by similar properties. The Subject Property contains cleared open areas as well as large areas of mixed native and exotic vegetation.

1.6 Sources of Information Used

A thorough literature review was undertaken to gain an insight into the ecology and applicable legislation within the locality and the Northern Beaches LGA, including:

- Relevant State Government Databases & Datasets:
 - NSW eSPADE v2.2 (NDCCEEW 2026b);
 - NSW BioNet. The website of the Atlas of NSW Wildlife (NDCCEEW 2026c);
 - NSW BioNet. Threatened Biodiversity Data Collection (NDCCEEW 2026d);
 - NSW BioNet. Vegetation Classification System (NDCCEEW 2026e); and
 - Six Maps Clip & Ship (NSW Government Spatial Services 2026).
- Vegetation and Soil Mapping:
 - NSW State Vegetation Type Map (DPE 2022); and
 - Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman et al. 2009).
- NSW State Guidelines:
 - Biodiversity Assessment Method (DPIE 2020a);
 - Guidance to assist a decision-maker to determine a serious and irreversible impact (DPIE 2019);
 - Biodiversity Assessment Method Calculator Version 1.5.0.00 (NDCCEEW 2026f);
 - Biodiversity Offsets and Agreement Management System (BOAMS);
 - Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method (DPIE 2020b); and
 - Threatened Species Survey and Assessment: Guidelines for developments and activities. Working Draft (DEC 2004).
- Council Documents:
 - Pittwater 21 Development Control Plan 2004 (DCP); and
 - Pittwater Local Environmental Plan 2014 (LEP).

Preparation of this SBDAR also involved the review of the following accompanying project documents:

- Site Plan (TaylorBrammer 2026a);
- Tree Retention and Removal Plan (TaylorBrammer 2026b);
- Groundwater Impact Assessment (WSP 2026); and
- Arboricultural Impact Assessment (Heartwood Tree Consulting, 2026).

These sources were used to gain an understanding of the natural environment and ecology of the Subject Land and its surrounds. Searches using NSW Wildlife Atlas (BioNet) (NDCCEEW 2026c) were conducted to identify current threatened flora and fauna records within and surrounding the Subject Land. These data were used to assist in establishing the presence or likelihood of any biodiversity values as occurring on, or adjacent to the Subject Land and helped inform our Ecologist on what to look for during the site assessment.

1.7 Aim and Approach

This report has been prepared in accordance with the BAM (DPIE 2020a) and aims to:

- Describe the biodiversity values present within the Subject Land, including the extent of native vegetation, vegetation integrity and the presence of Threatened Ecological Communities (TECs);
- Determine the habitat suitability within the Subject Land for candidate threatened species;

- Prepare an impact assessment in regard to potential impacts of the proposed development on biodiversity values, including potential prescribed impacts and SALLs within the Subject Land;
- Discuss and recommend efforts to avoid and minimise impacts on biodiversity values; and
- Calculate the biodiversity credits (i.e., ecosystem credits and species credits) that measure potential impacts of the development on biodiversity values. This calculation will inform the decision maker as to the number and class of offset credits required to be purchased and retired as a result of the proposed development.



Figure 1. The components of the Subject Land.

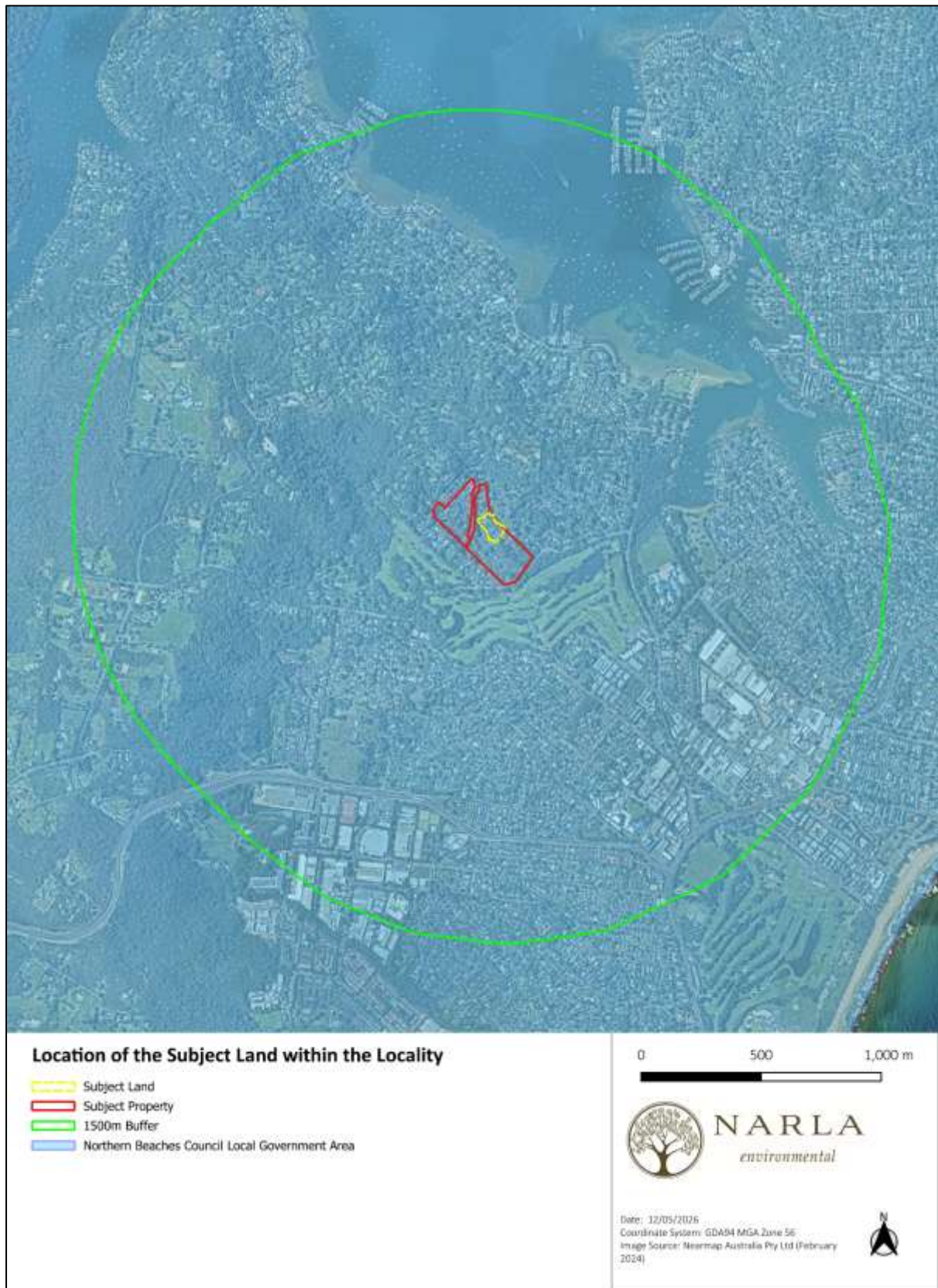


Figure 2. The location of the Subject Land within the locality.

2. Landscape

2.1 IBRA Bioregion and Subregion

The Subject Land occurs within the 'Pittwater' Interim Biogeographic Regionalisation for Australia 7 (IBRA7) Subregion, which is part of the 'Sydney Basin' IBRA7 Bioregion (**Figure 3**).

2.2 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 information on location and a meaningful descriptive landscape term.

The Subject Land occurs on the 'Sydney – Newcastle Barriers and Beaches' Mitchell Landscape Ecosystems (**Figure 4**), which is describe as quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands backed by sand dunes and intermittently closed and open lagoons. Includes areas of more extensive high dunes often located on top of the headlands. General elevation 0 to 30m, local relief 10m. Cliff top dunes may be found as high as 90m above sea level. Distinct zonation of vegetation and increasing soil development from the beach to the inland dunes. At the beach; Spinifex (*Spinifex hirsutus*), Spiky Mat-rush (*Lomandra longifolia*), Coast Wattle (*Acacia longifolia* ssp. *sophorae*) and Coast Tea-tree (*Leptospermum laevigatum*) colonise the frontal dune in which there is little soil development. Coast banksia (*Banksia integrifolia*) and Old Man Banksia (*Banksia serrata*) are found on the second dunes and these merge with more complex forest containing Blackbutt (*Eucalyptus pilularis*), Red Bloodwood (*Corymbia gummifera*), grass trees (*Xanthorrhoea* sp.) and numerous understorey shrubs on deep sands that have an organic rich A horizon, a bleached A2 horizon and the initial development of weak iron or organic pans in the sandy subsoil. Well-developed, deep podsol profiles are present in cliff top dunes with swampy swales indicating that these forms are probably older than the coastal dunes. Vegetation of *Banksia aemula* heathland and open scrub of Coast Banksia (*Banksia integrifolia*), Coast Rosemary (*Westringea fruticosa*), Coast Tea-tree and grass tree, with dwarfed Smooth-Barked Apple (*Angophora costata*) and Red Bloodwood. Freshwater sedge swamps in larger areas of sand. In the lagoons salinity varies depending on tidal flushing and they are often surrounded by Broad-leaved Tea-tree (*Melaleuca quinquenervia*) and Swamp Oak (*Casuarina glauca*). Water margins are occupied by *Juncus* sp. and Common Reed (*Phragmites australis*) in fresh water areas. Grey mangrove (*Avicennia marina*) may occur in some tidal inlets.

2.3 Topography, Geology and Soils

The Subject Land is situated on a north east facing slope with elevation ranging from 30m to 20m above sea level (asl; Google Earth 2026). The Subject Land is mapped as occurring on the Erina soil landscape as per the Soil Landscapes of Sydney 1:100,000 Sheet (Chapman et al. 2009).

The Erina soil landscape is characterised by undulating to rolling rises and low hills on fine-grained sandstones and claystones of the Narrabeen Group. Local relief to 60 m, slopes <20%. Rounded narrow crests with moderately inclined slopes. Vegetation is extensively cleared tall-open forest (wet sclerophyll forest) with open-heathland in exposed areas.

The Subject Land did not contain any areas of geological significance, such as karsts, caves, cliffs or crevices. The Subject Land and wider locality (1,500m buffer) are mapped as occurring on Class 1, 2, 3, 4 and 5 acid sulfate soils (**Figure 5**) according to the Pittwater LEP 2014.

2.4 Hydrology

One (1) mapped watercourse, is mapped as occurring within the Subject Land (**Figure 6**). Numerous first and second order watercourses occur within 1500m of the Subject Land (**Figure 7**).

2.5 State Environmental Planning Policy (Resilience and Hazards) 2021: Chapter 2 – Coastal Management

The Subject Land contains areas mapped as 'Littoral Rainforest Proximity Area' as per Chapter 2 – 'Coastal Management' of the State Environmental Planning Policy (Resilience and Hazards) 2021 (**Figure 8**). The wider locality (1,500m buffer) contains areas mapped as 'Coastal Wetlands', 'Coastal Wetlands Proximity Area', 'Coastal Environment Area', 'Coastal Use Area', as well as 'Littoral Rainforest' and 'Littoral Rainforest Proximity Area' as per Chapter 2 – 'Coastal Management' of the State Environmental Planning Policy (Resilience and Hazards) 2021 (**Figure 9**).

2.6 Native Vegetation Cover and Connectivity

Native vegetation cover and connectivity have been assessed in accordance with Section 3.1.3 and 3.2 of the BAM (DPIE 2020a). The native vegetation cover will be used to assess the habitat suitability of the Subject Land for threatened species. Areas of connectivity will determine the extent of habitat that may facilitate the movement of threatened species across their range. A 1500m buffer around the boundary of the Subject Land was calculated to determine the extent of native vegetation and habitat connectivity.

All areas within the 1500m buffer were not ground-truthed to determine whether native vegetation was present, therefore, native vegetation was mapped on the following assumptions:

- Turfed areas within sport ovals were determined to be non-native;
- Owing to the heavily urbanised landscape, street trees were considered non-native; and
- Tree'd areas connected to native vegetation within the Subject Land were considered to be native.

Native vegetation covered approximately 323ha within the buffer circle (total area = 902ha) which equates to approximately 35.8% and was therefore assigned to the >30-70% class (**Figure 10**).

Areas of connectivity that may facilitate the movement of threatened species were evident within the 1,500m surrounding the Subject Land (**Figure 10**).

2.7 Areas of Outstanding Biodiversity Value

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

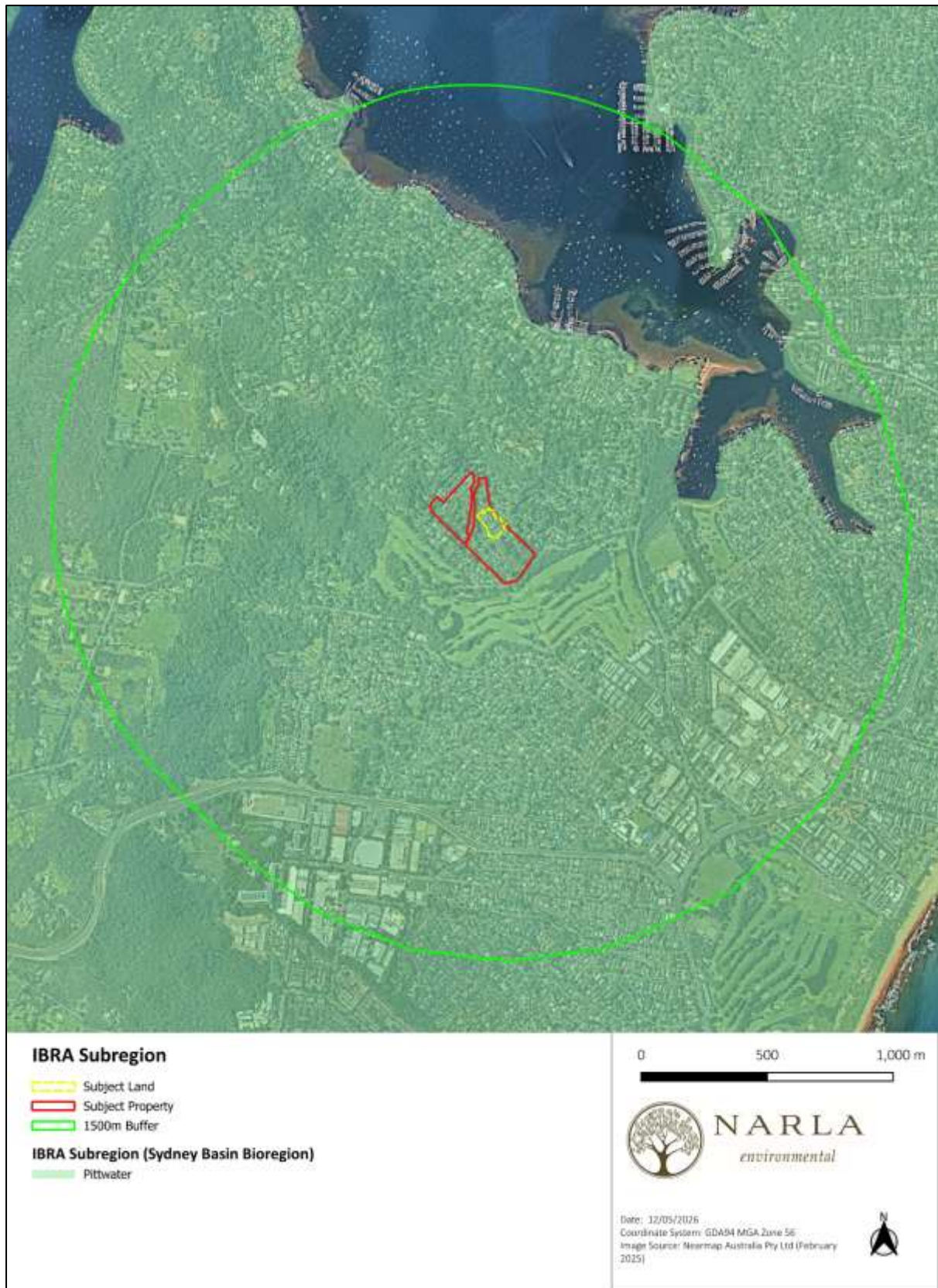


Figure 3. IBRA Bioregion and Subregion of the Subject Property and Subject Land, and within a 1,500m buffer.

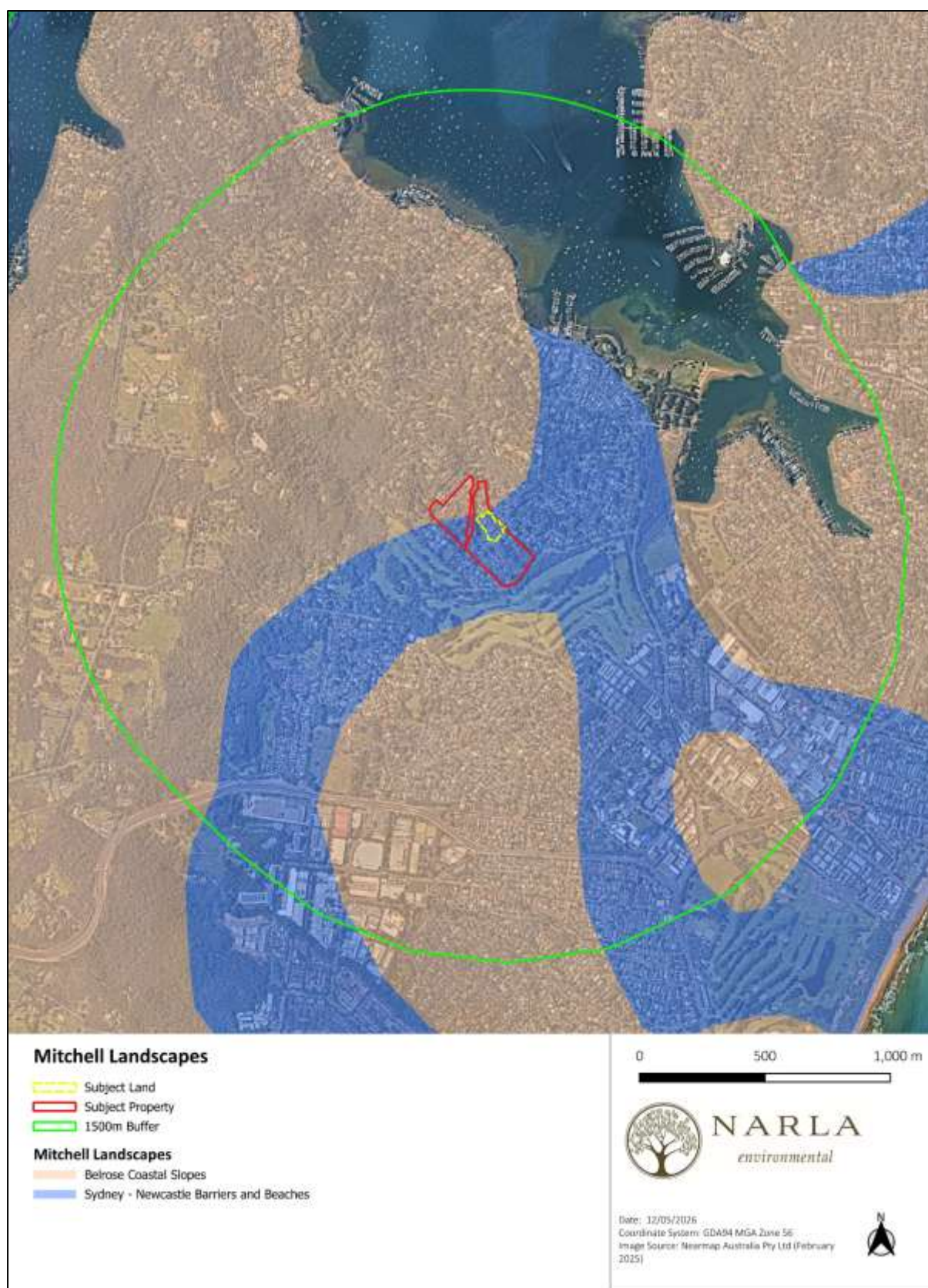


Figure 4. Mitchell Landscapes of the Subject Property and Subject Land, and within a 1,500m buffer.

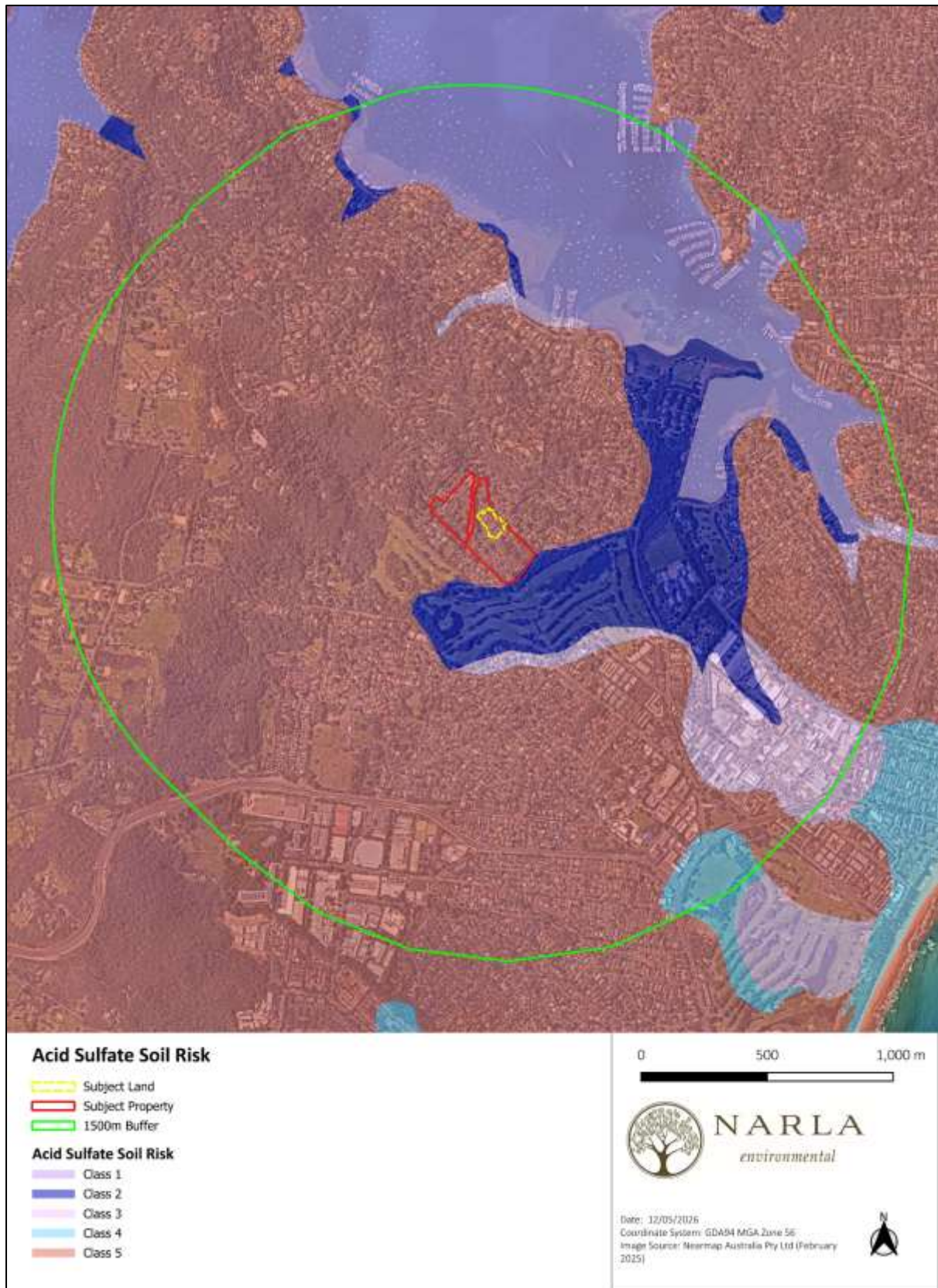


Figure 5. Acid Sulfate Soils of the Subject Property and Subject Land, and within a 1,500m buffer.



Figure 6. Watercourses occurring adjacent to the Subject Land.

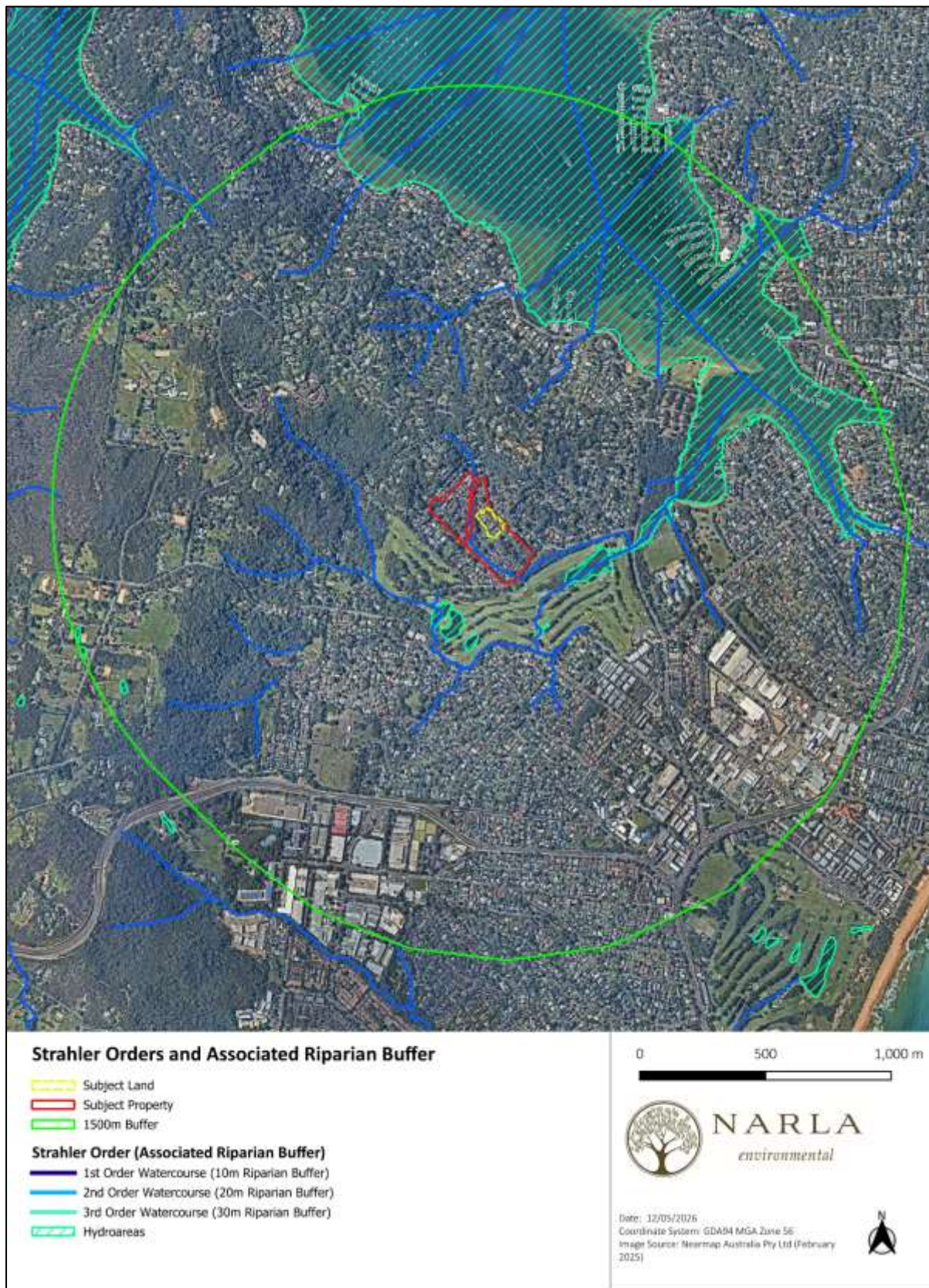


Figure 7. Rivers and streams (with associated riparian buffers) occurring within the 1,500m buffer.



Figure 8. Areas occurring within the Subject Land in which the State Environmental Planning Policy (Resilience and Hazards) 2021 applies.

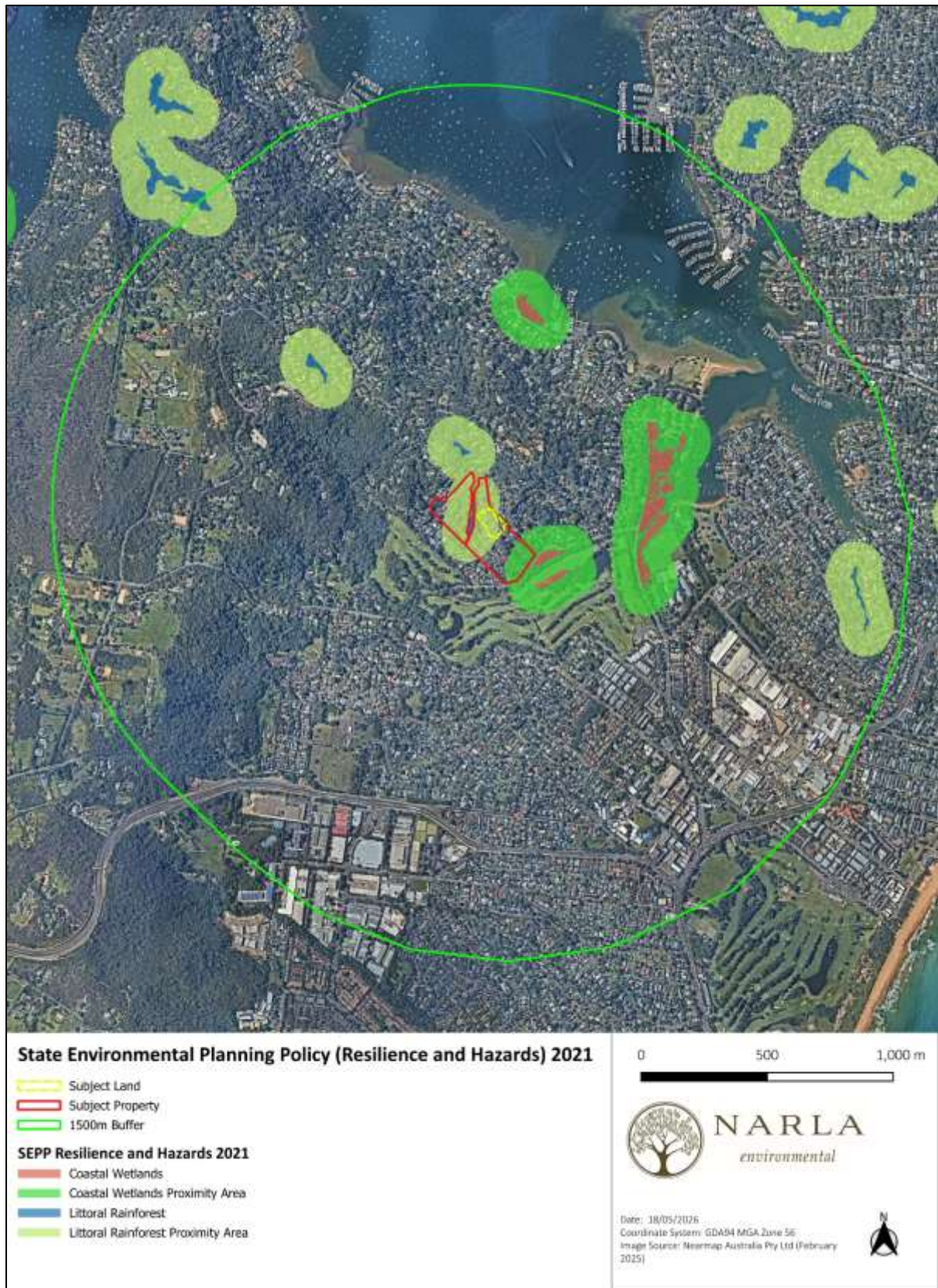


Figure 9. Areas occurring within the 1,500m buffer in which the State Environmental Planning Policy (Resilience and Hazards) 2021 applies.



Figure 10. The extent of native vegetation within the 1,500m buffer.

3. Native Vegetation

3.1 Dominant Plant Community Type (PCT) Identified within the Subject Land

3.1.1 Historically Mapped Vegetation

The vegetation adjacent to the Subject Land is mapped by the NSW State Vegetation Type Map (DPE 2022) as containing the following vegetation communities (**Figure 11**):

- Sydney Coastal Lilly-Pilly Palm Gallery Rainforest
- Central Coast Escarpment Moist Forest

3.1.2 Plant Community Type Selection Process

Plant Community Type selection for the vegetation community occurring on the Subject Land was undertaken using information and databases provided in the BioNet Vegetation Classification System (NDCCEEW 2026e). The following selection criteria were used in the PCT Filter Tool to develop the PCT shortlist:

- IBRA Bioregion: Sydney Basin
- IBRA Subregion: Pittwater
- Dominant Species: *Angophora floribunda*, *Banksia integrifolia*, *Banksia spinulosa*, *Eucalyptus tereticornis*, *Eucalyptus fibrosa*, *Livistona australis*, *Melaleuca quinquenervia* and *Corymbia maculata*.

This process delivered a selection of one (1) PCT that occur within the Pittwater IBRA Subregion (and Sydney Basin Bioregion) that had seven (7) of eight (8) dominant species observed within the Subject Land (i.e., the highest potential of occurring within the Subject Land). It was found that the Subject Land was located in the right distribution and contained the appropriate landscape attributes for two (2) candidate PCT. The steps taken to justify the presence/absence of the candidate PCTs within the Subject Land are detailed in **Table 3**.

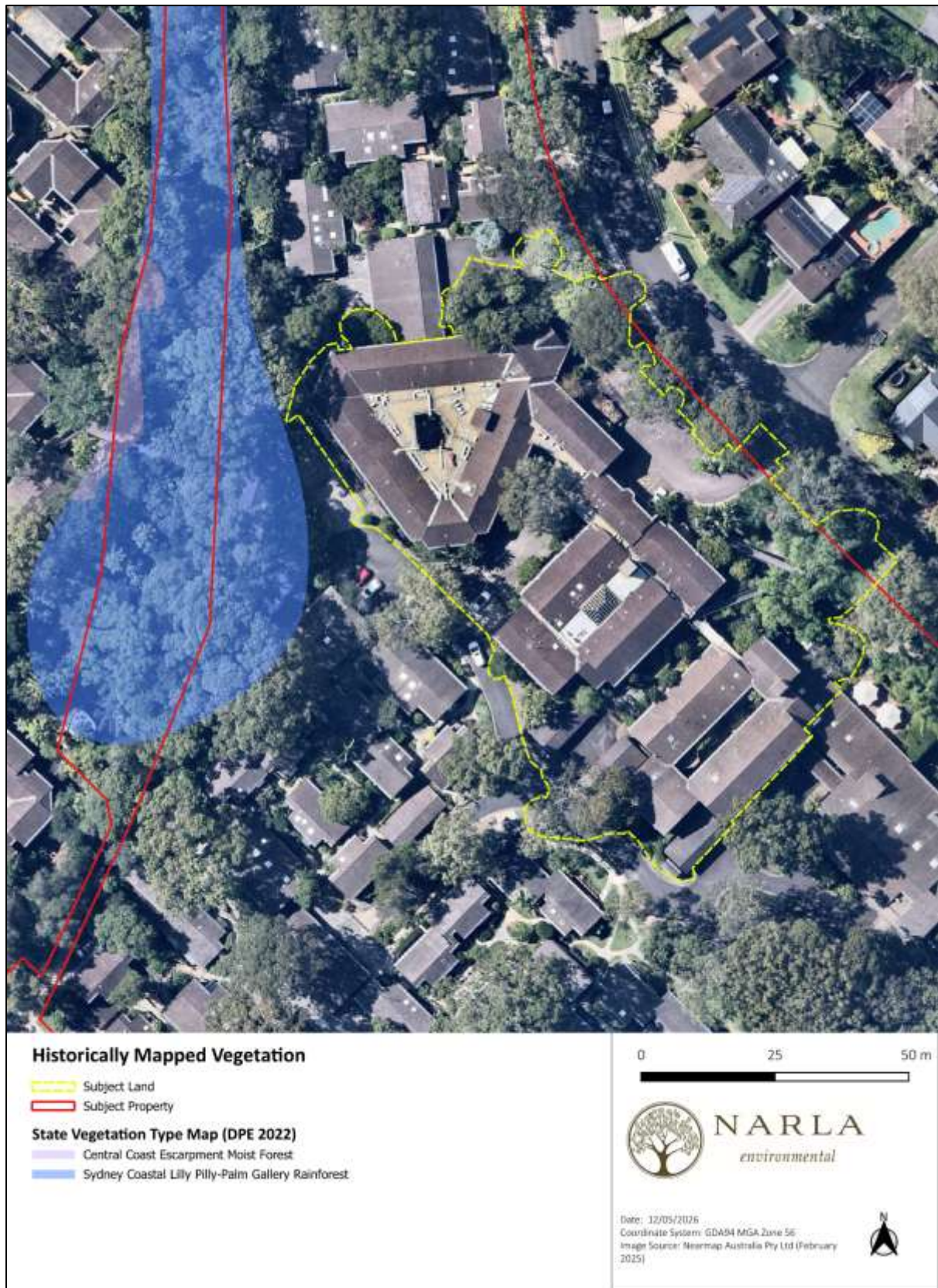


Figure 11. Historically mapped vegetation within and surrounding the Subject Land.

