Douglas PARTNERS

GROUNDED EXPERTISE

# Specialist Advice

# Report on Groundwater Impact Assessment

## Flide Street, Caringbah, Affordable Housing

## 2 Flide Street, Caringbah NSW

## Prepared for Homes NSW

**Project 233414.03**

**26 September 2025**

# Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

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## 1. Introduction

This report has been prepared by Douglas Partners Pty Ltd (Douglas) on behalf of Homes NSW for a concurrent State Significant Development Application (SSD-84862461) and Planning Proposal for the redevelopment of existing social housing (the Project) at 2 Flide Street, Caringbah (the Site). The Project involves the construction of two residential flat buildings, 14 storeys and 8 storeys in height, to accommodate 164 social and affordable housing apartments, a communal room, plus a basement car park over two levels.

To support the Proposal, adjustments to the permissible height and floor space (FSR) ratio via an amendment to the Sutherland Shire Local Environment Plan 2015 are required.

The purpose of this Groundwater Impact Assessment (GIA) is to address the Secretary's Environmental Assessment Requirements (SEARs) for the project issued on 6 June 2025 which identified the specific assessment requirements given below.

| Item | Description of Requirement |
|---|---|
| 12. Ground and Groundwater Conditions | 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 sulfate soil potential in an EPI provide a Salinity Management Plan or Acid Sulfate Soil Management Plan that includes appropriate management measures and strategies. |

Based on published mapping an Acid Sulfate Soils Management Plan (ASSMP) and Salinity Management Plan (SMP) are not considered to be required for the project.

This Groundwater Impact Assessment is based on information from the geotechnical and contamination investigation undertaken at the site in April and May 2025 (refer Douglas' report 233414.03.R.001.Rev1 [Douglas 2025a] and 233414.04.R.002.Rev1 [Douglas 2025b]). Details of the field work (permeability testing and groundwater monitoring) and inflow assessment undertaken are given in this report.

This Groundwater Impact Assessment was undertaken in accordance with Douglas' proposal 233414.00.P.001.Rev3 dated 21 March 2025 based on the award of Contract LAHC 2024/622 Geotechnical Services Due Diligence – HAFF by Homes NSW; and including the approved variation dated 3 April 2025. This report must be read in conjunction with all appendices including the notes provided in Appendix A.

# 2. Site description

## 2.1 General

The Site is located within the Sutherland Shire local government area (LGA) and is zoned R4 High Density Residential under the *Sutherland Shire Local Environmental Plan* (SSLEP) *2015*.

The Site has a total area of approximately 3 596 square metres (sqm) and is bound by Flide Street to the north, Gardere Street to the west, Willawong Road to the east and the rail corridor for the Eastern Suburbs & Illawarra Line to the south.

The site is accessible by public transport, being within 400 m of the entrance to Caringbah Station and bust stops on the Kingsway which have frequent services to Sutherland, Miranda and Cronulla.

The Site currently comprises 38 social housing units within two 3 storey buildings with a single level basement car park. An aerial image of the Site is shown in Figure 1.


**Figure 1: Aerial image of the site location**

## 2.2 Topography

Reference to the provided survey drawings indicates that ground surface levels around the perimeter of the site generally slope gently down from approximately RL 35.5 (reduced level, in metres, to Australian Height Datum, AHD) at the north-eastern boundary to approximately RL 32 at the south-western site boundary.

In landscaped areas above the footprint of the existing basement, which occupies the majority of the site, ground surface levels are more typically at approximately RL 33.8 to RL 33.9, and are separated from the surrounding ground levels by block walls, basement ventilation structures, and the building superstructure. The underlying basement floor level is at approximately RL 30.2 to RL 30.8.

More broadly, the site is located in the upper parts of a hillside slope, with ground levels generally sloping down to the south-west, towards a gully feeding Kareena Creek and Hacking River which is the likely receiving water body for runoff and stormwater discharge form the site.

Survey levels of the nearby T4 Eastern Suburbs & Illawarra rail line, located further down the slope, indicate that the rail level is at approximately RL 31.5 in the areas south of the site.

## 3. Published data

### 3.1 Geology

Reference to NSW Seamless Geology indicates the site is mapped as being underlain by predominantly 'Hawkesbury Sandstone – mudstone' and some 'Hawkesbury Sandstone' in the south, as shown in Figure 2.

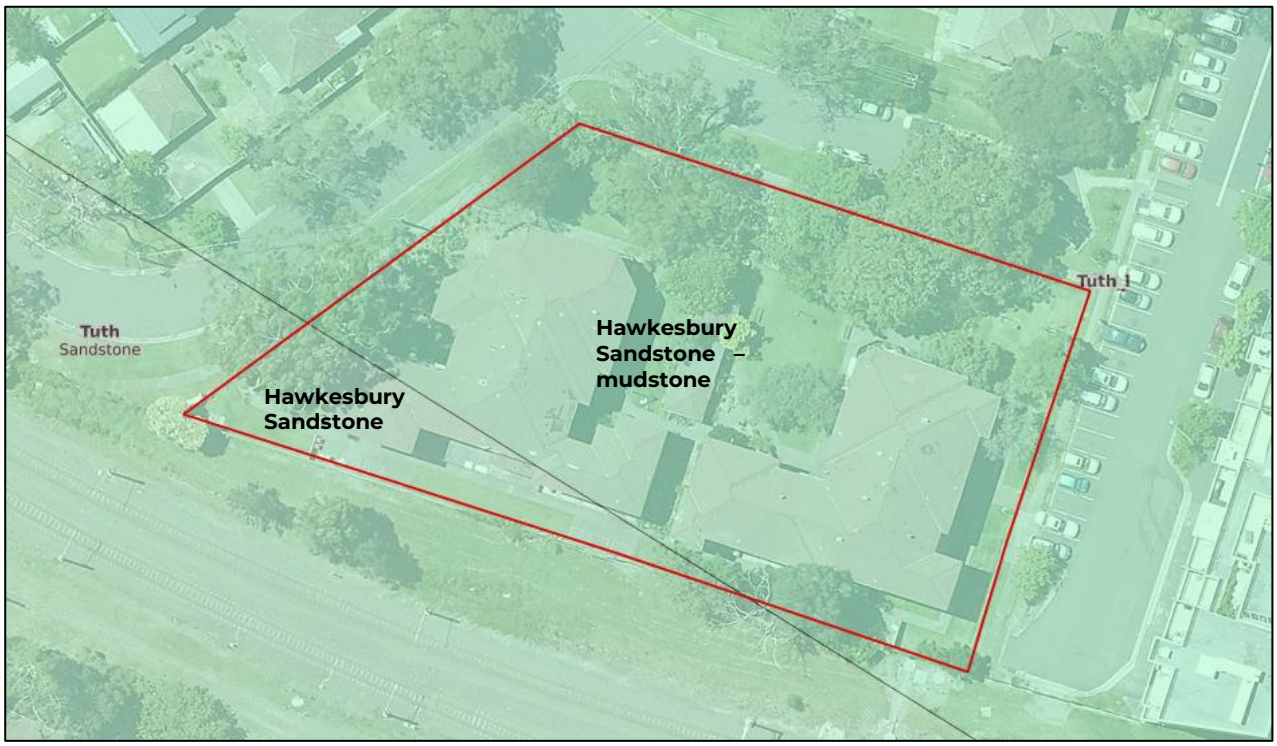


**Figure 2: NSW Seamless Geology Map with Approximate Site Location (Red Outline)**

The Hawkesbury Sandstone units comprise medium to coarse grained quartz sandstone, with minor shale and laminite lenses, aging from the Middle Triassic period. The mapped mudstone lens across the majority of the site typically comprises laminated mudstone and siltstone.

The results of the investigation are generally consistent with Hawkesbury Sandstone but do include some siltstone beds and laminations.

### 3.2 Groundwater

A search of the NSW Office of Water groundwater database indicated that there are four registered groundwater bores within 500 m of the site, summarised as follows:

- GW024170 – domestic bore installed in 1966, 250 m to the south-west, with a standing water level recorded at 1.2 m; and
- GW114287, GW114288, GW114289 – monitoring bores installed in 2012, 150 m to the north. No standing water levels are recorded.

Reference to the Greater Metropolitan Region Groundwater Sharing Plan (2023) indicates that underlying aquifers are of the Sydney Basin Central Groundwater Source.

### 3.3 Other mapping

A summary of selected other, relevant geotechnical mapping for the site is included in Table 1.

**Table 1: Summary of Other Mapping**

| Map type | Site Conditions | Reference |
|---|---|---|
| Soil Landscape | **Blacktown** – residual soil landscape, typically red and brown podzolic soils in well drained areas. | Sydney 1:100 000 Soils Landscape sheet, (NSW DECC, 2008) |
| Acid Sulfate Soil | **No known risk** – site is located outside of areas of known acid sulfate risk and outside of the EPI – Acid Sulfate Soil Class mapping. | Acid Sulfate Soil Risk, (NSW DECC, 1994-1998); Environmental Planning Instrument – Acid Sulfate Soils (NSW DPHI, 2019) |
| Salinity | **No known risk** – the site is located outside of the salinity potential zones identified in the Environmental Planning Instrument - salinity mapping and outside of the Western Sydney mapping. | Western Sydney Salinity Risk Mapping (NSW DPIE, 2002) Environmental Planning Instrument – Salinity (State of NSW & NSW DPHI, 2017) |
| Groundwater dependant ecosystems (GDEs) | **Sydney Turpentine Ironbark Forest** – low potential GDE about 435 m north west of site<br>**Hinterland Sandstone Gully Forest** – moderate potential GDE about 500 m south west of site<br>**Estuarine Mangrove Forest** – high potential GDE about 630 m south west of site | Groundwater Dependant Ecosystems Atlas (Bureau of Meteorology, 2020) |

| Map type | Site Conditions | Reference |
|---|---|---|
| Riparian lands | **Environmentally sensitive land** – about 250 m west of site | Sutherland Shire Local Environmental Plan (NSW Government, 2024) |

Notes: * The results of field work indicate a geology of Hawkesbury Sandstone.

Based on the published mapping summarised in Table 1, an Acid Sulfate Soils Management Plan (ASSMP) and Salinity Management Plan (SMP) are not considered to be required for the project.

# 4. Field work and analytical results

## 4.1 Geotechnical investigation

A geotechnical and contamination investigation was undertaken by Douglas in April and May 2025. Boreholes were drilled to depths ranging between 0.3 m to 15.0 m depth. Borehole locations from the investigation are shown on Drawing 1 in Appendix B. A summary of the subsurface conditions encountered within the site are provided below.

| | |
|---|---|
| **Fill:** | dark brown and brown, highly variable, silty sand, sand, silty and sandy clay, clay and sandy silt, to depths of 0.2 m to 0.9 m below ground surface; although at BH05 and BH06, where underlain by the basement structure the fill comprised sandy silt then silty sand at both locations; overlying |
| **Residual soils:** | Very stiff and hard, low to medium plasticity, grey and mottled red brown, silty clay and silty sandy clay with ironstone gravel, including some extremely weathered material; to depths of 0.3 m to 2.0 m; underlain by, |
| **Sandstone and Clay** | interbedded clay (extremely weathered sandstone), and moderately weathered sandstone, with ironstone and iron-cemented bands of low, medium and high strength, grey and pale grey, orange, orange-brown and red-brown; to depths of 5.5 m to 5.8 m; underlain by, and |
| **Hawkesbury Sandstone:** | low and medium, moderately weathered with clay seams, becoming medium and high strength, slightly weathered and fresh sandstone, orange brown and grey, with some siltstone beds and laminations at BH03. |

## 4.2 Groundwater Investigation

During hand auger drilling of the boreholes in garden areas above the basement (BH05 and BH06), water was observed at 0.05 m from ground surface. This is likely perched water overlying the existing basement, possibly from rainfall or irrigation which has not dissipated due to ineffective drainage. At other locations, groundwater seepage was generally not observed whilst augering. The necessary introduction of water to deeper boreholes while wash boring or rock coring precluded further groundwater observations during drilling.

Three groundwater monitoring wells were installed during the geotechnical investigation. The manually measured water levels during the groundwater monitoring period to date are presented in Table 2.