Table 3. Output from the PCT Filter Tool (NDCCEEW 2026e) and subsequent shortlisting of dominant PCTs. Green shading indicates the selected best fit dominant PCT.

Plant Community Type (PCT)	Subject Land within known geographic distribution/ landscape position	No. of Floristic Matches
3234: Hunter Coast Lowland Spotted Gum Moist Forest	Yes. This community occurs on sheltered Permo-Triassic sandstone escarpments and hills in coastal lowlands, primarily between Pittwater and the Karuah River. It is found at low elevations, with a distribution extending from the Central Coast to Lake Macquarie and north to Newcastle, with northern outliers on Nerong Volcanic substrates. The topography includes sheltered escarpments and hills, transitioning to drier communities on exposed aspects. The Subject Land is located within the correct elevation range, geographic distribution and landscape position for the PCT.	7/8
3250: Northern Foothills Blackbutt Grassy Forest	No. This community occurs extensively on the coast, coastal ranges, and foothills between Grafton and Gosford, with outliers near Woodburn and Wollongong. It is found at low to mid-elevations (10-370 metres above sea level) on clay-rich sedimentary or meta-sedimentary substrates, occasionally higher-quartz sediments. The topography includes ridge to mid-slope sites, with transitions to more mesic communities in sheltered or fertile areas. The Subject Land is not located within the correct geographic distribution for the PCT.	7/8
3437: Hunter Coast Lowland Spotted Gum Dry Forest	Yes. This community is found on exposed low elevation coastal hills and rises, primarily on Permo-Triassic sediments, with outliers on Nerong Volcanics and Carboniferous sandstone. It occurs at elevations below 80 metres above sea level, typically in coastal landscapes between Pittwater and Seal Rocks. The topography is characterized by exposed aspects, with transitions to other communities in more sheltered areas or at higher elevations. The Subject Land is located within the correct elevation range, geographic distribution and landscape position for the PCT.	7/8
3581: Hunter Coast Foothills Apple Forest	No. This community is mainly found on enriched sedimentary hills and rises on coastal plains between Gosford and Wallis Lake. It occurs on Narrabeen sandstone, Permian and Carboniferous sandstones, and Nerong Volcanics, typically below 160 metres above sea level, though it can reach over 350 metres on higher peaks. The topography includes coastal plains and foothills, with transitions to other communities based on soil fertility and elevation. The Subject Land is not located within the correct geographic distribution for the PCT.	7/8

Table 4. PCT selection criteria. Green indicates the selected PCT.

Candidate PCT	PCT Description (NDCCEEW 2026e)	Justification
3234: Hunter Coast Lowland Spotted Gum Moist Forest	A tall to very tall sclerophyll open forest with a mid-stratum of mesophyll shrubs and a ground layer of grasses, graminoids and small climbers, found on sheltered Permo-Triassic sandstone escarpments and hills along the coastal lowlands between Pittwater and the Karuah River, central and lower north coast. The tree canopy commonly includes a high cover of <i>Corymbia maculata</i>, occasionally with <i>Eucalyptus paniculata</i> and <i>Eucalyptus umbra</i> or another related species from the mahogany group of eucalypts. One or all of these species may be replaced or accompanied by a range of other species, occasionally including <i>Angophora costata</i>, rarely <i>Syncarpia glomulifera</i> or <i>Corymbia gummifera</i>. The mid-stratum is layered with a sparse cover of smaller trees that commonly includes <i>Allocasuarina torulosa</i>, eucalypt species, <i>Pittosporum undulatum</i> or <i>Glochidion ferdinandi</i>, and rarely <i>Allocasuarina littoralis</i>. Occasionally a sparse cover of <i>Livistona australis</i> may be present, though more frequently it is recorded in the lower shrub layer. Other members of the lower shrub layer very frequently include <i>Breynia oblongifolia</i>, commonly with <i>Notelaea longifolia</i>, and occasionally <i>Pittosporum undulatum</i>, <i>Pittosporum revolutum</i> and <i>Myrsine variabilis</i>. The ground layer has a high diversity of mesic climbers with <i>Eustrephus latifolius</i> and <i>Pandorea pandorana</i> subsp. <i>pandorana</i> almost always present. Grasses very frequently include <i>Imperata cylindrica</i> and <i>Entolasia stricta</i> and occasionally <i>Oplismenus imbecillis</i>, while the fern <i>Pteridium esculentum</i> is very frequent. The graminoids <i>Dianella caerulea</i> and <i>Lomandra longifolia</i> are almost always present. This PCT is common on low-lying Narrabeen sandstone escarpments and hills between Pittwater and the lower Central Coast between Wagstaff, Bouddi and Wamberal. From there, its distribution northwards is interrupted until Lake Macquarie, where it is more commonly associated with Permian sediments in similar low-lying coastal landscapes north to Newcastle. Northern outliers occur on either side of the Karuah River at Nelson Bay on Nerong Volcanic substrates. This community grades into dry shrub grass forests, PCT 3437 on adjoining exposed aspects in the coastal low elevation landscapes, and is replaced by PCT 3230 on coarser Narrabeen sandstone soils or in lower rainfall zones.	Narla has chosen this PCT as the ‘best fit’ as the Subject Land includes <i>Corymbia maculata</i> which is a dominant canopy species for the PCT. Additionally, <i>Syncarpia glomulifera</i> was also present which is mentioned as an occasional canopy species. The Subject Land also includes <i>Pittosporum undulatum</i>, <i>Oplismenus aemulus</i>, and <i>Parsonsia straminea</i> which are also associated with the PCT. It is acknowledged that this Vegetation Zone within this Subject Land is highly altered, containing locally occurring native canopy species that have most likely been planted as part of previous landscaping efforts within the Subject Property. However, owing to the species being locally occurring they are required to be assigned to a PCT. Narla have therefore assigned this PCT to this Vegetation Zone within the Subject Land as it most accurately describes the geology, landscape features and canopy species coverage associated with the vegetation within this zone of the Subject Land and was therefore considered to be the “Best Fit”.

Candidate PCT	PCT Description (NDCCEEW 2026e)	Justification
3437: Hunter Coast Lowland Spotted Gum Dry Forest	A mid-high to tall, occasionally very tall, sclerophyll open forest with a sparse dry shrub layer and grassy ground layer on exposed low elevation coastal hills and rises between Pittwater and Seal Rocks on the Lower North and Hunter coasts. The tree canopy almost always includes a high cover of <i>Corymbia maculata</i> very frequently with species from the ironbark and mahogany eucalypt groups of which <i>Eucalyptus paniculata</i> and <i>Eucalyptus umbra</i> are most frequent. Other common however less abundant members of the canopy include <i>Eucalyptus punctata</i> or <i>Angophora costata</i>. The mid-stratum is typically sparse however includes a taller layer of small trees, commonly <i>Allocasuarina littoralis</i> or <i>Allocasuarina torulosa</i>. Lower growing dry shrubs commonly include <i>Dodonaea triquetra</i>, <i>Persoonia linearis</i>, <i>Pultenaea villosa</i> or <i>Acacia longifolia</i>. The ground layer is grassy, almost always including <i>Entolasia stricta</i> and <i>Themeda triandra</i>, commonly with <i>Imperata cylindrica</i>. The grass like appearance is enhanced by the high frequency of graminoid species such as <i>Dianella caerulea</i> and clumps of <i>Lomandra longifolia</i>. Small climbers are also very frequent including <i>Eustrephus latifolius</i> and <i>Pandorea pandorana</i>. This PCT is strongly associated with elevations below 80 metres asl on Permo-Triassic sediments of the central coast, with outliers on the Nerong Volcanics at Port Stephens and Carboniferous sandstone at Blueys Beach, Smiths Lake. With increased shelter, this community grades into PCT 3234, and as distance from the coast and elevation increases, it grades into drier shrub grass <i>Corymbia maculata</i> forest PCT 3433.	Narla has not chosen this PCT as best-fit for the vegetation within the Subject Land. While <i>Corymbia maculata</i> is present, the site lacks <i>Eucalyptus paniculata</i> and <i>Eucalyptus umbra</i>, which are key canopy species for the PCT. The site does not include <i>Allocasuarina littoralis</i> or <i>Allocasuarina torulosa</i>, which are common in the mid-stratum of PCT 3437.

3.1.3 Final PCT and Vegetation Zone Selection

Field surveys conducted by Narla confirmed that one (1) PCT was identified within the Subject Land, along with areas of exotic vegetation:

- PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest

This PCT was then assigned to one (1) native vegetation zone within the Subject Land:

- Zone 1: PCT 3234 (Moderate)

The other vegetation within the Subject Land that did not conform to a locally occurring PCT due its exotic nature and will hereafter be referred to as:

- Exotic-Dominated Vegetation.

These vegetation zones are detailed in **Table 5** and **Table 6** and displayed in **Figure 12**.

Table 5. PCT 3234 identified within the Subject Land.

PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest	
	
Vegetation Class	Northern Hinterland Wet Sclerophyll Forests
Total Area Within the Subject Land	0.13ha
Vegetation Zone	Zone 1: PCT 3234 (Moderate)
Field survey effort	One (1) 20m x 50m VIS plot was established. The BAM plot was situated in an area within the Subject Property that was determined to be indicative of the vegetation community and condition class of the Subject Land (Figure 12).

PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest	
Description of vegetation	The vegetation within this zone is characterised by a native canopy above a mixed native and exotic midstory and ground layer in the form of garden beds. The canopy consists of wide variety of trees, including <i>Angophora floribunda</i> , <i>Brachychiton acerifolius</i> , <i>Corymbia maculata</i> , <i>Eucalyptus fibrosa</i> , <i>Eucalyptus grandis</i> , <i>Eucalyptus microcorys</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus saligna</i> , <i>Eucalyptus tereticornis</i> , <i>Grevillea robusta</i> , <i>Melaleuca quinquenervia</i> and <i>Syncarpia glomulifera</i> . The midstorey comprises sporadic native species including <i>Banksia integrifolia</i> , <i>Banksia spinulosa</i> , <i>Callistemon salignus</i> , <i>Cyathea australis</i> , <i>Elaeocarpus reticulatus</i> , <i>Leptospermum petersonii</i> , <i>Livistona australis</i> and <i>Pittosporum undulatum</i> . The ground layer contains a mix of native and exotic species. Native groundcovers include incidental occurrences of <i>Adiantum aethiopicum</i> , <i>Adiantum hispidulum</i> , <i>Centella asiatica</i> , <i>Commelina cyanea</i> , <i>Crassula ovata</i> , <i>Dendrobium speciosum</i> , <i>Dichondra repens</i> , <i>Oplismenus aemulus</i> , <i>Parsonsia straminea</i> and <i>Viola banksii</i> . Exotic species in the ground cover include <i>Agapanthus</i> spp., <i>Alpinia</i> spp., <i>Begonia semperflorens</i> , <i>Bidens pilosa</i> , <i>Bromelia</i> spp., <i>Chlorophytum comosum</i> , <i>Clivia</i> spp., <i>Ehrharta erecta</i> , <i>Monstera deliciosa</i> , <i>Sida rhombifolia</i> , <i>Solanum nigrum</i> , <i>Sonchus oleraceus</i> , <i>Spathiphyllum</i> spp. and <i>Tulbaghia violacea</i> .
Structure of vegetation	Native canopy cover was moderate within the VIS plot, with native trees totalling 35% cover. Native shrub coverage was moderate at 15.5% and native ground cover was very low at 0% grasses, 0.2% forbs and 0% ferns and 5% other due to the presence of <i>Livistona australis</i> . High Threat Exotics were at a low coverage within the plot at 0%. A moderate coverage of leaf litter (44%) was present. The VIS plot contained tree stems recorded in three (3) DBH classes. No (0) large trees (+80cm DBH) were recorded. No hollow bearing trees were recorded. No fallen logs were recorded.
BC Act 2016 Status	This vegetation conforms to the BC Act listed EEC Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion (see Section 3.2.1)
EPBC Act 1999 Status	Not Listed
Scientific Reference from VIS (NDCCEW 2026e)	Connolly, D., Binns, D., Turner, K., Hager, T., Lyons, M., Magarey, E. (in prep.) A revised classification of Plant Community Types for eastern New South Wales. NSW DPIE, Parramatta;

Table 6. Exotic-Dominated Vegetation identified within the Subject Land

Exotic-Dominated Vegetation	
	
Total area within the Subject Land (approximate)	0.14ha
Field Survey Effort	No VIS plots were established within this zone owing to its exotic nature.
Description of vegetation within the Subject Land	The vegetation comprises a series of garden beds dominated by a diverse assemblage of horticultural species, including <i>Acer palmatum</i> , <i>Alpinia</i> spp., <i>Agapanthus</i> spp., <i>Camellia sasanqua</i> , <i>Crassula ovata</i> , <i>Duranta erecta</i> , <i>Eriobotrya japonica</i> , <i>Grevillea</i> cv. 'Robyn Gordon', <i>Jacaranda mimosifolia</i> , <i>Lagerstroemia indica</i> , <i>Magnolia grandiflora</i> , <i>Monstera deliciosa</i> , <i>Murraya paniculata</i> , <i>Nandina domestica</i> , and <i>Tulbaghia violacea</i> . The vegetation is maintained in a highly modified state, consistent with an intensively managed garden setting.
Justification of vegetation assignment	The vegetation within this zone consisted of environmental weeds and landscaped exotic species. The vegetation within the does not conform to a locally occurring PCT and was therefore classified as 'Exotic-Dominated Vegetation'.
Associated TEC	None.



Figure 12. Narla field-validated vegetation mapping and location of BAM VIS plot within the Subject Property.

3.2 Threatened Ecological Communities

3.2.1 Biodiversity Conservation Act 2016 - Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion

The Hunter Coast Lowland Spotted Gum Moist Forest in Vegetation Zone 1 is associated with the BC Act listed Endangered Ecological Community (EEC), known as the Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion (PWSGF). Vegetation Zone 1 is situated on Narrabeen series geology within the Northern Beaches Local Government Area (LGA), formerly known as Pittwater.

The vegetation within the subject land includes several canopy species identified in the Final Determination for PWSGF, such as *Angophora floribunda*, *Corymbia maculata*, *Livistona australis*, *Pittosporum undulatum*, and *Pteridium esculentum*. Based on the presence of these species and the ecological characteristics of the area, Vegetation Zone 1 aligns with the description of the BC Act listed EEC, PWSGF (**Figure 12**).

3.3 Assessing Patch Size

A patch is defined by the BAM (DPIE 2020a) as an area of native vegetation that occurs on the Subject Land and includes native vegetation that has a gap of less than 100m from the next area of native vegetation (or $\leq 30\text{m}$ for non-woody ecosystems). A patch may extend onto adjoining land.

For each vegetation zone, the assessor must determine the patch size in hectares and assign it to one of the following classes:

- $<5\text{ha}$
- $5\text{--}<25\text{ha}$
- $25\text{--}<100\text{ha}$
- $\geq 100\text{ha}$.

The patch size class is used to assess habitat suitability on the Subject Land for threatened species. The assessor may assign more than one patch size class to the vegetation zone if both of the following apply:

- A vegetation zone comprises two or more discontinuous areas of native vegetation, and
- The areas of discontinuous native vegetation have more than one patch size class.

As areas outside of the Subject Property were not assessed as part of the scope of this assessment, the vegetation zones identified within the Subject Land were assigned to the following category to allow for aerial mapping of patch size within the broader area (**Table 7**; **Figure 13**)

- Woody Ecosystems:
 - Zone 1: PCT 3234 – Moderate Condition.

Owing to the exotic nature of the Exotic Dominated Vegetation, it is not required to be assigned a patch size under the BAM.

Table 7. Patch size classes that each PCT and associated vegetation zone fall into.

Plant Community Type	Vegetation Zone	Patch Size Class
PCT 3234	Zone 1	$>100\text{ha}$

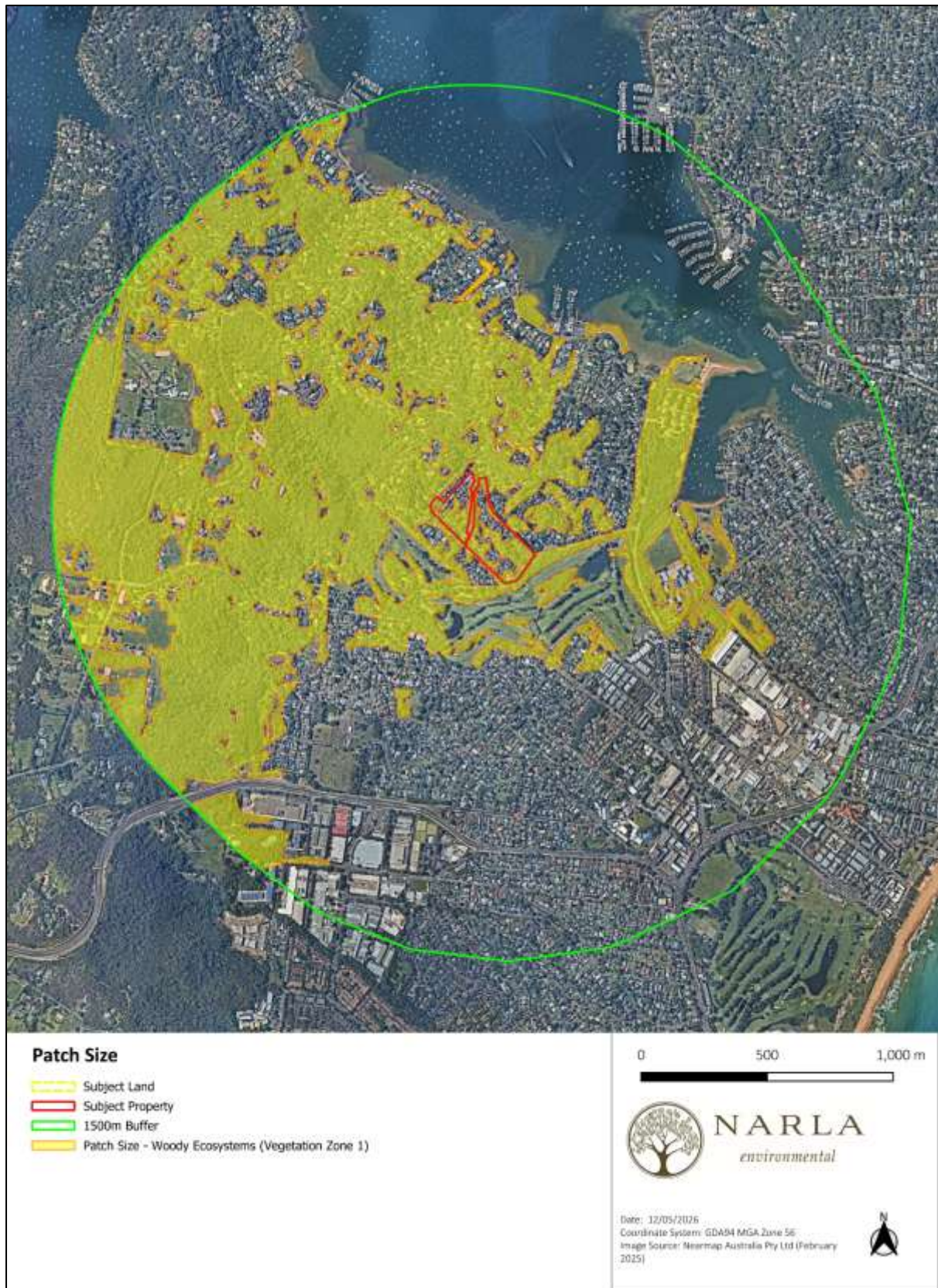


Figure 13. Patch size within the 1500m buffer for each vegetation zone identified within the Subject Land.

3.4 Vegetation Integrity Survey (VIS) Plots

One (1) BAM VIS Plot was undertaken to determine the integrity score of the vegetation within the Subject Land. The plot was located in vegetation that is likely to be indicative of the vegetation community and condition class of the Subject.

Plot data gathered for each attribute used to assess the function of the Subject Land vegetation is detailed in **Appendix B**. Vegetation Integrity (VI) scores represented by existing vegetation within each vegetation zone is detailed in **Table 8**.

3.4.1 Determining future vegetation integrity scores

Most projects will result in complete clearing of vegetation and threatened species habitat within the development footprint. In this scenario, the assessor must assess the proposed future value of each of the VI attributes as zero in the BAMC. However, in circumstances where partial clearing of vegetation is proposed and remaining vegetation will be maintained, the assessor may determine that the future value of the relevant VI attributes are greater than zero (DPIE 2020a).

The vegetation within this zone has been assessed as complete removal to facilitate the proposed development. Consequently, the vegetation within the Subject Land has been assigned to the following management zones (**Figure 14**):

- Management Zone 1: PCT 3234 (Moderate) Complete Removal
 - The vegetation within this zone incorporates all locally native vegetation proposed for removal to facilitate the proposed development. The canopy of neighbouring trees overhanging the Subject Land has also been assessed for removal to account for potential select canopy trimming that may occur owing to the future utilisation of the Subject Land. This however does not provide approval for additional vegetation removal and only trees in the corresponding Arboricultural Impact Assessment (Heartwood Tree Consulting 2026) that are listed for removal/trimming/pruning are to be impacted to facilitate the proposed development.

The attributes influencing future vegetation scores within this management zone are detailed in **Table 9**.

Owing to the exotic nature of the remaining vegetation within the Subject Land, it not been assigned to a management zone and will not require further assessment.

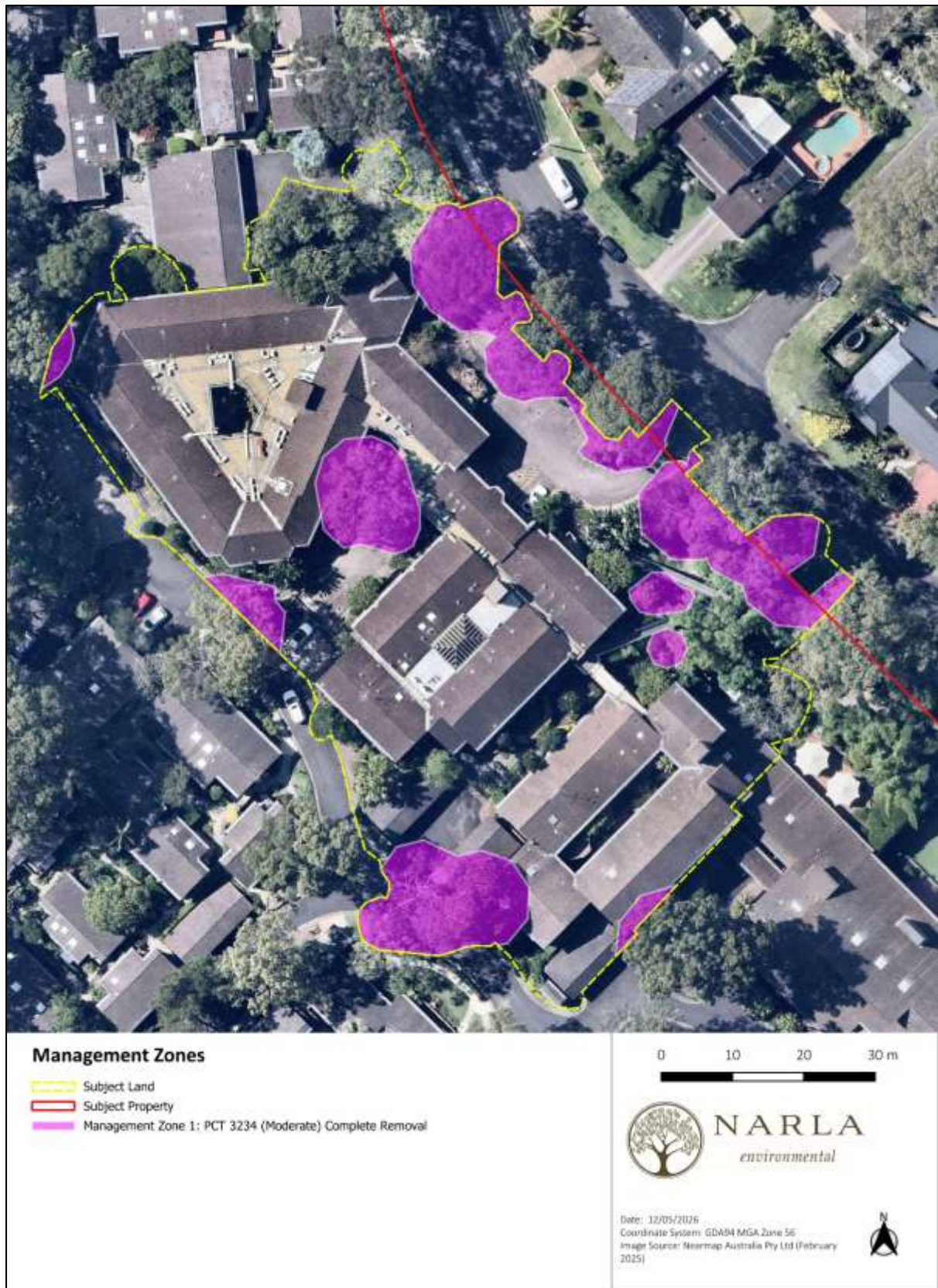


Figure 14. Management zones within the Subject Land.

Table 8. Vegetation integrity scores for the identified zone.

PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest											
Vegetation Zone	Management Zone	Area (ha)	Survey Effort	Composition Condition Score	Structure Condition Score	Function Condition Score	VI Score	Future VI Score	Change in VI Score	Total VI Loss	Hollow bearing trees
Zone 1: PCT 3234 (Moderate)	Management Zone 1: PCT 3234 (Moderate) Complete Removal	0.13ha	1 x 1000m2 (20m x 50m) VIS Plot	13.1	45.9	24.8	24.6	0	-24.6	24.6	absent

Table 9. Management zone within the Subject Land and relevant vegetation attributes (composition, structure and function) affecting future VI scores.

Vegetation Zone	Management Zone	Changes in Current Vegetation Attributes	Vegetation Attributes Not Changed	Future Vegetation Scores and Justification
Zone 1: PCT 3234 (Moderate)	Management Zone 1: PCT 3234 (Moderate) Complete Removal	All vegetation within the Subject Land has been assessed and lost.	N/A	- The vegetation within this zone incorporates all locally native vegetation proposed for removal to facilitate the proposed development. The canopy of neighbouring trees overhanging the Subject Land has also been assessed for removal to account for potential select canopy trimming that may occur owing to the future utilisation of the Subject Land. This however does not provide approval for additional vegetation removal and only trees in the corresponding Arboricultural Impact Assessment (Heartwood Tree Consulting 2026) that are listed for removal/trimming/pruning are to be impacted to facilitate the proposed development. - Future VI Score is 0.

4. Threatened Species

4.1 Candidate Ecosystem Credit Species

Ecosystem credit species associated with the Subject Land are listed below in **Table 10**. No predicted by the BAM calculator as potential ecosystem credits were excluded from the assessment due to habitat constraints.

Table 10. Candidate ecosystem credits predicted to occur within the Subject Land.

Scientific Name	BC Act Status	Sensitivity to gain class	Excluded from Assessment	Reason for Exclusion from Assessment
<i>Anthochaera phrygia</i> Regent Honeyeater (Foraging)	Critically Endangered	High	No	-
<i>Artamus cyanopterus cyanopterus</i> Dusky Woodswallow	Vulnerable	Moderate	No	-
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo (Foraging)	Endangered	Moderate	No	-
<i>Calyptorhynchus lathami lathami</i> South-eastern Glossy Black-Cockatoo (Foraging)	Vulnerable	High	No	-
<i>Climacteris picumnus victoriae</i> Brown Treecreeper (eastern subspecies)	Vulnerable	High	No	-
<i>Daphoenositta chrysoptera</i> Varied Sittella	Vulnerable	Moderate	No	-
<i>Dasyurus maculatus</i> Spotted-tailed Quoll	Vulnerable	High	No	-
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle	Vulnerable	High	No	-
<i>Gallinago hardwickii</i> Latham's Snipe	Vulnerable	High	No	-
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle (Foraging)	Vulnerable	High	No	-
<i>Hieraaetus morphnoides</i> Little Eagle (Foraging)	Vulnerable	Moderate	No	-
<i>Hirundapus caudacutus</i> White-throated Needletail	Vulnerable	High	No	-
<i>Ixobrychus flavicollis</i> Black Bittern	Vulnerable	Moderate	No	-
<i>Lathamus discolor</i> Swift Parrot (Foraging)	Endangered	Moderate	No	-
<i>Lophoictinia isura</i> Square-tailed Kite (Foraging)	Vulnerable	Moderate	No	-
<i>Melithreptus gularis gularis</i> Black-chinned Honeyeater (eastern subspecies)	Vulnerable	Moderate	No	-

Scientific Name	BC Act Status	Sensitivity to gain class	Excluded from Assessment	Reason for Exclusion from Assessment
<i>Micronomus norfolkensis</i> Eastern Coastal Free-tailed Bat	Vulnerable	High	No	-
<i>Miniopterus australis</i> Little Bent-winged Bat (Foraging)	Vulnerable	High	No	-
<i>Miniopterus orianae oceanensis</i> Large Bent-winged bat (Foraging)	Vulnerable	High	No	-
<i>Pandion cristatus</i> Eastern Osprey (Foraging)	Vulnerable	Moderate	No	-
<i>Parvipsitta pusilla</i> Little Lorikeet	Vulnerable	High	No	-
<i>Petaurus australis</i> Yellow-bellied Glider	Vulnerable	High	No	-
<i>Petroica boodang</i> Scarlet Robin	Vulnerable	Moderate	No	-
<i>Petroica phoenicea</i> Flame Robin	Vulnerable	Moderate	No	-
<i>Phoniscus papuensis</i> Golden-tipped Bat	Vulnerable	High	No	-
<i>Pseudomys novaehollandiae</i> New Holland Mouse	Vulnerable (EPBC Only)	High	No	-
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox (Foraging)	Vulnerable	High	No	-
<i>Ptilinopus regina</i> Rose-crowned Fruit-Dove	Vulnerable	Moderate	No	-
<i>Ptilinopus superbus</i> Superb Fruit-Dove	Vulnerable	Moderate	No	-
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	Vulnerable	High	No	-
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	Vulnerable	High	No	-
<i>Varanus rosenbergi</i> Rosenberg's Goanna	Vulnerable	High	No	-

4.2 Candidate Species Credit Species Summary

This section provides a summary of the candidate species credit fauna and flora species for the Subject Land derived from BAMC (NDCCEEW 2026f). A summary of the targeted survey effort applied to each species is provided along with the results of the survey effort, specifically whether or not the species credit needs to be offset through retiring of Biodiversity Offset Credits (**Table 11** and **Table 12**).

Table 11. Candidate Fauna Credit Species predicted to occur within the Subject Land.

Scientific Name	Included in Assessment?	Targeted Survey conducted?	Present within Subject Land?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
<i>Anthochaera phrygia</i> Regent Honeyeater (Breeding)	No, the Subject Land is not included on the map of important areas for Regent Honeyeaters.	No	N/A	Very High – 3	No
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	Yes. Potential breeding habitat is identified as land within 100m of rocky areas containing caves, overhangs, crevices, cliffs, escarpments, old mines, tunnels, culverts, or derelict concrete buildings with potential foraging habitat being associated PCTs within 2km of these rocky areas (NDCCEEW 2026d). Whilst no breeding habitat was present within or immediately surrounding the Subject Land, based on the terrain in the broader locality surrounding the Subject Land, such habitat is believed to exist within 2km. As such this species has been included in the assessment.	No	Assumed Present (foraging)	Very High – 3	Yes
<i>Lathamus discolor</i> Swift Parrot (Breeding)	No, the Subject Land is not included on the map of important areas for Swift Parrots.	No	N/A	Very High – 3	No
<i>Lophoictinia isura</i> Square-tailed Kite (Breeding)	Whilst this species is not listed as being at risk of SAIL (NDCCEEW 2026d), it has been historically recorded and confirmed as nesting in close proximity to the Subject Land (i.e. the other side of Annam Road). Therefore it is required to be included in the assessment.	No	Confirmed Present (adjacent to Subject Land)	Moderate – 1.5	Yes
<i>Miniopterus australis</i> Little Bent-winged Bat (Breeding)	No. This species is known to breed in caves, tunnels, mines and culverts. As such habitat constraints are not present within the Subject Land, this species was excluded from the assessment.	No	N/A	Very High – 3	No

Scientific Name	Included in Assessment?	Targeted Survey conducted?	Present within Subject Land?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
<i>Miniopterus orianae</i> oceanensis Large Bent-winged Bat (Breeding)	No. This species is known to breed in caves, tunnels, mines and culverts. As such habitat constraints are not present within the Subject Land, this species was excluded from the assessment.	No	N/A	Very High – 3	No
<i>Vespadelus trougtoni</i> Eastern Cave Bat	Yes. Potential breeding habitat is identified as land within 100m of rocky areas containing caves, overhangs, crevices, cliffs, escarpments, old mines, tunnels, culverts, or derelict concrete buildings with potential foraging habitat being associated PCTs within 2km of these rocky areas (NDCCEEW 2026d). Whilst no breeding habitat was present within or immediately surrounding the Subject Land, based on the terrain in the broader locality surrounding the Subject Land, such habitat is believed to exist within 2km. As such this species has been included in the assessment.	No	Assumed Present (foraging)	Very High – 3	Yes

Table 12. Candidate Flora Credit Species predicted to occur within the Subject Land.

Scientific Name	Included in Assessment?	Targeted Survey conducted?	Present within Subject Land?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
<i>Rhizanthella slateri</i> Eastern Australian Underground Orchid	Yes. As potential habitat was identified within the Subject Land this species was included in the assessment.	Yes	No	Very High – 3	No
<i>Rhodamnia rubescens</i> Scrub Turpentine	Yes. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. As such habitat is present within the Subject Land, this species was included in the assessment.	Yes	No	Very High – 3	No
<i>Rhodomyrtus psidioides</i> Native Guava	Yes. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest. As such habitat is present within the Subject Land, this species was included in the assessment.	Yes	No	Very High – 3	No

4.3 Species Credit Habitat Surveys

Species credit habitat surveys were undertaken for any SAI species credit species considered likely to have suitable habitat within the Subject Land (**Figure 15**). These surveys were implemented in accordance with Section 5.3 of the BAM and all relevant OEH, DPE and DCCEEW threatened species survey guidelines.

Habitat surveys were undertaken on the 19th November 2024 by experienced ecologists Brodie Miller and Luke Johnson within and surrounding the Subject Land. Weather conditions taken from the nearest weather station (Terrey Hills, station no. 066059) in the lead up and during the field survey are outlined in **Table 13**.

Pre-survey weather conditions were generally conducive for identifying threatened species and their habitats should they occur within the Subject Land. Limited rainfall and moderate temperature in the week prior to the targeted flora surveys may have provided ideal conditions for the flowering and/or emergence of the targeted flora species.

Table 13. Weather conditions taken from the nearest weather stations (Station number 066059) in the lead up and during the field survey (BOM 2023). Survey date is in bold.

Timing/activities	Date	Temperature		Rainfall (mm)
		Min	Max	
Lead up to the survey	12/11/2024	16.4	21.5	0
	13/11/2024	16.6	22.6	1.2
	14/11/2024	15.8	20.7	1.4
	15/11/2024	15.3	18.9	1.8
	16/11/2024	16.2	22.7	1.4
	17/11/2024	18.6	26.2	0.4
	18/11/2024	17.2	27.2	18.6
Site Assessment, Habitat Survey, Threatened Flora Survey	19/11/2024	15.6	20	0.4

4.3.1 Fauna Species Credit Survey

A total of six (6) SAI threatened fauna species were identified within the BAMC (NDCCEEW 2026f) as having the potential to occur within the Subject Land. Following the site assessment, it was then determined that four (4) of the predicted species were unlikely to be present within the Subject Land due to the follow:

- The assessor determines that microhabitats required by a species are absent from the Subject Land (or specific vegetation zone) [(Section 5.2.3(2ai) of the BAM (DPIE 2020a)].

The remaining two (2) species were required to be assumed present. Whilst surveys were conducted to rule out breeding habitat (see **section 4.3.1.1**) within and surrounding the Subject Land, it is considered likely that the vegetated areas within 2kms of the Subject Land provide foraging habitat for these species and therefore the offsetting of species credits is required.

In addition to the SAI species predicted by the BAMC (NDCCEEW 2026f), one (1) additional threatened species (not SAI) was required to be included in the assessment owing to a confirmed nesting site being located in close proximity to the Subject Land (other side of Annam Road). Therefore the offsetting of species credits for this species is also required.

4.3.1.1 Threatened Microchiropteran Bat Survey

Owing to the presence of man-made structures within the Subject Land that will require demolition to facilitate the proposed works, a targeted survey for threatened microchiropteran bat (microbats) species with potential to utilise such habitat was conducted. The following threatened microbat species, which are known to inhabit buildings, occur within the locality of the Subject Land (NDCCEEW 2026b):

- *Chalinolobus dwyeri* (Large-eared Pied Bat);
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat);
- *Miniopterus australis* (Little Bent-winged Bat);
- *Saccolaimus flaviventris* (Yellow-bellied Sheath Tail Bat);
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle);
- *Scoteanax rueppellii* (Greater Broad-nosed Bat);
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat); and
- *Vespadelus troughtoni* (Eastern Cave Bat).

The survey was conducted during daylight hours, on the 19th November 2024 by experienced Narla Ecologists Brodie Miller and Luke Johnson. During the site assessment the Ecologists conducted a walk over of both the inside and outside of all structure which are proposed to be demolished as part of this SSDA.

The ecologists focussed searches on potential entry and exit points as well as cracks, crevices and holes that could be utilised for roosting. Each area of potential habitat was examined using an endoscope as well as a EchoMeter Touch 2 Pro to record any potential individuals for analysis.

No threatened microbats, were observed within or surrounding the structures during the site assessment. Photos from the assessment can be found in **Appendix D**.

4.3.2 Flora Species Credit Survey

Three (3) SAIL threatened flora species was identified within the BAMC (NDCCEEW 2025f) as having the potential to occur within the Subject Land.

A targeted survey was undertaken for these in accordance with the 'Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method' (DPE 2020a; **Table 13**). This species was not detected within the Subject Land or Subject Property.

Table 13. Species credit flora species requiring targeted surveys.

Candidate Fauna Species	Survey Period (BAMC)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Rhizanthella slateri</i> Eastern Australian Underground Orchid											✓	
<i>Rhodamnia rubescens</i> Scrub Turpentine											✓	
<i>Rhodomyrtus psidioides</i> Native Guava											✓	
Key	✓ = Time of Site Assessment						= NDCCEEW Endorsed Survey Period					

4.4 Species Polygons

4.4.1 Confirmed Present

No SAI species were confirmed to be present within the Subject Land. One (1) additional threatened species not considered at risk of SAI is required to be offset as a result of the proposed works owing to the location of a confirmed nest in close proximity to the Subject Land. The following species polygon has therefore been applied:

- *Lophoictinia isura* (Square-tailed Kite): Where a breeding site has been identified in accordance with the BAM the species buffer polygon should be established by providing a circular polygon with a 300m radius around the nest tree and incorporate all woody and non-woody native vegetation within the radius. The species polygon for this species has been assigned to all vegetation zones that occurs within the Subjects Land (**Figure 16**). Areas of Exotic Dominated Vegetation have been excluded.

Two (2) species were assumed present within the Subject Land owing to the presence of suitable foraging habitat occurring within the broader locality.

Where a species credit species is assumed to be present within the Subject Land, the assessor must assign a species polygon that encompasses the entire vegetation zone(s) within which the candidate species is predicted to occur.

The following species have been assumed present within the Subject Land and were assigned species polygons as per below:

- *Chalinolobus dwyeri* (Large-eared Pied Bat): The species polygon for this species has been assigned to all vegetation zones that occurs within potential foraging habitat (i.e. within 2km of mapped rocky areas with crevices; **Figure 17**). Areas of Exotic Dominated Vegetation have been excluded.
- *Vespadelus troughtoni* (Eastern Cave Bat): The species polygon for this species has been assigned to all vegetation zones that occurs within potential foraging habitat (i.e. within 2km of mapped rocky areas with crevices; **Figure 17**). Areas of Exotic Dominated Vegetation have been excluded.

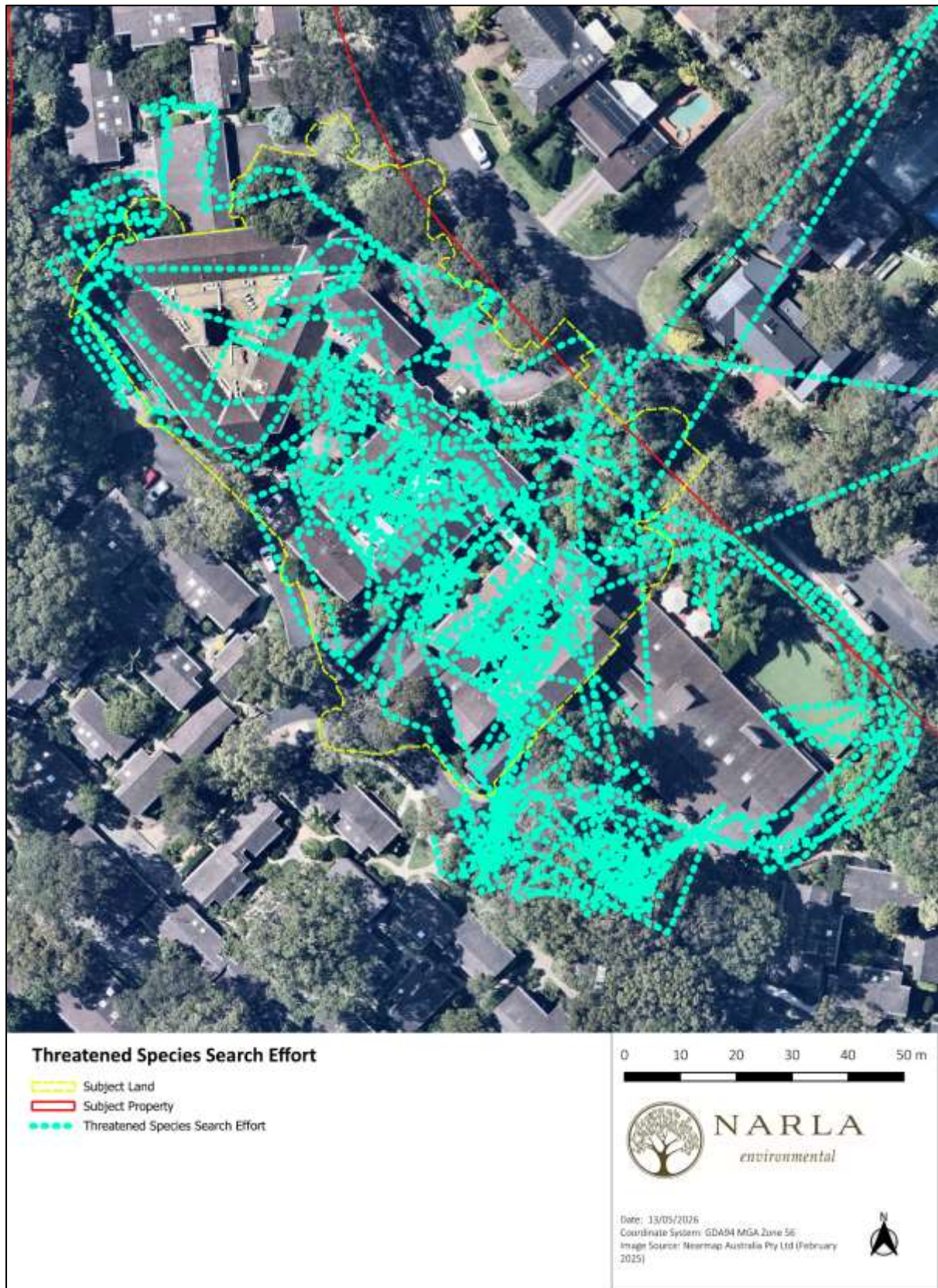


Figure 15. Targeted survey effort for SAI threatened species and their habitats.

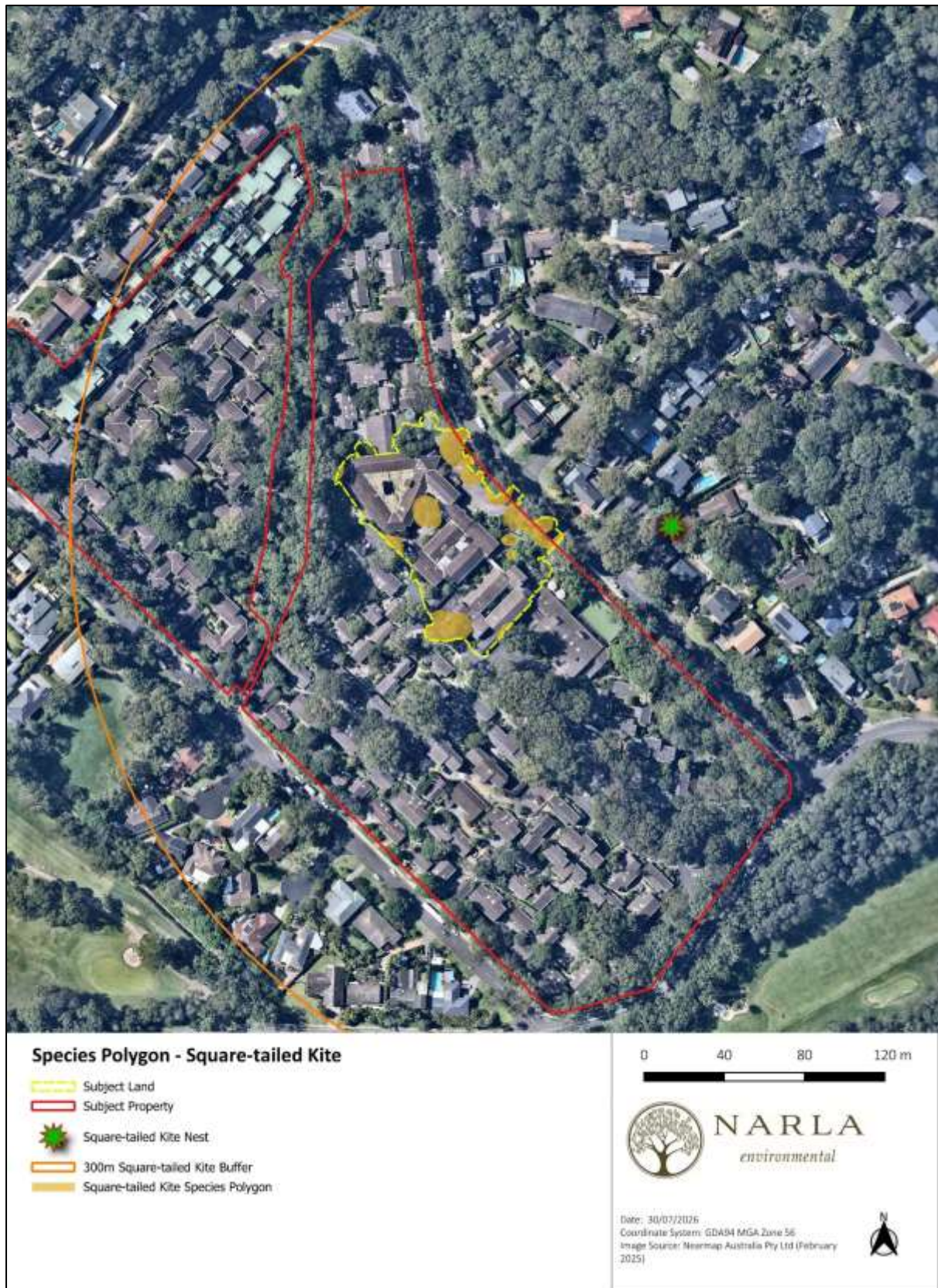


Figure 16. Square-tailed Kite Species Polygon.



Figure 17. Species polygon for Large-eared Pied Bat and Eastern Cave Bat.

5. Prescribed Impacts

Certain projects may have impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. For many of these impacts, the biodiversity values may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical. Prescribed biodiversity impacts require an assessment of the impacts of the proposed development on the habitat of threatened species or ecological communities. This is discussed in **Table 14**.

Table 14. Prescribed and uncertain impacts associated with the proposed development.

Will there be impacts on any of the following?	Yes/No	If Yes, Address all of the assessment questions from section 6 of the BAM
Habitat of threatened entities including: - karst, caves, crevices, cliffs, rocks and other geological features of significance, or - human-made structures, or - non-native vegetation	Yes	There are no karsts, caves, crevices, cliffs and other features of geological significance on or near the Subject Land. The Subject Land contains human-made structure that will be demolished as part of the development. The following threatened microbat species may utilise this human-made structures for roosting and breeding: <i>Chalinolobus dwyeri</i> (Large-eared Pied Bat); <i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle); <i>Micronomus norfolkensis</i> (Eastern Coastal Free-tailed Bat); <i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail-bat); <i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat); and <i>Vespadelus troungtoni</i> (Eastern Cave Bat). Two (2) other species may use such structures for roosting purposes, but not breeding purposes: <i>Miniopterus australis</i> (Little Bent-winged Bat); and <i>Miniopterus orianae oceanensis</i> (Large bent-winged Bat). A survey was undertaken for threatened microbats (Section 4.3.1.1) and no microbats, or evidence of microbats, were observed. However, as a precaution this prescribed impact is assessed further in Section 7.2. Non-native vegetation within the Subject Land is not expected to provide habitat for threatened species, considering it mostly constituted of manicured gardens.

Will there be impacts on any of the following?	Yes/No	If Yes, Address all of the assessment questions from section 6 of the BAM
On areas connecting threatened species habitat, such as movement corridors	No	It is unlikely the proposed development will interrupt connectivity for any threatened species, owing to the areas of habitat connectivity that will continue to exist in vegetated areas surrounding the Subject Land.
That affect water quality, water bodies and hydrological processes that sustain threatened entities (including from subsidence or upsidence from underground mining)	No	No threatened species were identified within the Subject Land that are sustained by water bodies and hydrological processes. It is also not expected that the removal of vegetation within the Subject Land will impact upon any groundwater processes within the surrounding landscape. Furthermore, a Groundwater Impacts Assessment (WSP 2026) was prepared for the proposed development which concluded “ <i>The annual volume of groundwater intake is expected to have minimal impact to the surrounding groundwater system, neighbouring properties, and other water supply works</i> ”. Therefore impacts associated within the proposed drained basement are also not expected to impact surrounding vegetation.
On threatened and protected animals from turbine strikes from a wind farm	No	No wind farms are associated with the proposed development.
On threatened species or fauna that are part of a TEC from vehicle strikes.	No	Due to the highly urbanised nature of the Subject Land and locality it is highly unlikely that vehicle strikes will be an issue with the proposed development, especially considering the slow speeds required to manoeuvre the site.

6. Avoid, Minimise and Mitigate Impacts

6.1 Avoidance and Minimisation of Impacts

The proposed development where possible has largely utilised existing dwellings, hardstand and landscaped garden beds containing both native and exotic vegetation. Owing to the proximity of locally native trees, to existing infrastructure however complete avoidance was not possible in order to facilitate the proposed works. Through the implementation of tree sensitive techniques however several significant trees have been proposed for retention which in earlier assessments were originally proposed for removal. This includes trees 17, 19, 23, 24 and 26 which are located along Annam Road. Further discussions were also conducted with Narla, to see if further reiterations could be made to the proposed plans to retain additional trees within the works area. This resulted in the retention of trees 20 and 21 also, which had previously been assessed as lost to accommodate construction.

6.2 Impact Mitigation and Minimisation Measures

This section details the measures to be implemented before, during and post construction to avoid and minimise the impacts of the project (Table 15).

Table 15. Mitigation and management of impacts associated with the proposed development.

Action	Outcome	Timing	Responsibility
Preparation of a Construction Environmental Management Plan (CEMP)	A CEMP may be required for the construction phase of the project, and will be prepared prior to issue of the Construction Certificate. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures, including the procedures outlined below. The proposed mitigation measures would include environmental safeguards for protection of neighbouring properties and nearby waterways in accordance with relevant policy documentation and Government guidelines. In order to address the potential impacts of the proposal on biodiversity, the mitigation and management measures outlined within this table would be implemented as part of the CEMP for the site.	Pre-construction phase	Proponent Construction Contractor
Landscaping	Future landscaping efforts should incorporate vegetation representative of PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest. All trees proposed for removal should be replaced at a 2:1 ratio with locally sourced, native species representative of this community.	Post-construction phase	Proponent
Assigning a Project Ecologist for vegetation clearing	Prior to construction, the applicant should commission the services of a qualified and experienced Ecologist Consultant with a minimum tertiary degree in Science, Conservation, Biology, Ecology, Natural Resource Management, Environmental Science or Environmental Management. The Ecologist must be licensed with a current	Prior to and during vegetation	Proponent Project Ecologist

Action	Outcome	Timing	Responsibility
	Department of Primary Industries Animal Research Authority permit and New South Wales Scientific License issued under the BC Act. The Ecologist will be commissioned to: Undertake an extensive pre-clearing survey, identifying potential habitat trees as well as reinspecting roof cavities of buildings to be removed for potential microbat species.	clearance works	
Square-tailed Kite Impact Mitigation	The following mitigation measures are to be impacted to minimise the potential of impacting the Square-tailed Kite Nest identified in close proximity to the Subject Land: - Construction activities are to be limited during breeding season (September to January), with only low impact/noise producing works, that don't exceed regular noise/vibration levels for the area to be conducted during this time. This is to be confirmed by a suitably qualified acoustic consultant to monitor noise levels. - If works are to occur during the breeding season, the Project Ecologist is to attend site to monitor the nest for signs of distress (alarm calling, regularly leaving the nest, increased vigilance etc). If signs of distress are observed the works are to stop until the behaviour of the birds have returned to normal. - The utilisation of sound barriers is to be explored and are to be installed where practical.	Prior to and during vegetation clearance works	Proponent Project Ecologist Acoustic Consultant Contractor
Tree Protections	In accordance with AS 4970-2025 Protection of Trees on Development Sites, a Tree Protection Zone (TPZ) will be established around all trees designated for retention. These zones will be fenced and clearly signposted as no-disturbance areas to prevent accidental damage. If minor encroachments (<10% TPZ) occur, these must be compensated within the same TPZ area to maintain tree health. If major encroachments (>10% TPZ or within the Structural Root Zone) occur, a detailed root investigation using non-destructive methods (e.g., air-spading) must be undertaken. Tree-sensitive construction techniques (e.g., bridging over root zones) will be applied where required.	Prior to and during vegetation clearance works, Construction phase; post-construction phase	Proponent
Erosion and Sedimentation	To prevent sediment runoff and indirect biodiversity impacts, erosion and sediment control measures must be installed prior to earthworks and maintained throughout construction. These measures will comply with The Blue Book (Landcom 2004, Volume 1), the NSW industry standard for soil and water management. Regular inspections will be undertaken, and sediment basins/silt fences will be installed in high-risk areas to prevent runoff into nearby waterways or adjacent native vegetation.	Construction phase	Proponent Construction Contractor
Erection of temporary fencing	To protect retained native vegetation from accidental disturbance, temporary fencing will be erected around these areas. The fencing will be:	Construction phase	Proponent

Action	Outcome	Timing	Responsibility
	- Clearly marked and signed as a 'No-go Zone' for construction workers. - Monitored to ensure effectiveness, with repairs undertaken as necessary. - Installed before ground disturbance and remain in place until completion of works.		Construction Contractor
Storage and Stockpiling (Soil and Materials)	Stockpiling sites will be designated outside of native vegetation zones to avoid trampling and degradation of retained habitats. Any soil or materials imported onto the site must be certified weed-free to prevent the introduction of invasive species or pathogens that could impact local biodiversity. Stockpiles will be managed to prevent erosion and sediment loss, with stabilisation measures applied where necessary.	Construction phase	Construction Contractors

7. Assessment of Impacts

7.1 Direct Impacts

7.1.1 Full Clearing

The proposed works will result in complete clearing to the following vegetation:

- 0.13ha of PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest which conforms to the EEC Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion; and
- 0.14 ha of Exotic Dominated Vegetation.

7.1.2 Partial Clearing

No partial clearing will occur as a result of the proposed development.

7.2 Prescribed Impacts

As there is potential for the Subject Land to contain habitat for a number of threatened microbat species in the form of human-made structures (**Figure 18**) an assessment of this prescribed impact must be undertaken in accordance with Section 8.3 of the BAM (DPIE 2020a). Although a survey was undertaken for threatened microbats (**Section 4.3.1.1; Appendix D**) and no microbats were observed, this prescribed impact is still assessed in **Table 16**.

Table 16. Prescribed and uncertain impacts associated with the proposed development.

Prescribed Impact	Nature, Extent and Duration	Threatened Species and Their Habitat Likely to be Impacted	Consequences of the Impacts on Threatened Entities
Habitat of threatened entities: human-made structures.	There is the low potential that threatened microbat species use human-made structures (in particular, roof cavities) within the Subject Land for roosting and potentially breeding. A survey was completed of all of the buildings considered to have potential habitat for roosting, and no microbats were observed, this does not exclude these species using such spaces in the future. The demolition of these structures has the potential to temporarily displace any occurring individuals. These species are highly mobile and there is ample suitable roosting/breeding habitat nearby. It is therefore likely that this prescribed impact will have a low impact of short duration To manage these impacts works a pre-clearing survey is to be conducted for microbats in the roof space of the building prior to demolition. If any individuals are found to be present, they are to be captured the morning of demolition works, and released at night time into surrounding bushland following demolition works.	<i>Chalinolobus dwyeri</i> (Large-eared Pied Bat); <i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle) <i>Micronomus norfolkensis</i> (Eastern Coastal Free-tailed Bat) <i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail-bat) <i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat). <i>Miniopterus australis</i> (Little Bent-winged Bat) <i>Miniopterus orianae oceanensis</i> (Large bent-winged Bat) <i>Vespadelus troughtoni</i> (Eastern Cave Bat).	While the demolition of potential roost/breeding sites may have a temporary displacement-impact to local populations of threatened microbats, these species are highly mobile and as such, any impacts would be considered minor and temporary. Habitat connectivity will continue to exist in the locality through streets trees and planted vegetation, which would provide alternative and potentially higher-quality roosting/breeding sites for these species.

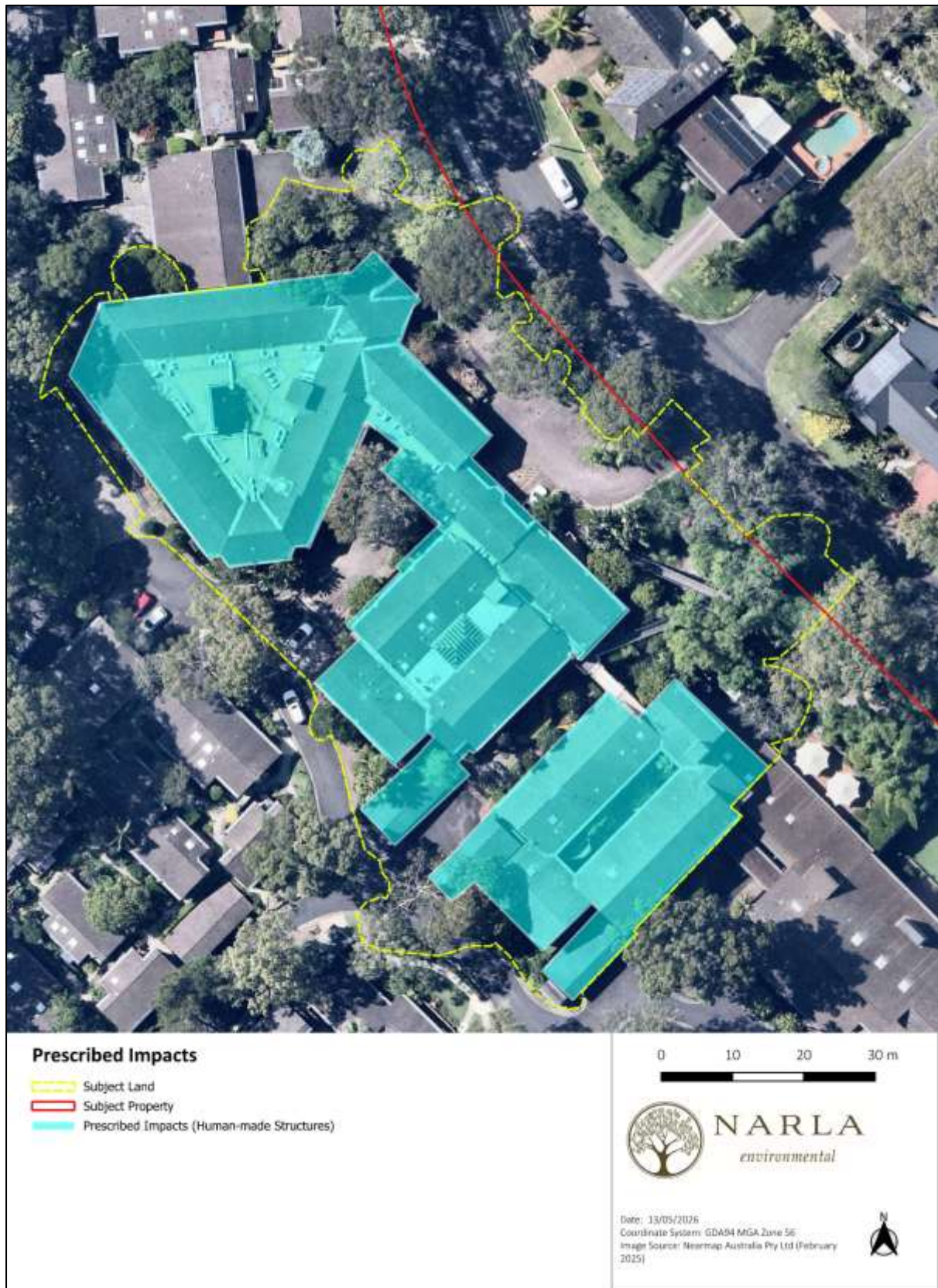


Figure 18. Prescribed impacts identified within the Subject Land.

7.3 Indirect 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 that have the potential to occur as a result of the development are outlined in **Table 17**.

Table 17. Indirect impacts associated with the proposed development.

Indirect Impact	Nature, Extent and Duration	TEC's/PCTs and/or Threatened Species and Their Habitat Likely to be Impacted	Consequences of the Impacts for the Bioregional Persistence of the Threatened Species, Threatened Ecological Communities and Their Habitats.
(a) inadvertent impacts on adjacent habitat or vegetation	Vegetation and habitat directly adjacent to the Subject Land may experience ongoing indirect impacts from the development. Construction activities may facilitate weed invasion, reducing habitat quality. Accidental trampling could degrade vegetation. However, given the existing disturbance and exotic species presence, significant alteration is unlikely.	One (1) TEC occurs within and adjacent the Subject Land – Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion. One (1) threatened species (Square-tailed Kite) has been confirmed in the neighbouring area. There is also the potential that other threatened species occur in areas adjacent the Subject Land that may be impacted by a decrease in habitat condition and direct impacts such as trampling. One (1) other TEC (Littoral Rainforest) is mapped as occurring in close proximity to the Subject Land however this is not expected to be impacted by the proposed works.	While changes to vegetation condition, hydrology and threats of trampling may have a localised impact to threatened species, threatened ecological communities and their habitats, this is not expected to impact on their bioregional persistence.
(b) reduced viability of adjacent habitat due to edge effects	Construction may lead to increased weed infiltration due to edge effects. However, the area is already highly urbanised, limiting additional impacts. The small scale of the	One (1) TEC occurs within and adjacent the Subject Land – Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion. One (1) threatened species (Square-	While edge effects may have a localised impact to TECs and threatened species, this is not expected to impact on their bioregional persistence, considering the areas of habitat

Indirect Impact	Nature, Extent and Duration	TEC's/PCTs and/or Threatened Species and Their Habitat Likely to be Impacted	Consequences of the Impacts for the Bioregional Persistence of the Threatened Species, Threatened Ecological Communities and Their Habitats.
	development is unlikely to disrupt species movement significantly. Impacts are expected to be localised (within a few metres).	tailed Kite) has been confirmed in the neighbouring area. There is also the potential that other threatened species occur in areas adjacent the Subject Land. The TEC and threatened species may be impacted by edge effects leading to a reduced viability in habitat. One (1) other TEC (Littoral Rainforest) is mapped as occurring in close proximity to the Subject Land however this is not expected to be impacted by the proposed works.	connectivity that continue to exist within the surrounding areas.
(c) reduced viability of adjacent habitat due to noise, dust or light spill	Noise levels will increase during construction and occupation, potentially affecting diurnal species roosting nearby. However, construction will occur during standard working hours, limiting impact on nocturnal species. Dust may temporarily affect adjacent vegetation but is unlikely to significantly reduce habitat viability. Light spill is expected to be minimal.	One (1) TEC occurs within and adjacent the Subject Land – Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion. One (1) threatened species (Square-tailed Kite) has been confirmed in the neighbouring area. There is also the potential that threatened species occur in areas adjacent the Subject Land. Threatened species may be impacted by an increase in noise and dust spill into adjacent habitats, although this will be primarily restricted to the construction period. One (1) other TEC (Littoral Rainforest) is mapped as occurring in close proximity to the Subject Land however this is not expected to be impacted by the proposed works.	While the construction may have a localised impact to the TEC and threatened species, this is not expected to impact on their bioregional persistence. The areas of habitat connectivity that continue to exist within the surrounding areas will allow their movement away from potentially impacted areas.

Indirect Impact	Nature, Extent and Duration	TEC's/PCTs and/or Threatened Species and Their Habitat Likely to be Impacted	Consequences of the Impacts for the Bioregional Persistence of the Threatened Species, Threatened Ecological Communities and Their Habitats.
(d) transport of weeds and pathogens from the site to adjacent vegetation	Construction and ongoing use of the site may introduce weeds into adjacent habitats, but human or vehicular transport of invasive species is unlikely.	One (1) TEC occurs within and adjacent the Subject Land – Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion. One (1) threatened species (Square-tailed Kite) has been confirmed in the neighbouring area. There is also the potential that other threatened species occur in areas adjacent the Subject Land. The TEC and threatened species may be impacted by weed and pathogen transportation leading to a reduced viability in habitat. One (1) other TEC (Littoral Rainforest) is mapped as occurring in close proximity to the Subject Land however this is not expected to be impacted by the proposed works.	While weeds and pathogens may have a localised impact to TECs and threatened species, this is not expected to impact on their bioregional persistence considering the patchy habitat connectivity within the surrounding areas.
(e) increased risk of starvation, exposure and loss of shade or shelter	Tree removal may increase exposure to predation and extreme weather, particularly for fauna dependent on canopy cover. However, the small-scale impact and presence of surrounding habitat reduce significant risks.	One (1) threatened species (Square-tailed Kite) has been confirmed in the neighbouring area. There is the potential that other threatened species occur in areas adjacent the Subject Land. These threatened species may be impacted by an increased risk of starvation, exposure and loss of shade or shelter.	While the proposed development may have a localised impact to threatened species, this is not expected to impact on their bioregional persistence. The areas of habitat connectivity that continue to exist within the surrounding areas will allow their movement away from potentially impacted areas.
(f) loss of breeding habitats	Noise and vegetation removal may reduce breeding opportunities for species dependent on intact habitat. The loss of prey species may also affect predatory species.	One (1) threatened species (Square-tailed Kite) has been confirmed in the neighbouring area. There is potential that other threatened fauna species use habitat adjacent to the Subject	This impact is expected to be localised and will not have an overall impact on the bioregional persistence of threatened species. The areas of habitat connectivity that continue to exist

Indirect Impact	Nature, Extent and Duration	TEC's/PCTs and/or Threatened Species and Their Habitat Likely to be Impacted	Consequences of the Impacts for the Bioregional Persistence of the Threatened Species, Threatened Ecological Communities and Their Habitats.
		Land for breeding. Such species may be impacted by an increase in noise, exposure, fragmentation and loss of vegetation which may impact on their breeding habitat.	within the surrounding areas will allow their movement away from potentially impacted areas.
(g) trampling of threatened flora species	Increased foot and vehicle traffic during and after construction may pose a risk to adjacent vegetation. However, as most remaining vegetation is outside the Subject Property, direct trampling is unlikely.	There is potential that threatened flora species occur in habitat adjacent to the Subject Land.	Any potential impacts to threatened species adjacent to the Subject Land is expected to be localised and will not have an overall impact on the bioregional persistence of threatened species.
(h) inhibition of nitrogen fixation and increased soil salinity	Soil disturbance may temporarily alter nitrogen levels, potentially impacting adjacent vegetation. However, clearing is confined to the Subject Land, limiting broader effects.	One (1) TEC occurs within and adjacent the Subject Land – Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin. The PCT may be impacted by weed and pathogen transportation leading to inhibition of nitrogen fixation and increased soil salinity. One (1) other TEC (Littoral Rainforest) is mapped as occurring in close proximity to the Subject Land however this is not expected to be impacted by the proposed works.	While changes to vegetation condition may have a small and localised impact to threatened species, threatened ecological communities and their habitats, this is not expected to impact on their bioregional persistence
(i) fertiliser drift	The development is unlikely to generate fertiliser drift that would impact surrounding vegetation.	N/A	N/A
(j) rubbish dumping	There is the possibility that rubbish dumping (including littering) in adjacent vegetation increases during construction and on-going.	One (1) threatened species (Square-tailed Kite) has been confirmed in the neighbouring area. There is potential that other threatened fauna	This impact is expected to be localised and will not have an overall impact on the bioregional persistence of threatened species.

Indirect Impact	Nature, Extent and Duration	TEC's/PCTs and/or Threatened Species and Their Habitat Likely to be Impacted	Consequences of the Impacts for the Bioregional Persistence of the Threatened Species, Threatened Ecological Communities and Their Habitats.
	The dumping/littering of food resources may provide a food source for fauna, including threatened species. However, this may also encourage invasive species into such habitats. This impact can be mitigated by the appropriate disposal of rubbish.	species use habitat adjacent to the Subject Land. Such species may be impacted by the dumping of rubbish, particularly food resources. This may result in both positive (food source) and negative impacts (increase in predators) to such species.	
(k) wood collection	Wood collection is not expected to occur, as adjacent vegetation is on private property.	N/A	NA
(l) bush rock removal and disturbance	No bush rock was observed within the Subject Land, though it occurs in the general vicinity. The proposed development is not expected to disturb these features.	N/A	NA
(m) increase in predatory species populations	The presence of human settlements and waste may attract invasive predators (e.g., foxes, cats). This could increase predation pressure on native fauna.	There is potential that threatened fauna species use habitat adjacent to the Subject Land. Such species may be impacted by an increase in predatory species populations.	An increase in predatory species adjacent to the Subject Land may have widespread ramifications for any locally occurring threatened species. In particular, the patchy areas of habitat connectivity adjacent to the Subject Land will allow for the movement of predatory species across the wider landscape.
(n) increase in pest animal populations	Development may facilitate the spread of pest species (e.g., rodents, rabbits). This could lead to competition with native species.	One (1) threatened species (Square-tailed Kite) has been confirmed in the neighbouring area. There is potential that other threatened fauna species use habitat adjacent to the Subject Land. Such species may be impacted by an increase in pest animal populations.	An increase in pest animal species adjacent to the Subject Land may have widespread ramifications for any locally occurring threatened species. In particular, the patchy areas of habitat connectivity adjacent to the Subject Land will allow for the movement of

Indirect Impact	Nature, Extent and Duration	TEC's/PCTs and/or Threatened Species and Their Habitat Likely to be Impacted	Consequences of the Impacts for the Bioregional Persistence of the Threatened Species, Threatened Ecological Communities and Their Habitats.
			pest animal species across the wider landscape.
(o) increased risk of fire	The Subject Land is within a bushfire-prone area. However, the proposed development follows Rural Fire Service (RFS) guidelines and does not increase fire risk beyond existing conditions.	N/A	N/A
(p) disturbance to specialist breeding and foraging habitat, e.g., beach nesting for shorebirds.	One (1) active Square-tailed Kite nest has been recorded in close proximity to the Subject Land (other side of Annam Road). This habitat could experience indirect impacts associated with an increase of noise in the area during construction works.	Square-tailed Kite	This impact is expected to be localised and temporary. Owing to the highly urbanised nature of the environment of the nest, this pair is likely to be familiar with urbanised noises such as construction common in the area. This species has been offset in accordance with the BAM and a series of mitigation measures have also been proposed in Table 15 , to further minimise the potential risks to this species.

8. Threshold for Assessing and Offsetting

8.1 Impacts on Native Vegetation

The following native vegetation within the Subject Land is proposed to be impacted as a result of the proposed development:

- 0.13ha representative of PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest.