**Table 2: Summary of manual groundwater level measurements**

| Borehole | Material[1] | Ground level (mAHD) | Measured Depth to Groundwater (m) [Groundwater Level (mAHD)] | | | |
|---|---|---|---|---|---|---|
| | | | 9/05/2025 | 6/06/2025 | 7/07/2025 | 5/08/2025 |
| BH03 | Clay (XWM) and Weathered Sandstone | 35.2 | 5.3 [29.9] | 4.9 [30.3] | 5.2 [30.0] | 5.0 [30.2] |
| BH08 | Sandstone | 31.9 | 2.5 [29.4] | 2.2 [29.7] | 2.3 [29.6] | 2.0 [29.9] |
| BH11 | Sandstone | 33.3 | 8.5 [24.8] | 8.3 [25.0] | 8.5 [24.8] | 8.3 [25.0] |

Notes: 1 – refers to the lithology which the monitoring well is screened within (i.e. gravel pack)

Dataloggers were installed in the groundwater monitoring wells for ongoing groundwater monitoring. The dataloggers were installed on 5 May 2025 and data was last downloaded on 5 August 2025. The results of the groundwater monitoring are presented in Appendix C.

### 4.3 Hydraulic conductivity testing

Several rising head hydraulic conductivity tests were carried out in each groundwater monitoring well. The tests involved the removal of groundwater from the well (using a pump), then monitoring the water level recovery at regular time intervals using a data logger.

Hydraulic conductivity tests were analysed using Hvorslev (1951) solution for permeability testing interpretation. The results are summarised in Table 2, with detailed results provided in Appendix D.

**Table 3: Summary of hydraulic conductivity results**

| Borehole | Screen Depth[1] (m) | Screen Material[1] | Average Horizontal Hydraulic Conductivity $k_h$ (m/s) |
|---|---|---|---|
| BH03 | 3.50 - 9.00 | Clay (XWM) and Weathered Sandstone | $1.3 \times 10^{-6}$ |
| BH08 | 6.00 - 9.50 | Sandstone | $5.2 \times 10^{-7}$ |
| BH11 | 4.50 – 11.50 | Sandstone | $1.0 \times 10^{-8}$ |

Notes: 1 – refers to the depth/lithology which the monitoring well is screened within (i.e. gravel pack)

### 4.4 Groundwater quality results

The DSI (Douglas 2025b) reported on water quality testing undertaken on groundwater samples taken from the three monitoring wells installed during the geotechnical investigation. Stabilised field parameters for groundwater prior to sampling are presented in Table 4. The dissolved oxygen levels indicated generally anoxic conditions within borehole BH08 and aerobic in the other wells. The pH was observed to be slightly acidic. The electrical conductivity values are typical of fresh water as would be expected of Hawkesbury Sandstone. The redox potential (mV) indicates slightly oxidising conditions.

No light non-aqueous phase liquid (LNAPL) was observed whilst sampling and no sheens or odours were recorded.

**Table 4: Stabilised groundwater readings prior to sampling on 9 May 2025**

| Borehole | Temperature (°C) | Dissolved oxygen (mg/L) | Electrical conductivity (mS/cm) | pH | Redox (mV) |
|---|---|---|---|---|---|
| BH03 | 20.1 | 1.89 | 338.4 | 4.54 | 172.9 |
| BH08 | 19.8 | 0.40 | 653.0 | 4.70 | 167.3 |
| BH11 | 18.3 | 1.14 | 930 | 5.82 | 75.3 |

The DSI (Douglas, 2025b) tested groundwater samples for potential contaminants of concern identified in the conceptual site model (CSM) as well as additional analytes as required by DPE (2022) as shown in the summary table in Appendix F.

A copy of the laboratory certificate and chain of custody documentation is provided in Appendix G.

All contaminant concentrations recorded in groundwater were below the water quality acceptance criteria (WAC) provided in Appendix E of this GIA with the exception of:

- Copper in samples BH03 (2 µg/L), BH08 (7 mg/kg) and BH11 (2 mg/kg), compared to the WAC of 1.4 µg/L;
- Nickel in sample BH08 (9 µg/L) which MWG of 7 µg/L, and BH11 (24 µg/L), compared to the WAC of 24 µg/L;
- Zinc in samples BH03 (18 µg/L), BH08 (39 µg/L) and BH11 (89 µg/L), compared to the WAC of 8 µg/L;
- Total dissolved solids were detected in the range of 190 mg/L to 660 mg/L and total suspended solids between 66 mg/L to 460 mg/L compared to the WAC of 50 NTU (turbidity) for low land rivers; and
- pH was recorded between 5.4 and 6.1 which is low when compared to the WAC range 6.5 – 8.5 for discharge to recreational waters (for aesthetic reasons) and close to the range of 6 to 8 for discharge to lowland rivers.

The recorded metal concentrations (copper, nickel and zinc) were considered representative of diffuse background concentrations across urbanised Sydney. It is noted that dissolved metals

were tested for the purpose of the DSI, which would generally be expected to be lower than the total metal concentrations, which are relevant to discharge.

In addition, the following is noted:

- VOC (one or more of chloroform, bromodichloromethane and cyclohexane) was recorded in samples from all boreholes, at concentrations below the available 95% LOP for each contaminant, with total detected VOC ranging between 1 and 28 µg/L. It is noted that TRH C6-C10 was also recorded, with the recorded concentrations considered to be consistent with the concentrations being the recorded VOC. The DSI noted that drilling muds were used to drill the boreholes, and as such the recorded VOC detected could be sourced from traces of drilling mud remaining the wells at the time of sampling;
- Nutrient levels were below the WAC (where available);
- All concentrations for TRH>C10, BTEX, PAH, OCP, OPP, PCB, E.Coli and facal coliforms were below the laboratory practical quantification limit (PQL). It was noted in the DSI that the PQL for several PAH, OCP and OPP compounds were above the WAC, however it was not considered to be of concern as the concentrations recorded in soils were very low, mostly below the PQL, and as such were not considered to present an on-site source to groundwater; and
- The following should be considered when devising treatment methods, as they may impact the successfulness of treatment:
    - Electrical conductivity (EC) was recorded between 370 µS/cm to 1100 µS/cm, which is indicative of freshwater and within typical range for lowland rivers in south east Australia (ANZECC, 2000); and
    - Anions and cations concentrations varied and ionic balance ranged between -10,000 mg/kg to 70,000 mg/kg.

## 5. Conceptual hydrogeological model

The site subsurface profile observed during the investigation comprises fill to varying depths over residual clay soils and extremely weathered sandstone with soil-like properties. The soils are underlain by weathered bedrock encountered at between RL 29.9 and RL 31.5, comprising interbedded extremely weathered sandstone (soil like properties) with low, medium and high strength sandstone bands. The weathered profile is underlain by medium and high strength Hawkesbury Sandstone bedrock, encountered at between RL 26.6 and RL 27.0.

The groundwater levels measured in the wells during the monitoring period typically ranged between about RL 25.0 to RL 30.2. Despite the change in surface level, the groundwater elevation observed in boreholes BH03 and BH08 were similar, however the groundwater level observed in borehole BH11 was observed to be significantly lower than other locations.

The topography of the area suggests that groundwater would flow south-west, towards a gully feeding Kareena Creek, however the lower groundwater level observed in borehole BH11 suggests groundwater flow towards the south-east. This is likely due to the presence of a drained basement at 178-186 Willarong Road (about 50 m south-east of the site).

The monitoring results indicate groundwater is within the bedrock underlying the site. It is expected that the measured water level likely captures perched seepage within fractures in the sandstone bedrock and the perennial groundwater table would be expected at greater depths. It should be noted that groundwater levels are transient and fluctuate with climatic conditions and other factors (e.g., adjacent basements).

It is expected that water inputs to the ground profile beneath the site include:

- Rainfall infiltration on the site and surrounds, including water flowing downslope laterally through the natural soils and bedrock from areas of higher topography; and
- Possible anthropogenic recharge from seepage from nearby leaking water mains and / or stormwater pipes, garden irrigation etc.

Water outputs or losses from the ground beneath the site include:

- Evapotranspiration from the vegetation across the surface; and
- Nearby dewatering projects or drained basements.

# 6. Proposed development

The proposed development comprises the construction of two residential flat buildings, one rising to part 13 and part 14 storeys and the other to 8 storeys, comprising a total of 164 social and affordable housing apartments. The development also includes a communal room and a two-level basement car park.

The proposal includes bulk earthworks, tree removal and associated landscaping and public domain works.

# 7. Groundwater inflow assessment

## 7.1 Inflow assessment

### 7.1.1 Theory of analytical solution

The Marinelli and Niccoli (2000) method presents a simple analytical solution for predicting the groundwater inflow to an open excavation below the water table. This method of inflow prediction is reliant on the following assumptions:

- Lowering the water table decreases the saturated thickness of rock materials providing excavation inflow;
- Relative to seepage from the excavation walls, significant inflow occurs through the excavation base;
- The rock formation is semi-infinite below the excavation and no impermeable boundary exists at depth; and
- Steady state flow conditions exist near the excavation.

Under this method two zones are identified; Zone 1 represents flow through the excavation walls above the base and Zone 2 extends from the bottom of the excavation downward and considers

flow into the excavation base. The analytical model assumes no flow occurs between the two zones.

The Zone 1 analytical solution considers steady-state, unconfined, horizontal radial flow with uniformly distributed recharge at the water table. The analytical solution assumes the following:

- The excavation walls are approximated as a right circular cylinder;
- Groundwater flow is horizontal;
- The static water table is approximately horizontal;
- Uniform distributed recharge occurs across the site as a result of surface infiltration (rainwater); and
- Groundwater flow toward the excavation is axially symmetric.

The groundwater inflow through the excavation walls is determined by the following equation:

$$Q_1 = W \pi (r_o^2 - r_p^2)$$

Where $Q_1$ is the inflow rate, W is the distributed recharge flux, $r_o$ is the radius of influence (maximum extent of groundwater cone depression) and $r_p$ is the effective excavation radius.

The radius of influence ($r_o$) is determined by iteration process using the following equation:

$$h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}}\left[r_o^2 \ln\left(\frac{r_o}{r_p}\right) - \frac{(r_o^2 - r_p^2)}{2}\right]}$$

Where $h_o$ is the initial saturated thickness above the excavation base, $h_p$ is the saturated thickness above the excavation base and $K_{h1}$ is the horizontal hydraulic conductivity of materials within Zone 1.

The Zone 2 analytical solution considers steady-state flow to one side of a circular disk (excavation base) of constant and uniform drawdown. The analytical solution assumes the following:

- Hydraulic head is initially uniform throughout Zone 2;
- The excavation base has a constant hydraulic head equal to the elevation of the excavation base;
- Flow into the excavation base is three-dimensional and axially symmetric; and
- Materials within Zone 2 are anisotropic.

The groundwater inflow through the excavation base is determined by the following equations:

$$Q_2 = 4\, r_p \left(\frac{K_{h2}}{m_2}\right)(h_o - d)$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

Where $K_{h2}$ and $K_{v2}$ are the horizontal and vertical hydraulic conductivity of materials in Zone 2 and d is the depth of water in the excavation (typically 0).

### 7.1.2 Input parameters

Based on the architectural plans provided (drawing reference DA03.001 revision 2, dated 16 September 2025), it is understood that the finished floor level of Basement Level 01 is at RL 28.8. Hence, it has been assumed that the bulk excavation level will be at RL 28.3. Adopting a site groundwater elevation at RL 29.5 gives an initial saturated thickness above the excavation base ($h_o$) of 1.2 m.

Based on the architectural plans provided (drawing reference DA03.001 Revision 2, dated 16 September 2025), Basement Level 01 will be about 33 m wide and 69 m long. This equates to a total plan area of about 2 277 $m^2$, with an estimated equivalent radius ($r_p$) of 26.9 m.

The assumed bulk level at RL 28.3 is within the weathered bedrock encountered on site during the investigation. The monitoring well in borehole BH03 is screened within this strata. The results of the permeability testing within this borehole indicates a horizontal hydraulic conductivity ($K_h$) of 1 x $10^{-6}$ m/s. A ratio of 3H :1V has been adopted between the horizontal and vertical hydraulic conductivity.

The distributed recharge flux was calculated based on 2% surface infiltration of 1.2 m per year of rainfall.

The radius of influence was determined in accordance with the process outlined in Section 7.1.1.

A summary of the input parameters used for the inflow calculations is provided in Table 5.

**Table 5: Input parameters for inflow assessment**

| Parameter | Value |
|---|---|
| Initial saturated thickness ($h_o$) | 1.2 m |
| Saturated thickness above excavation ($h_p$) | 0 m |
| Effective excavation radius ($r_p$) | 26.9 m |
| Radius of influence ($r_o$) | 67 m |
| Horizontal hydraulic conductivity ($K_h$) | 1.0 x $10^{-6}$ m/s |
| Vertical hydraulic conductivity ($K_v$) | 3.3 x $10^{-7}$ m/s |
| Distributed recharge flux (W) | 6.6 x $10^{-5}$ m/day |
| Depth of water in excavation (d) | 0 m |

Sensitivity analyses were undertaken to assess the impact of intersecting more permeable ground conditions, shallower water table and a lower ratio of horizontal to vertical hydraulic conductivity. The sensitivity cases analysed are summarised below:

- Sensitivity case 1 – assuming the weathered rock has a higher hydraulic conductivity ($K_h$ of 2.0 x $10^{-6}$ m/s and $K_v$ of 6.7 x $10^{-7}$ m/s);
- Sensitivity case 2 – assuming the weathered rock has a lower ratio of vertical to horizontal hydraulic conductivity ($K_h/K_v$=1); and
- Sensitivity case 3 – assuming the groundwater table is about 1 m higher than the level adopted in the baseline case (RL 30.5).

### 7.1.3 Inflow results

Groundwater inflows into the basement excavation were calculated for the baseline case and each sensitivity case using the methods and input parameters previously outlined. Considering the hydrogeological conditions encountered on site, it is likely that only the northern and western excavation face, and the north-west portion of the excavation base, will encounter groundwater. As a result, the calculated total inflow was halved.

The predicted yearly groundwater inflows into the basement under the baseline case and each sensitivity case are presented in Table 6.

**Table 6: Summary of inflow calculations results**

| Case | Zone 1 inflow ($Q_1$, ML/yr)[1] | Zone 2 inflow ($Q_2$, ML/yr)[2] | Total inflow (Q, ML/yr) |
|---|---|---|---|
| Baseline | 0.1 | 1.2 | 1.3 |
| Sensitivity case 1 | 0.2 | 2.4 | 2.6 |
| Sensitivity case 2 | 0.1 | 2.1 | 2.2 |
| Sensitivity case 3 | 0.3 | 2.1 | 2.4 |

Notes: 1 – represents flow through side wall of excavation
2 – represents flow through base of excavation

The results of the groundwater inflow calculations indicate that under the baseline and sensitivity cases, the volume of groundwater requiring extraction is predicted to be less than 3 ML/year. It is noted that; the precision to which the results are presented does not represent the accuracy of the predictions, the level of precision is provided to allow comparison of scenarios. In reality the accuracy will be lower because of the inherent variability in key parameters such as hydraulic conductivity and recharge and results could vary significantly. The sensitivity analysis attempts to simulate the possible variations in inflows arising from these variations in key parameters.

It is noted that the standing water level observed in the monitoring wells is likely to be perched groundwater. It is also noted that given the expected hydrogeological conditions (i.e. groundwater input) on site, recharge of the perched groundwater following the initial drawdown event (during construction) may be limited (i.e. to rainfall seepage). As a result, it is considered that the volume of groundwater requiring extraction during construction dewatering and for the proposed drained basement will likely be under 3 ML/year and the estimated volumes are considered to be conservative.

Should inflows exceed 3 ML/year for the drained basement post construction, then a Water Access Licence (and water entitlements) will be required from WaterNSW / Department of Climate Change, Energy Environment and Water (DCCEEW).

#### 7.1.4 Drawdown

It is expected that groundwater levels directly adjacent to the northern and western site boundary will be drawn down to the dewatering level for the proposed excavation. Based on the groundwater levels observed during the monitoring period, the basement is not expected to significantly impact the groundwater levels on the southern and eastern side of the site.

Based on the standing groundwater level observed within the monitoring period, the groundwater underlying the site is within the weathered rock profile. Settlements caused by the drawdown of groundwater within the rock profile are expected to be negligible.

## 8. Potential risks associated with dewatering

### 8.1 Aquifer interference policy

The NSW Aquifer Interference Policy (AIP) indicates that the term “aquifer” is commonly understood to mean a groundwater system that is sufficiently permeable to allow water to move within it, and which can yield productive volumes of groundwater. A groundwater system is defined as any type of saturated geological formation that can yield low or high volumes of water. However, for the purpose of the AIP, the term aquifer has the same meaning as groundwater system and includes low yielding and saline systems.

Table 1 in Section 3.2.1 of the AIP outlines minimal impact considerations. The AIP indicates that “if predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable”. The following minimal impact considerations are outlined for less productive porous and fractured rock groundwater sources:

- Less than or equal to 10% cumulative variation in water table 40 m from any high priority GDE or high priority culturally significant site;
- A cumulative pressure head decline of no more than 2 m at any water supply work; and
- Any change in groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.

### 8.2 Risk assessment

An assessment of the potential effects of dewatering on neighbouring properties and groundwater receptors has been summarised in Table 7.

**Table 7: Assessment of potential effects of dewatering**

| Item | Comment |
|---|---|
| Impacts on potential GDEs | There are no GDEs within the predicted radius of groundwater depression, hence drawdown impacts on GDEs are unlikely. |
| Water supply losses by neighbouring users | There are no registered groundwater users within the predicted radius of groundwater depression, hence drawdown impacts on any registered groundwater users is unlikely. |
| Potential subsidence of neighbouring structures | The settlements induced by groundwater drawdown within the weathered rock profile are predicted to be negligible. |

The excavation is not expected to impact any GDEs or groundwater supply works in the area and potential settlements are predicted to be negligible. Hence, the proposed works are considered to be acceptable with reference to the AIP minimal impact considerations.

### 8.3 Groundwater contamination

Based on results of the current testing (refer to Section4.4), it is considered that there are some minor contamination risks that will need to be managed during dewatering. Copper, nickel and zinc concentrations recorded in groundwater were above the SAC but likely representative of diffuse background concentrations across urbanised Sydney. The following is recommended to manage contamination risks during dewatering:

- Design the dewatering treatment system with consideration of the potential contaminants of concern and groundwater properties such as but not limited to pH, TSS, EC and ionic balance;
- Undertake an initial testing (pilot trial) of the treatment system prior to discharge; and
- Continually test groundwater during dewatering as outlined in Section 9.4.

## 9. Recommended management strategy

This section outlines the proposed management strategy based on the anticipated methodology for dewatering and disposal.

### 9.1 Dewatering methodology

Based on the inflow assessment (refer Section 7.1.3), seepage inflows should be readily controllable for discharge during construction by pumping from sumps in the basement excavation. It is expected that majority of the seepage inflow will be from the north-west half of the site. It should be noted that inflows may temporarily increase following high rainfall events. The groundwater will be pumped into a temporary holding / treatment tank for groundwater quality monitoring and treatment.

Appropriate planning should be in place to monitor and compensate for possible variations in the actual inflow rate.

## 9.2 Water quality control

### 9.2.1 Proposed testing

Groundwater quality must be tested prior to discharge to prevent contamination and adverse impacts during construction. Pre-treatment and post-treatment testing of groundwater is generally undertaken to allow review of the treatment methods in place, and to ensure that the quality of groundwater post-treatment is consistent with the discharge requirements.

The recommended methodology for water quality testing is as follows:

- Collection of water samples and quality control samples from the tanks (post-treatment) to inform suitability for discharge and the sumps (pre-treatment), as required to inform treatment;
- Measurement of general groundwater physical parameters (EC, pH and temperature) using a calibrated water quality meter;
- Analysis of the samples by a NATA accredited laboratory for the analytes presented in Table 8 below.
    - These analytes have been selected based on analytes determined to be mandatory by the DPE (2022);
    - Negotiable analytes (DPE, 2022) have not been included where previous groundwater results did not identify any exceedance or elevated concentration. Selected metals and hydrocarbons have been included as construction works have a potential to introduce these to the groundwater;
    - Analytes required for testing have to be confirmed with the regulatory authority; and
- Review and update of this water quality testing methodology as required.

Water quality sampling should be conducted in accordance with Geoscience Australia's Groundwater Sampling and Analysis – A Field Guide (Geoscience Australia 2009).

Quality assurance / quality control (QA/QC) procedures should be used to establish accurate, reliable and precise results. QA/QC procedures should include: calibration of equipment, analyses of samples within holding times, keeping samples chilled and wearing gloves during sampling.

**Table 8: Proposed suite of analytes for water quality monitoring**

| Category | Analytes |
|---|---|
| Field parameters | T, EC, pH, turbidity and visual oil and grease |
| Physical properties | TDS, TSS |
| Ionic Balance | Major anions: chloride, sulphate, bromide and fluoride<br>Major cations: Calcium, magnesium, sodium, potassium<br>Alkalinity:, hydroxide and total<br>Total Hardness<br>Ionic Balance |

| Category | Analytes |
|---|---|
| Metals | Arsenic, cadmium, chromium, copper, iron, mercury, nickel, lead and zinc<br>• Total metals are to be analysed prior to discharge;<br>• Dissolved metals analysis is only proposed if required to treatment to inform treatment |
| Organics | VOC, TRH / TPH and BTEX |

Notes: EC: electrical conductivity | TDS: total dissolved solids | TSS: total suspended solids
TRH: total recoverable hydrocarbons | TPH: total petroleum hydrocarbons
BTEX: benzene, toluene, ethylbenzene and xylenes
PAH: polycyclic aromatic hydrocarbons

### 9.2.2 Discharge Options

Any groundwater requiring off-site disposal may be managed under the three options shown in Table 9.

**Table 9: Summary of disposal options**

| Disposal Options | Comments |
|---|---|
| On-site treatment and disposal to stormwater | Generally applicable where the treatment required is routine e.g. solids removal, alum dosing and pH adjustment.<br>Treatment of specific contaminants may require more physical space and result in higher treatment costs.<br>Water discharged to stormwater is typically required to meet general NSW DPE requirements (NSW DPE 2022) and ANZG (2018) water quality standards for the relevant receiving water body and any associated uses (e.g., aquatic ecology / recreation), see Appendix E for recommended WAC.<br>Further requirements may be enforced depending on the specific approval documentation. |
| On-site treatment and disposal to the sewer under a Trade Waste Agreement with Sydney Water | Generally, will require further negotiation and establishment of water quality screening levels prior to disposal.<br>Waste quality screening levels will depend on the specific trade waste agreement with Sydney Water. |
| Tanker off-site for disposal at an aqueous treatment plant by a suitably licenced contractor | May be suitable for more heavily contaminated liquids where on-site treatment is not practicable.<br>Can be limited in applicability for larger volumes of water, given cost and practical considerations.<br>Water quality screening levels will depend on specific requirements of the contractor and facility licenced to accept the liquid waste. |

### 9.2.3 Water quality acceptance criteria

Groundwater quality results should be assessed against water quality acceptance criteria (WAC) for each analyte prior to disposal. The WAC should be chosen based on the receptor's water quality, relevant guidelines and regulatory authority's requirements.

Depending on the receiving water body, the following assessment criteria are nominated as recommended screening levels for disposal to stormwater:

- ANZG, '*Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018*' (ANZG, 2018);
- ANZECC, '*Australian Water Quality Guidelines 2000*', Tables 3.3.2 to 3.3.3 Default trigger values for physical and chemical stressors in south-east Australia for slightly disturbed ecosystems (ANZECC, 2000);
- NHMRC, '*Guidelines for Managing Risks In Recreational Water*' (NHMRC, 2008), which is based on the Australian drinking water guidelines (NHMRC, 2025); and
- NSW DPE, '*Minimum requirements for building site groundwater investigations and reporting*' (DPE, 2022).

The WAC are provided in Appendix E.

It should be noted that the disposal criteria (i.e. to stormwater or sewer) may vary depending on the receiving water body and is subject to approval from the relevant consent authority (e.g. Council or Sydney Water).

### 9.2.4 Treatment Options

Based on the current results, treatment will likely be required prior to be disposal for metals, along with standard treatment requirements for suspended solids and pH. It is anticipated that groundwater treatment can be achieved using water treatment methods that are standard industry practice, and the specific processes required should be discussed with the dewatering contractor. Following treatment, it is expected that the groundwater will be suitable for discharge to the stormwater system, subject to approval by the relevant authority. It should be noted that the site specific dewatering criteria should be confirmed by the relevant authority prior to disposal.

A suitably experienced dewatering contractor should be engaged to provide a suitable treatment system to enable treatment of the water prior to testing and disposal. The system could be set up to automatically treat the water as part of the temporary storage system, or deployed to treat stored water following water quality testing. Testing of groundwater quality is to be carried out according to the monitoring plan in Section 9.4, to ensure that groundwater treatment has been carried out successfully.

Potential treatment options for managing groundwater quality prior to discharge may include:

- Sediment control: Settling tanks or flocculation to reduce turbidity and suspended solids.
- pH adjustment: Dosing with lime or acid to achieve acceptable discharge pH.
- Metals removal: Filtration or chemical precipitation, if metal concentrations exceed guidelines following flocculation.