The purchase and retirement of Biodiversity Offset Credits will be required for the 0.13ha of vegetation within Zone 1: PCT 3234 (Moderate) (**Figure 19**). No offsets are required for the impacts associated with the Exotic-Dominated Vegetation owing its exotic nature.

8.2 Impacts on Threatened Species

The following threatened species have been assumed present within the Subject Land owing to the presence of potential foraging habitat and will therefore require the purchase and retirement of Biodiversity Offset Credits:

- *Chalinolobus dwyeri* (Large-eared Pied Bat); and
- *Vespadelus troughtoni* (Eastern Cave Bat).

The following threatened species have been identified adjacent to the Subject Land and will therefore require the purchase and retirement of Biodiversity Offset Credits:

- *Lophoictinia isura* (Square-tailed Kite)



Figure 19. Impacts summary and offset requirements.

8.3 Serious and Irreversible Impacts (SAIL's)

One (1) threatened ecological community and two (2) assumed present threatened species within the Subject Land has been identified as an entity at risk of an SAIL in the Threatened Biodiversity Data Collection (NDCCEEW 2026d):

- Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion (Principle 3)
- *Chalinolobus dwyeri* (Large-eared Pied Bat; Principle 4); and
- *Vespadelus troughtoni* (Eastern Cave Bat; Principle 4).

8.3.1 Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion

Due to the sensitivity of this TEC to any impact, a determination of whether or not the proposed impacts are serious and irreversible is to be undertaken in accordance with Section 9.1 of the BAM (DPIE 2020a) is required. This is outlined in **Table 18**.

Table 18. Additional impact assessment provisions for ecological communities that are associated with a serious and irreversible impact.

Serious and Irreversible Impact (SAIL) Impact assessment provisions for ecological communities: Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion (PWSGF)	
BC Act Status: Endangered	
The action and measures taken to avoid the direct and indirect impact on the potential entity for a SAIL	The development is designed to minimise environmental impacts by being confined within an existing development footprint, reducing disturbance to undisturbed areas. However, removal of several trees is required for construction. A 2:1 compensatory planting ratio is recommended to offset vegetation loss. The primary impacts involve the removal of exotic species, with lesser concerns for native habitat disturbance. Additional mitigation measures are outlined in Table 15 .
Current total geographic extent (ha) of the TEC in NSW	The current estimated total geographic extent of PWSGF as per the State Vegetation Type Mapping in NSW is 264.88ha (DPE 2022).
Estimated reduction in geographic extent of the TEC since 1970	No precise data is available; however, extensive clearing since European settlement has reduced the TEC's distribution by approximately 75% (NSW Threatened Species Scientific Committee, 2013)
Extent of reduction in ecological function, describing the degree of environmental degradation or disruption to biotic processes such as: • Change in community structure; • Change in species composition; • Disruption of ecological processes; • Invasion and establishment of exotic species; • Degradation of habitat; and	PWSGF has undergone significant ecological degradation, resulting in a substantial decline in its ecological function. Once an open-forest ecosystem, it now persists mainly as fragmented woodland or isolated remnant trees, with few large stands remaining. This disruption has altered community structure and species composition, with native species increasingly replaced by invasives and bird-dispersed species such as <i>Pittosporum undulatum</i> , <i>Glochidion ferdinandi</i> , <i>Livistona australis</i> , and <i>Elaeocarpus reticulatus</i> . Elevated nutrient levels and the absence of fire further favour these species at the expense of fire-dependent flora. Weed invasion exacerbates degradation, with many escaped garden plants smothering native vegetation, reducing reproduction and survival rates, and inhibiting seedling establishment. Inappropriate fire regimes have further disrupted ecological processes, particularly the recruitment of fire-cued species. The prolonged absence of high-intensity fires since the 1960s has led to a decline in short-lived, fire-dependent species, altering community composition and structure. Ongoing threats include urban development, bushfire mitigation, and onsite wastewater disposal, which contribute to

Serious and Irreversible Impact (SII) Impact assessment provisions for ecological communities: Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion (PWSGF)	
BC Act Status: Endangered	
Fragmentation of habitat	fragmentation, reduced genetic diversity, and increased vulnerability to environmental stressors. Urban runoff, rubbish dumping, and garden refuse further degrade habitat quality, compounding pressures on the ecosystem (NSW Threatened Species Scientific Committee, 2013).
Evidence of restricted geographic distribution (Principle 3) based on the TEC's geographic range in NSW: - Extent of occurrence (ha); - Area of occupancy (ha); - Number of threat-defined locations	The total extant area of this ecological community is approximately 227 hectares, with an area of occupancy of about 88 km², calculated using 2 × 2 km grid cells as recommended by the IUCN. The extent of occurrence is estimated at approximately 104 km² based on a minimum convex polygon (NSW Threatened Species Scientific Committee, 2013). Clause 4.21 of the Biodiversity Conservation Regulation (BC Reg.) provides guidelines for interpreting listing criteria under the Biodiversity Conservation Act (BC Act). Subclause 4.10(f) of the BC Reg. requires an assessment of the number of threat-defined locations, which are areas occupied by the community that face serious and plausible threats. Under the IUCN Red List criteria for ecosystems, an entity is classified as Endangered if fewer than five such locations exist. Given that Pittwater and Wagstaffe Spotted Gum Forest is listed as Endangered, it meets this criterion, with fewer than five threat-defined locations identified.
Area of TEC to be impacted by the proposal (ha)	0.13ha of vegetation confirming to PWSGF will be impacted by the proposed works.
Area of TEC to be impacted by the proposal as a % of the current geographic extent in NSW (%)	Current extent is estimated at 264.88 (DPE 2022). The proposed development will impact less than 0.06% of the current geographic extent in NSW.
Direct/indirect impacts likely as a result of the proposal to contribute to loss of flora/fauna species characteristic of the TEC	The proposed development will result in direct impacts to approximately 0.13ha of PWSGF. The PWSGF within the Subject Land was found to be in moderate condition, with a VI score of 24.6. It is possible for the vegetation surrounding the Subject Land to be indirectly impacted by the proposal, however as discussed in Section 7.3 these potential impacts are not expected to be significant.
Remaining extent of isolated areas of TEC (ha)	The impacts to this TEC are restricted to the edges of a disturbed patch in a highly urbanised locality, therefore no further isolation is likely to occur as a result of the proposed development.
Average distance between remaining remnants – remnant is retained (m) vs remnant is removed.	As previously mentioned, the area of TEC to be removed is located on the edge of a disturbed patch and is considered small (0.06% of total extent) which is not likely to result in any further isolation of remaining areas of the TEC as it will continue, as it currently does, to exist around within the broader locality.
Estimated maximum dispersal distance of species associated with the TEC (km)	It is assumed that native species within the TEC have an estimated maximum dispersal distance of 100m for the exchange of genetic material, based on the definition of a “patch” of vegetation within the BAM 2020.
Other information relevant to describing the impact on connectivity and fragmentation,	The total area to perimeter ratio of the patches PWSGF in a 1500m radius from the Subject Land is currently estimated to be 17.35m ²

Serious and Irreversible Impact (SII) Impact assessment provisions for ecological communities: Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion (PWSGF)	
BC Act Status: Endangered	
such as the area to perimeter ratio for remaining areas of the TEC as a result of the development	The total area perimeter ratio following the proposed development is estimated to be of the patches PWSGF in a 1500m radius from the Subject Land is estimated to be 18.21m² This represents an approximate 4.95% change in the levels of fragmentation of PWSGF in the 1500m radius.
Vegetation Integrity Analysis: - Composition Score; - Structure Score; - Function Score	- Composition Score: 13.1 - Structure Score: 45.9 - Function Score: 24.8 - Total VIS: 24.6

8.3.2 *Chalinolobus dwyeri* (Large-eared Pied Bat) and *Vespadelus troughtoni* (Eastern Cave Bat)

The SII threshold for these species is impacts to potential breeding habitat, which is defined as PCTs associated with these species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments. As no such habitat occurs within 100m of the Subject Land, the habitat within the Subject Land is considered to be foraging habitat and the SII threshold for these species is not met. Therefore, no further assessment in accordance with Section 9.1 of the BAM (DPIE 2020a) is required.

9. Biodiversity Offset Credit Requirements

The preferred approach to offset the residual impacts of the proposal is to purchase and retire the appropriate species credits from registered Biodiversity Stewardship Sites that comply with the trading rules of the NSW BOS in accordance with the 'like for like' report generated by the BAM calculator. If such credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAMC.

A payment to the Biodiversity Conservation Trust (BCT) would be considered as a contingency option if a suitable number and type of biodiversity credits cannot be secured. A quote will be required from the BCT to determine the costings of any credits to be offset through a payment to the BCT.

9.1 Offset Requirement for Ecosystem Credits

A total of two (2) ecosystem credits are required to offset the biodiversity impacts of the proposed development (Table 19).

Table 19. Ecosystem credits required to offset the proposed development.

PCT	BC Act Status	Vegetation Zone	Total Area (ha)	Ecosystem Credits Required
PCT 3234: Hunter Coast Lowland Spotted Gum Moist Forest	EEC	Zone 1: PCT 3234 (Moderate)	0.13	2
Total Ecosystem Credits				2

9.2 Offset Requirement for Species Credits

Two (2) candidate species credits species were 'assumed present' within the Subject Land owing to the presence of foraging habitat, and one (1) other threatened species was identified adjacent to the Subject Land and will therefore require offsetting through the retiring of biodiversity offset species credits under the BOS as a result of the proposed development (Table 20).

Table 20. Species credits required to offset the proposed development.

Species	BC Act Status	Zone	Total Area (ha)	Species Credits Required
<i>Chalinolobus dwyeri</i> (Large-eared Pied Bat) Confirmed	Endangered	Zone 1: PCT 3234 (Moderate)	0.13	2
<i>Lophoictinia isura</i> (Square-tailed Kite)	Vulnerable	Zone 1: PCT 3234 (Moderate)	0.13	1
<i>Vespadelus troughtoni</i> (Eastern Cave Bat) Confirmed	Vulnerable	Zone 1: PCT 3234 (Moderate)	0.13	2

10. Other Relevant Legislation and Planning Policies

10.1 State Environmental Planning Policy (Biodiversity and Conservation) 2021 – Chapter 4 Koala Habitat Protection 2021

This Policy aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline. This chapter of the SEPP applies to LGAs that are listed in Schedule 2 'Local government areas' of the SEPP. The Northern Beaches LGA is included in Schedule 2, this Chapter applies to the Subject Land. As such, the development control provisions of Part 2, Clause 11 of the SEPP apply to development applications relating to the land, as the land:

- Has an area of at least 1 hectare (including adjoining land within the same ownership); and
- Does not have an approved koala plan of management applying to the land.

Before a Consent Authority may grant consent to a development application for consent to carry out development on the land, the Consent Authority must assess whether the development is likely to have any impact on koalas or koala habitat. If the council is satisfied that the development is likely to have low or no impact on koalas or koala habitat, the Consent Authority may grant consent to the development application.

A site assessment was undertaken to determine whether the land contained core koala habitat, which is defined by the SEPP as:

- a) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or
- b) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas have been recorded as being present in the previous 18 years.

The Subject Property contains suitable habitat (where 15% or greater of the total number of trees within any Plant Community Type are the regionally relevant species of those listed in Schedule 3 of the SEPP).

However, during the site assessment no koalas or signs of koala occupancy (scats, scratch marks) were observed within the Subject Property. A spatial search using NSW Wildlife Atlas (DPE 2025e) reveals no records within a 2.5km radius of the Subject Property that are within 18 years. The vegetation within Subject Property therefore does not meet the definition of Core Koala Habitat as defined by the SEPP.

10.2 State Environmental Planning Policy (Resilience and Hazards) 2021- Chapter 2 Coastal Management

State Environmental Planning Policy (Resilience and Hazards) 2021: Chapter 2 – Coastal Management applies to land within the coastal zone. The coastal zone means the area of land comprised of the following coastal management areas:

- The coastal wetlands and littoral rainforests area;
- The coastal vulnerability area;
- The coastal environment area; or
- The coastal use area.

The Subject Land contains areas identified as 'proximity area for littoral rainforest', as such this SEPP applies.

Development consent must not be granted to development on land identified as “proximity area for coastal wetlands” or “proximity area for littoral rainforest” on the Coastal Wetlands and Littoral Rainforests Area Map unless the consent authority is satisfied that the proposed development will not significantly impact on:

- The biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or
- The quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.

The Subject Land is within the ‘proximity area for littoral rainforest’ as mapped under the Coastal Wetlands and Littoral Rainforests Area Map. However, the proposed development has been designed to ensure no significant impact on the biophysical, hydrological, or ecological integrity of adjacent littoral rainforests. Measures have been incorporated to protect surface and groundwater flows, ensuring no adverse effects on the quantity or quality of water flows to and from adjacent coastal ecosystems. Furthermore, a Groundwater Impacts Assessment (WSP 2026; **Appendix E**) was prepared for the proposed development which concluded “The proposed drained basement is considered appropriate because it would interact with a shallow, perched and low-yielding groundwater system; predicted inflows are minor; drawdown is expected to remain localised; and the deeper regional groundwater system is not expected to be affected. The predicted groundwater take is sufficiently small to support the conclusion that material consequential impacts to downgradient ecological receptors, including the SEPP Coastal Management Littoral Rainforest community, are unlikely. WSP considers the drained basement design justified and suitable for assessment of SSD-77240466. Measures such as separating groundwater and stormwater drainage, reusing or re-infiltrating collected groundwater where feasible, treating water quality if required, and monitoring can be incorporated into the design and operation to further minimise potential effects on local groundwater recharge and shallow groundwater movement. Therefore, impacts associated within the proposed drained basement are also not expected to impact surrounding Littoral Rainforest vegetation.

10.3 Water Management Act 2000

In accordance with Schedule 4 Section 62 – “Controlled Activities Exemptions on Certain Waterfront Land” of the Water Management Regulation 2025. The following are exempt from controlled activities:

- A controlled activity separated from certain waterfront land by a lawfully constructed—:
 - (a) a public road,
 - (b) a hard stand space (such as a car park or building),
 - (c) a levee bank, but only if the levee bank is in an urban area, was the subject of a development consent under the Environmental Planning and Assessment Act 1979 and is located within a designated high risk flood area (within the meaning of clause 45 of this regulation).

As the proposed works are located on the waterfront land and is separated by a hard stand place, comprised of a combination of a regularly utilised access road, buildings and parking areas. The proposed works area is considered to meet the requirements for an exemption for controlled activity approval under Schedule 4 Section 62 of the Water Management Regulation 2025.

10.4 Pittwater Local Environmental Plan (LEP) 2014

10.4.1 Biodiversity (Clause 7.6)

The Subject Land is located within land mapped as ‘Biodiversity’ on the Pittwater LEP Biodiversity Map. As such, clause 7.6 of the Pittwater LEP applied to the proposed development. The objective of this clause is to maintain terrestrial, riparian and aquatic biodiversity by:

- Protecting native fauna and flora;

- Protecting the ecological processes necessary for their continued existence; and
- Encouraging the conservation and recovery of native fauna and flora and their habitats.

Before determining a development application, the consent authority must consider:

- Whether the development is likely to have:
 - Any adverse impact on the condition, ecological value and significance of the fauna and flora on the land;
 - Any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna;
 - Any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land; and
 - Any adverse impact on the habitat elements providing connectivity on the land;
- Any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

Development consent must not be granted unless the consent authority is satisfied that:

- The development is designed, sited and will be managed to avoid any significant adverse environmental impact;
- If that impact cannot be reasonably avoided by adopting feasible alternatives—the development is designed, sited and will be managed to minimise that impact; or
- If that impact cannot be minimised—the development will be managed to mitigate that impact.

The proposed development has been purposefully designed to minimise impacts on biodiversity values as much as possible. In order to avoid and minimise potential impacts of the proposal on local biodiversity values, a series of mitigation and management measures have been identified, which are to be implemented as part of any Construction Environmental Management Plan (CEMP) produced for the site. To offset the removal of vegetation, a compensatory planting ratio of 2:1 is recommended. This approach ensures adequate replacement of lost vegetation.

Pittwater Development Control Plan (DCP) 2003

10.4.2 Pittwater Spotted Gum Forest – Endangered Ecological Community (Part B4.7)

The Subject Land contains Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion (formerly Pittwater Spotted Gum Forest), an EEC. As the proposed development involves the clearing of this EEC, part B4.7 of the Pittwater DCP applies. The following controls apply to the proposed development:

- Development shall not have an adverse impact on Pittwater Spotted Gum Endangered Ecological Community;
- Development shall restore and/or regenerate Pittwater Spotted Gum Endangered Ecological Community and provide links between remnants;
- Development shall be in accordance with any Pittwater Spotted Gum Forest Recovery Plan;
- Development shall result in no significant onsite loss of canopy cover or a net loss in native canopy trees;
- Development shall retain and enhance habitat and wildlife corridors for locally native species, threatened species and endangered populations;
- Caretakers of domestic animals shall prevent them from entering wildlife habitat;
- Fencing shall allow the safe passage of native wildlife;
- Development shall ensure that at least 80% of any new planting incorporates native vegetation (as per species found on the site or listed in Pittwater Spotted Gum Endangered Ecological Community); and
- Development shall ensure any landscaping works are outside areas of existing Pittwater Spotted Gum Endangered Ecological Community and do not include Environmental Weeds.

Although the proposed development will have an impact on PWSGF, a series of mitigation and management measures have been identified in order to avoid, minimise and offset potential impacts of the proposal on PWSGF (Table 15).

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12. Appendices

Appendix A. Proposed Site Plans (TaylorBrammer 2026a).

Appendix B. BAM Site- Field Survey Forma (copied directly from Electronic Data Sheet).

Appendix C. BAMC Biodiversity Credit Report.

Appendix D. Photographs taken during the microbat survey undertaken in October 2024.

Appendix E. Groundwater Impact Assessment.

Appendix E. Groundwater Impact Assessment.

Appendix A. Proposed Site Plans (TaylorBrammer 2026a).



SITE PLAN

Opal Bayview
LANDSCAPE ARCHITECTURE SSDA DRAWINGS

BOUNDARY LINE	PLANTING ON GROUND	TURF ON GROUND	CONCRETE FOOTPATH	PERGOLA
EXISTING TREE RETAINED	PLANTING ON SLAB	TURF ON SLAB	TIMBER DECK	

CLIENT	OPAL BAYVIEW	DATE	2026-01-01
DESIGNER	TAYLOR BRAMMER	DATE	2026-01-01
REVISION	LA100	DATE	2026-01-01
PROJECT	OPAL BAYVIEW	DATE	2026-01-01

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Appendix B. BAM Site- Field Survey Form (copied directly from Electronic Data Sheet).

BAM Site – Field Survey Form					
Date:	19.11.24	Plot ID:	1	Photo #:	n/a
Zone:	56	Plot Dimensions:	50x20m	Easting:	341983
Datum:	GDA94	Middle bearing from 0m:	298	Northing:	6273450
PCT:	Zone 1: PCT 3234 (Moderate)				
Growth Form	Scientific Name		Cover	Abundance	
Tree (TG)	<i>Eucalyptus tereticornis</i>		20	5	
Tree (TG)	<i>Eucalyptus microcorys</i>		10	2	
Exotic	Protea spp.		1	10	
Shrub (SG)	<i>Grevillea juniperina</i>		5	50	
Tree (TG)	<i>Melaleuca quinquenervia</i>		5	2	
Exotic	Magnolia spp.		3	3	
Shrub (SG)	<i>Grevillea lanigera</i>		5	50	
Shrub (SG)	Callistemon spp.		5	20	
Other (OG)	<i>Livistona australis</i>		5	1	
Forb (FG)	<i>Commelina cyanea</i>		0.1	50	
Exotic	Lagerstroemia spp.		1	2	
Shrub (SG)	<i>Banksia spinulosa</i>		0.5	1	
Exotic	<i>Grevillea banksii</i> × <i>Grevillea bipinnatifida</i>		1	10	
Exotic	<i>Dianthus chinensis</i>		0.2	15	
Exotic	<i>Sida rhombifolia</i>		0.1	5	
Exotic	<i>Isopogon formosus</i>		0.1	1	
Forb (FG)	<i>Dichondra repens</i>		0.1	50	
DBH		# Tree Stems Count	# Hollow Bearing Trees		
80+cm		absent	0		
50-79cm		4	0		
30-49cm		present	0		
20-29cm		present	0		
10-19cm		absent	0		
5-9cm		absent	0		
<5cm		absent	0		
Length of Logs (m)		0			
BAM Attribute (1x1m)			Litter Cover (%)		
1 (5m)			50		
2 (15m)			30		
3 (25m)			70		
4 (35m)			20		
5 (45m)			50		
Average			44		
Growth Form		Composition Data		Structure Data	

	(Count of Native Cover)	(Sum of Cover)
Tree	3	35
Shrub	4	15.5
Grass	0	0
Forb	2	0.2
Fern	0	0
Other	1	5
High Threat Exotics	0	0



BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00055762/BAAS21009/25/00055763	36 Cabbage Tree Road Bayview	09/04/2026
Assessor Name	Assessor Number	BAM Data version *
Christopher Moore	BAAS21009	Current classification (live - default) (94)
Proponent Names	Report Created	BAM Case Status
	30/07/2026	Finalised
Assessment Revision	BOS entry trigger	Assessment Type
4	BOS Threshold: Biodiversity Values Map and area clearing threshold	Part 4 Developments (Small Area)
Date Finalised	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
30/07/2026		

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion		3234-Hunter Coast Lowland Spotted Gum Moist Forest

Assessment Id	Proposal Name	Page 1 of 3
00055762/BAAS21009/25/00055763	36 Cabbage Tree Road Bayview	

BAM Biodiversity Credit Report (Like for like)

Species

Chalinolobus dwyeri / Large-eared Pied Bat

Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT

No Changes

Predicted Threatened Species Not On Site

Name

No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
3234-Hunter Coast Lowland Spotted Gum Moist Forest	Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion	0.1	0	2	2

Assessment Id

00055762/BAAS21009/25/00055763

Proposal Name

36 Cabbage Tree Road Bayview

Page 2 of 3

BAM Biodiversity Credit Report (Like for like)

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Chalinolobus dwyeri / Large-eared Pied Bat	3234_Moderate	0.1	2.00
Lophoictinia isura / Square-tailed Kite	3234_Moderate	0.1	1.00
Vespadelus troughtoni / Eastern Cave Bat	3234_Moderate	0.1	2.00

Credit Retirement Options

Like-for-like credit retirement options

Chalinolobus dwyeri / Large-eared Pied Bat	Spp	IBRA subregion
	Chalinolobus dwyeri / Large-eared Pied Bat	Any in NSW
Lophoictinia isura / Square-tailed Kite	Spp	IBRA subregion
	Lophoictinia isura / Square-tailed Kite	Any in NSW
Vespadelus troughtoni / Eastern Cave Bat	Spp	IBRA subregion
	Vespadelus troughtoni / Eastern Cave Bat	Any in NSW

Appendix D. Photographs taken during the microbat survey undertaken in October 2024.







Appendix E. Groundwater Impact Assessment.



Our ref: PS223670-SYD-HYD-LTR-0003-RevB2

By email
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23 July 2026

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Tyron Nicholson
c/o Harry Bate
Essence Project Management Pty Ltd
Level 8, 68 Pitt Street
Sydney, NSW 2000

Dear Harry

SSD-77240466 Proposed aged care facility, 36-42 Cabbage Tree Road, Bayview, NSW
Basement design options and groundwater recharge management

1. Introduction

WSP Australia Pty Limited refers to the proposed Aged Care Facility at 36–42 Cabbage Tree Road, Bayview, NSW, currently being assessed as State Significant Development Application SSD-77240466.

This letter provides further clarification on groundwater matters relevant to SEARs Items 12 and 13, particularly the proposed drained basement design and its potential interaction with shallow perched groundwater. It should be read together with WSP's *Groundwater Impact Assessment* (GIA), November 2025, and subsequent hydrogeological correspondence prepared in response to assessment comments (refer attachments).

In summary, WSP confirms that the GIA conclusions remain valid. The proposed drained basement design is appropriate for the site conditions, predicted groundwater take is minor, and the risk of material impacts to downgradient groundwater conditions, including the SEPP Coastal Management Littoral Rainforest community, is considered negligible.

2. Background

The proposed development would replace the existing aged care buildings and associated hardstand areas. The basement carpark would cover approximately 2,745 m², with a finished floor level of about RL 20.48 mAHD and an assumed bulk excavation level of about RL 19.98 mAHD.

The relevant shallow groundwater system at the site is interpreted as a rainfall-responsive perched system within residual soils and weathered sandstone/siltstone above more competent bedrock. It is localised, low-yielding, responsive to rainfall events, and considered ephemeral.

The GIA conservatively estimated long-term operational groundwater inflows to the proposed drained basement of up to 0.35 ML/year, with a modelled radius of influence of about 43.4 m after 10 years. These inflows are minor, having been calculated using maximum groundwater levels and the highest on-site permeability values, and are consistent with the interpreted low-permeability, low-productivity nature of the shallow perched groundwater system.

A deeper regional groundwater system is inferred within the Hawkesbury Sandstone at greater depth. As is typical in the Sydney Basin, this system is not expected to be dewatered by the proposed basement excavation or the operational drained basement system.

3. Drained basement design

Subject to detailed design, the proposed drained basement would include perimeter drains, a sub-slab drainage layer, collector drains, sump pits and pumps to manage minor groundwater seepage, relieve hydrostatic pressure, and maintain the potential for aquifer recharge through infiltration to the deeper regional system that supports the rainforest. This approach is considered suitable for the site because:

- the basement would interact with a shallow, perched, low-yielding groundwater system, rather than a productive regional aquifer;
- predicted long-term groundwater inflows are low;
- drawdown is expected to remain localised and limited in extent;
- the predicted groundwater take is minor;
- the development would replace existing buildings and hardstand areas that already affect rainfall infiltration and local recharge; and
- the drained system would avoid forming a groundwater barrier, which could occur with a fully impermeable basement structure.

A fully tanked basement would prevent operational groundwater collection; however, in this setting it would also form an impermeable subsurface barrier within the shallow perched groundwater system. This could modify local groundwater flow by causing upgradient mounding and reducing downgradient throughflow. By comparison, a drained basement enables controlled groundwater management and reduces the potential to dam the perched groundwater system.

The drained basement design can also include practical measures to minimise net groundwater loss from the local system, where appropriate, including:

- separating groundwater drainage from stormwater drainage;
- reusing collected groundwater where feasible;
- re-infiltrating or returning collected groundwater to the local subsurface system where practicable;
- treating water before re-infiltration or reuse, if required; and
- monitoring groundwater levels and water quality during construction.

These measures support the objective of maintaining the shallow groundwater balance, as far as practicable, while providing a constructible and reliable basement design.

4. Scale of groundwater take and exemption considerations

WSP notes that the GIA considered whether the predicted groundwater take may qualify for an applicable exemption (<3 ML/year), given the minor scale and nature of the groundwater interaction.

If the relevant exemption is accepted, it supports WSP's assessment that the groundwater take is minor and unlikely to cause material hydrogeological impacts. In WSP's opinion, the same rationale applies to potential consequential ecological impacts. Where groundwater take is very low, localised, confined to a shallow perched system and not expected to affect the deeper regional groundwater system, the likelihood of consequential impacts to downgradient ecological receptors is correspondingly negligible (i.e. consistent with the DCCEE minimal impact requirements).

This does not disregard ecological receptors. Rather, it indicates that the scale and nature of the groundwater interaction are not expected to materially change the groundwater or soil moisture regime supporting the downgradient littoral rainforest.

5. Littoral rainforest considerations

Subsequent submissions have raised concerns about the potential relationship between shallow groundwater, near-surface soil moisture and the downgradient SEPP Coastal Management Littoral Rainforest community.

WSP acknowledges that this is a relevant assessment issue. Based on the available hydrogeological information, however, WSP considers the risk of material impact to the littoral rainforest to be very low because:

- predicted groundwater take from the drained basement is minor;
- the intercepted groundwater system is shallow, perched, rainfall-responsive and low-yielding;
- the basement is not expected to dewater the deeper regional groundwater system;
- modelled drawdown is localised;
- the development would replace existing buildings and hardstand areas, so the overall change to site recharge is expected to be limited;
- the basement drainage system can be designed to minimise net groundwater loss, including through reuse or re-infiltration where feasible; and
- collected groundwater can be managed and treated before discharge or re-infiltration, if required.

On this basis, WSP considers that the proposed drained basement is unlikely to materially affect groundwater availability to the downgradient littoral rainforest. Accordingly, the potential for consequential ecological impact associated with the drained basement is considered negligible.

6. Groundwater quality

Groundwater quality sampling for the GIA did not identify contamination that would prevent use of the proposed drained basement design. Aluminium, cobalt, copper and zinc exceeded the ANZG 2018 default guideline values in some samples; however, these concentrations are typical of groundwater and seepage water quality commonly encountered in urbanised sandstone catchments and are likely to be partly associated with suspended solids.

Groundwater collected during construction or operation can be managed using standard measures, such as sedimentation, filtration and pH adjustment where required, before discharge or re-infiltration. This is considered a manageable water quality issue and does not change WSP's conclusion that a drained basement is suitable for the site.

7. Conclusion

WSP confirms that the conclusions of the *Groundwater Impact Assessment* remain valid for the proposed redevelopment.

The proposed drained basement is considered appropriate because it would interact with a shallow, perched and low-yielding groundwater system; predicted inflows are minor; drawdown is expected to remain localised; and the deeper regional groundwater system is not expected to be affected. The predicted groundwater take is sufficiently small to support the conclusion that material consequential impacts to downgradient ecological receptors, including the SEPP Coastal Management Littoral Rainforest community, are unlikely.

WSP considers the drained basement design justified and suitable for assessment of SSD-77240466. Measures such as separating groundwater and stormwater drainage, reusing or re-infiltrating collected groundwater where feasible, treating water quality if required, and monitoring can be incorporated into the design and operation to further minimise potential effects on local groundwater recharge and shallow groundwater movement.

Accordingly, WSP considers the proposed drained basement design appropriate and the risk of material impact to the downgradient littoral rainforest negligible.

Please contact the undersigned if further information is required.

Yours sincerely

A handwritten signature in blue ink, appearing to be 'R. Hatley', with a long horizontal flourish extending to the right.

Ray Hatley
Technical Director Hydrogeology
Attachments:

1. Relevant RFI Response Table / Northern Beaches Council Catchment comments
2. WSP Response to DPHI comments on hydrogeological matters, 6 May 2026
3. WSP Groundwater Impact Assessment, November 2025

Our ref: PS223670-0002

6 May 2026

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Mr Harry Bate
Bloompark
Suite 3.02/165 Walker Street
North Sydney 2060

Dear Harry

Response to DPHI comments on hydrogeological matters

This letter is provided by WSP in response to your email dated 20 April 2026 (9.22am), which requested a reply to the Department of Planning, Housing and Infrastructure's letter of 13 March 2026. That letter asked for a written response to the issues raised in submissions received during the exhibition of the above development application, under section 59(2) of the *Environmental Planning and Assessment Act 1979*, repeated below for convenience.

5. Catchment/ Riparian and Water Quality

a. The proposed drained basement will intercept and dewater soil-groundwater, altering subsurface flow paths. This presents a significant hydrological risk to the SEPP Coastal Management – Littoral Rainforest community located directly downstream, which is highly sensitive to groundwater drawdown and changes in moisture regime.

b. Should groundwater be intercepted, any groundwater discharge must comply with ANZG (2018) Freshwater Quality Guidelines – Toxicant Default Guideline Values (DGV), 95% protection of species. At present, no evidence has been provided demonstrating the feasibility of achieving these discharge quality levels for the site's groundwater conditions.

c. Engineering drawings show the basement subsoil drainage system connecting to the stormwater quality chamber, indicating mixing of groundwater and stormwater. This contradicts Appendix S1, which requires: "Separate any subsoil/groundwater drainage from the rainwater system." This inconsistency must be resolved, as mixing groundwater with stormwater can compromise treatment system performance and regulatory compliance.

d. A tanked basement is required to avoid groundwater interception and protect the downstream SEPP- listed Littoral Rainforest, thereby preventing hydrological impacts, eliminating the need for ongoing groundwater extraction and water-quality treatment, and removing risks associated with mixing stormwater and groundwater.

In response to these specific comments, WSP notes that at the time of writing the development's *Groundwater Impacts Assessment*¹ (GIA), the *Groundwater Dependent Ecosystems Atlas* ([GDE Atlas Map: Water Information: Bureau of Meteorology](#)) on which our GIA depends for the assessment of impacts, did not include the *SEPP CM Littoral Rainforest* mapping. As such, the groundwater flow and impact assessments were carried out to a level of detail that was commensurate with GDE's identified in the atlas being at a considerable distance from the proposed development (Section 4.6.2 of GIA).

¹ Principal Healthcare Finance Pty Limited, Opal Residential Aged Care Facility, Bayview, *Groundwater Impact Assessment* report (WSP, 11/2025)

Since the proposed development will replace an existing structure and is situated on the brow of a hill – serving as the divide for groundwater flow to the west and to the east of the site - WSP has assessed that any additional impacts are likely to be minimal. That is, the diversion of rainfall recharge over the proposed new development footprint is expected to be similar to that of the existing building and associated hard cover, which already impact aquifer recharge. Furthermore, the proposed basement carpark’s relatively shallow excavation interacts only with the surficial, ephemeral perched water system rather than the deeper regional groundwater system located beneath the Basement Excavation Level (BEL), thereby capturing minimal water, and resulting in minimal additional impact.

To reiterate, the littoral rainforest is likely predominantly sustained by groundwater discharge from the regional groundwater system and since there is minimal change to rainfall recharge, the minimal groundwater ‘take’ from the perched water system is not material to the sustenance of this urban GDE Rainforest.

We also note that the groundwater quality from the perched aquifer intercepted by the development’s proposed basement have now been compared with the ANZG (2018) Freshwater Quality Guidelines – Toxicant Default Guideline Values (DGV), 95% protection of species. The results indicate exceedance of DGV trigger levels for Aluminium, Cobalt, Copper and Zinc (typically adsorbed on suspended solids content (silt and clay particles) in captured seepage water). The GIA report observes that, in urban settings, of which Sydney is typical (including the development site), these exceedances are a common feature of urban development, creeks and stormwater systems around Greater Sydney.

The development will implement suitable water treatment measures, such as siltation, filtration, and pH adjustment as needed, to reduce urban contaminant concentrations in intercepted seepage groundwater before discharge to stormwater or preferred re-infiltration, thus minimising loss of rainfall recharge and maintaining perched water levels. WSP also notes that the creek near the littoral rainforest already features a downstream aeration treatment mechanism.

Based on the updated GIA findings, including confirmation of littoral rainforest, an improved understanding of the unchanged rainfall-recharge regime, the limited depth and lateral extent of the ephemeral perched groundwater system (characterised as a relatively low-productivity system), and the minimal groundwater take, WSP considers that a drained basement remains fit-for-purpose and appropriate for the proposed redevelopment. This conclusion is supported by the assessment of minimal impact under the NSW Aquifer Interference Policy (2012), with respect to water table levels, groundwater pressure drawdown, and potential changes to groundwater and surface water quality.

Yours sincerely

Ray Hatley
Technical Director, Hydrogeologist

Principal Healthcare Finance Pty Limited

Opal Residential Aged Care Facility, Bayview

Groundwater Impact Assessment

November 2025



Question today *Imagine tomorrow* Create for the future

Opal Residential Aged Care Facility,
Bayview
Groundwater Impact Assessment

Principal Healthcare Finance Pty Limited

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Rev	Date	Details
Rev1	28/11/2025	Draft

	Name	Date	Signature
Prepared by:	David Hughes	21/11/2025	
Reviewed by:	Ray Hatley	25/11/2025	
Approved by:	Ray Hatley	28/11/2025	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Appendix B Well development records

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Appendix E Groundwater sampling laboratory certificates

Appendix F Architectural plans

1 Introduction

1.1 Overview

This Groundwater Impact Assessment (GIA) has been prepared by WSP Australia Ltd (WSP) for Principal Healthcare Finance Pty Limited (Opal Healthcare) for its planned 177-bed Residential Aged Care Facility at 36–42 Cabbage Tree Road, Bayview, New South Wales (the ‘Site’). The report supports the State Significant Development Application (SSD-77240466) and addresses SEARs Items 12 and 13, focusing on groundwater conditions and contamination.

The Groundwater Impact Assessment has been prepared within the context of the groundwater related risks associated with the project site to specifically address the guidance provided by the NSW Department of Planning and Environment (DPE; currently the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW)) document titled “*Minimum requirements for building site groundwater investigations and reporting*”, dated October 2022 (DPE, 2022).