### 9.3 Treatment system pilot trial

The specific treatment system selected by the licensed dewatering contractor should be trialled on a reduced scale to establish its effectiveness. This application should serve as a preliminary investigation to identify any potential issues with the treatment system before larger quantities of water are treated.

During the pilot trial, water quality testing by an environmental consultant should be undertaken prior to each discharge event for all parameters in Section 9.2.1. During this period, appropriate management / storage of water will be required to allow water to be held pending the testing results.

The pilot trial is to continue until three sequential samples record results within the WAC.

### 9.4 Monitoring and reporting requirements

The monitoring program and associated reporting presented in Table 10 is to be adopted until the end of excavation and dewatering works on-site.

**Table 10: Monitoring and report requirements during dewatering**

| Item | Monitoring Requirements | Methodology |
|---|---|---|
| Visual inspection | No visible oil and grease, 'sheen' and / or no significant discolouration or odours, water visually clear (ie no visible sediment). | Daily inspections to be conducted from stored liquids in the intermediate flocculation tank (by the contractor).<br><br>**HOLD POINT** - If any of the visual inspection signs are noted, then any discharge will be suspended until further analytical testing is completed. |
| Field monitoring | Meets WAC | Daily monitoring by the dewatering contractor for field pH, turbidity and temperature. |
| Groundwater level monitoring | Groundwater level recording from the three monitoring wells to assess drawdown in the vicinity of the site. Given the low risk this requirement could be deleted subject to approval by DCCEEW/NRAR. | Continuous groundwater level monitoring using data loggers recording at six-hourly intervals in three monitoring wells in the vicinity of the site.<br><br>Groundwater level monitoring is to be undertaken during construction and continued until one month after completion of construction.<br><br>Quarterly manual groundwater level measurements in monitoring wells.<br><br>Inclusion of results in dewatering completion report. |
| Water quality | Samples from treated water to assess | Sampling undertaken by a suitably qualified Environmental Consultant. |

| Item | Monitoring Requirements | Methodology |
|---|---|---|
| sampling and testing | compliance with parameters in Table 8.<br>Samples of water prior to treatment as required to inform treatment. | • Pilot Trial as per Section 9.3;<br>• Weekly testing or pre-discharge testing. Required until the end of dewatering unless otherwise advised by the environmental consultant. Frequency may be reduced when water quality results stabilise, to be advised by project environmental consultant;<br>• Groundwater parameters (temperature, pH, turbidity, EC, TDS, DO) may be monitored using suitable on-site probes / testing kits;<br>• Laboratory analysis to be done at NATA accredited laboratory.<br>• Samples will be recorded using chain of custody (COC) documentation to accompany all samples, including the date, name and signature of sampler and sample ID.<br><br>**HOLD POINT** – If treated water concentrations exceed WAC, then the contingency strategy to be adopted (refer Section 9.6.1).<br><br>Inclusion of results in dewatering completion report. |
| Quality control sampling | Collection of replicate samples to verify quality of laboratory results at a frequency of 10% of all samples analysed. Testing suite to include Metals, TRH and BTEX. | Sampling undertaken by a suitably qualified Environmental Consultant.<br><br>Samples will be recorded using industry standard COC documentation, including the date, sample ID, name and signature of sampler, and transportation records to the NATA accredited laboratory.<br><br>Inclusion of results in dewatering completion report. |
| Quantity of groundwater inflows | Calibrated flowmeter connected to pump-out system to measure volumes of water disposed off-site.<br><br>Measurement of groundwater volumes contained in the sumps. | Weekly monitoring and recording of dewatering volumes.<br>**HOLD POINT** - If dewatering volumes exceed those outlined in Section 7.1.3, construction will be halted, and contingency strategy adopted (refer Section 9.6.2).<br>Weekly reporting of volumes to the Environmental Consultant.<br>Inclusion of results in dewatering completion report. |

| Item | Monitoring Requirements | Methodology |
|---|---|---|
| Dewatering completion report | To be prepared by a suitably qualified consultant upon completion of all dewatering works and submitted to council. The summary report will incorporate the above information, and any on-site records kept by the contractor (e.g. visual observations, any unexpected finds records, etc.), all analytical results (i.e., each batch of water disposed) compared to the adopted assessment criteria, quality control testing, record of dewatering volumes (i.e. for each discharge event) and comment on any unexpected finds or non-conformances, and / or otherwise if the dewatering works have complied with this DMP. | |

Notes: Testing frequency, assessment criteria and analysis requirements may be reviewed in consultation with the Environmental Consultant based on ongoing results.

### 9.5 Personnel and responsibilities

Table 11 outlines the proposed project personnel and relevant responsibilities as part of the management plan.

**Table 11: Key roles and responsibilities**

| Role | Organisation | Responsibilities |
|---|---|---|
| Site manager / contractor | tbc | Routine visual inspection.<br>Monitoring / recording of discharge volumes.<br>Maintaining any unexpected / contingency records.<br>Provision of data to the geotechnical and environmental consultant to inform their assessments. |
| Dewatering contractor | tbc | Design / specification and ongoing maintenance of the dewatering system.<br>Provision of data to the geotechnical and environmental consultant to inform their assessments. |
| Geotechnical consultant | Douglas Partners – 02 9809 0666 | Groundwater level monitoring and review of disposal volumes.<br>The contractor to engage directly with Douglas to assist with the preparation of the dewatering completion report for submission to council. |
| Environmental consultant | Douglas Partners – 02 9809 0666 | Water quality sampling (analysis using NATA accredited laboratories).<br>Interim advice for each sampling event to confirm (or otherwise) compliance with discharge requirements.<br>Quality control sampling.<br>The contractor to engage directly with Douglas Partners to assist with the preparation of the |

| Role | Organisation | Responsibilities |
|---|---|---|
| | | dewatering completion report for submission to council. |

## 9.6 Contingency plan

### 9.6.1 Groundwater quality exceedance

If any exceedance of the acceptance criteria or non-conformance in monitoring and testing occurs, then the Site manager and dewatering contractor should be contacted. The environmental consultant should undertake an assessment of the exceedance or non-conformance and provide further guidance, with particular focus on the possible suspension of discharge (but also with consideration of risk associated with any required suspicion of dewatering). A review of the treatment will need to be undertaken in consultation with the dewatering contractor.

If discharge has been halted, it may be resumed once the groundwater has been adequately treated to meet discharge requirements with written results provided by the environmental consultant.

If water quality cannot be treated to meet the receiving water authority's discharge requirements, then alternative management / disposal options will be required, and may include:

- Additional on-site buffering tank capacity to manage groundwater pending approvals/ treatment for discharge;
- Off-site disposal of groundwater as liquid waste; and / or
- Discharge to the sewer network. Note this option requires an application (Trade Waste Agreement) to Sydney Water. It is noted that application for a Trade Waste Agreement take some time and are not always approved (especially if there is no anthropogenic contamination). As such this considered to be a long-term solution and not suitable as an interim solution.

### 9.6.2 Groundwater volumes greater than predicted

Should dewatering volumes be higher than predicted (refer Section 7.1.3), the geotechnical consultant should be notified to undertake further assessment of inflows and provide further advice. Dewatering and discharge may be allowed to continue providing the detention tank capacity and discharge limits are not exceeded.

### 9.6.3 Emergency event

In the event of an emergency, the principal contractor must be notified, and in conjunction with the dewatering contractor, determine if it is safe to continue or necessary to suspend dewatering. In such an event, discharging will be discontinued until deemed safe to resume.

Failure of the dewatering, treatment and / or discharge systems will require dewatering and discharge to be suspended until the issue is resolved. Written approval to continue will be required from the environmental consultant.

## 10. Conclusion

The geotechnical investigation undertaken in April and May 2025 suggests the site is generally underlain by residual soils over Hawkesbury Sandstone bedrock. Three groundwater monitoring wells were installed during this investigation, with dataloggers installed for three months of groundwater level monitoring. Groundwater levels have generally been observed between RL 25.0 and RL 30.2.

Based on architectural drawings provided, the proposed basement has a finished floor level of RL 28.8. It is assumed that bulk excavation / dewatering level will be at RL 28.3. Based on the results of the groundwater monitoring, the excavation will intersect groundwater (assumed to be perched and not perennial groundwater system).

Groundwater calculations undertaken for the project predicts that groundwater inflow rates are likely to be under 3 ML/year for both the baseline and sensitivity cases. Groundwater inflows may be very low or absent during dry periods. These predictions are estimates based on the information available; actual flow rates may vary from these and will only be known once the excavation is complete and inflow rates can be measured.

The current WaterNSW dewatering limits indicate up to 3 ML/year of groundwater may be extracted without needing a Water Access License (and water entitlements). It should be noted that if inflows exceed 3 ML/year during long-term dewatering of the drained basement, then a Water Access Licence (and water entitlements) will be required from WaterNSW / DCCEEW however this is not expected based on current data and our assessment.

It is predicted that groundwater levels directly adjacent to the northern and western side of the site will be drawn down to the dewatering level for the proposed excavation. Based on the groundwater levels observed during the monitoring period, the basement is not expected to significantly impact the groundwater levels on the southern and eastern side of the site. The settlements induced by the drawdown in rock are expected to be negligible (and acceptable).

The predicted impacts of dewatering are considered to be less than the Level 1 minimal impact considerations detailed in the AIP and are considered acceptable.

Groundwater quality results suggested that some background metal concentrations exceed the adopted WAC. The results indicate that groundwater treatment will likely be required prior to disposal. Water quality testing should be undertaken on the groundwater collected following treatment and prior to discharge / disposal to confirm the success of the treatment. The water quality test results should be evaluated against the WAC as provided herein. This GIA provides a contingency plan to be enacted should the stormwater disposal criteria be exceeded.

## 11. References

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NHMRC. (2008). *Guidelines for Managing Risks In Recreational Water*.

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NSW Government. (2021). *State Environmental Planning Policy (Resilience and Hazards) 2021*. NSW Government.

## 12. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at 2 Flide Street, Caringbah NSW in line with Douglas' proposal dated 21 March 2025 based on the award of Contract LAHC 2024/622 Geotechnical Services Due Diligence – HAFF by Homes NSW; and including the approved variation dated 3 April 2025. This report is provided for the exclusive use of Homes NSW for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after Douglas' field testing has been completed.

Douglas' advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the environmental and groundwater components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

This report provides specialist advice only and no part of it is considered a Regulated Design under the Design and Building Practitioner Act 2020 (NSW).

## Appendix A

About This Report

# About this Report

October 2024

## Introduction

These notes have been provided to amplify Douglas' report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

Douglas' reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

## Copyright



## Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

## Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, Douglas will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, Douglas cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, Douglas will be pleased to assist with investigations or advice to resolve the matter.

# About this Report

### Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, Douglas requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

### Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. Douglas would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

### Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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# Terminology, Symbols and Abbreviations

November 2023

## Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style XW. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

| Term | Description | Abbreviation Code |
|---|---|---|
| Core loss | No core recovery | KL |
| Unknown | Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned. | UK |
| No data | Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others | ND |
| Not Applicable | Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement | NA |

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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# Soil Descriptions

Terminology
Symbols
Abbreviations

March 2024

## Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:


The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

| Particle Size Designation | Particle Size (mm) | Behaviour Model | |
|---|---|---|---|
| | | Behaviour | Approximate Dry Mass |
| Boulder | >200 | Excluded from particle behaviour model as "oversize" | |
| Cobble | 63 - 200 | | |
| Gravel[1] | 2.36 - 63 | Coarse | >65% |
| Sand[1] | 0.075 - 2.36 | | |
| Silt | 0.002 - 0.075 | Fine | >35% |
| Clay | <0.002 | | |

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

| Component Proportion Designation | Definition[1] | Relative Proportion | |
|---|---|---|---|
| | | In Fine Grained Soil | In Coarse Grained Soil |
| Primary | The component (particle size designation, refer above) which dominates the engineering behaviour of the soil | The clay/silt component with the greater proportion | The sand/gravel component with the greater proportion |
| Secondary | Any component which is not the primary, but is significant to the engineering properties of the soil | Any component with greater than 30% proportion | Any granular component with greater than 30%; or Any fine component with greater than 12% |
| Minor[2] | Present in the soil, but not significant to its engineering properties | All other components | All other components |

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

# Soil Descriptions

## Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

## Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

| Component [1] | Prominence in Soil Name |
|---|---|
| Primary | Noun (eg "CLAY") |
| Secondary | Adjective modifier (eg "Sandy") |
| Minor | No influence |

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

## Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

| Minor Component Proportion Term | Relative Proportion | |
|---|---|---|
| | In Fine Grained Soil | In Coarse Grained Soil |
| With | All fractions: 15-30% | Clay/silt: 5-12%<br>sand/gravel: 15-30% |
| Trace | All fractions: 0-15% | Clay/silt: 0-5%<br>sand/gravel: 0-15% |

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

## Soil Composition

Plasticity

| Descriptive Term | Laboratory liquid limit range | |
|---|---|---|
| | Silt | Clay |
| Non-plastic materials | Not applicable | Not applicable |
| Low plasticity | ≤50 | ≤35 |
| Medium plasticity | Not applicable | >35 and ≤50 |
| High plasticity | >50 | >50 |

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

| Type | | Particle size (mm) |
|---|---|---|
| Gravel | Coarse | 19 - 63 |
| | Medium | 6.7 - 19 |
| | Fine | 2.36 – 6.7 |
| Sand | Coarse | 0.6 - 2.36 |
| | Medium | 0.21 - 0.6 |
| | Fine | 0.075 - 0.21 |

Grading

| Grading Term | Particle size (mm) |
|---|---|
| Well | A good representation of all particle sizes |
| Poorly | An excess or deficiency of particular sizes within the specified range |
| Uniformly | Essentially of one size |
| Gap | A deficiency of a particular size or size range within the total range |

Note, AS1726-2017 provides terminology for additional attributes not listed here.

## Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

| Applicability | Term | Tactile Assessment | Abbreviation code |
|---|---|---|---|
| Fine | Dry of plastic limit | Hard and friable or powdery | w<PL |
| | Near plastic limit | Can be moulded | w=PL |
| | Wet of plastic limit | Water residue remains on hands when handling | w>PL |
| | Near liquid limit | "oozes" when agitated | w=LL |
| | Wet of liquid limit | "oozes" | w>LL |
| Coarse | Dry | Non-cohesive and free running | D |
| | Moist | Feels cool, darkened in colour, particles may stick together | M |
| | Wet | Feels cool, darkened in colour, particles may stick together, free water forms when handling | W |

The abbreviation code NDF, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

| Consistency Term | Tactile Assessment | Undrained Shear Strength (kPa) | Abbreviation Code |
|---|---|---|---|
| Very soft | Extrudes between fingers when squeezed | <12 | VS |
| Soft | Mouldable with light finger pressure | >12 - ≤25 | S |
| Firm | Mouldable with strong finger pressure | >25 - ≤50 | F |
| Stiff | Cannot be moulded by fingers | >50 - ≤100 | St |
| Very stiff | Indented by thumbnail | >100 - ≤200 | VSt |
| Hard | Indented by thumbnail with difficulty | >200 | H |
| Friable | Easily crumbled or broken into small pieces by hand | - | Fr |

Relative Density (coarse grained soils)

| Relative Density Term | Density Index | Abbreviation Code |
|---|---|---|
| Very loose | <15 | VL |
| Loose | >15 - ≤35 | L |
| Medium dense | >35 - ≤65 | MD |
| Dense | >65 - ≤85 | D |
| Very dense | >85 | VD |

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

| Compaction Term | Abbreviation Code |
|---|---|
| Well compacted | WC |
| Poorly compacted | PC |
| Moderately compacted | MC |
| Variably compacted | VC |

Cementation (natural and anthropogenic)

| Cementation Term | Abbreviation Code |
|---|---|
| Moderately cemented | MOD |
| Weakly cemented | WEK |

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as "extremely weathered material" in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

## Soil Origin

| Term | Description | Abbreviation Code |
|---|---|---|
| Residual | Derived from in-situ weathering of the underlying rock | RS |
| Extremely weathered material | Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock. | XWM |
| Alluvial | Deposited by streams and rivers | ALV |
| Fluvial | Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin) | FLV |
| Estuarine | Deposited in coastal estuaries | EST |
| Marine | Deposited in a marine environment | MAR |
| Lacustrine | Deposited in freshwater lakes | LAC |
| Aeolian | Carried and deposited by wind | AEO |
| Colluvial | Soil and rock debris transported down slopes by gravity | COL |
| Slopewash | Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water | SW |
| Topsoil | Mantle of surface soil, often with high levels of organic material | TOP |
| Fill | Any material which has been moved by man | FILL |
| Littoral | Deposited on the lake or seashore | LIT |
| Unidentifiable | Not able to be identified | UID |

## Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

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## Rock Strength

Rock strength is defined by the unconfined compressive strength, and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $I_{s(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

| Strength Term | Unconfined Compressive Strength (MPa) | Point Load Index[1] $I_{s(50)}$ MPa | Abbreviation Code |
|---|---|---|---|
| Very low | 0.6 - 2 | 0.03 - 0.1 | VL |
| Low | 2 - 6 | 0.1 - 0.3 | L |
| Medium | 6 - 20 | 0.3 - 1.0 | M |
| High | 20 - 60 | 1 - 3 | H |
| Very high | 60 - 200 | 3 - 10 | VH |
| Extremely high | >200 | >10 | EH |

[1] Rock strength classification is based on UCS. The UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site. The point load Index ranges shown above are as suggested in AS1726 and should not be relied upon without supporting evidence.

The following abbreviation codes are used for soil layers or seams of material "within rock" but for which the equivalent UCS strength is less than 0.6 MPa.

| Scenario | Abbreviation Code |
|---|---|
| The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The properties of the material encountered over this interval are described in the "Description of Strata" and soil properties columns. | SOIL |
| The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The prominence of the material is such that it can be considered to be a seam (as defined in Table 22 of AS1726-2017) and the properties of the material are described in the defect column. | SEAM |

## Degree of Weathering

The degree of weathering of rock is classified as follows:

| Weathering Term | Description | Abbreviation Code |
|---|---|---|
| Residual Soil[1] | Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported. | RS |
| Extremely weathered[1] | Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible | XW |
| Highly weathered | The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores. | HW |
| Moderately weathered | The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock. | MW |
| Slightly weathered | Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock. | SW |
| Fresh | No signs of decomposition or staining. | FR |
| Note: If HW and MW cannot be differentiated use DW (see below) | | |
| Distinctly weathered | Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores. | DW |

[1] The parent rock type, of which the residual/extremely weathered material is a derivative, will be stated in the description (where discernible).

## Degree of Alteration

The degree of alteration of the rock material (physical or chemical changes caused by hot gasses or liquids at depth) is classified as follows:

| Term | Description | Abbreviation Code |
|---|---|---|
| Extremely altered | Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible. | XA |
| Highly altered | The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching or may be decreased due to precipitation of secondary materials in pores. | HA |
| Moderately altered | The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock. | MA |
| Slightly altered | Rock is slightly discoloured but shows little or no change of strength from fresh rock | SA |
| Note: If HA and MA cannot be differentiated use DA (see below) | | |
| Distinctly altered | Rock strength usually changed by alteration. The rock may be highly discoloured, usually by staining or bleaching. Porosity may be increased by leaching or may be decreased due to precipitation of secondary minerals in pores. | DA |

## Degree of Fracturing

The following descriptive classification apply to the spacing of natural occurring fractures in the rock mass. It includes bedding plane partings, joints and other defects, but excludes drilling breaks. These terms are generally not required on investigation logs where fracture spacing is presented as a histogram, and where used are presented in an unabbreviated format.

| Term | Description |
|---|---|
| Fragmented | Fragments of <20 mm |
| Highly Fractured | Core lengths of 20-40 mm with occasional fragments |
| Fractured | Core lengths of 30-100 mm with occasional shorter and longer sections |
| Slightly Fractured | Core lengths of 300 mm or longer with occasional sections of 100-300 mm |
| Unbroken | Core contains very few fractures |

## Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections > 100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e., drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

## Stratification Spacing

These terms may be used to describe the spacing of bedding partings in sedimentary rocks. Where used, these terms are generally presented in an unabbreviated format

| Term | Separation of Stratification Planes |
|---|---|
| Thinly laminated | < 6 mm |
| Laminated | 6 mm to 20 mm |
| Very thinly bedded | 20 mm to 60 mm |
| Thinly bedded | 60 mm to 0.2 m |
| Medium bedded | 0.2 m to 0.6 m |
| Thickly bedded | 0.6 m to 2 m |
| Very thickly bedded | > 2 m |

## Defect Descriptions

Defect Type

| Term | Abbreviation Code |
|---|---|
| Bedding plane | B |
| Cleavage | CL |
| Crushed seam | CS |
| Crushed zone | CZ |
| Drilling break | DB |
| Decomposed seam | DS |
| Drill lift | DL |
| Extremely Weathered seam | EW |
| Fault | F |
| Fracture | FC |
| Fragmented | FG |
| Handling break | HB |
| Infilled seam | IS |
| Joint | JT |
| Lamination | LAM |
| Shear seam | SS |
| Shear zone | SZ |
| Vein | VN |
| Mechanical break | MB |
| Parting | P |
| Sheared Surface | S |

Rock Defect Orientation

| Term | Abbreviation Code |
|---|---|
| Horizontal | H |
| Vertical | V |
| Sub-horizontal | SH |
| Sub-vertical | SV |

Rock Defect Coating

| Term | Abbreviation Code |
|---|---|
| Clean | CN |
| Coating | CT |
| Healed | HE |
| Infilled | INF |
| Stained | SN |
| Tight | TI |
| Veneer | VNR |

Rock Defect Infill

| Term | Abbreviation Code |
|---|---|
| Calcite | CA |
| Carbonaceous | CBS |
| Clay | CLAY |
| Iron oxide | FE |
| Manganese | MN |
| Pyrite | Py |
| Secondary material | MS |
| Silt | M |
| Quartz | Qz |
| Unidentified material | MU |

Rock Defect Shape/Planarity

| Term | Abbreviation Code |
|---|---|
| Curved | CU |
| Discontinuous | DIS |
| Irregular | IR |
| Planar | PR |
| Stepped | ST |
| Undulating | UN |

Rock Defect Roughness

| Term | Abbreviation Code |
|---|---|
| Polished | PO |
| Rough | RF |
| Smooth | SM |
| Slickensided | SL |
| Very rough | VR |

Defect Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

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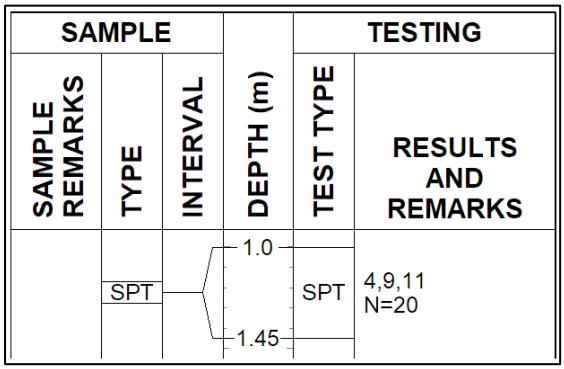
# Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

October 2024

## Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:




Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

| Sample Type | Code |
|---|---|
| Auger sample | A |
| Acid Sulfate sample | ASS |
| Bulk sample | B |
| Core sample | C |
| Disturbed sample | D |
| Environmental sample | ES |
| Driven Tube sample | DT |
| Gas sample | G |
| Piston sample | P |
| Sample from SPT test | SPT |
| Undisturbed tube sample | U[1] |
| Water sample | W |
| Material Sample | MT |
| Core sample for unconfined compressive strength testing | UCS |

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

| Test Type | Code |
|---|---|
| Pocket penetrometer (kPa) | PP |
| Photo ionisation detector (ppm) | PID |
| Standard Penetration Test<br>x/y =*x* blows for *y* mm penetration<br>HB = hammer bouncing<br>HW = fell under weight of hammer | SPT |
| Shear vane (kPa) | V |
| Unconfined compressive strength, (MPa) | UCS |

Field and laboratory testing (continued)

| Test Type | Code |
|---|---|
| Point load test, (MPa), axial (A), diametric (D), irregular (I) | PLT(_) |
| Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2) | DCP9/150 |
| Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3) | PSP/150 |

## Groundwater Observations

| | |
|---|---|
| ▷ | seepage/inflow |
| ▽ | standing or observed water level |
| NFGWO | no free groundwater observed |
| OBS | observations obscured by drilling fluids |

## Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

| Method | Abbreviation Code |
|---|---|
| Direct Push | DP |
| Solid flight auger. Suffixes:<br>/T = tungsten carbide tip,<br>/V = v-shaped tip | AD[1] |
| Air Track | AT |
| Diatube | DT[1] |
| Hand auger | HA[1] |
| Hand tools (unspecified) | HAND |
| Existing exposure | X |
| Hollow flight auger | HSA[1] |
| HQ coring | HQ3 |
| HMLC series coring | HMLC |
| NMLC series coring | NMLC |
| NQ coring | NQ3 |
| PQ coring | PQ3 |
| Predrilled | PD |
| Push tube | PT[1] |
| Ripping tyne/ripper | R |
| Rock roller | RR[1] |
| Rock breaker/hydraulic hammer | EH |
| Sonic drilling | SON[1] |
| Mud/blade bucket | MB[1] |
| Toothed bucket | TB[1] |
| Vibrocore | VC[1] |
| Vacuum excavation | VE |
| Wash bore (unspecified bit type) | WB[1] |

[1] – numeric suffixes indicate tool diameter/width in mm

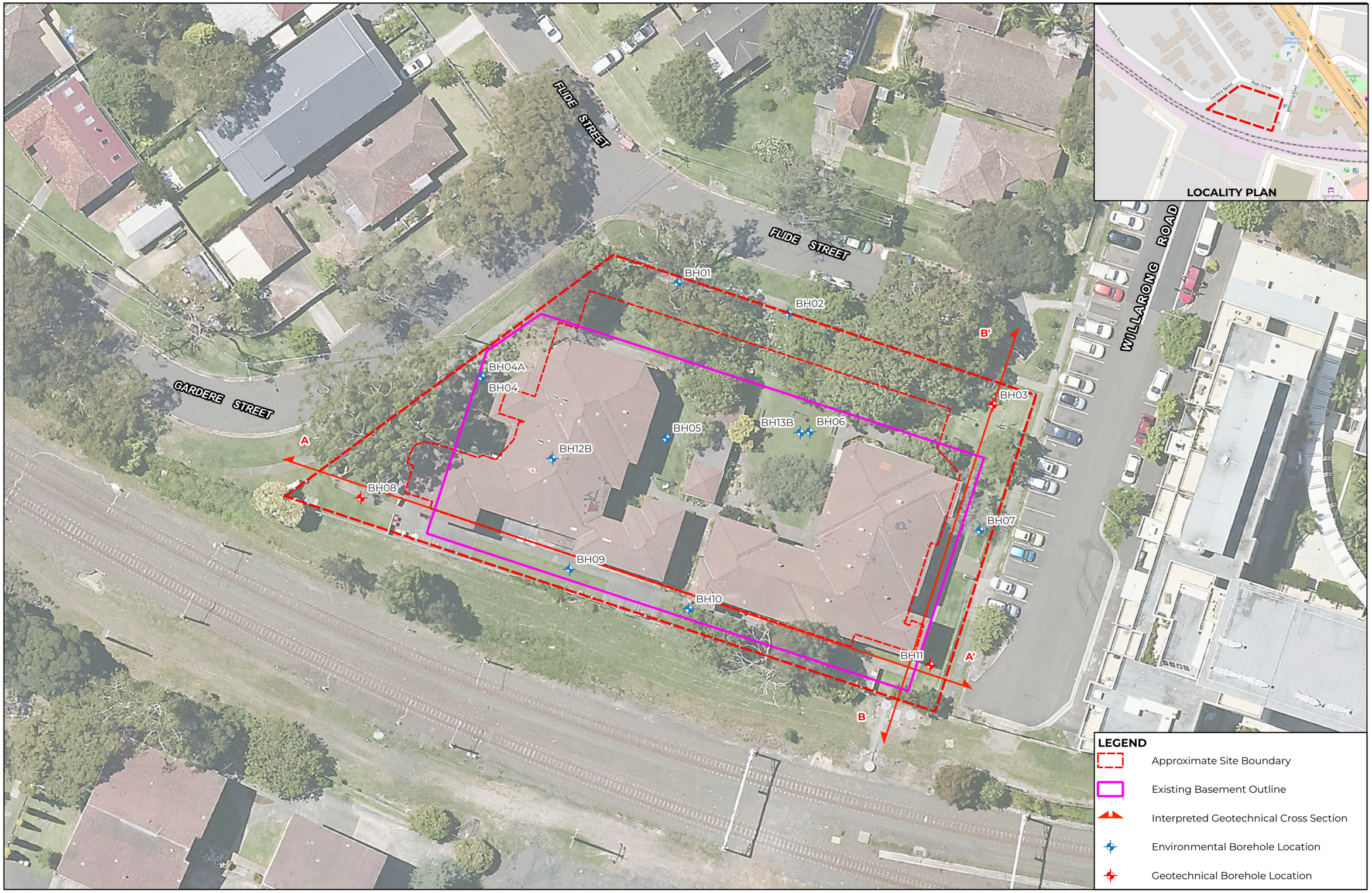




Douglas PARTNERS

## Appendix B

Drawings




| REV | DESCRIPTION/COMMENT | DATE | DRAWN BY |
|---|---|---|---|
| 0 | INITIAL ISSUE | 29.08.2025 | EC |
| | | | |
| | | | |

SCALE: 0 5 10 15 20 25 m
1:500 @ A3

Douglas PARTNERS
OFFICE: SYDNEY
96-98 Hermitage Rd, West Ryde NSW 2114
(02)9809 0666

CLIENT:
**Homes NSW**

NOTE:
1: Basemap from Metromap (Dated 15.12.2024)
2: Basement Outline from Norton Survey Partners, Reference 36313, Revision 1 (Dated 20.05.2025)

COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 56

PROJECT NAME:
**Flide Street, Caringbah, Affordable Housing**

PROJECT ADDRESS:
**2 Flide Street, Caringbah**

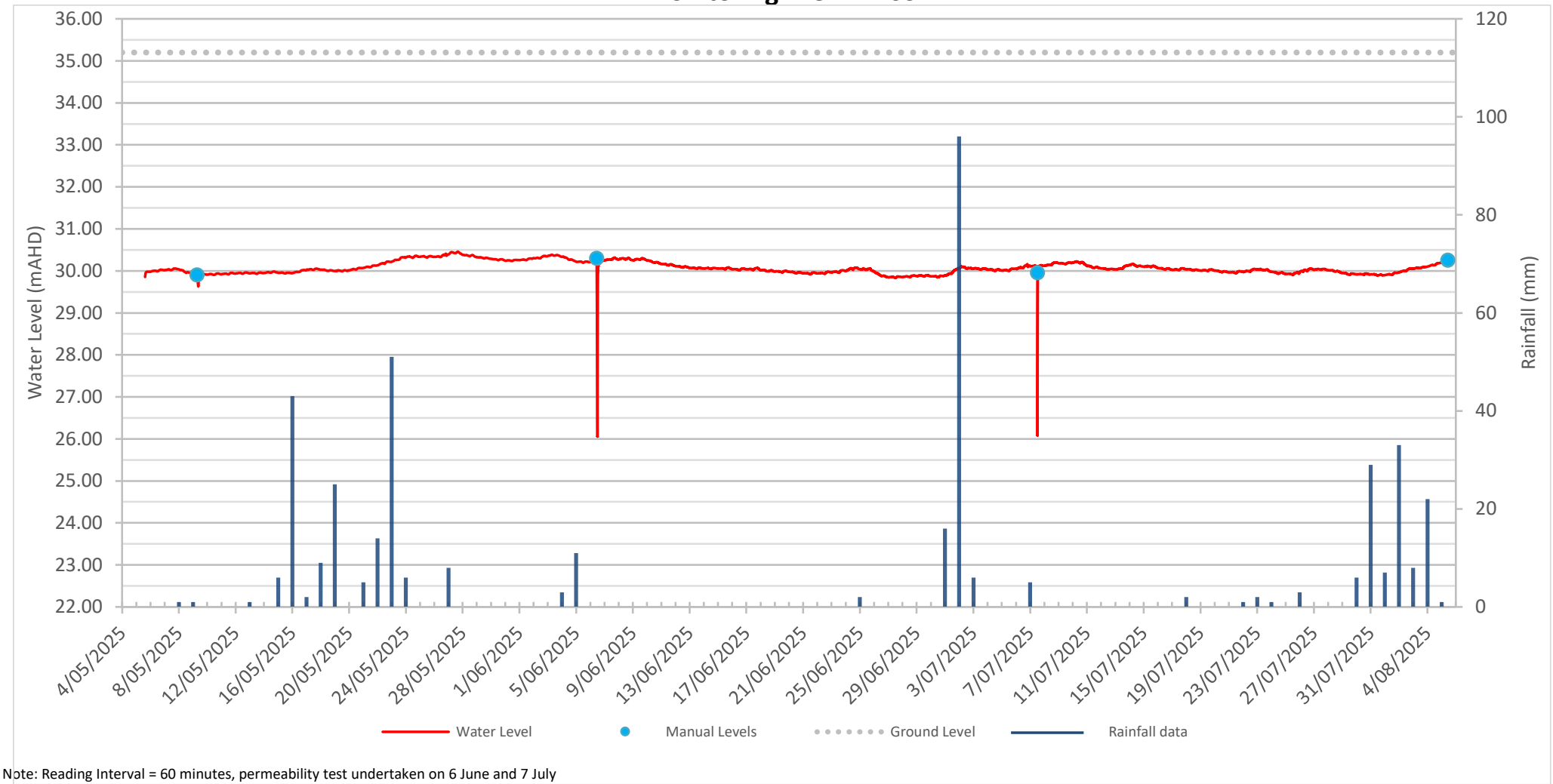
DRAWING TITLE:
**Test Location Plan**

PROJECT NO: **233414.03**
DRAWING NO: **1**
REVISION: **0**

## Appendix C

Groundwater monitoring results

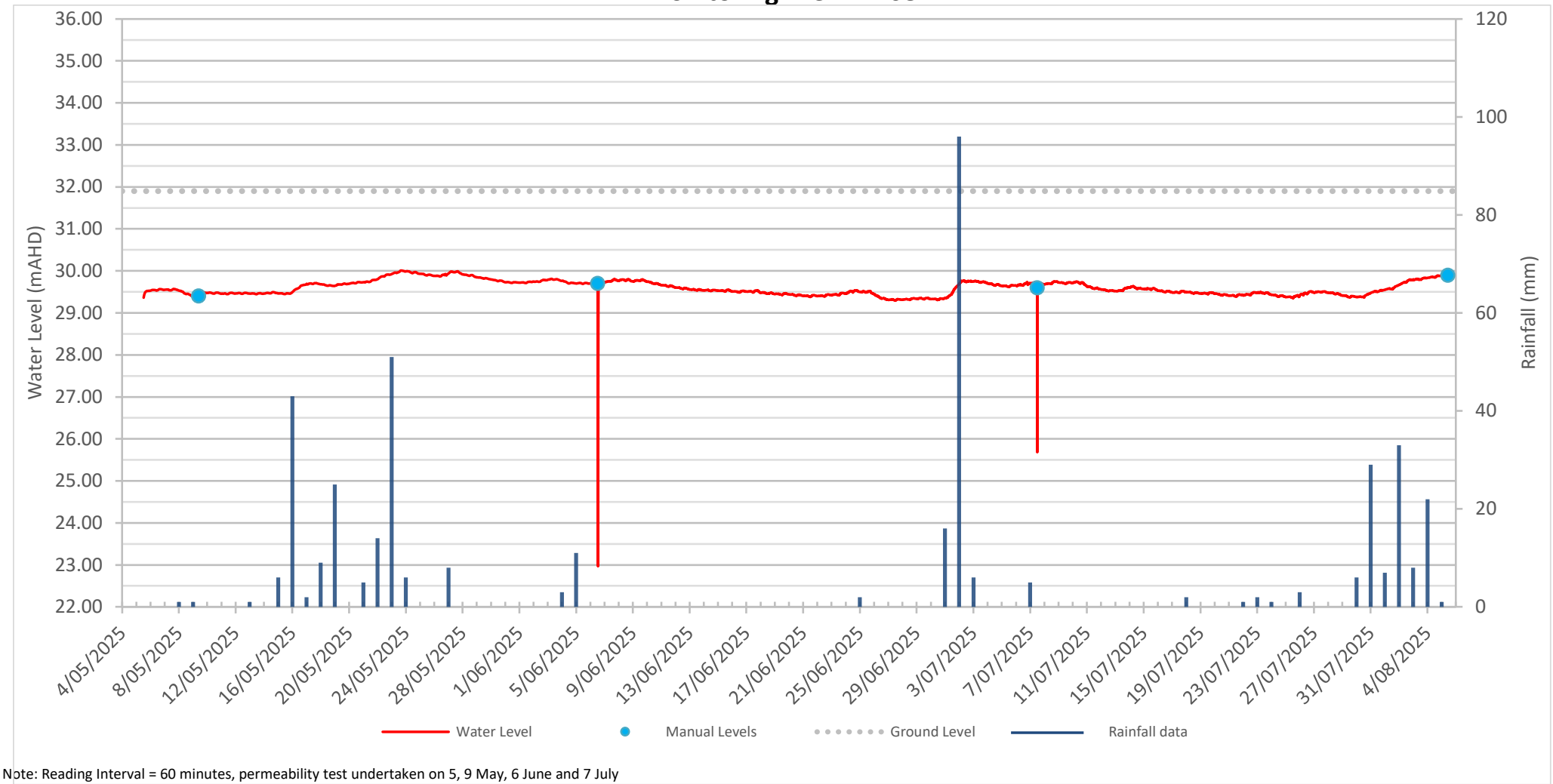
# Monitoring Well: BH03




Note: Reading Interval = 60 minutes, permeability test undertaken on 6 June and 7 July

| | | | |
|---|---|---|---|
| Douglas PARTNERS | **Client:** Homes NSW | **Project Number:** 233414.03 | **From** 5/05/2025 / **To:** 5/08/2025 |
| | **Address:** 2 Flide Street, Caringbah | | **Drawn:** LHS / **Date:** 25/08/2025 |