1.2 Objective

The objectives of this GIA are:

- To estimate the likely short-term and long-term groundwater impacts that may eventuate at the planned development.
- To assess the suitability of a drained basement for the planned development and allow WaterNSW to issue a Water Supply Works Approval for the planned development, both during construction and operation phases.

This information will allow consideration of the effects of a drained basement and provide appropriate dewatering management planning.

1.3 Scope of work

The scope of works undertaken as part of the GIA included the following:

- Review of planned geotechnical borehole locations for adequacy of hydrogeological investigations requirements.
- Completion of site geotechnical investigation borehole drilling at eight locations around the development site (outside the immediate footprint of the site) at locations which form a triangle.
- Installation of three groundwater monitoring wells (to 5 m depths based on the geotechnical borehole logs) in the SI boreholes to complete the hydrogeological investigations, with all monitoring wells screened between 2 and 5 mbgl.
- Monitoring well development (i.e. cleaning, de-silting) of the newly installed groundwater monitoring wells. These records can be used as evidence to support the functionality and confidence in groundwater level and quality data obtained from the monitoring wells.
- Installation and set-up of automatic pressure transducers (data and barometric loggers) in each monitoring well to record groundwater levels at 15-minute intervals. Note: the barometric logger was used to compensate the data for barometric influences (weather induces atmospheric changes). The datalogger continuous monitoring water level hydrograph plots provide the data to support an estimate of the probable maximum long-term water level.
- Carrying out of hydraulic (‘slug’) tests in each of the groundwater monitoring wells installed at the site to estimate the hydraulic conductivity of the screened rock and soil formations.

- Collection of groundwater samples from the three monitoring wells. Groundwater quality field parameters and samples were collected by a WSP Hydrogeologist. Samples were submitted to Australian Laboratory Services (ALS), a NATA accredited laboratory, under chain of custody procedures, where they were analysed as per the mandatory requirements listed in Table A.2 of the DPE (2022) guidelines.
- During sampling measurements of water pH, electrical conductivity, temperature and oxidation-reduction potential were recorded, whilst all field data and analytical results from these samples were used to inform an initial assessment of collected water disposal options, including disposal to stormwater.
- Data loggers were downloaded 3 months after installation as per the minimum requirements guidelines (DPE, 2022).

1.4 Relevant SEARs

This Groundwater Impact Assessment addresses the following relevant Secretary's Environmental Assessment Requirements (SEARs) set out in Table 1.1 below.

Table 1.1 SEARs Compliance table

Environmental Factor	Response / Location in report
No. 12 – Ground and Groundwater Conditions — Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site and including soil erosion. — Where required provide a Groundwater Impact Assessment in accordance with relevant Groundwater Guidelines. If the proposed development is on land identified as having high salinity or acid sulphate soil potential in an EPI provide a Salinity Management Plan or Acid Sulphate Management Plan that includes appropriate management measures and strategies.	Section 6 Soils are addressed in the Preliminary Site Investigation (WSP, 2025b)
No. 13 – Contamination and Remediation — In accordance with Chapter 4 of the State Environmental Planning Policy (Resilience and Hazards) 2021, assess and quantify any soil and groundwater contamination and demonstrate that the site is suitable (or will be suitable, after remediation) for the development	Section 4.5.5 Soils are addressed in the Preliminary Site Investigation (WSP, 2025b)

1.5 The site

The general site identification details are provided in Table 1.2 and site aerials are provided in Figure 1.1 and Figure 1.2.

Table 1.2 Summary of general site information

Site name	Opal Bayview
Site address	36-42 Cabbage Tree Road
Site identification	Part Lot 121 in DP 789400
Site area	Approximately 6,000 m ²
Current site use	Site is currently in use as a retirement village, Aveo Bayview Gardens Retirement Living (BGRL)
Surrounding land uses	The site is bound by Annam Road to the east, and the Aveo BGRL site to the north, west, and south. Residential premises are located beyond Annam Road and the Aveo BGRL.
Local government area (LGA) and zoning	Pittwater Council Local Government Area, Low Density Residential (R2)
Proposed site use	Continued aged care use



Figure 1.1 Context of site within the broader Aveo site



Figure 1.2 Development site

1.6 Proposed development

The proposed development will comprise the following:

- Demolition of the existing aged care building and driveway on the site;
- Construction of a three-storey residential aged care facility, accommodating:
 - 177 beds,
 - 1 level of basement parking,
 - Ground floor ancillary facilities;
- Construction of a community room, to be located on the Aveo Bayview Gardens Retirement Living (**Aveo BGRL**) site;
- Construction of a new driveway, to be located on the Aveo BGRL site;
- Torrens Title subdivision of the Opal Healthcare Bayview site from Aveo BGRL;
- Associated amenities and landscaping works;
- Augmentation of, and connection to, existing utilities as required.

The proposed basement level covers an area of approximately 2,745 m² and has a finished floor level (FFL) of RL 20.48 mAHD. It is assumed the basement will require a bulk excavation level (BEL) of RL 19.98 mAHD, 0.5 m below the FFL, with locally deeper areas to accommodate lift shafts and plant rooms. This GIA will be used to inform whether the final basement design should be drained or tanked.

Detailed Architectural plans are included in Architectural plans Appendix F.

2 Legislation, policies, and guidelines considerations

The following NSW state legislation, policies, and guidelines are applicable to the hydrogeological aspects of the planned development and have been considered during the preparation of this GIA.

- Water Management Act (2000) and Water Act (1912).
- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (DPIE, 2023).
- NSW Aquifer Interference Policy (NSW DPI 2012).
- Minimum requirements for groundwater investigations and reporting for building and construction sites (DPE, 2022).

3 Hydrogeological investigations

3.1 Overview

Two rounds of groundwater investigations at the Site were carried out by WSP in July/August 2025 and November 2025. These investigations were carried out to collect data required to comply with those data requirements presented in the publication *Minimum requirements for groundwater investigations and reporting for building and construction sites* (DPE, 2022), and comprised the following:

- Drilling of eight investigation boreholes at selected locations at the site (refer to the Geotechnical Investigation Report; WSP, 2025a)
- Installation of three new groundwater monitoring wells at the site (identified as BH01, BH02 and BH03).
- Development of monitoring wells installed at the site.
- Manual measurement of groundwater levels in all groundwater monitoring wells.
- Collection of groundwater samples collected from monitoring wells BH01, BH02 and BH03, and submission of these samples for laboratory analysis.
- Installation of automated water pressure transducers and data loggers ('water level loggers') in the three groundwater monitoring wells at the site and the monitoring and the recording of groundwater levels using these water level loggers.
- Performance of hydraulic tests using slug test methods on groundwater monitoring wells BH01, BH02 and BH03.

Further description of each of the above tasks comprising WSP's site investigations are discussed in the following sections of this GIA.

3.2 Drilling

The field investigation was managed by an experienced geotechnical engineer who was responsible for supervising drilling, soil logging, sample collection and engineering logs.

A total of eight investigation boreholes were drilled, with locations shown on Figure 3.1. Details of the drilling campaign are found in the Geotechnical Investigation Report (WSP, 2025a).

All wells were surveyed to an accuracy of +/-5mm using dGPS on 4th November 2025.



Figure 3.1 Test location plan at Opal Bayview

3.3 Well installation and development

Groundwater monitoring wells were installed in boreholes BH01, BH02 and BH03 which were used in this assessment and will also form part of the preferred groundwater investigation and monitoring system for the development moving forward.

Copies of the construction diagrams for these wells are included in Appendix A, whilst key features are summarised in Table 3.1.

Table 3.1 Groundwater monitoring well construction summary

Well feature	Groundwater monitoring well		
	BH01	BH02	BH03
Easting (metres east)	341927.8*	341874.2	341908.8
Northing (metres north)	6273575.4*	6273564.8	6273521.2
Ground level (mAHD)	27.15	23.83	25.38
Top of well casing elevation (m AHD)	27.03	23.74	25.19
Well head recess (m)	0.12	0.09	0.19
Well cover type	Gatic cover	Gatic cover	Gatic cover
Borehole depth (m bgl)	10	6	6.15

Well feature	Groundwater monitoring well		
	BH01	BH02	BH03
Well depth (m bgl)	5	5	5
Screen interval (m bgl)	3 to 5	3 to 5	3 to 5
Screened lithology	Highly weathered sandstone and interbedded sandstone and siltstone	Highly weathered sandstone and interbedded sandstone and siltstone	Highly weathered sandstone and interbedded sandstone and siltstone
Upper bentonite seal (m bgl)	0 to 2.5	0 to 2.5	0 to 2.5
Lower bentonite seal (m bgl)	5 to 6	5 to 6	5 to 6.15

*Taken adjacent to the well due access being obscured by a parked car

Development of the groundwater monitoring wells was carried out on the 3rd July 2025 (BH01 and BH02) and 10th July 2025 (BH03) in accordance with the recommendations outlined in AS/NZS 5667.11:1998 “*Water Quality – Sampling*”.

Development involves the purging of water and water entrained sediment (if present) and drilling mud from individual wells using the ‘hand bailing’ technique. Individual single-use high density polyethylene (HDPE) bailers were used to develop each well.

Development of groundwater monitoring wells continued until three well water volumes were removed or until the well was purged dry. To aid development, once the wells were purged dry, clean water was poured down the well to flush the screen. Copies of the well development field records are presented in Appendix B.

3.4 Groundwater quality sampling

Groundwater samples were collected from groundwater monitoring wells BH02 and BH03 by a Hydrogeologist from WSP on 4th August 2025. No sample was collected from BH01 as this well was dry for the duration of the investigation.

Samples were collected after purging the wells dry using individual single-use high density polyethylene (HDPE) bailers, then waiting for the wells to sufficiently recharge before taking a representative groundwater sample. It was not possible to purge three well volumes of water due to the slow recharge rates of the wells.

Measurements of pH, EC, redox potential, and temperature were measured during sampling using a calibrated water quality meter.

Groundwater samples were stored in containers provided by the laboratory. The containers were filled, sealed, and labelled with the job number, date and location identifier.

Samples for dissolved heavy metals analysis were filtered through a 0.45 µm filter and then placed within the appropriate sample containers provided by the laboratory.

Samples were transported to the laboratories under Chain of Custody (COC) protocols via courier to ALS Environmental for analysis. The COC generally detailed the following information:

- site identification
- sampler’s name
- nature of the sample
- collection date
- analyses to be performed
- sample preservation method.

The samples were analysed for the analytes presented in Table 3.2, as per the *Minimum requirements for building site groundwater investigations and reporting* (DPE, 2022).

Table 3.2 Groundwater sample analyte suite

Type	Analyses
Physical parameters	Alkalinity (bicarbonate, carbonate, hydroxide and total), electrical conductivity (EC), pH, redox potential (Eh), total dissolved solids (TDS), total hardness, temperature and dissolved oxygen (DO)
Major anions	Sulfate (SO ₄), chloride (Cl), carbonates (CO ₃), bromide (Br) and fluoride (F)
Major cations	Calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K)
Ionic balance	Cation/anion balance (as a percentage)
Dissolved inorganics and dissolved heavy metals	Aluminium (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), lithium (Li), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silica (dissolved SiO ₂), silver (Ag), strontium (Sr), uranium (U), vanadium (V) and zinc (Zn)
Nutrients	Ammonia (NH ₃), nitrate (NO ₃), total nitrogen (N), oxidised nitrogen (N), total phosphorus (P) and reactive phosphorus (P)
Microbiological organisms	Faecal coliforms, faecal streptococci and Escherichia coli
Organics	Benzene toluene ethylbenzene xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs) and total recoverable hydrocarbons (TRHs)

Copies of the field sampling summary sheets, COC, and sample receipt notification from the analytical laboratory are presented in Appendix E.

3.5 Groundwater level monitoring

Non-vented water level loggers were installed at monitoring wells BH01, BH02 and BH03 on 4th August 2025. A barometric logger was installed in groundwater monitoring well BH01 to allow barometric compensation of pressure data when estimating groundwater levels from this data.

All water level loggers were set to record water pressure (in kilopascals or metres head of water above the reference point of the instrument) and temperature (as degrees Celsius) at 15-minute intervals. The water level loggers used were of sufficient pressure rating at the locations installed to operate in accordance with the manufacturer's specifications and within their calibrated ranges.

Manual measurements of groundwater levels were taken using an electric water 'dipper' meter at the time of logger installation, during groundwater sampling events, prior to in-well hydraulic ('slug') testing and data logger download events; these data were collected to check the validity of groundwater levels estimated from data of the water pressure transducers and data loggers.

Measurements of pressure and temperature from each level logger was downloaded on the 4th of November 2025 (3 months after installation) using the *Win-Situ 5* software available from the *In-situ* website. Groundwater levels and elevations were then estimated from the data collected by the level logger using:

- the elevation of the water pressure transducer in each well
- the total pressure measured by the water level logger
- assumption regarding the density of the groundwater (in this case assumed to be 0.98 gram per millilitre)
- corrected for barometric effects using data obtained from the barometric logger

Given the magnitude of the water pressure measured by the water level loggers in the wells at the proposed development (which is typically less than 140 kPa) and negligible variation in groundwater salinity between locations, the use of 0.98 gram per millilitre for the density of groundwater (i.e., 9.80 kN/m³) is considered appropriate when estimating groundwater level elevations from the data sets generated.

3.6 Hydraulic ‘slug’ testing

Hydraulic ‘slug’ testing was carried out in BH02 and BH03 on 4th November 2025 following the completion of well development and once each monitoring well had sufficient time to recharge and a natural static groundwater level reached. One falling-head and one rising-head test was completed on each well.

No slug test was completed on BH01 as this well was dry for the duration of the investigation.

For falling head tests, a 1 m long solid slug with a diameter of 34 mm was quickly lowered into the groundwater monitoring well and below the initial elevation of the groundwater level to induce an abrupt increase in hydraulic head. The test induced head change in the well was then typically allowed to return (in this case ‘fall’) to about 90% or more of its pre-test elevation, with changes in the elevation of the test head monitored with time using a water level logger.

For rising head tests, carried out immediately following a falling head test, the same slug used for the falling head tests was quickly removed from the well and the induced head change allowed to return (in this case ‘rise’) to about 90% or more of its pre-test elevation. Changes in the elevation of the test head were again monitored with time using the water level logger in the well.

Due to the slow recovery rates, it was impractical to achieve 90% for all tests.

Groundwater levels were also manually dipped to check test completion once the water had stabilised.

4 Site setting and characterisation

4.1 Topography and surface drainage

The site slopes down to the southwest from approximately 30m Australian Height Datum (AHD) in the northeast to approximately 20 m AHD in the southwest.

Site water is expected to follow topography and flow across the site to the southwest.

The closest water body is an unnamed drainage channel located approximately 90 m west of the site, which drains to a tributary of Winnererremy Bay 400 m southeast of the site.

4.2 Rainfall

Rainfall data has been obtained from the closest BoM weather stations. The rainfall record and reliability of data for each of these stations are provided in Table 4.1, with average monthly rainfall provided in

Table 4.2.

Table 4.1 Rainfall station summary (BoM, 2025)

Station	Rainfall record
66059 (Terry Hills AWS)	2004 – 2025 (21 years)
66141 (Mona Vale Golf Club)	1969 – 2025 (56 years)

Table 4.2 Average rainfall (mm) across the monitoring period (excluding incomplete data sets)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
66059	109.4	139.3	175.0	119.1	73.7	120.8	77.8	71.0	66.4	79.9	97.3	84.8	1214.5
66141	109.8	131.0	134.4	116.4	103.0	123.5	69.0	73.3	61.9	74.3	90.9	71.1	1158.6

4.3 Geological setting

4.3.1 Background

A review of the Sydney 1:100,000 Geological Map Series Sheet 9130 (Geological Survey of NSW, 1983) indicates that the site is underlain by Middle Triassic (base) to Middle Triassic (top) Siliciclastic sedimentary rock derived from Narrabeen Group, Gosford Subgroup, Newport Formation consisting of interbedded laminite, shale and sandstone; white quartz to quartz-lithic, very fine- to medium-grained sandstone; minor shale breccia and pebble polymictic conglomerate (at base of sandstone units); minor red clays.

The NSW Soil and Land Information System Soil Essentials Report obtained through eSPADE indicated the site is underlain by a brownish-black fine sandy loam and yellowish-brown sandy clay loam.

4.3.2 Site information

The subsurface conditions encountered beneath the site during the investigation are summarised in the Geotechnical Investigation Report (WSP, 2025a). A summary of the ground conditions encountered is presented in Table 4.3. No potential asbestos containing material was noted.

Table 4.3 Stratigraphic layers identified at Opal Bayview site (from WSP, 2025a)

Unit	Layer	Depth Range (m BGL)	Description
1a	Asphalt and Concrete (Road)	0 – 0.15	Dark grey, angular aggregate
1b	Gravelly Sand and Silty Sand (Fill)	0.15 – 0.50	Fine to coarse grained, grey to brown, well graded, and fine to medium grained, sub-angular gravels
2	Silty Clay (Residual Soil)	0.40 – 3.00	Pale grey to brown, mottled red-orange high plasticity, very stiff to hard
3	Interbedded Sandstone and Siltstone (Class 3) ¹	1.70 +	Pale grey and brown, stained red-orange, low to medium strength with localised very low strength bands

(1) Rock unit classified in accordance with classification of sandstones and shales in the Sydney region (Pells, Mostyn, Bertuzzi & Wong, 2019).

4.4 Acid sulfate soils

As stated in the Preliminary Site Investigation (WSP, 2025b):

The CSIRO Atlas of Australian Acid Sulfate Soils indicated that the site is located in an area of “extremely low probability of occurrence” of acid sulfate soils.

The site is Class 5 and not subject to Acid Sulfate Soil development controls under the Pittwater LEP, 2014. The LEP notes works within 500 metres of adjacent Class 1, 2, 3, or 4 land that is below 5 metres AHD and by which the watertable is likely to be lowered below 1 metre AHD on adjacent Class 1, 2, 3 or 4 land, present an environmental risk.

4.5 Hydrogeology

4.5.1 Regional hydrogeology

Broadly the *Hawkesbury Sandstone* underlying the site, forms a low-yielding porous and fractured rock aquifer of moderate significance throughout the Sydney region. Typical characteristics of the regional aquifer in the Hawkesbury Sandstone are summarised in the following points:

- Dual porosity, although flow is generally via fractures and bedding planes, as matrix permeability is minimal.
- Typically, unconfined but can be locally semi-confined where mudstone and shale lenses or clay-rich horizons are present.
- Hydraulic conductivity generally decreases with depth due to the rock becoming tighter with fewer discontinuities.
- Anisotropic, with the majority of flow being horizontal via bedding planes and limited vertical flow via vertical joints.
- Shallow perched aquifers are common, found on the competent/weathered sandstone interface.
- The groundwater table follows topography, often within 5 to 15 m of the surface.
- Recharge is dominated by infiltration of rainfall via outcrop and shallow regolith.
- Fresh to slightly saline groundwater quality.

4.5.2 Regulated groundwater source

The *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023* divides the Greater Metropolitan Region of the east coast of NSW into 13 groundwater sources, of which this planned development is within the Sydney Central Basin Groundwater Source (SCBGS). The water sharing plan classifies the SCBGS as a porous rock groundwater source.

4.5.3 Groundwater elevations

A summary of groundwater level data collected during the investigation (from 4th August 2025 to 4th November 2025, 3 month period) are presented in Table 4.4 and Table 4.5.

Table 4.4 Groundwater level statistical summary in metres above Australian Height Datum (mAHD)

Groundwater monitoring well	Ground elevation (mAHD)	Groundwater level summary (mAHD)			
		Minimum	Average	Median	Maximum
BH01	27.15	Dry	Dry	Dry	Dry
BH02	23.83	*19.01	20.81	20.80	21.40
BH03	25.38	*20.20	22.71	22.79	23.08

*minimum groundwater levels were recorded after the wells were purged dry for groundwater sampling.

Table 4.5 Groundwater level statistical summary in metres below ground level (mbgl)

Groundwater monitoring well	Ground elevation (mAHD)	Groundwater level summary (mbgl)			
		Minimum	Average	Median	Maximum
BH01	27.15	Dry	Dry	Dry	Dry
BH02	23.83	2.39	2.98	2.99	4.78
BH03	25.38	2.30	2.66	2.58	5.17

Hydrographs showing the groundwater levels for the period measured in each of the monitoring wells are presented in Figure 1.1, alongside daily rainfall data from Terrey Hills AWS weather station (BoM station number 66059). The monitoring period included several wet periods, including 6 days where daily rainfall totals were greater than 20 mm.

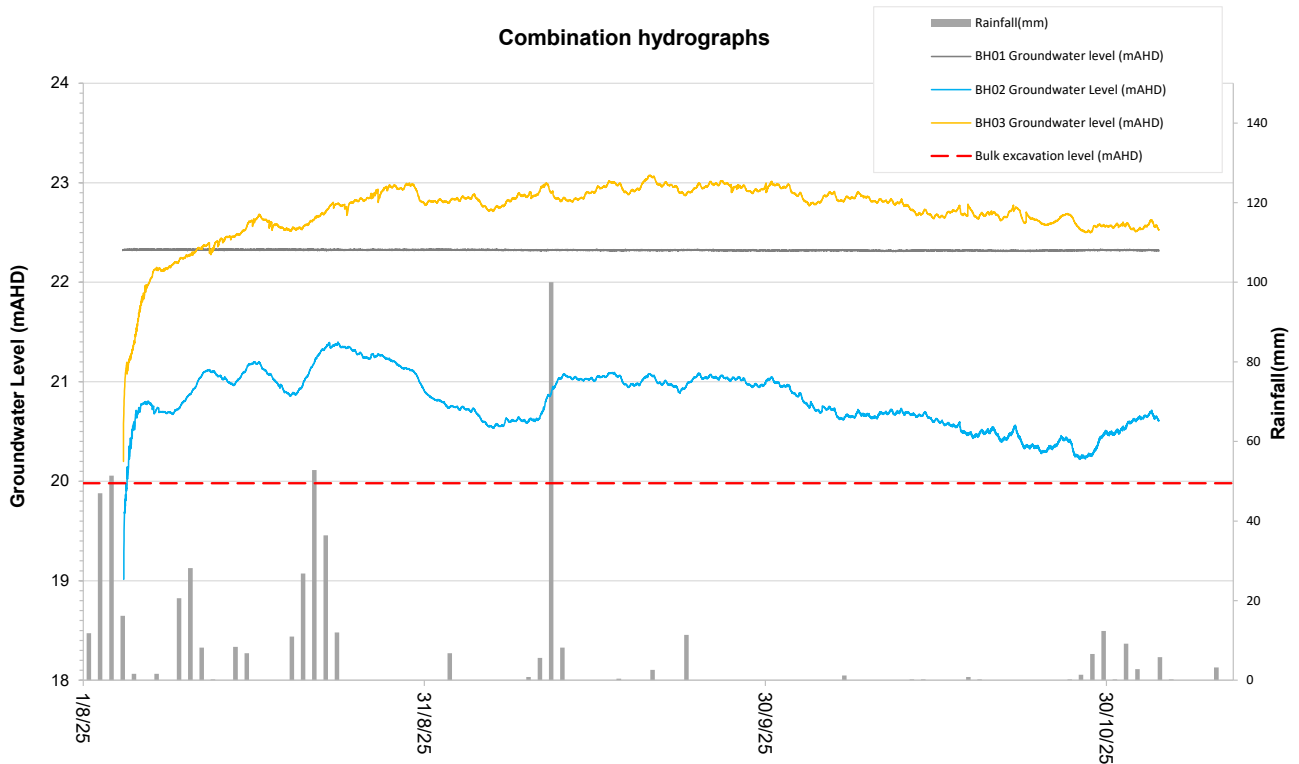


Figure 4.1 Hydrographs for monitoring wells BH01, BH02 and BH03.

Groundwater levels in both BH02 and BH03 show response to rainfall events indicating a good aquifer connection with surface, with larger magnitude responses observed in BH03.

Note, groundwater levels in BH01 are shown to be constant as water level remained below the level of the pressure transducer for the duration of the investigation.

Individual hydrographs for each monitoring well are presented in Appendix C.

4.5.4 Aquifer hydraulic conductivity

Estimates of horizontal hydraulic conductivity, K_h , derived from those slug tests carried out by WSP at the site are summarised in Table 4.6. All tests were analysed using the unconfined Hvorslev Method (1951) and Hyder et. al. (1994) using the analytical application *AqtesolvTM*. Solutions for each test are presented in Appendix D.

No slug test was performed on BH01 as the well was dry for the duration of the investigation.

Table 4.6 Summary of slug test estimates of horizontal hydraulic conductivity

Borehole	Groundwater monitoring well					
	Test interval (m bgl)	Lithology and Pells class of test interval	No. tests	Estimate of horizontal hydraulic conductivity, K		
				Minimum	Geometric mean	Maximum
BH02	3 - 5	Highly weathered Sandstone and interbedded Sandstone and Siltstone (Class 3)	2	2.20E-08 m/sec 1.90E-03 m/day	2.68E-08 m/sec 2.31E-03 m/day	3.61E-08 m/sec 3.11E-03 m/day
BH03	3 - 5	Highly weathered Sandstone and interbedded Sandstone and Siltstone (Class 3)	2	1.37E-08 m/sec 1.18E-03 m/day	2.36E-08 m/sec 2.04E-03 m/day	4.27E-08 m/sec 3.69E-03 m/day

Hydraulic testing elsewhere in the Sydney Basin Hawkesbury Sandstone indicates a bulk hydraulic conductivity with values of horizontal hydraulic conductivity ranging between about 0.002 m/day (about 2×10^{-8} m/sec) to 0.1 m/day (1×10^{-6} m/sec) (Tannetta and Hewitt, 2004).

4.5.5 Groundwater quality

Groundwater samples were collected by WSP from groundwater monitoring wells installed in boreholes BH02 and BH03. No sample was taken from BH01 as the well was dry for the duration of the investigation.

A summary of groundwater analytical results and accompanying exceedances of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) 2018 toxicant default guideline values (DGVs) for the 95% protection of organisms in marine waters (which is the end disposal point for surface water runoff at and surrounding the site given drainage from the site is expected to ultimately drain to Pittwater) is presented in Table 4.7. Copies of the analytical certificates for these samples are included in Appendix E.

The analytical suite was selected as per the mandatory requirements listed in Table A.2 of the DPE (2022) guidelines.

Table 4.7 Summary of groundwater analytical results and exceedances of DGVs

Analyte / parameter	Units	DGV 95% marine waters	Groundwater monitoring well	
			BH02	BH03
General water quality parameters - field measurements				
pH	pH units	N/A	6.45	6.39
Electrical conductivity	µS/cm	N/A	352.8	633
Dissolved oxygen (saturated)	%	N/A	58.0	57.9
Temperature	°C	N/A	18.1	18.6

Analyte / parameter	Units	DGV 95% marine waters	Groundwater monitoring well	
			BH02	BH03
Redox potential	mV	N/A	93.8	89.7
Physical parameters				
pH	pH units	N/A	6.35	6.4
Electrical Conductivity @ 25°C	µS/cm	N/A	396	700
Total Dissolved Solids @180°C	mg/L	N/A	368	522
Redox Potential	mV	N/A	138	143
pH Redox	pH Unit	N/A	6.16	6.25
Hydroxide Alkalinity as CaCO ₃	mg/L	N/A	<1	<1
Carbonate Alkalinity as CaCO ₃	mg/L	N/A	<1	<1
Bicarbonate Alkalinity as CaCO ₃	mg/L	N/A	51	64
Total Alkalinity as CaCO ₃	mg/L	N/A	51	64
Total Hardness as CaCO ₃	mg/L	N/A	33	31
Dissolved Oxygen	mg/L	N/A	9.3	9.2
Major Anions				
Bromide	mg/L	N/A	0.185	1.02
Iodide	mg/L	N/A	0.144	<0.010
Silicon as SiO ₂	mg/L	N/A	45.9	47.4
Sulfate as SO ₄	mg/L	N/A	92	204
Chloride	mg/L	N/A	24	38
Fluoride	mg/L	N/A	<0.1	<0.1
Major cations				
Calcium	mg/L	N/A	10	9
Magnesium	mg/L	N/A	2	2
Sodium	mg/L	N/A	67	128
Potassium	mg/L	N/A	2	5
Ionic balance	%			

Analyte / parameter	Units	DGV 95% marine waters	Groundwater monitoring well	
			BH02	BH03
Total Anions	meq/L	N/A	3.61	6.6
Total Cations	meq/L	N/A	3.63	6.31
Ionic Balance	%	N/A	0.24	2.24
Dissolved inorganics and heavy metals				
Aluminium	mg/L	0.037	0.04	0.08
Antimony	mg/L	N/A	<0.001	<0.001
Arsenic	mg/L	0.14	<0.001	0.002
Beryllium	mg/L	N/A	<0.001	<0.001
Barium	mg/L	N/A	0.018	0.018
Cadmium	mg/L	0.0055	<0.0001	<0.0001
Chromium	mg/L	0.0044	0.001	0.004
Cobalt	mg/L	0.001	0.002	0.003
Copper	mg/L	0.0013	0.006	0.007
Lead	mg/L	0.0044	<0.001	<0.001
Lithium	mg/L	N/A	0.003	0.004
Manganese	mg/L	0.08	0.048	0.05
Molybdenum	mg/L	N/A	<0.001	<0.001
Nickel	mg/L	0.07	0.002	0.003
Selenium	mg/L	N/A	<0.01	<0.01
Silver	mg/L	0.0014	<0.001	<0.001
Strontium	mg/L	N/A	0.034	0.054
Uranium	mg/L	N/A	<0.001	<0.001
Vanadium	mg/L	0.1	<0.01	<0.01
Zinc	mg/L	0.008	0.013	0.023
Boron	mg/L	N/A	0.14	0.35
Iron	mg/L	N/A	<0.05	0.17
Mercury	mg/L	0.0004	<0.0001	<0.0001
Nutrients				
Ammonia as N	mg/L	0.91	0.04	0.09
Nitrite as N	mg/L	N/A	<0.01	<0.01

Analyte / parameter	Units	DGV 95% marine waters	Groundwater monitoring well	
			BH02	BH03
Nitrate as N	mg/L	N/A	0.11	0.03
Nitrite + Nitrate as N	mg/L	N/A	0.11	0.03
Total Kjeldahl Nitrogen as N	mg/L	N/A	<0.5	<3.0
Total Nitrogen as N	mg/L	N/A	<0.5	<3.0
Total Phosphorus as P	mg/L	N/A	0.29	3.39
Reactive Phosphorus as P	mg/L	N/A	<0.01	<0.01
Microbiological organisms				
Thermotolerant Coliforms	CFU/100 mL	N/A	12000	8500
Escherichia coli	CFU/100 mL	N/A	~2	~160
Faecal Streptococci	CFU/100 mL	N/A	100	66
Organics				
Naphthalene	µg/L	70	<1.0	<1.0
Acenaphthylene	µg/L	N/A	<1.0	<1.0
Acenaphthene	µg/L	N/A	<1.0	<1.0
Fluorene	µg/L	N/A	<1.0	<1.0
Phenanthrene	µg/L	2	<1.0	<1.0
Anthracene	µg/L	0.4	<1.0	<1.0
Fluoranthene	µg/L	1.4	<1.0	<1.0
Pyrene	µg/L	0.2	<1.0	<1.0
Benz(a)anthracene	µg/L	N/A	<1.0	<1.0
Chrysene	µg/L	N/A	<1.0	<1.0
Benzo(b+j)fluoranthene	µg/L	N/A	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	N/A	<1.0	<1.0
Benzo(a)pyrene	µg/L	0.2	<0.5	<0.5

Analyte / parameter	Units	DGV 95% marine waters	Groundwater monitoring well	
			BH02	BH03
Indeno(1.2.3.cd)pyrene	µg/L	N/A	<1.0	<1.0
Dibenz(a,h)anthracene	µg/L	N/A	<1.0	<1.0
Benzo(g,h,i)perylene	µg/L	N/A	<1.0	<1.0
Sum of polycyclic aromatic hydrocarbons	µg/L	N/A	<0.5	<0.5
Benzo(a)pyrene TEQ (zero)	µg/L	N/A	<0.5	<0.5
Phenol-d6	%	N/A	23.2	24.6
2-Chlorophenol-D4	%	N/A	47.3	64.7
2.4.6-Tribromophenol	%	N/A	45.2	64.3
2-Fluorobiphenyl	%	N/A	68.7	84.1
Anthracene-d10	%	N/A	68.4	87.4
4-Terphenyl-d14	%	N/A	70.2	84.8
C6 - C9 Fraction	µg/L	N/A	<20	<20
C10 - C14 Fraction	µg/L	N/A	<50	<50
C15 - C28 Fraction	µg/L	N/A	<100	<100
C29 - C36 Fraction	µg/L	N/A	<50	<50
C10 - C36 Fraction (sum)	µg/L	N/A	<50	<50
C6 - C10 Fraction	µg/L	N/A	<20	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	N/A	<20	<20
>C10 - C16 Fraction	µg/L	N/A	<100	<100
>C16 - C34 Fraction	µg/L	N/A	<100	<100
>C34 - C40 Fraction	µg/L	N/A	<100	<100
>C10 - C40 Fraction (sum)	µg/L	N/A	<100	<100
>C10 - C16 Fraction minus Naphthalene (F2)	µg/L	N/A	<100	<100
Benzene	µg/L	700	<1	<1

Analyte / parameter	Units	DGV 95% marine waters	Groundwater monitoring well	
			BH02	BH03
Toluene	µg/L	180	<2	<2
Ethylbenzene	µg/L	80	<2	<2
meta- & para-Xylene	µg/L	75	<2	<2
ortho-Xylene	µg/L	N/A	<2	<2
Total Xylenes	µg/L	N/A	<2	<2
Sum of BTEX	µg/L	N/A	<1	<1
Naphthalene	µg/L	70	<5	<5
1,2-Dichloroethane-D4	%	N/A	118	111
Toluene-D8	%	N/A	123	117
4-Bromofluorobenzene	%	N/A	133	129

Notes: µS/cm – microSiemens per centimetre

mg/L – milligrams per litre

CFU / 100 ml – coliform forming units per 100 ml of sample volume

µg/L – micrograms per litre

BTEXN – benzene, toluene, ethylbenzene, xylene and naphthalene

Concentrations in red-shaded boxes – exceeds the relevant 95% LOSP toxicant DVG for marine water.

The results show that the groundwater encountered is fresh, with relatively low electrical conductivity and total dissolved solids. pH is slightly acidic and high the water is oxygenated, consistent with recently recharged rainwater.

There are exceedances of Aluminium, Cobalt, Copper and Zinc above the ANZG 2018 toxicant default guideline values (DGVs) for the 95% protection of organisms in marine waters. In urban setting, of which Sydney is typical, these exceedances are a common feature of urban development.

4.6 Receptors

4.6.1 Groundwater abstraction and drainage

The Preliminary Site Investigation (WSP, 2025b) states the following:

A search of the WaterNSW online database¹ for registered groundwater bores identified 5 registered bores within a 500 m radius of the site. The bores were registered for the purposes of water supply, irrigation and other purposes. Bore depth ranged from 150 -168 mbgl north and east of the site at a high elevation, to 1.5, 30 and 60 mbgl south and west of the site at a lower elevation.

The closest bore (GW106813) is greater than 200 m from the proposed excavation.

¹ <https://realtimedata.watnsw.com.au>

4.6.2 Groundwater-dependent ecosystems

Groundwater-dependent ecosystems (GDEs) are natural communities of plants, animals and other organisms which are dependent on access to groundwater on a constant or intermittent basis to sustain aquatic and terrestrial ecosystems such as vegetation, springs, wetlands, and rivers (DPIE, 2020). In New South Wales the NSW State GDEs Policy (DLWC, 2012) is designed to protect the valuable ecosystems which rely on groundwater for survival, so that wherever possible the ecological processes and biodiversity of these GDEs are maintained or restored.

A search of the Australian GDE Atlas potential² GDEs and the NSW High Ecological Value Aquatic Ecosystems (HEVAE) GDE within the project area and surroundings indicates the following:

- There are no **aquatic GDEs** within 1 km of the site.
- There are no **subterranean GDEs** within 1 km of the site
- There is one low potential **terrestrial GDE** within 1 km of the site.
- There are no **high priority GDEs** listed in the Water Sharing Plan for the Greater Metropolitan Region Groundwater Resources 2023 (DPIE, 2023) within 10 km of the site.
- There are no **high priority NSW HEVAE GDE** within 1 km of the site.

4.6.3 Springs and creeks

No natural springs have been identified at the site and no springs listed in the *Greater Metropolitan Regional Groundwater Water Sharing Plan 2023* (DPIE, 2023) are within 500 m of the site.

There is one third-order creek (Cahill Creek) within 500 m of the site.