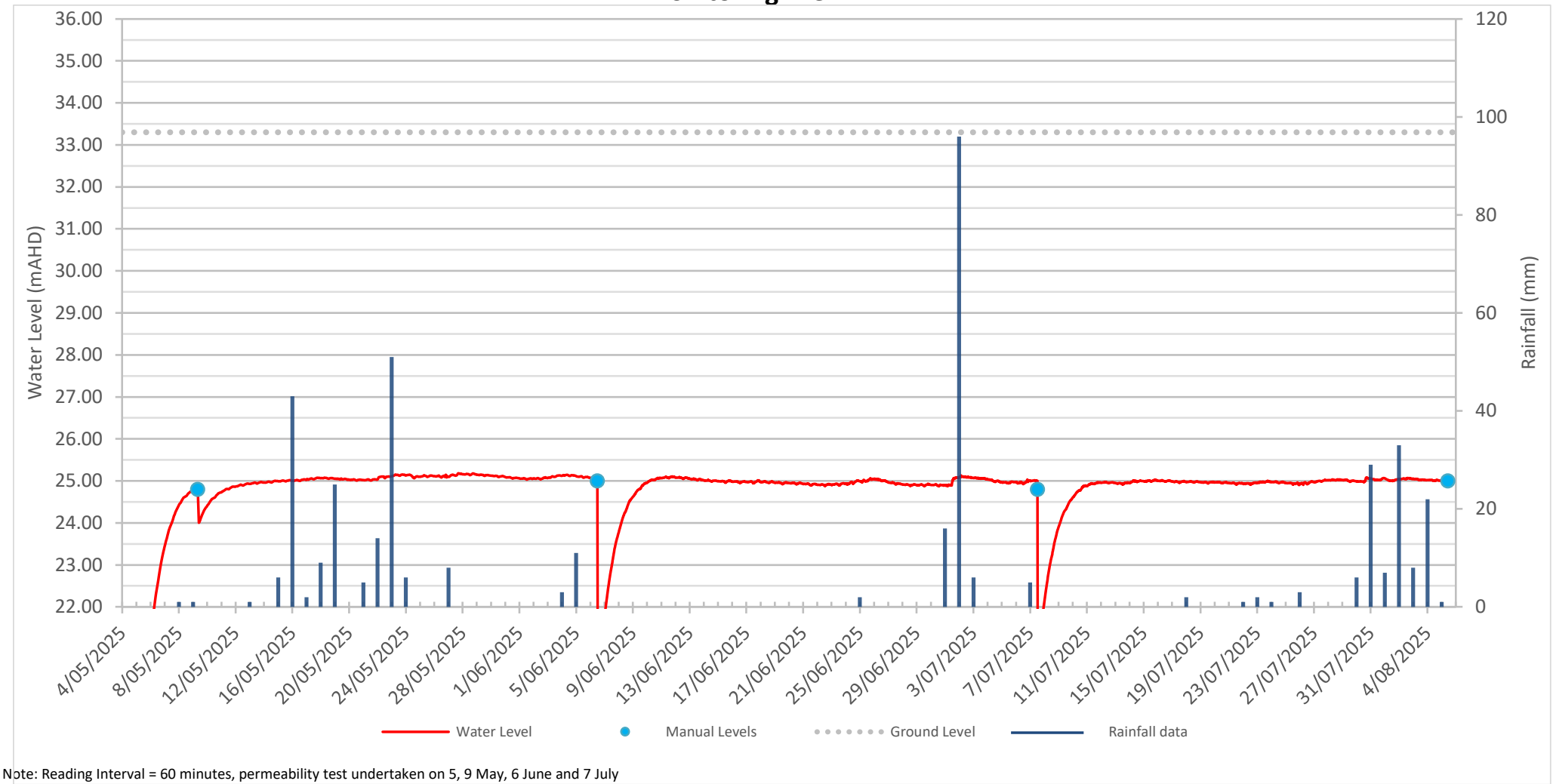
# Monitoring Well: BH08




Note: Reading Interval = 60 minutes, permeability test undertaken on 5, 9 May, 6 June and 7 July

| | | | |
|---|---|---|---|
| Douglas PARTNERS | **Client:** Homes NSW | **Project Number:** 233414.03 | **From** 5/05/2025 / **To:** 5/08/2025 |
| | **Address:** 2 Flide Street, Caringbah | | **Drawn:** LHS / **Date:** 25/08/2025 |

# Monitoring Well: BH11




Note: Reading Interval = 60 minutes, permeability test undertaken on 5, 9 May, 6 June and 7 July

| | | | |
|---|---|---|---|
| Douglas PARTNERS | **Client:** Homes NSW | **Project Number:** 233414.03 | **From** 5/05/2025 / **To:** 5/08/2025 |
| | **Address:** 2 Flide Street, Caringbah | | **Drawn:** LHS / **Date:** 25/08/2025 |

## Appendix D

Hydraulic conductivity test results

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au

# Permeability Testing - Rising Head Test Report

| | | | |
|---|---|---|---|
| Client: | Homes NSW | Project No: | 233414.03 |
| Project: | HAFF Project | Test date: | 6-Jun-25 |
| Location: | 2 Flide Street, Caringbah | Tested by: | JDS |

**Test Location**

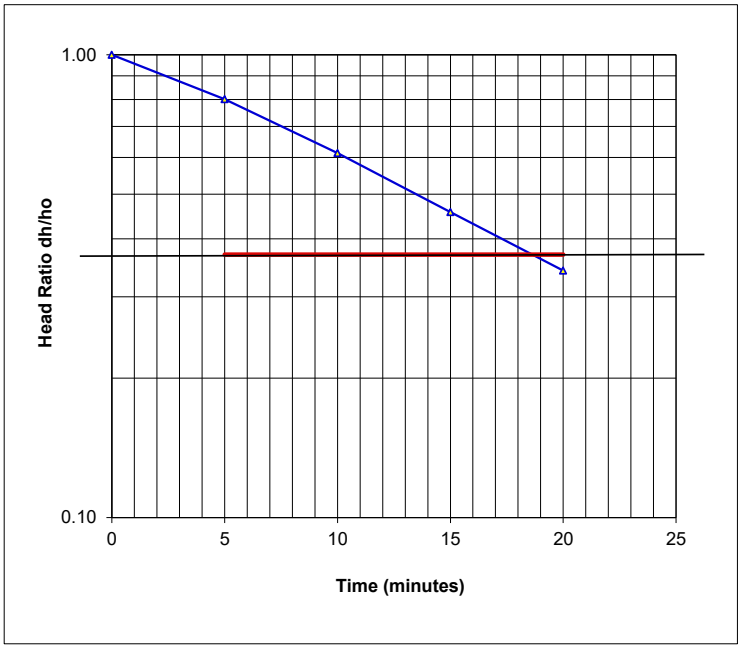
| | | | | |
|---|---|---|---|---|
| Description: | Standpipe in borehole | **Test No.** | BH03 | |
| Material type: | Sandstone | Easting: | 326452.1 | m |
| | | Northing | 6231726.3 | m |
| | | Surface Level: | 35.2 | m AHD |

**Details of Well Installation**

| | | | | | |
|---|---|---|---|---|---|
| Effective diameter (2re) | 96 | mm | Depth to water before test | 4.9 | m |
| borehole diameter (2R) | 96 | mm | Depth to water at start of test | 8.88 | m |
| Effective Length of well screen (Le) | 4.1 | m | Depth of top of gravel pack | 3.50 | m |
| | | | Depth of base of gravel pack | 9.00 | m |

**Test Results**

| Time (min) | Depth (m) | Change in Head δH (m) | δH/Ho |
|---|---|---|---|
| 0 | 8.88 | 3.98 | 1.000 |
| 5 | 8.09 | 3.19 | 0.802 |
| 10 | 7.34 | 2.44 | 0.613 |
| 15 | 6.72 | 1.82 | 0.457 |
| 20 | 6.26 | 1.36 | 0.342 |




To = 19 mins
1128 secs

**Theory:** Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

**Hydraulic Conductivity** **k = 1.1E-06** m/sec
**= 9.6E-02** m/day

Douglas Partners Pty Ltd
ABN 75 053 980 117
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# Permeability Testing - Rising Head Test Report

| | | | |
|---|---|---|---|
| Client: | Homes NSW | Project No: | 233414.03 |
| Project: | HAFF Project | Test date: | 7-Jul-25 |
| Location: | 2 Flide Street, Caringbah | Tested by: | LDS |

**Test Location**

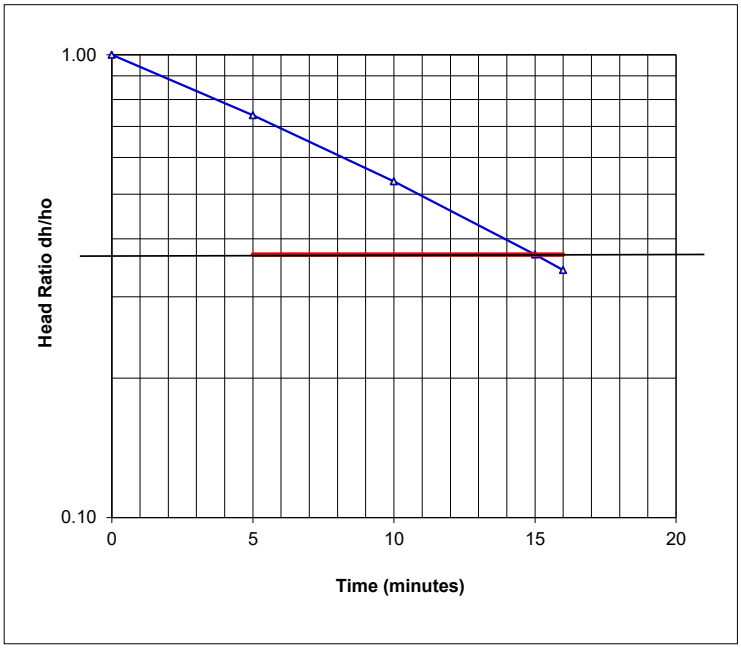
| | | | | |
|---|---|---|---|---|
| Description: | Standpipe in borehole | **Test No.** | BH03 | |
| Material type: | Sandstone | Easting: | 326452.1 | m |
| | | Northing | 6231726.3 | m |
| | | Surface Level: | 35.2 | m AHD |

**Details of Well Installation**

| | | | | | |
|---|---|---|---|---|---|
| Effective diameter (2re) | 96 | mm | Depth to water before test | 5.2 | m |
| borehole diameter (2R) | 96 | mm | Depth to water at start of test | 8.09 | m |
| Effective Length of well screen (Le) | 3.8 | m | Depth of top of gravel pack | 3.50 | m |
| | | | Depth of base of gravel pack | 9.00 | m |

**Test Results**

| Time (min) | Depth (m) | Change in Head δH (m) | δH/Ho |
|---|---|---|---|
| 0 | 8.09 | 2.89 | 1.000 |
| 5 | 7.34 | 2.14 | 0.740 |
| 10 | 6.74 | 1.54 | 0.533 |
| 15 | 6.27 | 1.07 | 0.370 |
| 16 | 6.19 | 0.99 | 0.343 |