4.6.4 Culturally-significant groundwater sites

No culturally significant sites are identified within the *Greater Metropolitan Regional Groundwater Water Sharing Plan 2023* (DPIE, 2023).

4.6.5 Nearby contaminated sites

The Preliminary Site Investigation (WSP, 2025b) summarises the following:

An online search of the NSW EPA *Protection of the Environment Operations Act 1997* public register found no notices or licenses, either current or former, for the site or properties within 500 m of the site.

A search of the NSW EPA online contaminated sites database³ did not identify the site or surrounding properties as currently being regulated by the NSW EPA, or as having been notified to NSW EPA as potentially contaminated. No former gas works, waste management facilities, or other sites with contamination issues regulated by the EPA are located on or within 500 m of the site.

No properties within a 500 m radius of the site are listed under the NSW EPA PFAS investigation program.

² GDE potential describes ecosystems in terms of their “potential to be interacting with groundwater”. The term “potential” is used to reflect the uncertainty inherent in identifying ecosystems as groundwater-dependent using desktop methods. Finer scale studies or fieldwork are needed to confirm this analysis.

³ www.epa.nsw.gov.au/prclmapp/searchregister

5 Analytical modelling – groundwater inflow and radius of influence assessment

5.1 Objective and approach

The objective of the modelling was to estimate potential future groundwater inflows to the basement and to assess the impact on surrounding groundwater users and the environment due to groundwater drawdown resulting from basement dewatering.

Two separate analytical models were utilised:

1. Marinelli and Niccoli (2000) – to estimate inflows to the excavation, outlined in Section 5.3.
 2. Bear (1979) – to estimate radius of influence as a result of drawdown from dewatering, outlined in Section 5.4.
-

5.2 Conceptual hydrogeological model

The following bullet points summarise the conceptual hydrogeological model (CHM) at and surrounding the site:

- The groundwater system comprises of an unconfined perched aquifer within the base of the residual soils and weathered zone above competent bedrock. This is evidenced by water levels fluctuating within 0.81 m of the highly weathered sandstone/residual soil and more competent sandstone interface at both BH02 and BH03.
- Groundwater flow is likely dominated by fracture flow in the weathered zone.
- The ratio of horizontal to vertical hydraulic conductivity of the Hawkesbury Sandstone is assumed to be 10:1, evidenced by the predominantly horizontal fractures and bedding plane noted in bore logs and observed in core photographs.
- Groundwater recharge is expected to be derived primarily from the infiltration of excess rainfall, evidenced by the response of groundwater levels to rainfall events during the investigation period. Recharge is estimated to be 5% of the annual average rainfall.
- The perched system is not spatially homogenous, shown by different responses to rainfall in BH02 and BH03 and BH01 remaining dry.
- Once the perched aquifer has been locally dewatered during construction, ongoing take is likely to be low, except for during high rainfall events.
- The bulk horizontal hydraulic conductivity (i.e., that of both the rock matrix and the discontinuities in the rock mass) of the weathered zone which is expected to form the walls of the excavation, and possibly part or all of the floor, of the planned excavation is estimated to be in the order of $3.69\text{E-}03$ m/d. This interval is underlain by competent sandstone bedrock (Hawkesbury Sandstone).

5.3 Marinelli and Niccoli (2000) solution for groundwater flow estimation

5.3.1 Approach

An assessment of groundwater inflow was conducted to estimate the potential seepage resulting from excavation associated with the proposed development. To quantify this, an analytical solution presented by Marinelli and Niccoli (2000) was utilised, as shown in Figure 5.1. A Python-based analytical script of the solution was employed within an Excel spreadsheet environment. A steady-state analytical solution was adopted.

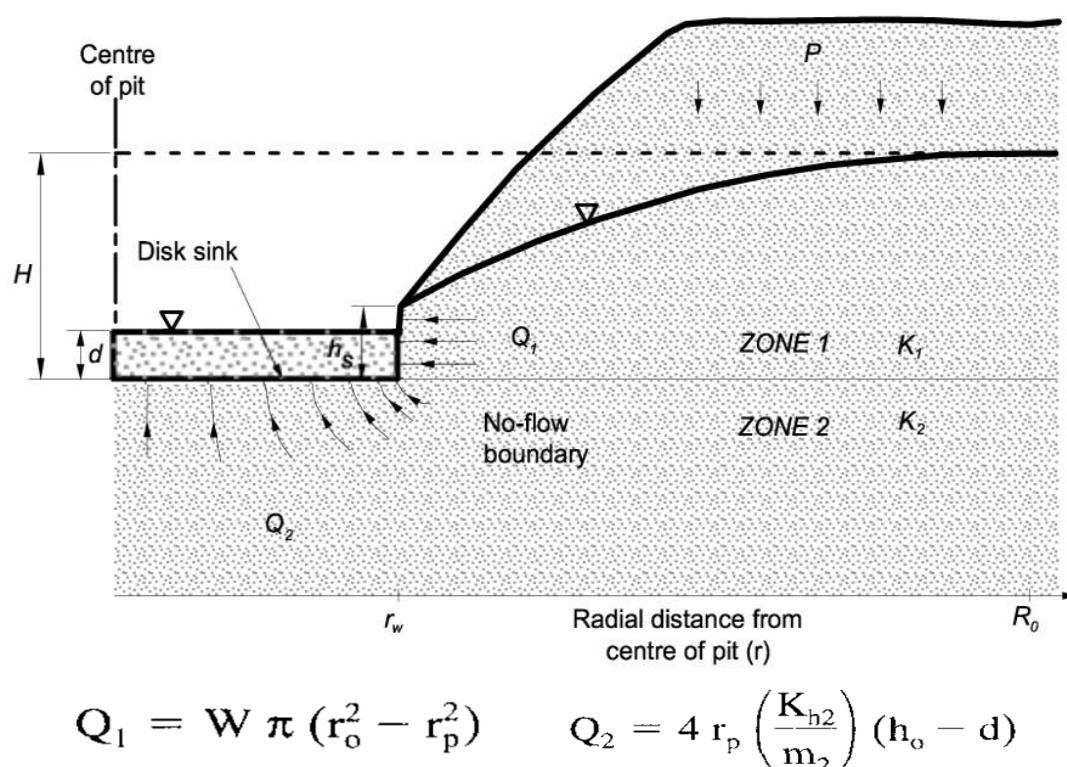


Figure 5.1 Analytical solution from Marinelli and Niccoli (2000)

5.3.2 Inflow modelling results

The analytical model inputs and resulting groundwater inflow are presented in Table 5.1. The estimated total groundwater seepage for the project is **0.35 ML/year**.

Table 5.1 Model inputs and inflow results

	Parameter	Units	Value
INPUTS	Basement area	m ²	2746
	Distributed recharge	m/d	1.66E-04
	Horizontal hydraulic conductivity, K_h	m/d	3.69E-03
	Vertical hydraulic conductivity, K_v	m/d	3.69E-04

	Parameter	Units	Value
	Anisotropy ratio, K_h/K_v	-	10
	Bulk excavation level, BEL	mAHD	19.98
	Static groundwater level, SWL	mAHD	23.08
OUTPUTS	Modelled inflow	l/s	0.01
	Modelled inflow	ML/yr	0.35

5.3.3 Assumptions

The following assumptions were adopted in the model:

- Distributed recharge was estimated to be 5% of annual rainfall.
- The hydraulic conductivity values adopted were based on the maximum values obtained by analysis of on-site slug testing.
- The modelled aquifer units had a $K_h:K_v$ anisotropy ratio of 10:1, typical of the Hawkesbury Sandstone aquifer.
- Static water levels adopted were based on the maximum measured water level recorded during the investigation period.
- The bulk excavation level is 0.5 m less than the proposed finished floor level.
- The model assumes steady state conditions.
- Storm or flood event circumstances occurring during construction are not accommodated in the estimates provided.

5.4 Bear (1979)

5.4.1 Approach

An assessment of the radius of influence as result of dewatering was completed to assess the potential impact on nearby receptors. To quantify this, an analytical solution presented by Bear (1979) was utilised, as shown below:

$$R = 1.5 \sqrt{\frac{KH_r t}{S_y}}$$

Where:

R = radius of influence

K = horizontal hydraulic conductivity

H = dewatering depth

t = time since dewatering commenced

S_y = specific yield

5.4.2 Radius of influence results

The analytical model inputs and resulting radius of influence after 10 years (3650 days) are presented in Table 5.2.

Table 5.2 Model inputs and radius of influence results.

	Parameter	Units	Value
INPUTS	Horizontal hydraulic conductivity, K_h	m/d	3.69E-03
	Dewatering depth, H	m/d	3.1
	Time since dewatering commenced, t	d	3650
	Specific yield, S_y	%	5
OUTPUTS	Radius of influence, R	m	43.4

5.4.3 Assumptions

The following assumptions were adopted in the model:

- The hydraulic conductivity values adopted were based on the maximum values obtained by analysis of on-site slug testing.
- Dewatering depth was estimated to be the difference between the maximum measured water level recorded during the investigation period and the bulk excavation level.
- The bulk excavation level is 0.5 m less than the proposed finished floor level.
- Aquifer is unconfined.
- The aquifer is composed of isotropic homogenous material.
- The specific yield of the aquifer is 5%.
- The model assumes steady state conditions.

5.5 Settlement

The primary aquifer at and surrounding the site is located within relatively low permeability, competent massive, high strength sandstone and siltstone (Hawkesbury Sandstone) bedrock and overlying residual weathered material. As such those predicted changes in the elevation of the water table attributable to dewatering and any depressurisation due to the proposed development is expected to result in negligible consolidation and settlement.

5.6 Groundwater drainage quality

At this stage it is not possible to definitively state what the quality and geochemistry of the groundwater that will collect in the excavation and basement will be, however, the analyses of groundwater samples carried out provide a reasonable indication of likely water quality. It is proposed that groundwater seepage collected in the excavation will be treated onsite and then disposed of to the local stormwater system under Council approval.

If deemed appropriate, approval for the disposal of groundwater effluent to stormwater will need to comply with the appropriate level of protection (LOP) “trigger levels” marine water quality outlined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (published by ANZG 2018) and fulfill the requirements for approval to discharge defined by Council.

The use of the LOPs for dewater disposal assessments assumes Pittwater, a marine water environment, is classified as a slightly (95% LOP) disturbed ecosystems (as defined in Section 3.1 of the guidelines) given they receive surface water

runoff from urban catchments which include various types of land uses and accompanying activities, all of which impact surface water quality.

Consideration needs to be given in particular to the potential presence of elevated metals (likely due to elevated silt content) and will be monitored as per the strategy outlined in Section 7.1

As indicated previously, discharge to the stormwater system will be subject to the approval of the relevant authority, either the Northern Beaches Council.

6 Groundwater Impact Assessment

6.1 Minimal impact considerations

The Aquifer Interference Policy (AIP) includes a set of minimal impact considerations for assessing the impacts of aquifer interference activities including those regulated under the WMA 2000, the Water Act 1912 and those decided under the terms and conditions of other legislation. It indicates the term ‘aquifer’ is commonly understood to mean a groundwater system of sufficient hydraulic conductivity to allow water to move in it, and which can yield productive volumes of groundwater, however, notes those criteria and considerations in the AIP are equally applicable to low-yielding and/or saline groundwater systems.

The area surrounding the site is underlain by silty clay residual soils and the Hawkesbury Sandstone. These soils and rock are of relatively low yield and are a ‘less productive groundwater source’ as outlined in the AIP.

Table 1 of the AIP outlines minimal impact considerations for both highly productive and less-productive groundwater sources. The AIP also states ‘*if ... predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable*’. An assessment of the ‘minimal impact considerations’ defined in the AIP for a less-productive groundwater source and responses to these are presented in Table 6.1.

Table 6.1 Minimal impact considerations under the Aquifer Interference Policy

AIP level 1 minimum impact consideration	Assessment
Water Sharing Plan and Groundwater source	Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 – Sydney Basin Central Groundwater Source
Aquifer	Porous rock
Category	Less productive
Water table Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic ‘post-water sharing plan’ variations, 40 m from any high priority: — groundwater dependent ecosystem (GDE), or — culturally significant site — listed in the schedule of the relevant water sharing plan. A maximum of a 2 m declines cumulative at any water <i>supply</i> work.	Water table The closest high priority HEAVE GDEs to the site are located 2.7 km or more to the south of the site. Given both construction-phase and long-term drawdown (due to the necessitated dewatering works and inclusion of a drained basement) is estimated to extend no more than 45 m from the site boundary, the planned development is not expected to impact these GDEs. No registered water supply works are in the estimated zone of groundwater drawdown (depressurisation). As such the proposed dewatering works and long-term drainage into the planned basement of the planned development are not expected to result in a decline of more cumulative 2 m decline in the water table at any water supply work.
Water pressure A cumulative water pressure head decline of no more than 2 m at any water supply work.	Water pressure No registered water supply works are in the estimated zone of groundwater drawdown (depressurisation). As such the proposed dewatering works and long-term drainage into the planned basement of the planned development are not expected to result in a decline of more than 2 m of the water level in any water supply work.

AIP level 1 minimum impact consideration	Assessment
Water quality Any change in groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	Water quality The proposed development (incorporating a drained basement) is not expected to lower the beneficial use category of groundwater beyond 45 m of the site.

Based on the assessment presented in Table 6.1, the proposed development is expected to have impacts that are less than the Level 1 minimum impact considerations, which according to the AIP minimal consideration requirements, would be considered as acceptable.

6.2 Water sharing plan rules for water access approval

The site is in the Greater Metropolitan Region Groundwater Sources (of Sydney) and Sydney Basin Central Groundwater Source. A summary of the rules in this Water Sharing Plan for the granting of water access licences, compared against the results of the groundwater impact assessment, is presented in Table 6.2. These rules are to be used as a guide only and actual licence conditions are granted at the discretion of WaterNSW.

Table 6.2 Water Sharing Plan rules and groundwater impact assessment considerations

Water Sharing Plan rule	Assessment
To minimise interference between neighbouring water supply works, no water supply works will be granted or amended within the following distances of <u>existing bores</u>: — 400 m from an aquifer access licenced bore on another landholding, or — 100 m from a basic landholder rights bore on another landholding, or — 50 m from a property boundary (unless written consent from the neighbour), or — 1000 m from a local or major water utility bore, or — 200 m from a NSW Office of Water monitoring bore (unless written consent provided by <i>WaterNSW</i> / NSW Office of Water).	The proposed development (and therefore the proposed water supply works) will be located more than: — 400 m from an aquifer access licenced bore on another landholding — 100 m from a basic landholder rights bore on another landholding — 1000 m from a local or major water utility bore, and — 200 m from a NSW Office of Water monitoring bore. Given the planned development includes the excavation of basements levels below the water table (in the perched aquifer system, primarily), drainage of water from the bedrock aquifer into the planned drained basement is predicted to occur within 45 m of the site and therefore neighbouring properties. However, there are no known registered groundwater supply bores located on any neighbouring properties and is it unlikely a water supply well will be installed near any neighbouring property give the urbanised and developed nature of the area and low yielding aquifer.

Water Sharing Plan rule	Assessment
To protect bores located near contamination, no water supply works are to be granted or amended within: — 250 m of contamination as identified in the plan, or — 250 to 500 m of contamination as identified in the plan unless no drawdown or water will occur within 250 m of the contamination source, or — Greater than 500 m of contamination as identified in the plan if necessary to protect the water source, the environment or public health and safety. <i>The plan though also lists circumstances in which these distances may be varied.</i>	There are no sites in the predicted zone of groundwater drawdown with ‘Declaration of Significantly Contaminated Land’ notifications on the <i>NSW Environment Protection Agency</i> online public search register. The closest site is the “significantly contaminated land” site is located 1.4 km southwest of the proposed development.
To protect bores located near sensitive environmental areas, no water supply works will be granted or amended within the following distances of high priority Groundwater Dependent Ecosystems (non-karst) as identified within the plan: — 100 m from bores used solely for extracting basic landholder rights, or — 200 m from bores used for all other access licences. No water supply works will be granted or amended within the following distances from these identified features: — 500 m of high priority karst GDEs, or — Greater than 500 m of a high priority karst GDE if the Minister is satisfied that the work is likely to cause drawdown at the perimeter if the high priority karst GDE, or — 40 m of a river or stream or lagoon (third-order or above), or — 40 m from a first or second-order stream, unless: (i) the water supply work is drilled into underlying parent material and slotted intervals commence deeper than 30 m, or (ii) the Minister is satisfied that a hydrogeological study, submitted by the applicant and assessed as adequate by the Minister, demonstrates that the water supply work will have no more than minimal impact on base flows in the river. — 100 m from the top of an escarpment.	The planned development will be located more than: — 1,000 m from the nearest GDE — 100 m from any registered bores used solely for extracting basic landholders (water) rights — 200 m of the closest registered bore licenced for water supply purposes — 40 m from a river, third-order or above stream or lagoon — 500 m from a high-priority karst GDE, and — 100 m from the top of an escarpment.

Water Sharing Plan rule	Assessment
To protect groundwater dependent culturally sensitive sites, no water supply works will be granted or amended within the following distances of groundwater-dependent culturally significant sites as identified in the plan: — 100 m for bores used for extracting groundwater for basic landholder rights, or — 200 m for bores used for all other aquifer access licences <i>The plan though also lists circumstances in which these distances may be varied.</i>	Based on a review of the Water Sharing Plan there are no groundwater-dependent culturally significant sites within 1 km of site-associated dewatering works. As such the proposed development is not expected to interfere or interact with any groundwater dependent culturally sensitive sites.
Available Water Determinations (AWDs): — 100% stock and domestic, total and major utilities and specific purpose access licences — 1 ML/unit of share aquifer access licences. AWD for aquifer access licences may be reduced in response to a growth in use.	Groundwater inflows are estimated to be <i>less</i> than 3 ML/year. As such this development could be considered as a ‘minor aquifer interference activity’ and therefore will not require a water access licence.
Trading Rules — <u>Into</u> the groundwater source – not permitted. — <u>Within</u> the groundwater source – permitted subject to local impact assessment. — <u>Conversion</u> to another category of access licence – not permitted.	

6.3 Water access rights, licenses, and approvals

To use groundwater in NSW, the following are required:

- a *Water Access Licence* (WAL, in a specific water source) plus allocation.
- a *Water Supply Work Approval* (WSWA) to construct, replace, or modify and operate a specified water supply work (including an excavation below the water table) at a specific location
- a *Water Use Approval* (WUS) to use water for a particular purpose at a particular location, such as for town water supply.

A water supply work approval and a water use approval are often combined into a single approval as they are both location-specific. A WAL holder must apply to nominate an approved water supply work in the water source designated on the WAL before groundwater can be taken (in this case the *Sydney Central Basin Groundwater Source*).

6.3.1 Water supply works approval (WSWA)

Water use approvals authorise the holder to use water for a particular purpose (such as construction dewatering) under the Water Management Act 2000 (NSW). A WSWA is an approval to ‘take’ water from a particular location. For the proposed development, a water supply works approval is required. Guidance and an application form can be accessed via

the following weblinks: [New water supply work and/or water use approvals](#) and [New water supply work and/or water use approval](#).

The WSWA will be provided by WaterNSW and must be given to Council.

6.3.2 *Water access license (WAL)*

Predicted maximum long term groundwater inflows to the planned drained basement during operation of the development are expected to be *less* than 3 ML/year. As such this development could be considered as a ‘minor aquifer interference activity’ which are generally exempt from the full extent of the Water Management Act and therefore may not require a licence, as presented in the [Dewatering exemptions](#) webpage (DCCEEW, 2025).

This webpage includes examples of where the exemption may apply, one of which is the ‘temporary dewatering to allow safe and efficient excavation during building construction’. Ultimately the decision as to whether a licence will be required for the long-term passive collection of groundwater seepage in the planned basement will be at the discretion of WaterNSW.

Water take must still be reported annually using the [Record of groundwater take under exemption](#) form, and reported to NRAR 28 days before the end of the water year (by 28 July).

6.3.3 *Condition of WSWA*

WSWA approval conditions for construction dewatering typically include the monitoring the following and formally record all results with date and time references for each entry for inclusion in a dewatering report:

- dewatering volumes (weekly meter readings) during the construction period,
- groundwater levels (continuous or daily measurements) during the construction period,
- water quality (weekly testing and monthly sampling and analysis) during the construction period

The approval holder must provide a copy of the dewatering completion report and all monitoring data to WaterNSW within eight (8) weeks of the completion of building construction.

7 Dewatering Monitoring and Management Strategy

7.1 Requirements

Hydrogeological monitoring will be required to meet the requirements of the NSW Government presented in the document titled *Minimum Requirements for Building Site Groundwater Investigations and Reporting* (DPE, 2022). This document prescribes certain requirements that must be complied with to meet the requirements of the Water Management Act 2000, relevant Water Sharing Plans and the NSW Aquifer Interference Policy.

The recommended monitoring should be carried out using the following groundwater monitoring wells, including using the automated water-pressure transducers and data loggers currently installed in these wells:

- BH01 – located in the north east of the site
- BH02 – located in the west of the site
- BH03 – located in the south of the site

Should any of these groundwater monitoring wells be damaged or lost, they shall be replaced with like for like replacement wells.

The monitoring and reporting presented in Table 7.1 is recommended during the remaining duration of project construction.

Table 7.1 Summary of monitoring and reporting requirements

Item	Monitoring	Monitoring Frequency	Reporting
Groundwater levels	Monitoring of groundwater levels in all groundwater monitoring wells installed around the basement excavation (i.e., BH01 to BH03 inclusive). [Automated water pressure transducers and data loggers, also referred to as ‘water level loggers’, to be retained in all wells at the site.]	Monthly data logger downloads at hourly intervals	Monthly
Groundwater quality	Sampling and laboratory analysis of collected groundwater from in-excavation sumps and discharge water for those analytes nominated by DPE (2022).	Sampling and laboratory testing to be conducted monthly throughout construction-stage activities and dewatering. Additionally, weekly measurements of pH, turbidity, temperature, redox and EC of groundwater and any discharge water until construction works are complete, extending to monthly during building operation for as long a dewatering continues.	
Inflow rates	If required, groundwater inflows to be measured using calibrated meters.	Weekly meter readings throughout construction dewatering and then monthly during building operations for as long as dewatering is carried out.	Weekly

Item	Monitoring	Monitoring Frequency	Reporting
Quantity of dewater	If required, a calibrated flow meter connected to any dewater or treated effluent pump-out system.	Weekly meter readings throughout construction dewatering and then monthly during building operations for as long as dewatering is carried out.	Weekly

7.2 Threshold criteria – construction dewatering

Table 7.2 summarises the proposed thresholds and actions to be adopted during construction-stage dewatering. A Dewatering Completion Report will be prepared on completion of construction and forwarded to Northern Beaches Council and WaterNSW.

Table 7.2 Proposed inflow threshold and actions for temporary dewatering

THRESHOLD DESCRIPTION	THRESHOLD / TRIGGER LEVEL	ACTION
Green – Alert	Groundwater inflow at various time-steps <80% than that presented in Table 5.1	— Continue work — Maintain monitoring at the nominated intervals and compare this with water disposal volumes. — Forward monitoring reports and accompanying data sets to all stakeholders (refer to Section 7.3).
Amber – Alarm	Actual groundwater inflows $\geq 80\%$ and $\leq 110\%$ of predicted groundwater inflows	— Continue excavation. — Review monitoring data and compare with predicted inflows presented in Table 5.1. — Increase frequency of monitoring of (i) groundwater inflows to 24-hour intervals, and (ii) groundwater levels to hourly, until notified otherwise by the nominated engineers in consultation with the Builder. — Notify stakeholders (refer to Section 7.3).
Red – Action	Groundwater inflow >110% of predicted inflows	— Cease excavation immediately. — Notify stakeholders (refer to Section 7.3). — Inspect walls and floor of excavation for any areas of enhanced groundwater inflow and unforeseen change(s) in ground conditions (e.g., previously unknown fracture zones). — Undertake a risk assessment and develop an action plan to mitigate ongoing unacceptable inflow volumes including the grouting of any localised high-flow geological features.

7.3 Stakeholders

Northern Beaches Council (Council) and WaterNSW are the only stakeholders. They should be contacted within seven days should any *alarm* or *action* items be triggered, and/or any unforeseen adverse impact groundwater at or immediately surrounding the site. Copies of all monitoring reports and accompanying data sets should also be sent to Council and WaterNSW.

7.4 Completion reporting

Opal Healthcare is required to provide WaterNSW with a plan for the ongoing measurement (this document), and a Dewatering Completion Report (DCR), for the Gateway development including: recording and reporting of groundwater take, water level monitoring and water quality monitoring at the frequencies required by the *Minimum Requirements for Building Site Groundwater Investigations and Reporting – Information for Developers and Consultants* (DPE, 2022) within the documented building management system prior to application for an Occupation Certificate. A copy of the DCR and all monitoring data to WaterNSW within eight weeks of the completion of building construction.

The approval holder must arrange for the installation of a meter to measure ongoing take of groundwater prior to application for an Occupation Certificate.

8 Conclusions

Predicted maximum inflows to the planned drained basement during the construction and operation phase of the development are expected to be **0.35 ML/year**.

Based on this, the passive collection of groundwater in the planned drained basement during the long-term operation of the development will not require a Water Access Licence from *WaterNSW*; this decision will be at the discretion of *WaterNSW*. During ongoing take, inflows will likely be below this as the perched aquifer system is dewatered.

This annual volume of groundwater intake is expected to have minimal impact to the surrounding groundwater system, neighbouring properties, and other water supply works. The maximum modelled groundwater drawdown extent remains within 45 m from the edge of the proposed development basement over a 10-year period.

Additionally, the planned development is not expected to:

- adversely impact groundwater quality
- interfere with any off-site soil and/or groundwater contamination which could be expected to constitute a significant risk or harm to human health or the environmental, or
- interfere and/or impact any ASS.

Based on the hydrogeological investigation, modelling and impact assessment, it is considered that a drained basement is suitable for the Opal Bayview development. There is no need for a tanked basement. However, this decision will be at the discretion of Northern Beaches Council.

9 Limitations

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Appendix A

Well logs





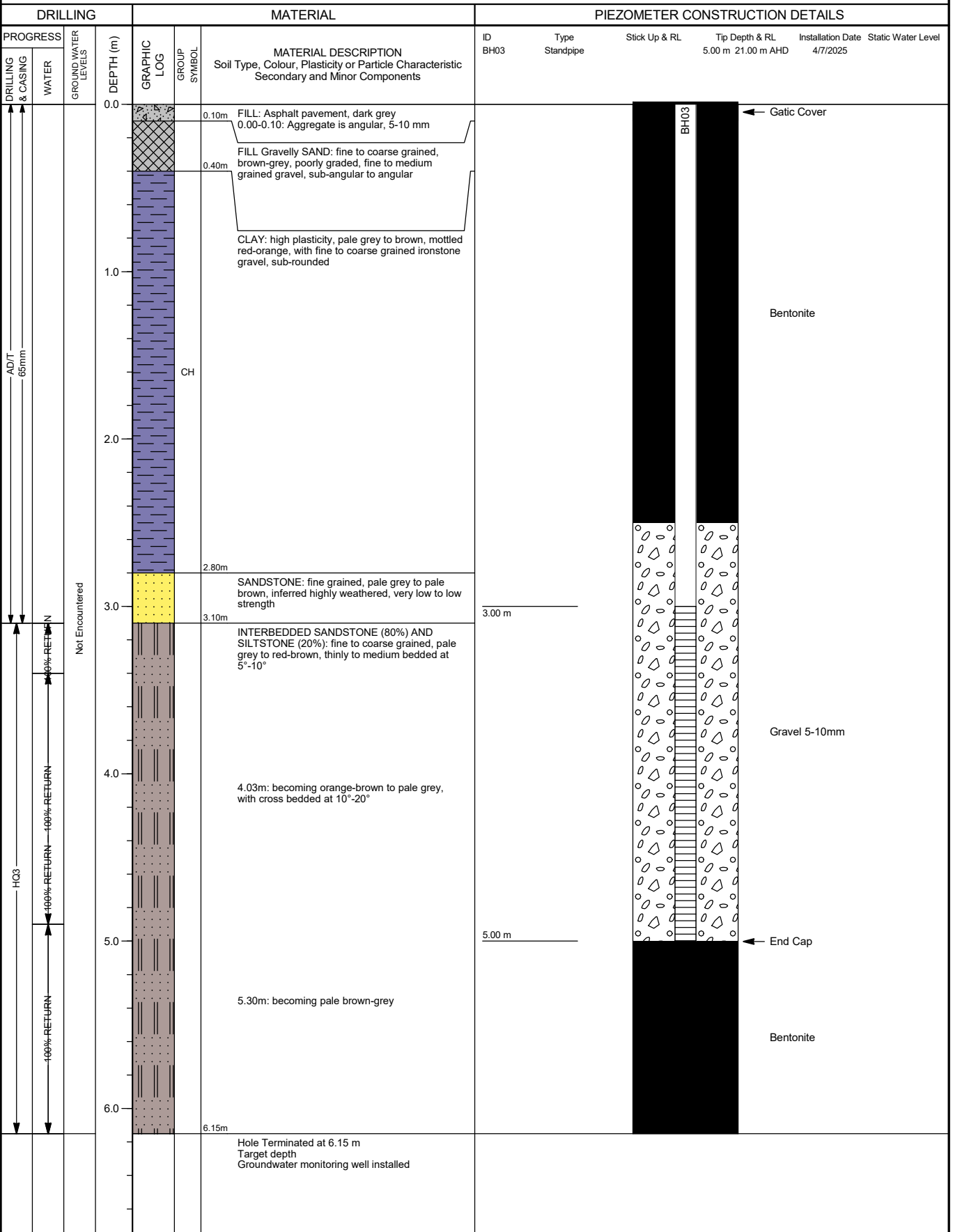
CLIENT : Bloompark
LOCATION : Bayview 5 Main Drive

PROJECT : Opal Bayview SI

HOLE NO : BH03

FILE / JOB NO : PS223670
SHEET : 1 OF 2

POSITION : E: 341910, N: 6273523 (MGA2020-56) SURFACE ELEVATION : 26.00 (AHD) ANGLE FROM HORIZONTAL : 90°
RIG TYPE : GEO205 MOUNTING : Track CONTRACTOR : Terratest
DATE STARTED : 3/7/2025 DATE COMPLETED : 4/7/2025 DATE LOGGED : 4/7/2025 LOGGED BY : HW CHECKED BY : BMS



See Explanatory Notes for details of abbreviations & basis of descriptions.

Appendix B

Well development records



MONITORING WELL DEVELOPMENT RECORD

PROJECT NO.: PS223670

MONITORING WELL ID: BH01

WSP STAFF: DH

PROJECT: Opal Bayview

DATE: 3/07/2025

CONTRACTOR: N/A

WEATHER (Temp/Cloud cover/Precipitation): Sunny

DEVELOPMENT METOD: Pump type? Bailer

CALCULATION OF MINIMUM DEVELOPMENT VOLUME

All depths measured below top of PVC casing (TOC)

Time	Casing Diameter (mm)	Depth to Water (m)	Measured Depth of Well (mbTOC)	Depth of Well from TOC from Well Report Sheet (m)	Metres of Standing Water (m) D = B-A or C-A whichever is greater	One Well Casing Volume (L) E = D * 2	Min. Total Volume to be Purged (L) F = E x 3
		A	B	C			
9:20 AM	50	4.75	4.80	5.00	0.25	0.50	15.00

DEVELOPMENT RECORDS

Field Measurements

[illegible]

Final Measured Depth of Well from TOC(m)	N/A
--	-----

MONITORING WELL DEVELOPMENT RECORD

PROJECT NO.:	PS223670	PROJECT:	Opal Bayview
MONITORING WELL ID:	BH02	DATE:	3/07/2025
WSP STAFF:	DH	CONTRACTOR:	N/A
WEATHER (Temp/Cloud cover/Precipitation): Sunny			
DEVELOPMENT METHOD: Pump type? Bailer			

CALCULATION OF MINIMUM DEVELOPMENT VOLUME

All depths measured below top of PVC casing (TOC)

Time	Casing Diameter (mm)	Depth to Water (m)	Measured Depth of Well (mbTOC)	Depth of Well from TOC from Well Report Sheet (m)	Metres of Standing Water (m) D = B-A or C-A whichever is greater	One Well Casing Volume (L) E = D * 2	Min. Total Volume to be Purged (L) F = E x 3
		A	B	C			
8:40 AM	50	0.865	4.790	5.00	4.135	8.27	24.81

DEVELOPMENT RECORDS

Field Measurements

Time	Cumulative Volume Purged (L)	Cumulative No. of Surge Cycles	Temp (°C)	Conductivity (µS/cm)	pH	Redox (mV)	Appearance & Odour (colour/clarity/odour/sheen)	Notes
8:45 AM	5	-	-	-	-	-	Turbid 50%, brown	
8:50 AM	10	-	-	-	-	-	Opaque, brown	
8:52 AM	13.5	-	-	-	-	-	Opaque, brown	Bailed until well dry
Well slow to recharge so approximatley 10 l of clean water was poured down well until TOC reached.								

Final Measured Depth of Well from TOC(m) N/A

MONITORING WELL DEVELOPMENT RECORD

PROJECT NO.: PS223670

MONITORING WELL ID: BH03

WSP STAFF: DH

PROJECT: Opal Bayview

DATE: 10/07/2025

CONTRACTOR: N/A

WEATHER (Temp/Cloud cover/Precipitation): Sunny, windy

DEVELOPMENT METOD: Pump type? Bailer

CALCULATION OF MINIMUM DEVELOPMENT VOLUME

All depths measured below top of PVC casing (TOC)

Time	Casing Diameter (mm)	Depth to Water (m)	Measured Depth of Well (mbTOC)	Depth of Well from TOC from Well Report Sheet (m)	Metres of Standing Water (m) D = B-A or C-A whichever is greater	One Well Casing Volume (L) E = D * 2	Min. Total Volume to be Purged (L) F = E x 3
		A	B	C			
9:45 AM	50	4.680	5.100	5.00	0.420	0.84	2.52

DEVELOPMENT RECORDS

Field Measurements

[illegible]

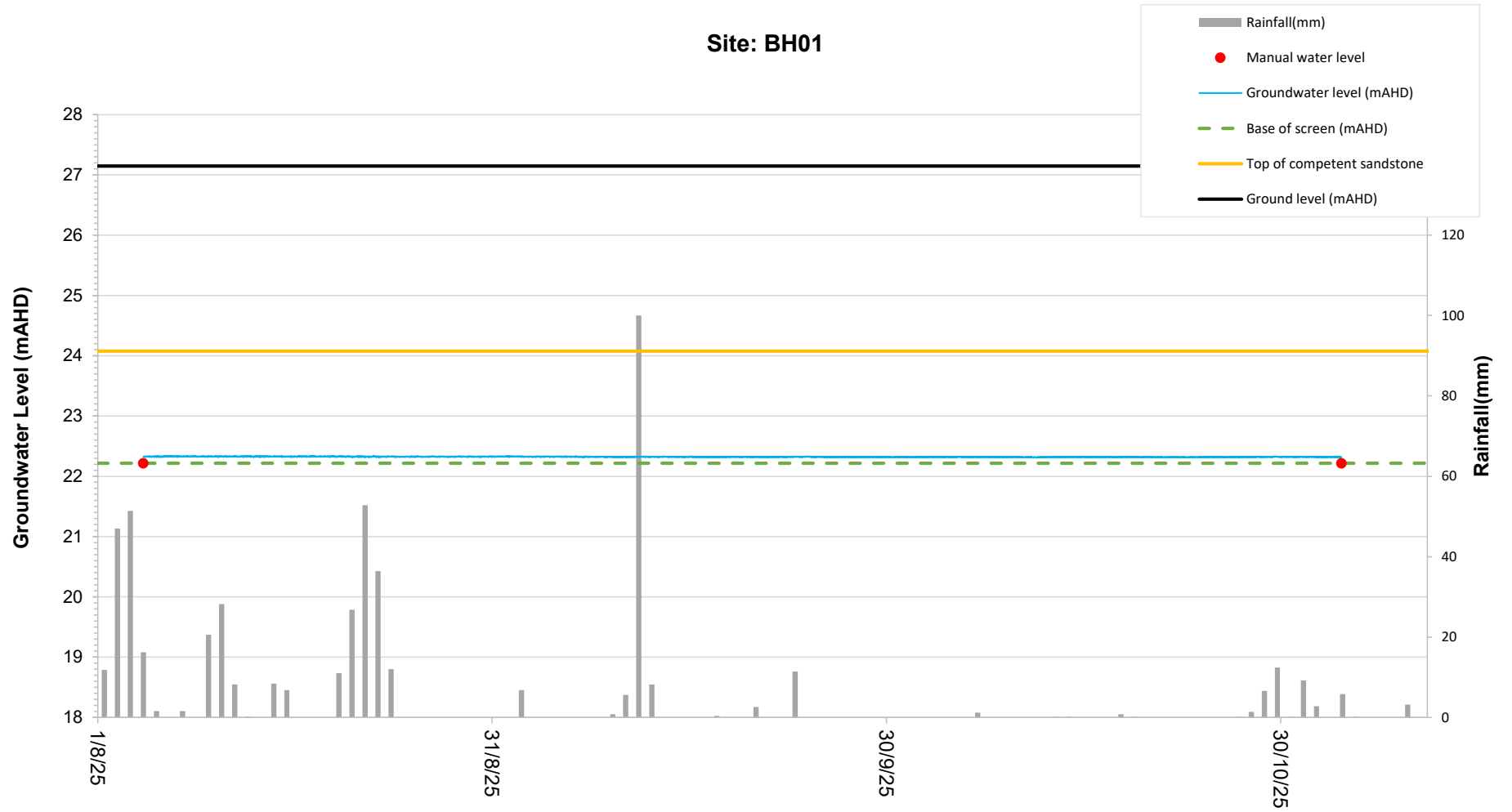
Final Measured Depth of Well from TOC(m)	DRY
--	-----

Appendix C

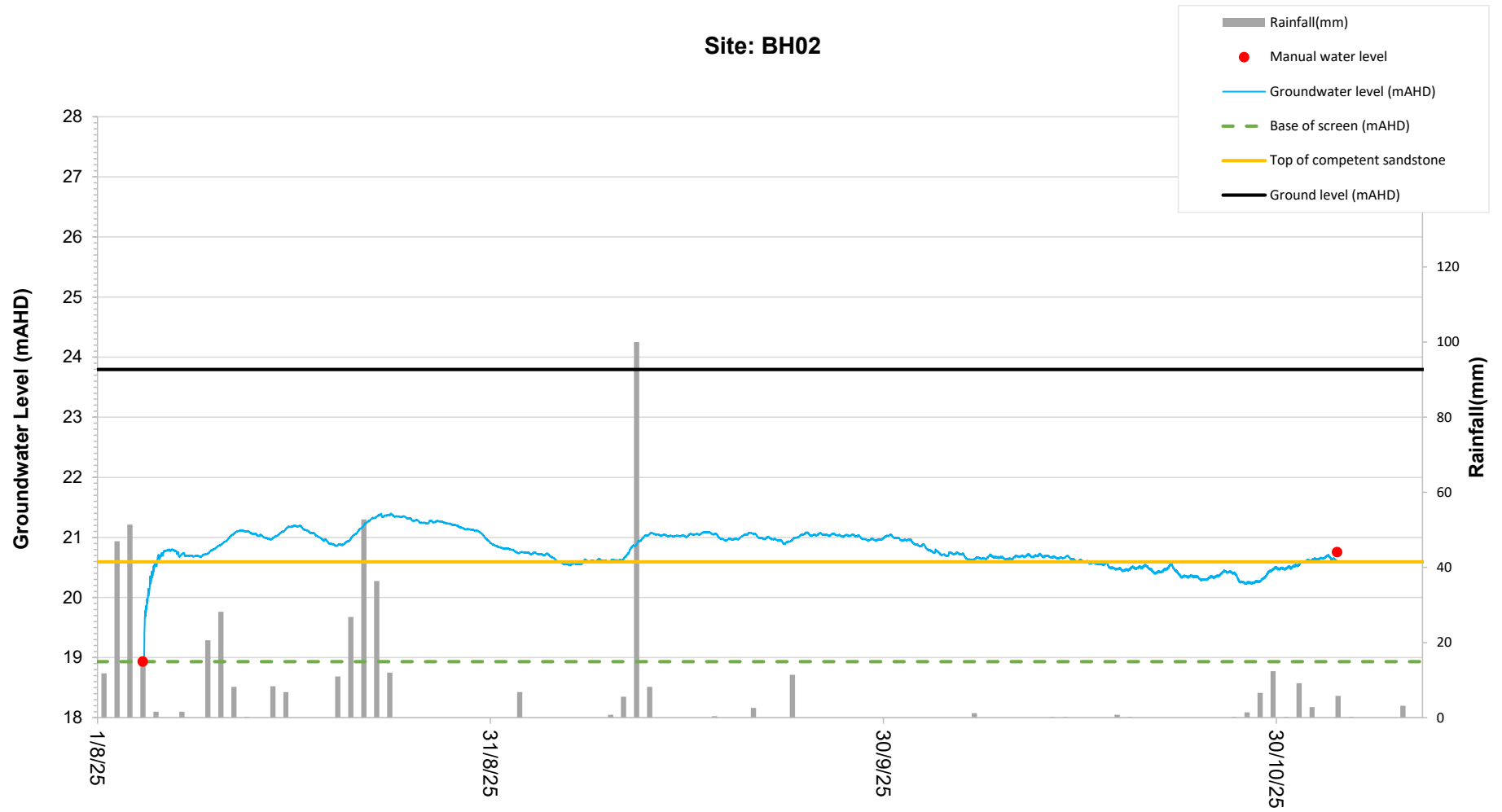
Groundwater level hydrographs



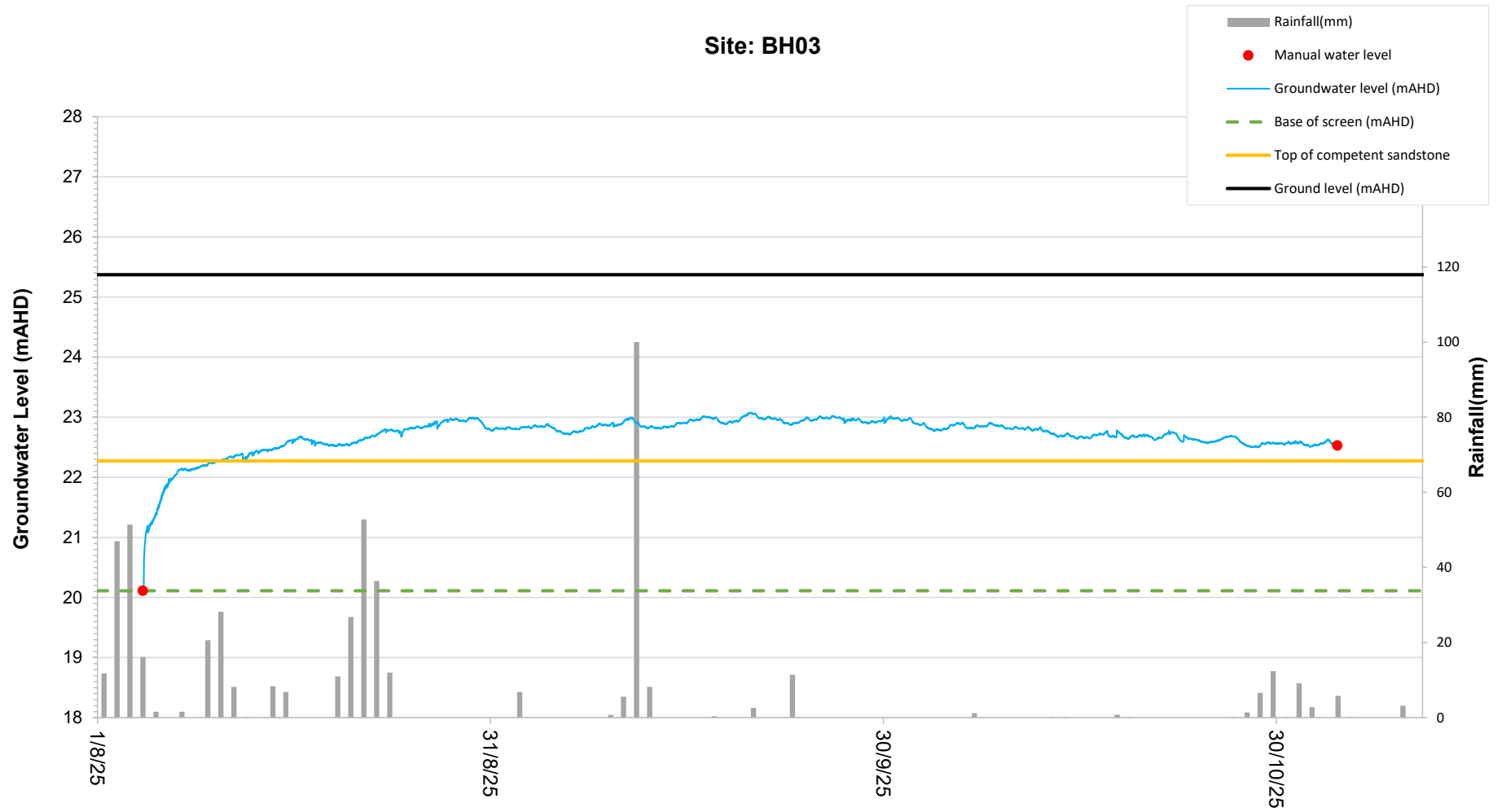
Site: BH01



Site: BH02



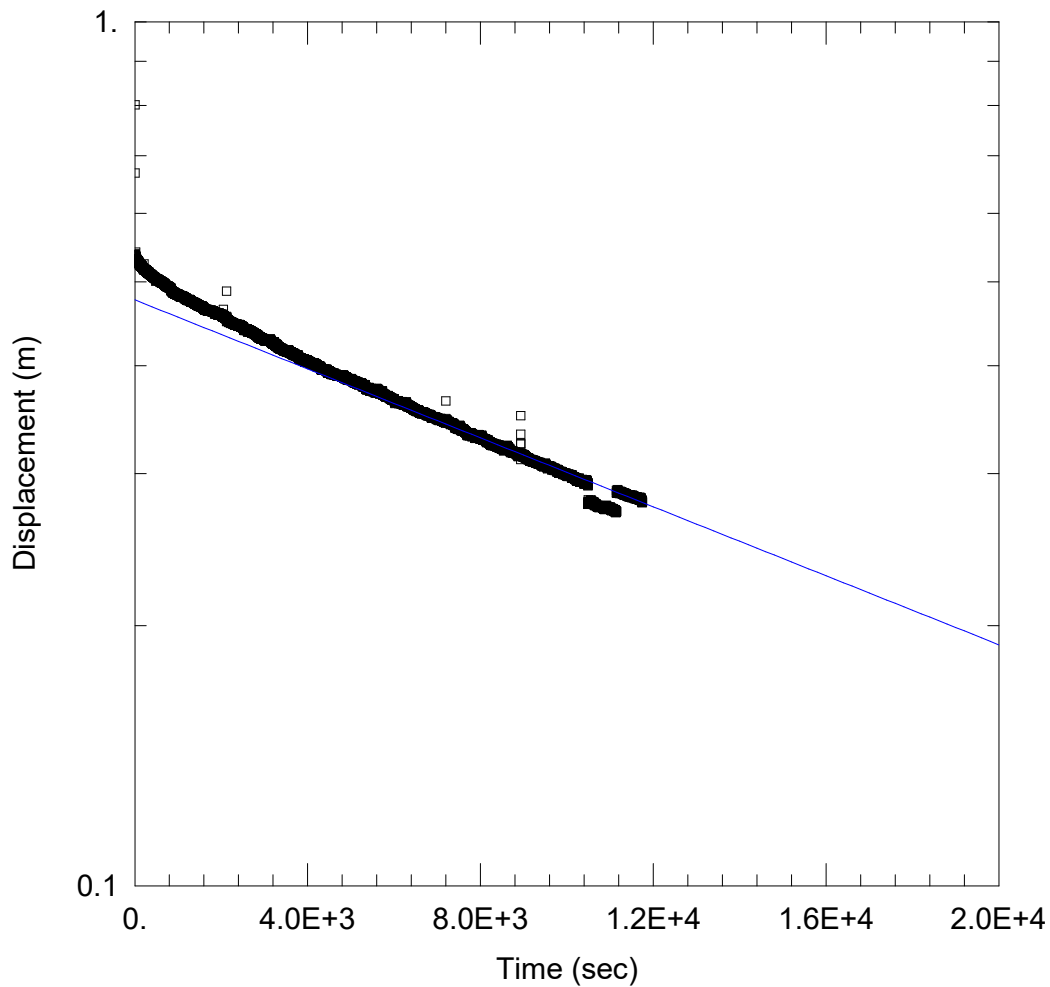
Site: BH03



Appendix D

Slug test analysis





WELL TEST ANALYSIS

Data Set: \...\BH02_FHT_HS.aqt

Date: 11/14/25

Time: 15:12:25

PROJECT INFORMATION

Company: WSP

Client: Opal Healthcare

Project: PS223670

Location: Opal Bayview

Test Well: BH02

Test Date: 4/11/2025

AQUIFER DATA

Saturated Thickness: 2.11 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH02)

Initial Displacement: 0.538 m

Total Well Penetration Depth: 2.11 m

Casing Radius: 0.025 m

Static Water Column Height: 2.11 m

Screen Length: 2.11 m

Well Radius: 0.048 m

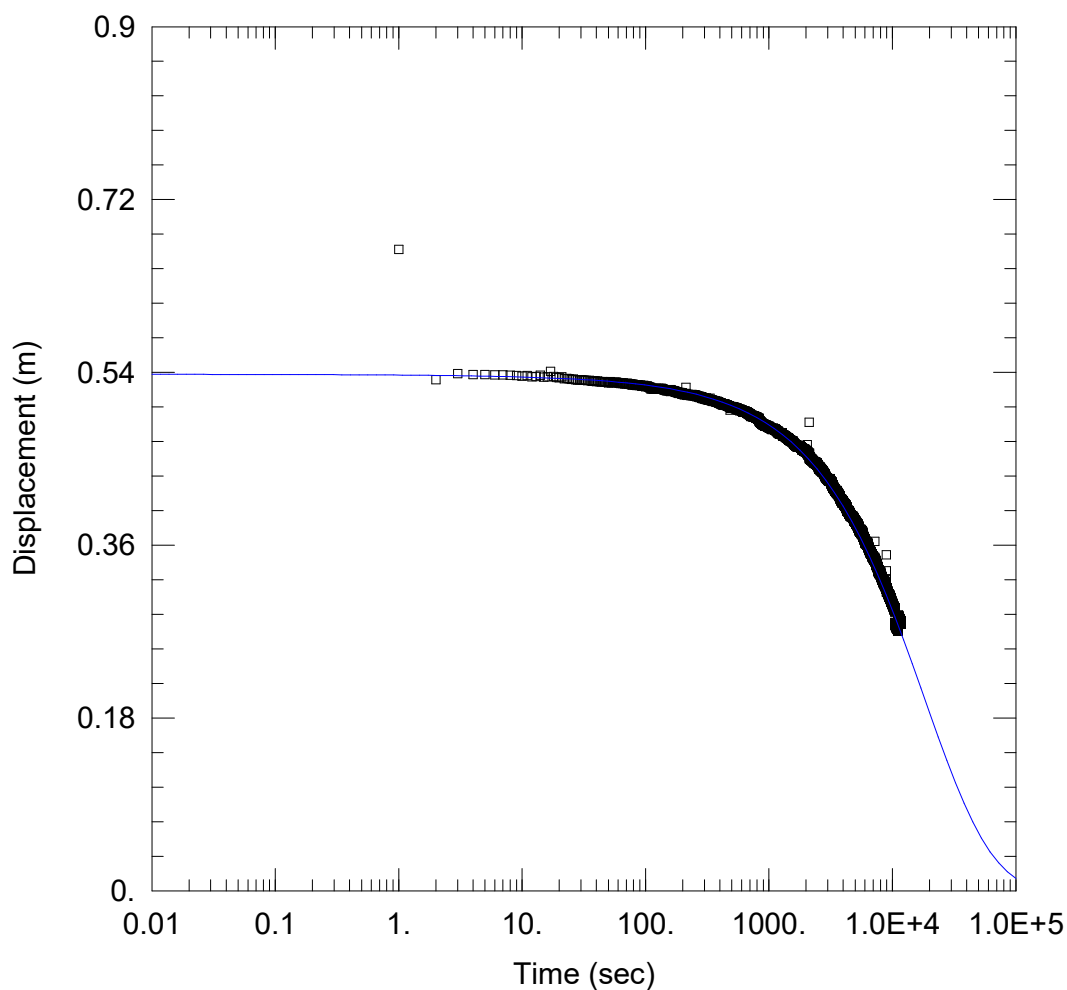
SOLUTION

Aquifer Model: Unconfined

$K = 3.605E-8$ m/sec

Solution Method: Hvorslev

$y_0 = 0.4765$ m



WELL TEST ANALYSIS

Data Set: \...\BH02_FHT_KGS.aqt

Date: 11/14/25

Time: 15:12:47

PROJECT INFORMATION

Company: WSP

Client: Opal Healthcare

Project: PS223670

Location: Opal Bayview

Test Well: BH02

Test Date: 4/11/2025

AQUIFER DATA

Saturated Thickness: 2.11 m

WELL DATA (BH02)

Initial Displacement: 0.538 m

Total Well Penetration Depth: 2.11 m

Casing Radius: 0.025 m

Static Water Column Height: 2.11 m

Screen Length: 2.11 m

Well Radius: 0.048 m

SOLUTION

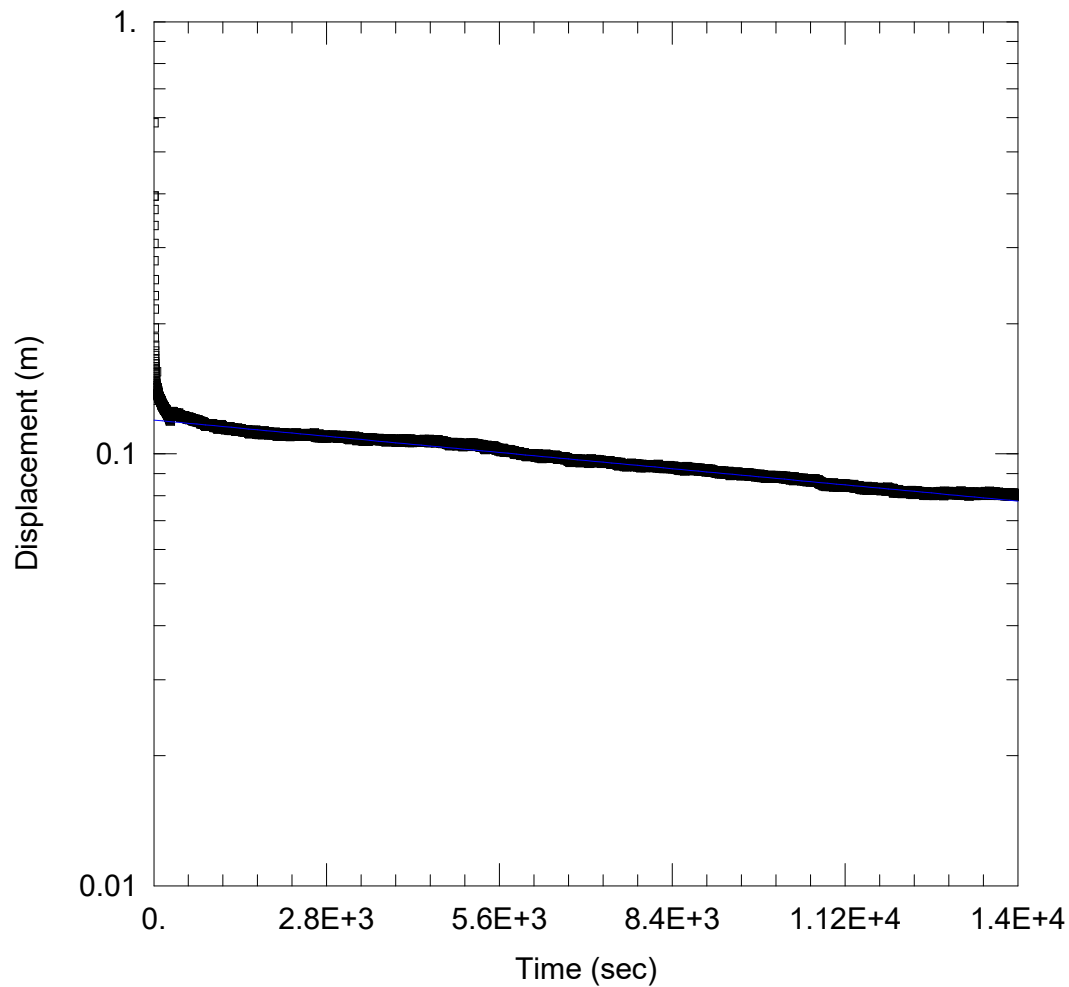
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 2.197E-8 m/sec

Ss = 0.0007173 m⁻¹

Kz/Kr = 1.



WELL TEST ANALYSIS

Data Set: \...\BH02_RHT_HS.aqt
Date: 11/14/25

Time: 15:13:18

PROJECT INFORMATION

Company: WSP
Client: Opal Healthcare
Project: PS223670
Location: Opal Bayview
Test Well: BH02
Test Date: 4/11/2025

AQUIFER DATA

Saturated Thickness: 2.11 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH02)

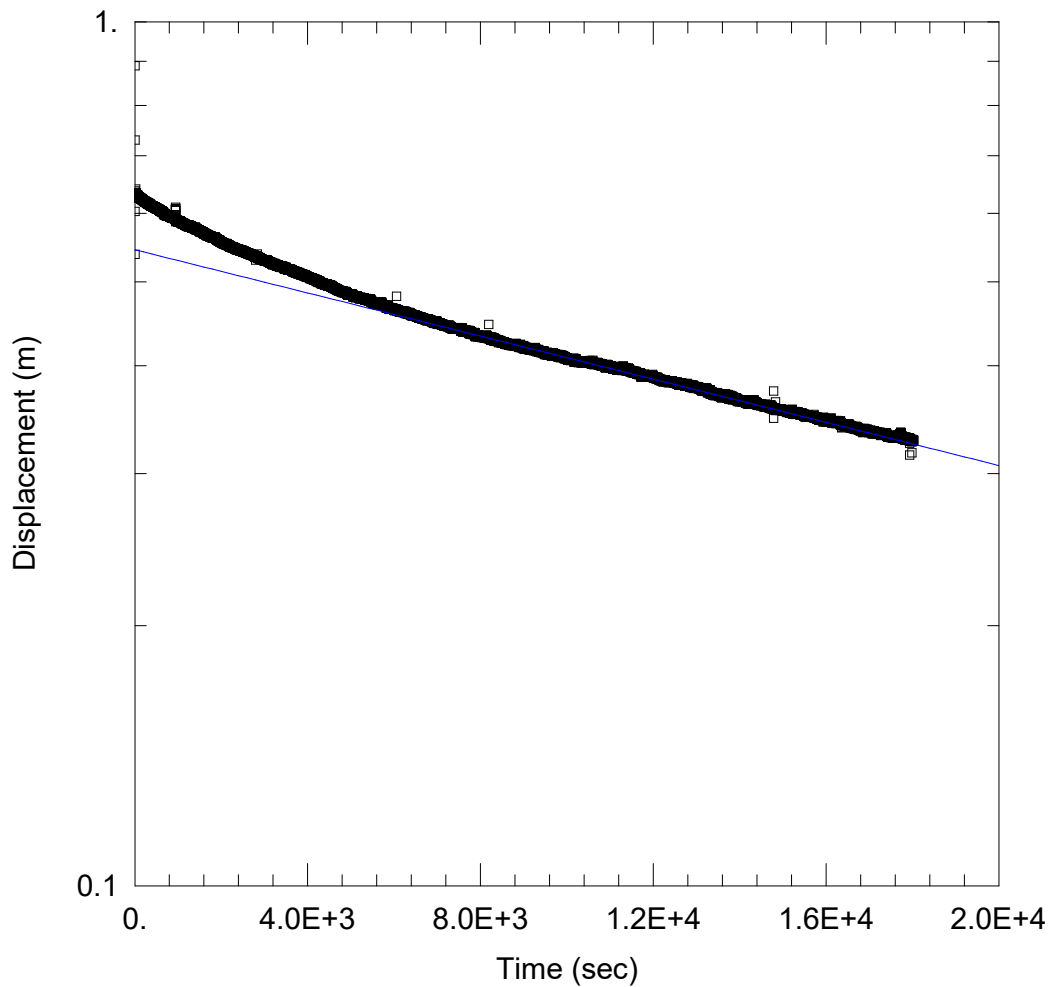
Initial Displacement: 0.3949 m
Total Well Penetration Depth: 2.11 m
Casing Radius: 0.025 m

Static Water Column Height: 2.11 m
Screen Length: 2.11 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
 $K = 2.42E-8$ m/sec

Solution Method: Hvorslev
 $y_0 = 0.1197$ m



WELL TEST ANALYSIS

Data Set: \...\BH03_FHT_HS.aqt

Date: 11/14/25

Time: 15:11:43

PROJECT INFORMATION

Company: WSP

Client: Opal Healthcare

Project: PS223670

Location: Opal Bayview

Test Well: BH02

Test Date: 4/11/2025

AQUIFER DATA

Saturated Thickness: 2.11 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH02)

Initial Displacement: 0.538 m

Total Well Penetration Depth: 2.11 m

Casing Radius: 0.025 m

Static Water Column Height: 2.11 m

Screen Length: 2.11 m

Well Radius: 0.048 m

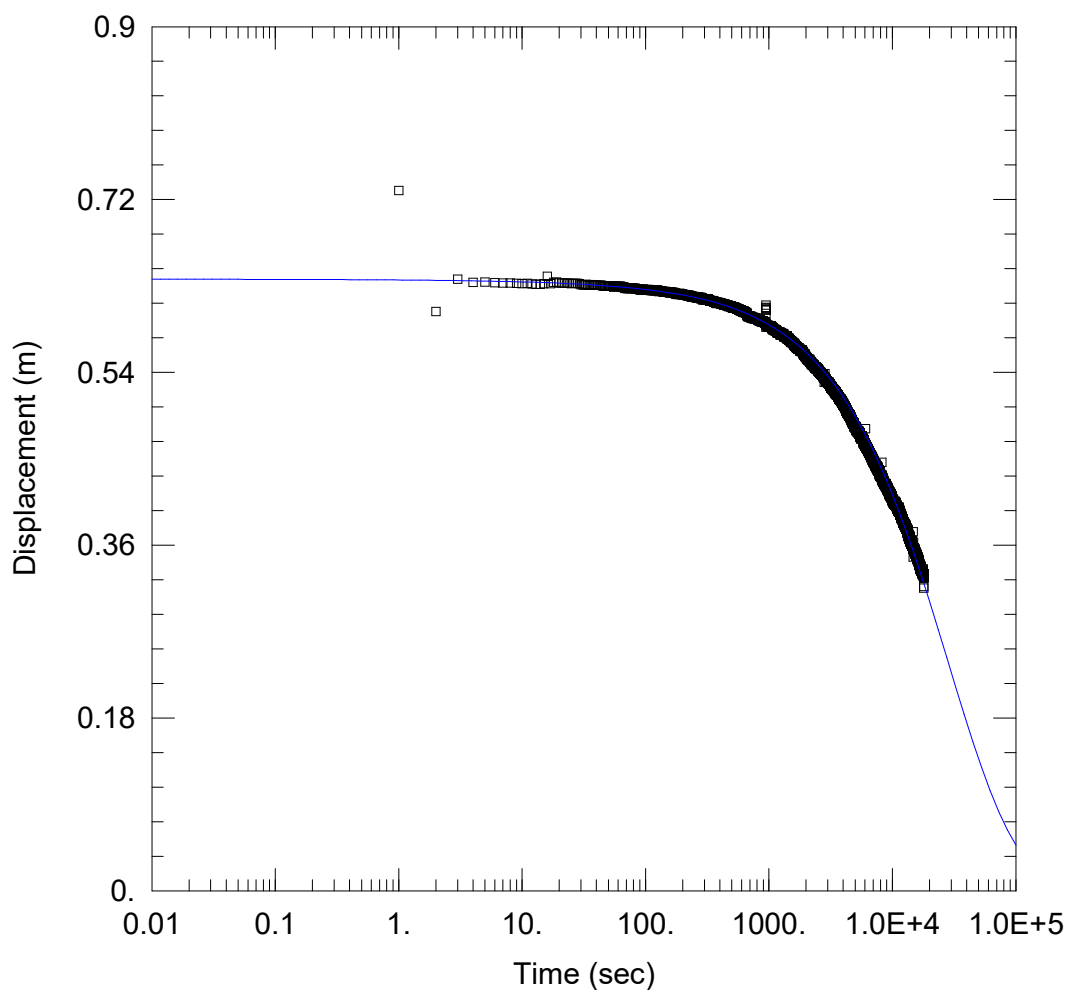
SOLUTION

Aquifer Model: Unconfined

$K = 2.255E-8$ m/sec

Solution Method: Hvorslev

$y_0 = 0.5446$ m



WELL TEST ANALYSIS

Data Set: \...\BH03_FHT_KGS.aqt

Date: 11/14/25

Time: 15:11:17

PROJECT INFORMATION

Company: WSP

Client: Opal Healthcare

Project: PS223670

Location: Opal Bayview

Test Well: BH02

Test Date: 4/11/2025

AQUIFER DATA

Saturated Thickness: 2.11 m

WELL DATA (BH02)

Initial Displacement: 0.6371 m

Total Well Penetration Depth: 2.11 m

Casing Radius: 0.025 m

Static Water Column Height: 2.11 m

Screen Length: 2.11 m

Well Radius: 0.048 m

SOLUTION

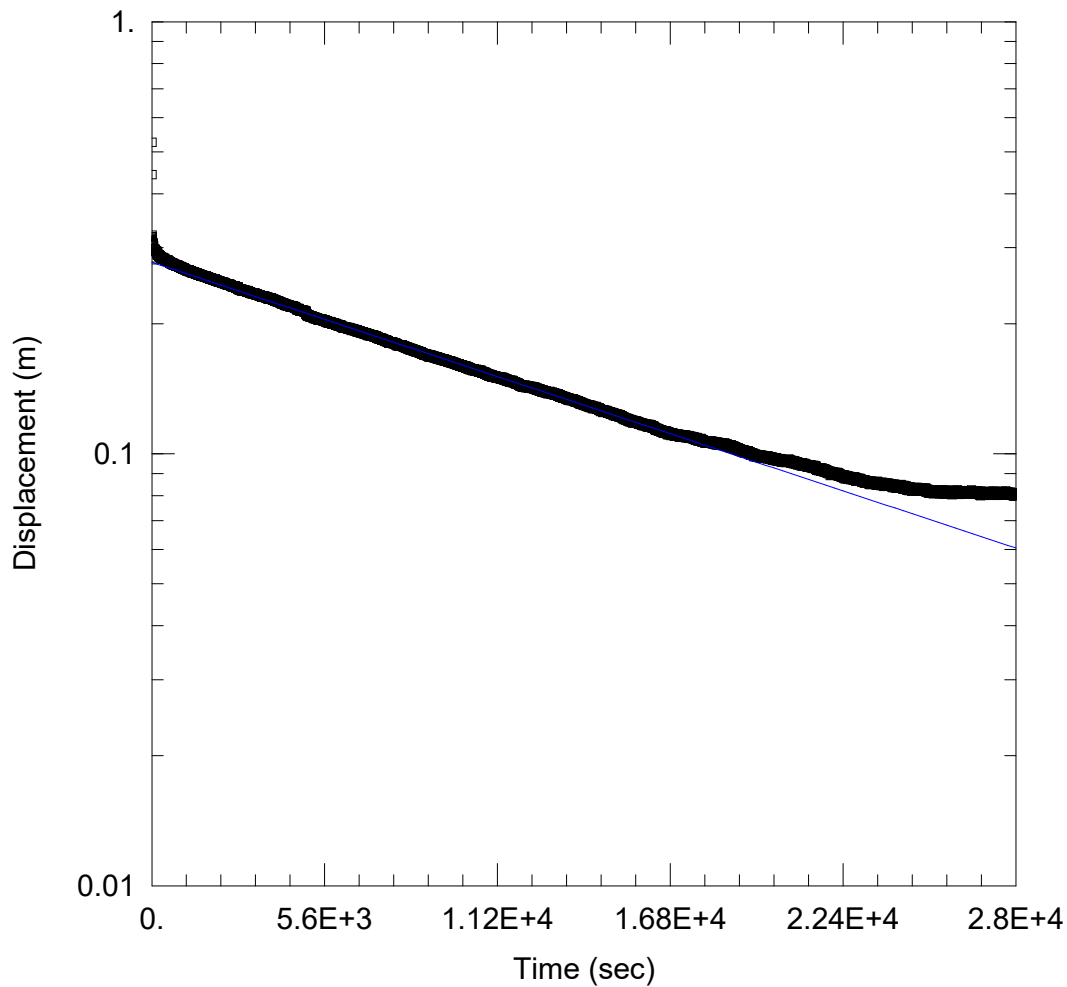
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.371E-8 m/sec

Ss = 0.0008825 m⁻¹

Kz/Kr = 1.



WELL TEST ANALYSIS

Data Set: \...\BH03_RHT_HS.aqt
Date: 11/14/25

Time: 15:10:07

PROJECT INFORMATION

Company: WSP
Client: Opal Healthcare
Project: PS223670
Location: Opal Bayview
Test Well: BH02
Test Date: 4/11/2025

AQUIFER DATA

Saturated Thickness: 2.11 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH02)

Initial Displacement: 0.318 m
Total Well Penetration Depth: 2.11 m
Casing Radius: 0.025 m

Static Water Column Height: 2.11 m
Screen Length: 2.11 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
 $K = 4.269\text{E-}8$ m/sec

Solution Method: Hvorslev
 $y_0 = 0.2776$ m

Appendix E

Groundwater sampling laboratory certificates





RECEIVED BY: <u> </u>		DATE/TIME: <u> </u>	
present upon ☒ Yes ☐ No	present upon ☒ Yes ☐ No	No N/A	No N/A

are on Receipt: -1.1, 0.8°C 1.6°C
20 Bx

Environmental Division

total (unfiltered bottle required) or Dissolved (field filtered bottle required).

[illegible]

total

[illegible]

mg, or d	- NH	Mr	IC / EG

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NT-
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D, C
-03
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c, A
H (V)
TEX

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D4,
NT-C
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NEP
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dg (Y
issa
LI, N
N/P/
(9)/E
0800

(3) Cationic activity of Zn, Ba, Fe, and Al (EX-5-5) (E)

W07	Major or Florida Ordnance Corps	Me + Re	V, B,	Additional Sp.	H/B	H(C)	EX
-----	---------------------------------	---------	-------	----------------	-----	------	----

(N)	M	H	T	A	A	T	B	
	C			S				
		P		19				

					X
					X
					X
					X
					X

[illegible]

	X
	X
	X
	X
	X
	X

[illegible]

X

[illegible][illegible][illegible]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

[illegible][illegible]

[illegible][illegible]

ide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic

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CERTIFICATE OF ANALYSIS

Work Order : **ES2523743**
Client : **WSP Australia Pty Ltd**
Contact : Callum Fisher
Address : LEVEL 27 680 GEORGE STREET
SYDNEY 2000
Telephone : ----
Project : PS223670
Order number : PS223670
C-O-C number : ----
Sampler : DAVID HUGHES
Site : ----
Quote number : WSP MSA 2025
No. of samples received : 4
No. of samples analysed : 4

Page : 1 of 9
Laboratory : Environmental Division Sydney
Contact : Andrew Wotherspoon
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 04-Aug-2025 16:00
Date Analysis Commenced : 04-Aug-2025
Issue Date : 11-Aug-2025 15:50



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Lauren Waters	Microbiology Laboratory Technician	Sydney Microbiology, Smithfield, NSW
Sarah Griffiths	Microbiologist	Sydney Microbiology, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- MF = membrane filtration
- CFU = colony forming unit
- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenzo(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- MW006 is ALS's internal code and is equivalent to AS4276.5.
- Microbiological Comment: Membrane filtration result for ES2523743-02 MW006 E.coli is reported as estimate (~) due to the presence of many non-target organism colonies that may have inhibited the growth of the target organisms on the filter membrane. It may be informative to record this fact.
- EK061G: LOR raised for TKN due to sample matrix.
- TDS by method EA-015 may bias high due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- MW013 is ALS's internal code and is equivalent to AS4276.9.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BH02	BH03	Trip spike	Trip blank	----
Sampling date / time					04-Aug-2025 13:45	04-Aug-2025 12:50	28-Jul-2025 00:00	28-Jul-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2523743-001	ES2523743-002	ES2523743-003	ES2523743-004	-----	
				Result	Result	Result	Result	----	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	6.35	6.40	----	----	----	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	396	700	----	----	----	
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L	368	522	----	----	----	
EA075: Redox Potential									
Redox Potential	----	0.1	mV	138	143	----	----	----	
pH Redox	----	0.01	pH Unit	6.16	6.25	----	----	----	
ED009: Anions									
Bromide	24959-67-9	0.010	mg/L	0.185	1.02	----	----	----	
Iodide	20461-54-5	0.010	mg/L	0.144	<0.010	----	----	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	51	64	----	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	51	64	----	----	----	
ED040F: Dissolved Major Anions									
Silicon as SiO2	14464-46-1	0.1	mg/L	45.9	47.4	----	----	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	92	204	----	----	----	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	24	38	----	----	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	10	9	----	----	----	
Magnesium	7439-95-4	1	mg/L	2	2	----	----	----	
Sodium	7440-23-5	1	mg/L	67	128	----	----	----	
Potassium	7440-09-7	1	mg/L	2	5	----	----	----	
ED093F: SAR and Hardness Calculations									



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				BH02	BH03	Trip spike	Trip blank	----
Sampling date / time				04-Aug-2025 13:45	04-Aug-2025 12:50	28-Jul-2025 00:00	28-Jul-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2523743-001	ES2523743-002	ES2523743-003	ES2523743-004	-----
				Result	Result	Result	Result	----

ED093F: SAR and Hardness Calculations - Continued

Total Hardness as CaCO3	----	1	mg/L	33	31	----	----	----
-------------------------	------	---	------	----	----	------	------	------

EG020F: Dissolved Metals by ICP-MS

Aluminium	7429-90-5	0.01	mg/L	0.04	0.08	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.002	----	----	----
Boron	7440-42-8	0.05	mg/L	0.14	0.35	----	----	----
Barium	7440-39-3	0.001	mg/L	0.018	0.018	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	0.002	0.003	----	----	----
Chromium	7440-47-3	0.001	mg/L	0.001	0.004	----	----	----
Copper	7440-50-8	0.001	mg/L	0.006	0.007	----	----	----
Manganese	7439-96-5	0.001	mg/L	0.048	0.050	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.002	0.003	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	0.013	0.023	----	----	----
Lithium	7439-93-2	0.001	mg/L	0.003	0.004	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	0.034	0.054	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	0.17	----	----	----

EG035F: Dissolved Mercury by FIMS

Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
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EK040P: Fluoride by PC Titrator



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BH02	BH03	Trip spike	Trip blank	----
Sampling date / time					04-Aug-2025 13:45	04-Aug-2025 12:50	28-Jul-2025 00:00	28-Jul-2025 00:00	----
Compound	CAS Number	LOR	Unit		ES2523743-001	ES2523743-002	ES2523743-003	ES2523743-004	-----
					Result	Result	Result	Result	----
EK040P: Fluoride by PC Titrator - Continued									
Fluoride	16984-48-8	0.1	mg/L		<0.1	<0.1	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		0.04	0.09	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		0.11	0.03	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		0.11	0.03	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.5	<3.0	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		<0.5	<3.0	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.29	3.39	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	----	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		3.61	6.60	----	----	----
ø Total Cations	----	0.01	meq/L		3.63	6.31	----	----	----
ø Ionic Balance	----	0.01	%		0.24	2.24	----	----	----
EP025: Oxygen - Dissolved (DO)									
Dissolved Oxygen	----	0.1	mg/L		9.3	9.2	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	----	----	----
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	----	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				BH02	BH03	Trip spike	Trip blank	----
Sampling date / time				04-Aug-2025 13:45	04-Aug-2025 12:50	28-Jul-2025 00:00	28-Jul-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2523743-001	ES2523743-002	ES2523743-003	ES2523743-004	-----
				Result	Result	Result	Result	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	----	----	----
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	-----	0.5	µg/L	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (zero)	-----	0.5	µg/L	<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	-----	20	µg/L	<20	<20	----	<20	----
C10 - C14 Fraction	-----	50	µg/L	<50	<50	----	----	----
C15 - C28 Fraction	-----	100	µg/L	<100	<100	----	----	----
C29 - C36 Fraction	-----	50	µg/L	<50	<50	----	----	----
^ C10 - C36 Fraction (sum)	-----	50	µg/L	<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	----	<20	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	----	<20	----
>C10 - C16 Fraction	-----	100	µg/L	<100	<100	----	----	----
>C16 - C34 Fraction	-----	100	µg/L	<100	<100	----	----	----
>C34 - C40 Fraction	-----	100	µg/L	<100	<100	----	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				BH02	BH03	Trip spike	Trip blank	----
Sampling date / time				04-Aug-2025 13:45	04-Aug-2025 12:50	28-Jul-2025 00:00	28-Jul-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2523743-001	ES2523743-002	ES2523743-003	ES2523743-004	-----
				Result	Result	Result	Result	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	17	<1	----
Toluene	108-88-3	2	µg/L	<2	<2	17	<2	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	17	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	17	<2	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	23	<2	----
^ Total Xylenes	----	2	µg/L	<2	<2	40	<2	----
^ Sum of BTEX	----	1	µg/L	<1	<1	91	<1	----
Naphthalene	91-20-3	5	µg/L	<5	<5	21	<5	----
MW006: Thermotolerant Coliforms & E.coli by MF								
Thermotolerant Coliforms	----	1	CFU/100mL	12000	8500	----	----	----
Escherichia coli	----	1	CFU/100mL	~2	~160	----	----	----
MW013: Faecal Streptococci by MF								
Faecal Streptococci	----	1	CFU/100mL	100	66	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	23.2	24.6	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	47.3	64.7	----	----	----
2,4,6-Tribromophenol	118-79-6	1.0	%	45.2	64.3	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	68.7	84.1	----	----	----
Anthracene-d10	1719-06-8	1.0	%	68.4	87.4	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	70.2	84.8	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	2	%	118	111	108	97.0	----
Toluene-D8	2037-26-5	2	%	123	117	112	103	----



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BH02	BH03	Trip spike	Trip blank	----
Sampling date / time					04-Aug-2025 13:45	04-Aug-2025 12:50	28-Jul-2025 00:00	28-Jul-2025 00:00	----
Compound	CAS Number	LOR	Unit		ES2523743-001	ES2523743-002	ES2523743-003	ES2523743-004	-----
					Result	Result	Result	Result	----
EP080S: TPH(V)/BTEX Surrogates - Continued									
4-Bromofluorobenzene	460-00-4	2	%		133	129	118	110	----



Surrogate Control Limits

Sub-Matrix: **WATER**

		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2,4,6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	72	143
Toluene-D8	2037-26-5	75	131
4-Bromofluorobenzene	460-00-4	73	137



QUALITY CONTROL REPORT

Work Order	: ES2523743	Page	: 1 of 11
Client	: WSP Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: Callum Fisher	Contact	: Andrew Wotherspoon
Address	: LEVEL 27 680 GEORGE STREET SYDNEY 2000	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: PS223670	Date Samples Received	: 04-Aug-2025
Order number	: PS223670	Date Analysis Commenced	: 04-Aug-2025
C-O-C number	: ----	Issue Date	: 11-Aug-2025
Sampler	: DAVID HUGHES		
Site	: ----		
Quote number	: WSP MSA 2025		
No. of samples received	: 4		
No. of samples analysed	: 4		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Lauren Waters	Microbiology Laboratory Technician	Sydney Microbiology, Smithfield, NSW
Sarah Griffiths	Microbiologist	Sydney Microbiology, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot

CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

RPD = Relative Percentage Difference

= Indicates failed QC

* = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED009: Anions (QC Lot: 6766382)									
ES2523743-001	BH02	ED009-X: Bromide	24959-67-9	0.01	mg/L	0.185	0.187	1.1	0% - 50%
		ED009-X: Iodide	20461-54-5	0.01	mg/L	0.144	0.117	20.7	0% - 50%
EA005P: pH by PC Titrator (QC Lot: 6764629)									
ES2523714-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.98	7.99	0.1	0% - 20%
ES2523737-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.80	7.71	1.2	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 6764631)									
ES2523737-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	632	632	0.0	0% - 20%
ES2523743-001	BH02	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	396	402	1.6	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 6772203)									
ES2523087-006	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	738	728	1.4	0% - 20%
EA075: Redox Potential (QC Lot: 6764540)									
ES2523743-001	BH02	EA075: Redox Potential	----	0.1	mV	138	141	2.6	0% - 20%
		EA075: pH Redox	----	0.01	pH Unit	6.16	6.16	0.0	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6764630)									
ES2523714-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	812	812	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	812	812	0.0	0% - 20%
ES2523743-001	BH02	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 6764630) - continued									
ES2523743-001	BH02	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	51	52	2.5	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	51	52	2.5	0% - 20%
ED040F: Dissolved Major Anions (QC Lot: 6767871)									
EN2512999-001	Anonymous	ED040F: Silicon as SiO2	14464-46-1	0.1	mg/L	1.5	1.4	0.0	0% - 50%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6767868)									
EN2512975-003	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	60	57	4.6	0% - 20%
ES2523768-003	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	45	44	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 6767867)									
EN2512975-003	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	16	16	0.0	0% - 50%
ES2523768-003	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	54	53	2.2	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 6767401)									
ES2523525-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	8	8	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	1	1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	3	3	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
ES2523525-011	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	2	2	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	1	1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	2	2	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 6767399)									
ES2523525-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.014	0.015	0.0	0% - 50%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.001	0.002	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.12	0.13	0.0	0% - 50%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 6767399) - continued									
ES2523525-001	Anonymous	EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.06	0.07	0.0	No Limit
ES2523525-011	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.002	0.003	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.10	0.10	0.0	0% - 50%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.06	0.06	0.0	No Limit
		EG020F: Dissolved Metals by ICP-MS (QC Lot: 6767400)							
ES2523525-001	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.020	0.020	0.0	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
ES2523525-011	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.011	0.011	0.0	0% - 50%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 6767402)									
ES2523525-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
ES2523525-010	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 6764633)									
ES2523743-001	BH02	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 6767901)									
ES2523356-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	12.3	11.8	3.5	0% - 20%
ES2523525-009	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.01	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 6767866)									



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 6767866) - continued									
ES2523750-004	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EN2512975-003	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.02	0.02	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 6767900)									
ES2523356-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.01	0.01	0.0	No Limit
ES2523525-009	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.01	<0.01	0.0	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 6767893)									
ES2523356-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1 (0.5)*	mg/L	24.8	23.2	6.6	0% - 20%
ES2523525-010	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.2	0.3	0.0	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 6767894)									
ES2523356-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01 (0.05)*	mg/L	6.69	6.39	4.6	0% - 20%
ES2523525-010	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.04	0.04	0.0	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 6767869)									
ES2523750-004	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EN2512975-003	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.09	0.09	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 6765986)									
CA2504551-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
CA2504551-006	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	70	70	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 6765986)									
CA2504551-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
CA2504551-006	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	70	70	0.0	No Limit
EP080: BTEXN (QC Lot: 6765986)									
CA2504551-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
CA2504551-006	Anonymous	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
		EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	24	24	0.0	0% - 50%
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
ED009: Anions (QCLot: 6766382)								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	103	93.0	109
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	0.5 mg/L	79.8	79.0	123
EA005P: pH by PC Titrator (QCLot: 6764629)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	99.8	98.8	101
				----	7 pH Unit	100	99.2	101
EA010P: Conductivity by PC Titrator (QCLot: 6764631)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	220 µS/cm	102	89.9	110
				<1	2100 µS/cm	96.4	90.2	111
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 6772203)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2000 mg/L	97.1	87.0	109
				<10	293 mg/L	116	75.2	126
				<10	2420 mg/L	101	83.0	124
EA075: Redox Potential (QCLot: 6764540)								
EA075: Redox Potential	----	----	mV	----	234 mV	99.4	96.0	106
				----	300 mV	102	97.0	105
				----	86 mV	107	89.0	111
ED037P: Alkalinity by PC Titrator (QCLot: 6764630)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	100	81.0	115
				----	50 mg/L	105	80.0	128
ED040F: Dissolved Major Anions (QCLot: 6767871)								
ED040F: Silicon as SiO2	14464-46-1	0.1	mg/L	<0.1	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6767868)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	100	82.0	122
				<1	500 mg/L	98.0	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 6767867)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	50 mg/L	107	80.9	127
				<1	1000 mg/L	105	80.9	127
ED093F: Dissolved Major Cations (QCLot: 6767401)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	103	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	103	82.0	120

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result		LCS	Low	High
ED093F: Dissolved Major Cations (QCLot: 6767401) - continued								
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	99.8	85.0	113
EG020F: Dissolved Metals by ICP-MS (QCLot: 6767399)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	106	80.0	116
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.02 mg/L	105	70.0	130
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	94.2	85.0	114
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	90.6	85.0	115
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	94.1	82.0	110
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.0	84.0	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	98.7	85.0	111
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	92.5	82.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	93.6	81.0	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	91.5	83.0	111
EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	0.1 mg/L	93.2	79.0	117
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	99.3	82.0	110
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	98.6	79.0	113
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	94.4	82.0	112
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.1	85.0	115
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	97.6	83.0	109
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	98.0	81.0	117
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	102	85.0	115
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	95.9	82.0	112
EG020F: Dissolved Metals by ICP-MS (QCLot: 6767400)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.02 mg/L	79.8	70.0	130
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	92.1	81.0	113
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	94.9	85.0	115
EG035F: Dissolved Mercury by FIMS (QCLot: 6767402)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	98.0	83.0	105
EK040P: Fluoride by PC Titrator (QCLot: 6764633)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	93.4	82.0	116
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6767901)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	100	90.0	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6767866)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	103	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 6767900)								

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
Method: Compound	CAS Number	LOR	Unit		Result	Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 6767900) - continued								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.3	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6767893)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	5 mg/L	87.3	69.0	123
				<0.1	2.5 mg/L	87.6	70.0	123
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6767894)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	2.21 mg/L	93.8	71.3	126
				<0.01	0.5 mg/L	75.0	71.3	126
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6767869)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	107	85.0	117
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 6764868)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	74.3	50.0	94.0
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	78.7	63.6	114
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	81.5	62.2	113
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	80.7	63.9	115
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	114	62.6	116
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	93.2	64.3	116
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	95.4	63.6	118
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	97.1	63.1	118
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	84.8	64.1	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	91.8	62.5	116
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2	1	µg/L	<1.0	5 µg/L	64.7	61.7	119
	205-82-3							
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	73.8	63.0	115
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	92.7	63.3	117
EP075(SIM): Indeno(1,2,3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	79.9	59.9	118
EP075(SIM): Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	81.0	61.2	117
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	78.0	59.1	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6764869)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	76.8	53.7	97.0
EP071: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	95.4	63.3	107
EP071: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	101	58.3	120
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6765986)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	95.6	75.0	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6764869)								



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6764869) - continued								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	75.6	53.9	95.5
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	102	57.8	110
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	95.9	50.5	115
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6765986)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	92.2	75.0	127
EP080: BTEXN (QCLot: 6765986)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	96.4	68.3	119
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	99.8	73.5	120
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	103	73.8	122
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	104	73.0	122
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	108	76.4	123
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	96.4	75.5	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery(%) MS	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number			Low	High
ED009: Anions (QCLot: 6766382)							
ES2523743-001	BH02	ED009-X: Bromide	24959-67-9	0.2 mg/L	71.5	70.0	130
		ED009-X: Iodide	20461-54-5	0.2 mg/L	124	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6767868)							
EN2512975-003	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	# Not Determined	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6767867)							
EN2512975-003	Anonymous	ED045G: Chloride	16887-00-6	300 mg/L	112	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 6767399)							
ES2523525-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	93.2	70.0	130
		EG020A-F: Beryllium	7440-41-7	1 mg/L	93.8	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	92.3	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	96.6	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	98.4	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	93.3	70.0	130

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 Client : WSP Australia Pty Ltd
 Project : PS223670



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 6767399) - continued							
ES2523525-002	Anonymous	EG020A-F: Copper	7440-50-8	1 mg/L	94.1	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	102	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	101	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	94.4	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	98.5	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	96.0	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 6767402)							
ES2523525-003	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	104	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 6764633)							
ES2523743-002	BH03	EK040P: Fluoride	16984-48-8	5 mg/L	74.8	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6767901)							
ES2523356-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	# Not Determined	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6767866)							
EN2512975-003	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	129	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 6767900)							
ES2523356-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	111	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6767893)							
ES2523525-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	81.0	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6767894)							
ES2523525-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	72.6	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6767869)							
EN2512975-003	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	119	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6765986)							
CA2504551-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	118	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6765986)							
CA2504551-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	110	70.0	130
EP080: BTEXN (QCLot: 6765986)							
CA2504551-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	99.5	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	102	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	107	70.0	130
		EP080: meta- & para-Xylene	108-38-3	25 µg/L	106	70.0	130
			106-42-3				
		EP080: ortho-Xylene	95-47-6	25 µg/L	113	70.0	130
		EP080: Naphthalene	91-20-3	25 µg/L	108	70.0	130





QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2523743	Page	: 1 of 11
Client	: WSP Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: Callum Fisher	Telephone	: +61-2-8784 8555
Project	: PS223670	Date Samples Received	: 04-Aug-2025
Site	: ----	Issue Date	: 11-Aug-2025
Sampler	: DAVID HUGHES	No. of samples received	: 4
Order number	: PS223670	No. of samples analysed	: 4

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, where applicable to the methodology, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO ₄ 2- by DA	EN2512975--003	Anonymous	Sulfate as SO ₄ - Turbidimetric	14808-79-8	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EK055G: Ammonia as N by Discrete Analyser	ES2523356--001	Anonymous	Ammonia as N	7664-41-7	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Natural BH02, BH03		----	----	----	06-Aug-2025	05-Aug-2025	1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Natural BH02, BH03		06-Aug-2025	05-Aug-2025	1	----	----	----
EP025: Oxygen - Dissolved (DO)							
Clear Plastic Bottle - Natural BH02, BH03		----	----	----	05-Aug-2025	04-Aug-2025	1

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type		Count		Rate (%)		Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)						
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	17	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	17	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)						
Major Anions - Dissolved	ED040F	0	4	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)						
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	17	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	17	0.00	5.00	NEPM 2013 B3 & ALS QC Standard



Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P) BH02,	BH03	04-Aug-2025	----	----	----	04-Aug-2025	04-Aug-2025	✓
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P) BH02,	BH03	04-Aug-2025	----	----	----	04-Aug-2025	01-Sep-2025	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Clear Plastic Bottle - Natural (EA015H) BH02,	BH03	04-Aug-2025	----	----	----	07-Aug-2025	11-Aug-2025	✓
EA075: Redox Potential								
Clear Plastic Bottle - Natural (EA075) BH02,	BH03	04-Aug-2025	----	----	----	04-Aug-2025	04-Aug-2025	✓
ED009: Anions								
Clear Plastic Bottle - Natural (ED009-X) BH02,	BH03	04-Aug-2025	----	----	----	05-Aug-2025	01-Sep-2025	✓
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P) BH02,	BH03	04-Aug-2025	----	----	----	04-Aug-2025	18-Aug-2025	✓
ED040F: Dissolved Major Anions								
Clear Plastic Bottle - Natural (ED040F) BH02,	BH03	04-Aug-2025	----	----	----	06-Aug-2025	01-Sep-2025	✓
ED041G: Sulfate (Turbidimetric) as SO ₄ ²⁻ by DA								
Clear Plastic Bottle - Natural (ED041G) BH02,	BH03	04-Aug-2025	----	----	----	06-Aug-2025	01-Sep-2025	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) BH02,	BH03	04-Aug-2025	----	----	----	06-Aug-2025	01-Sep-2025	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) BH02,	BH03	04-Aug-2025	----	----	----	06-Aug-2025	01-Sep-2025	✓
ED093F: SAR and Hardness Calculations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) BH02,	BH03	04-Aug-2025	----	----	----	06-Aug-2025	01-Sep-2025	✓

Page : 4 of 11
 Work Order : ES2523743
 Client : WSP Australia Pty Ltd
 Project : PS223670



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020B-F) BH02, BH03	04-Aug-2025	----	----	----	06-Aug-2025	31-Jan-2026	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) BH02, BH03	04-Aug-2025	----	----	----	07-Aug-2025	01-Sep-2025	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P) BH02, BH03	04-Aug-2025	----	----	----	04-Aug-2025	01-Sep-2025	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK055G) BH02, BH03	04-Aug-2025	----	----	----	06-Aug-2025	05-Aug-2025	✗
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) BH02, BH03	04-Aug-2025	----	----	----	06-Aug-2025	06-Aug-2025	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Natural (EK059G) BH02, BH03	04-Aug-2025	----	----	----	06-Aug-2025	06-Aug-2025	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Natural (EK061G) BH02, BH03	04-Aug-2025	06-Aug-2025	05-Aug-2025	✗	06-Aug-2025	03-Sep-2025	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Natural (EK067G) BH02, BH03	04-Aug-2025	06-Aug-2025	06-Aug-2025	✓	06-Aug-2025	03-Sep-2025	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) BH02, BH03	04-Aug-2025	----	----	----	06-Aug-2025	06-Aug-2025	✓
EP025: Oxygen - Dissolved (DO)							
Clear Plastic Bottle - Natural (EP025) BH02, BH03	04-Aug-2025	----	----	----	05-Aug-2025	04-Aug-2025	✗
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) BH02, BH03	04-Aug-2025	05-Aug-2025	11-Aug-2025	✓	06-Aug-2025	14-Sep-2025	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP080) BH02, BH03	04-Aug-2025	05-Aug-2025	11-Aug-2025	✓	05-Aug-2025	11-Aug-2025	✓
Amber Glass Bottle - Unpreserved (EP071) BH02, BH03	04-Aug-2025	05-Aug-2025	11-Aug-2025	✓	06-Aug-2025	14-Sep-2025	✓
Amber VOC Vial - Sulfuric Acid (EP080) Trip blank	28-Jul-2025	05-Aug-2025	11-Aug-2025	✓	05-Aug-2025	11-Aug-2025	✓



Matrix: **WATER** Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP080) BH02, BH03	04-Aug-2025	05-Aug-2025	11-Aug-2025	✓	05-Aug-2025	11-Aug-2025	✓
Amber Glass Bottle - Unpreserved (EP071) BH02, BH03	04-Aug-2025	05-Aug-2025	11-Aug-2025	✓	06-Aug-2025	14-Sep-2025	✓
Amber VOC Vial - Sulfuric Acid (EP080) Trip blank	28-Jul-2025	05-Aug-2025	11-Aug-2025	✓	05-Aug-2025	11-Aug-2025	✓
EP080: BTEXN							
Amber Glass Bottle - Unpreserved (EP080) BH02, BH03	04-Aug-2025	05-Aug-2025	11-Aug-2025	✓	05-Aug-2025	11-Aug-2025	✓
Amber VOC Vial - Sulfuric Acid (EP080) Trip spike, Trip blank	28-Jul-2025	05-Aug-2025	11-Aug-2025	✓	05-Aug-2025	11-Aug-2025	✓
MW006: Thermotolerant Coliforms & E.coli by MF							
Sterile Plastic Bottle - Sodium Thiosulfate (MW006) BH02, BH03	04-Aug-2025	----	----	----	05-Aug-2025	05-Aug-2025	✓
MW013: Faecal Streptococci by MF							
Sterile Plastic Bottle - Sodium Thiosulfate (MW013) BH02, BH03	04-Aug-2025	----	----	----	05-Aug-2025	05-Aug-2025	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	2	12	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	2	50.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	1	4	25.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	17	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Redox Potential	EA075	1	2	50.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	2	50.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	7	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	17	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	2	12	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	2	16	12.50	8.33	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	0	4	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification .

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Control Samples (LCS) - Continued							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Redox Potential	EA075	3	2	150.00	15.00	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	7	42.86	12.50	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	20	15.00	15.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification .

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Matrix Spikes (MS) - Continued							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	17	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	2	50.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	16	6.25	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.56	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	17	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	13	7.69	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by Auto Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Conductivity by Auto Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of 'filterable' residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Redox Potential	EA075	WATER	In house: Ion selective electrode
Standard Anions -by IC (Extended Method)	ED009-X	WATER	In house: Referenced to APHA 4110B. This method is compliant with NEPM Schedule B(3)
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. Auto Titrator) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Major Anions - Dissolved	ED040F	WATER	In house: Referenced to APHA 3120. The 0.45µm filtered samples are determined by ICP/AES for Sulfur and/or Silicon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO ₄ 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO ₄ . Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO ₄ suspension is measured by a photometer and the SO ₄ -2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm.
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.



Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by Auto Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH ₃ G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO ₂ - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NO _x) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Combined oxidised Nitrogen (NO ₂ +NO ₃) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO ₃ -. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030E. This method is compliant with NEPM Schedule B(3)
Oxygen - Dissolved	EP025	WATER	In house: Referenced to APHA 4500-O G. Dissolved Oxygen Probe. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)

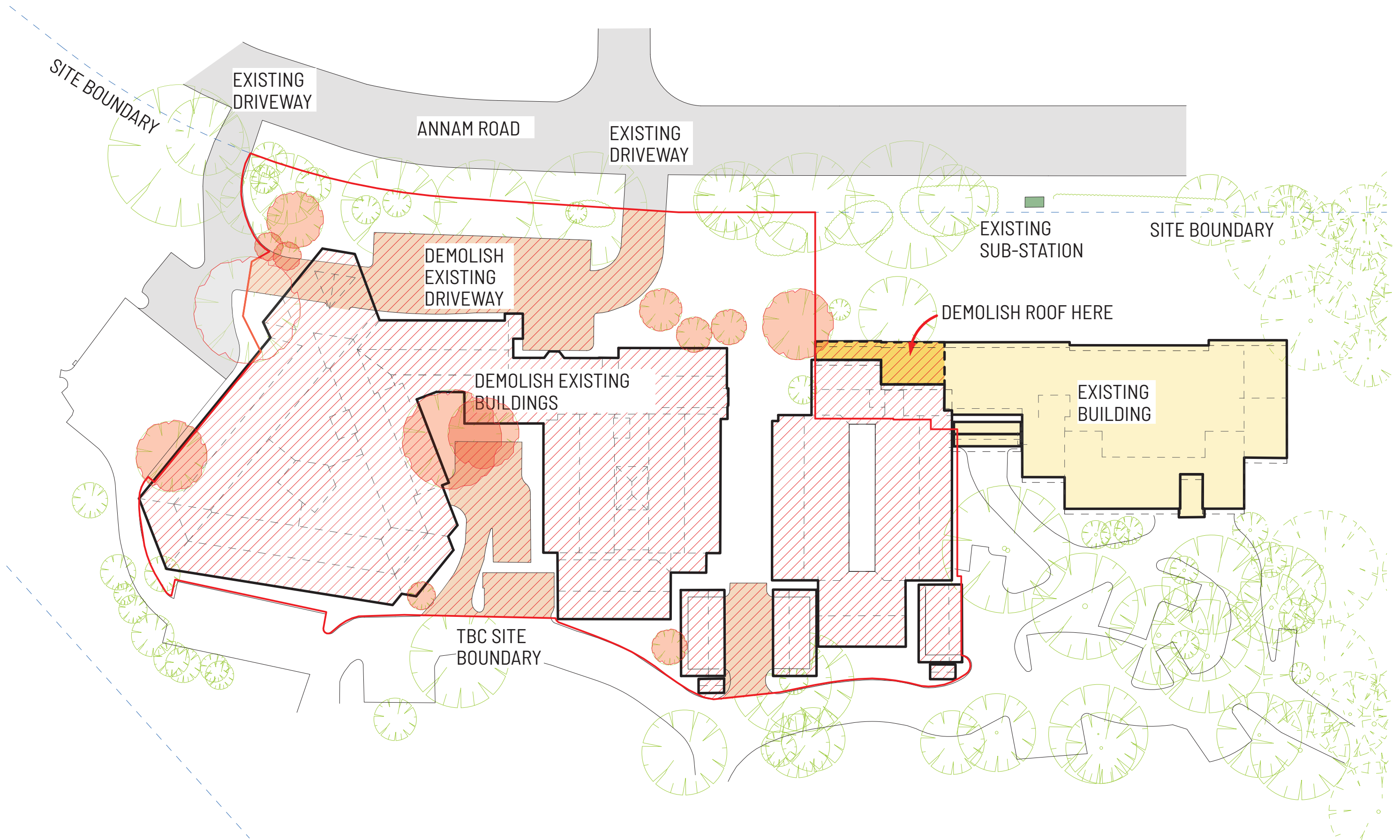


Analytical Methods	Method	Matrix	Method Descriptions
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
Thermotolerant Coliforms & E.coli by Membrane Filtration	MW006	WATER	AS 4276.5
Faecal Streptococci by Membrane Filtration	MW013	WATER	APHA 9230A
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.

Appendix F

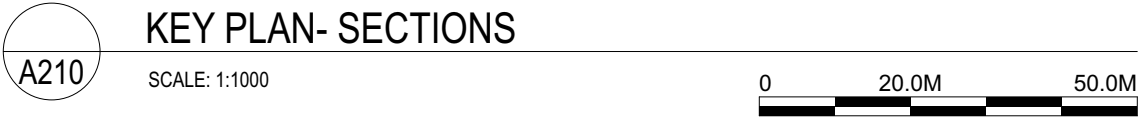
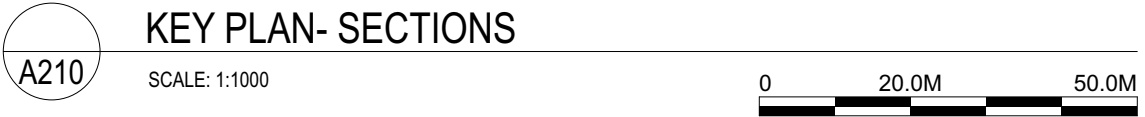
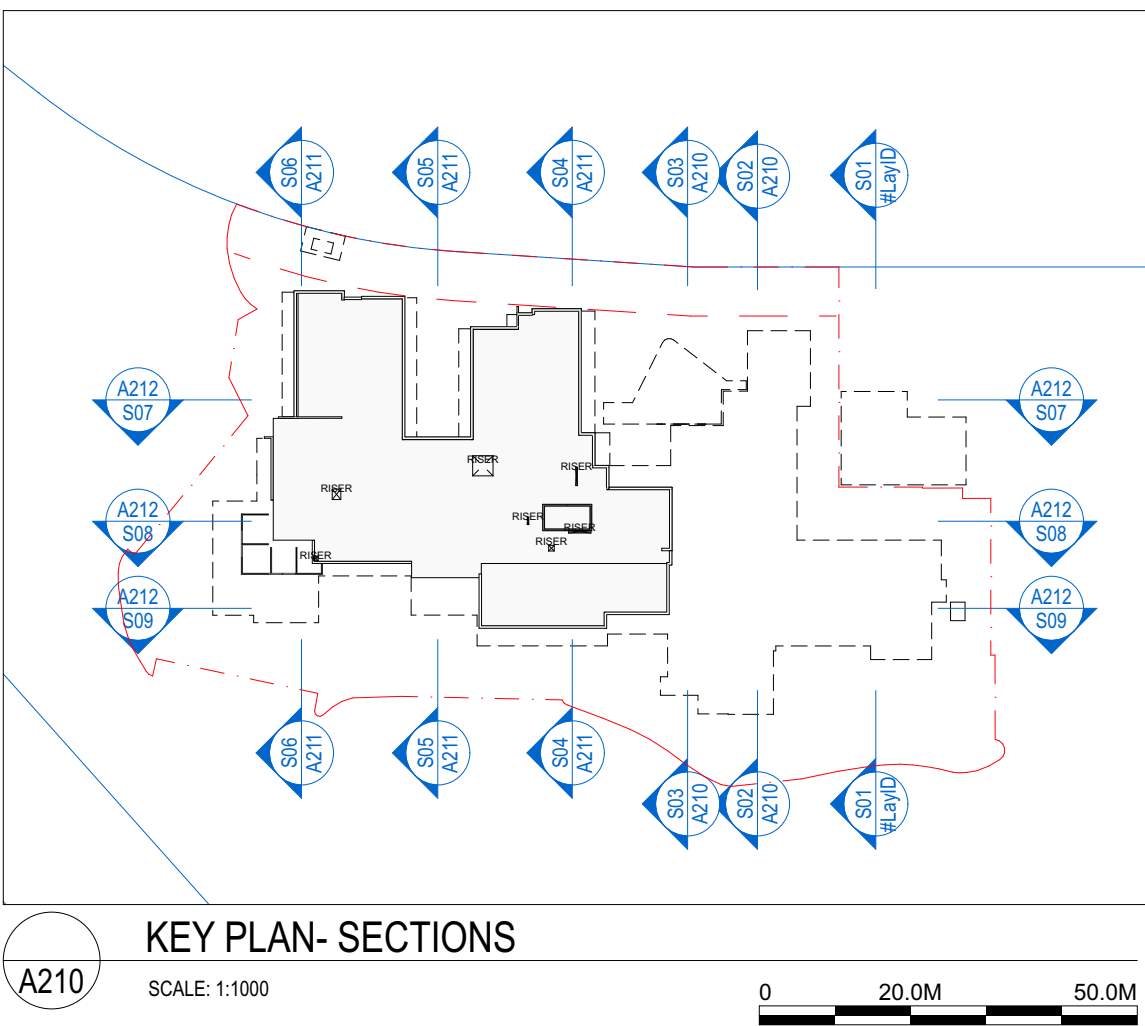
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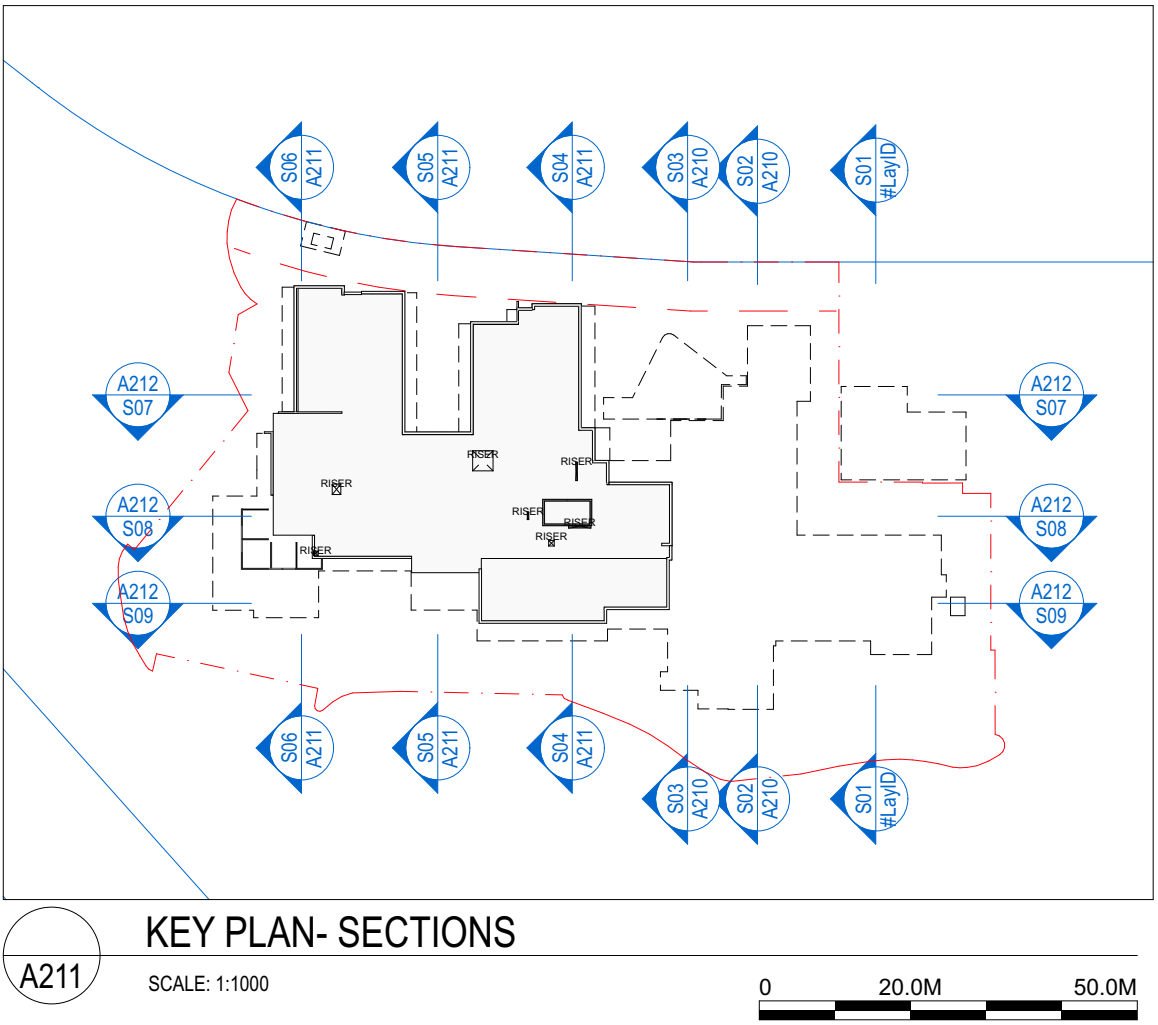
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