To = 15 mins
900 secs

**Theory:** Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

**Hydraulic Conductivity** **k = 1.5E-06** m/sec
**= 1.3E-01** m/day

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# Permeability Testing - Rising Head Test Report

| | | | |
|---|---|---|---|
| Client: | Homes NSW | Project No: | 233414.03 |
| Project: | HAFF Project | Test date: | 6-Jun-25 |
| Location: | 2 Flide Street, Caringbah | Tested by: | JDS |

**Test Location**

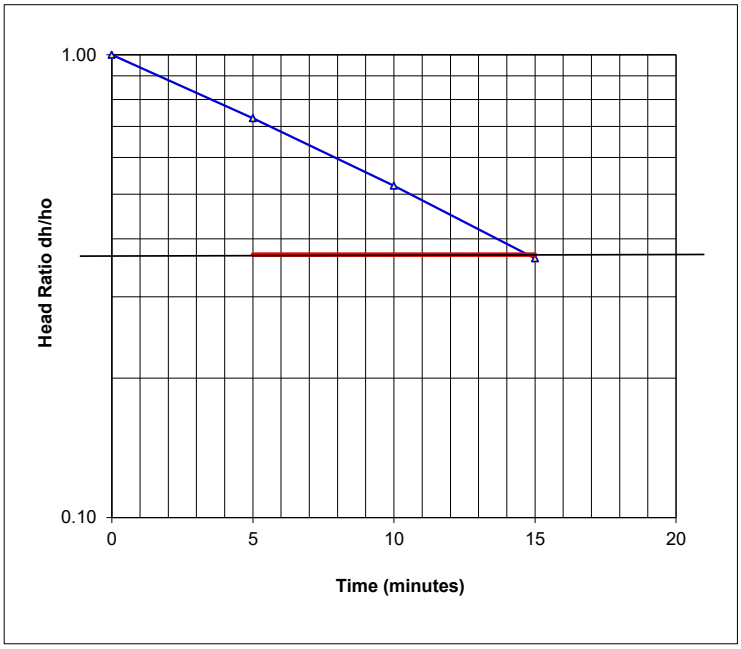
| | | | | |
|---|---|---|---|---|
| Description: | Standpipe in borehole | **Test No.** | BH08 | |
| Material type: | Sandstone | Easting: | 326364.0 | m |
| | | Northing | 6231713.3 | m |
| | | Surface Level: | 31.9 | m AHD |

**Details of Well Installation**

| | | | | | |
|---|---|---|---|---|---|
| Effective diameter (2re) | 52 | mm | Depth to water before test | 2.2 | m |
| borehole diameter (2R) | 96 | mm | Depth to water at start of test | 6.00 | m |
| Effective Length of well screen (Le) | 3.5 | m | Depth of top of gravel pack | 6.00 | m |
| | | | Depth of base of gravel pack | 9.50 | m |

**Test Results**

| Time (min) | Depth (m) | Change in Head δH (m) | δH/Ho |
|---|---|---|---|
| 0 | 6 | 3.80 | 1.000 |
| 5 | 4.97 | 2.77 | 0.729 |
| 10 | 4.18 | 1.98 | 0.521 |
| 15 | 3.58 | 1.38 | 0.363 |




To = 14.8 mins
888 secs

**Theory:** Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

**Hydraulic Conductivity** **k = 4.7E-07** m/sec
**= 4.0E-02** m/day

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# Permeability Testing - Rising Head Test Report

| | | | |
|---|---|---|---|
| Client: | Homes NSW | Project No: | 233414.03 |
| Project: | HAFF Project | Test date: | 7-Jul-25 |
| Location: | 2 Flide Street, Caringbah | Tested by: | LDS |

**Test Location**

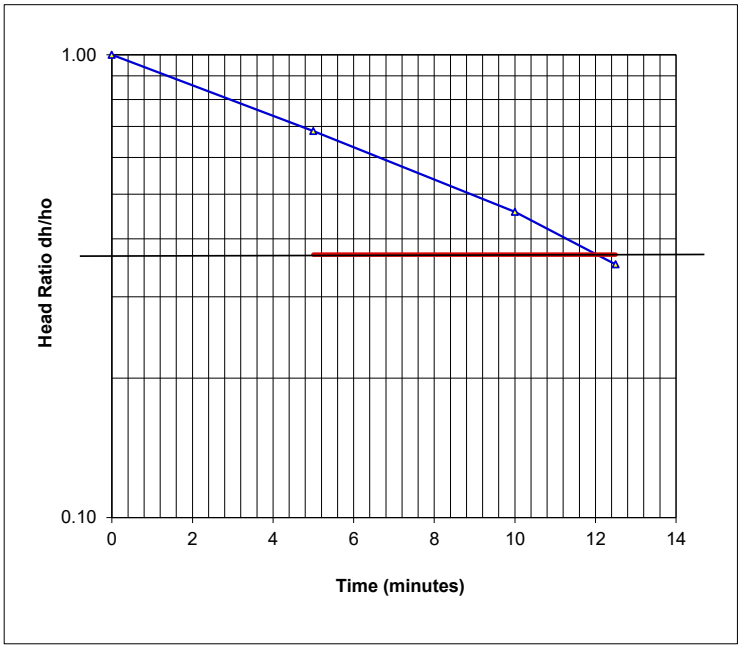
| | | | | |
|---|---|---|---|---|
| Description: | Standpipe in borehole | **Test No.** | BH08 | |
| Material type: | Sandstone | Easting: | 326364.0 | m |
| | | Northing | 6231713.3 | m |
| | | Surface Level: | 31.9 | m AHD |

**Details of Well Installation**

| | | | | | |
|---|---|---|---|---|---|
| Effective diameter (2re) | 52 | mm | Depth to water before test | 2.3 | m |
| borehole diameter (2R) | 96 | mm | Depth to water at start of test | 5.62 | m |
| Effective Length of well screen (Le) | 3.5 | m | Depth of top of gravel pack | 6.00 | m |
| | | | Depth of base of gravel pack | 9.50 | m |

**Test Results**

| Time (min) | Depth (m) | Change in Head δH (m) | δH/Ho |
|---|---|---|---|
| 0 | 5.62 | 3.32 | 1.000 |
| 5 | 4.57 | 2.27 | 0.684 |
| 10 | 3.82 | 1.52 | 0.458 |
| 12.5 | 3.47 | 1.17 | 0.352 |




To = 12.1 mins
726 secs

**Theory:** Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

**Hydraulic Conductivity** **k = 5.7E-07** m/sec
**= 4.9E-02** m/day

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# Permeability Testing - Rising Head Test Report

| | | | |
|---|---|---|---|
| Client: | Homes NSW | Project No: | 233414.03 |
| Project: | HAFF Project | Test date: | 6-Jun-25 |
| Location: | 2 Flide Street, Caringbah | Tested by: | JDS |

**Test Location**

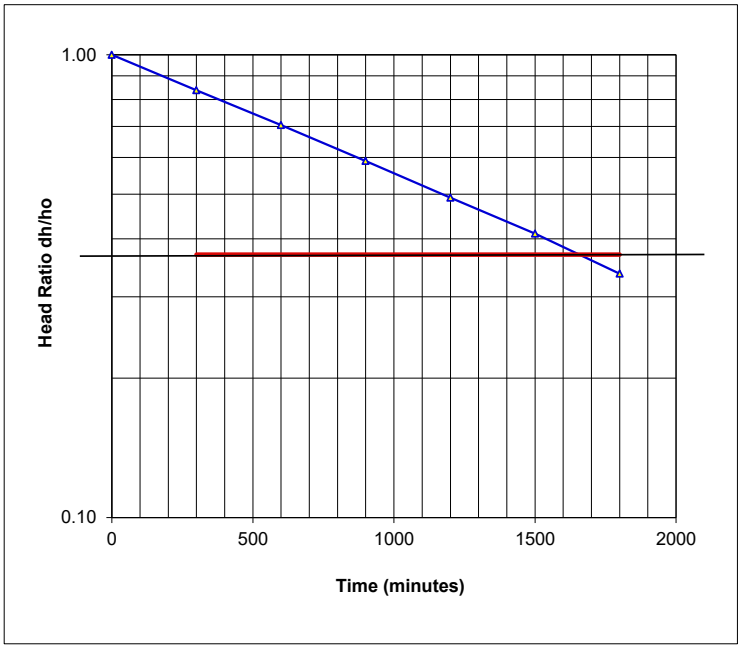
| | | | | |
|---|---|---|---|---|
| Description: | Standpipe in borehole | **Test No.** | BH11 | |
| Material type: | Sandstone | Easting: | 326443.4 | m |
| | | Northing | 6231690.0 | m |
| | | Surface Level: | 33.3 | m AHD |

**Details of Well Installation**

| | | | | | |
|---|---|---|---|---|---|
| Effective diameter (2re) | 96 | mm | Depth to water before test | 8.3 | m |
| borehole diameter (2R) | 96 | mm | Depth to water at start of test | 13.68 | m |
| Effective Length of well screen (Le) | 5.7 | m | Depth of top of gravel pack | 7.50 | m |
| | | | Depth of base of gravel pack | 14.00 | m |

**Test Results**

| Time (min) | Depth (m) | Change in Head δH (m) | δH/Ho |
|---|---|---|---|
| 0 | 13.68 | 5.38 | 1.000 |
| 300 | 12.81 | 4.51 | 0.838 |
| 600 | 12.09 | 3.79 | 0.704 |
| 900 | 11.47 | 3.17 | 0.589 |
| 1200 | 10.94 | 2.64 | 0.491 |
| 1500 | 10.51 | 2.21 | 0.411 |
| 1800 | 10.11 | 1.81 | 0.336 |




To = 1664 mins
99840 secs

**Theory:** Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

**Hydraulic Conductivity** **k = 9.7E-09** m/sec
**= 8.4E-04** m/day

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# Permeability Testing - Rising Head Test Report

| | | | |
|---|---|---|---|
| Client: | Homes NSW | Project No: | 233414.03 |
| Project: | HAFF Project | Test date: | 6-Jun-25 |
| Location: | 2 Flide Street, Caringbah | Tested by: | JDS |

**Test Location**

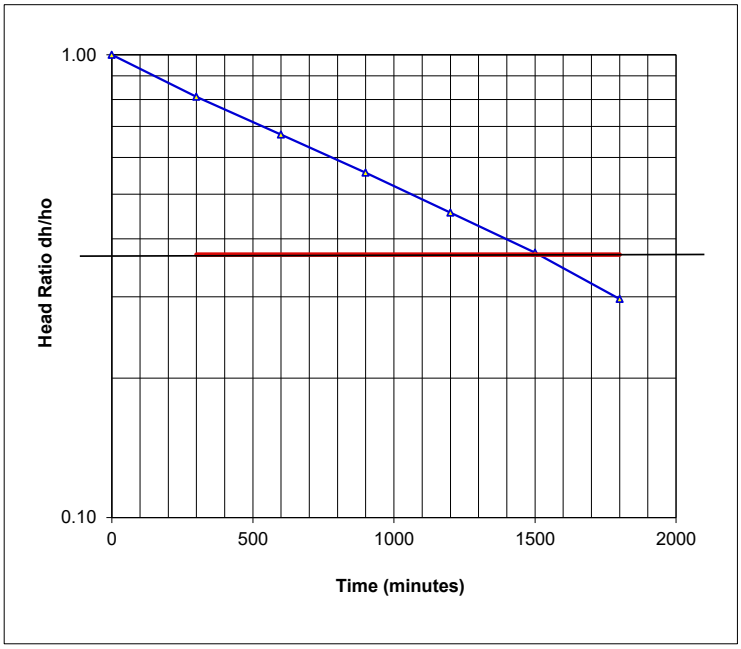
| | | | | |
|---|---|---|---|---|
| Description: | Standpipe in borehole | **Test No.** | BH11 | |
| Material type: | Sandstone | Easting: | 326443.4 | m |
| | | Northing | 6231690.0 | m |
| | | Surface Level: | 33.3 | m AHD |

**Details of Well Installation**

| | | | | | |
|---|---|---|---|---|---|
| Effective diameter (2re) | 96 | mm | Depth to water before test | 8.3 | m |
| borehole diameter (2R) | 96 | mm | Depth to water at start of test | 13.39 | m |
| Effective Length of well screen (Le) | 5.7 | m | Depth of top of gravel pack | 7.50 | m |
| | | | Depth of base of gravel pack | 14.00 | m |

**Test Results**

| Time (min) | Depth (m) | Change in Head δH (m) | δH/Ho |
|---|---|---|---|
| 0 | 13.39 | 5.09 | 1.000 |
| 300 | 12.43 | 4.13 | 0.811 |
| 600 | 11.72 | 3.42 | 0.672 |
| 900 | 11.13 | 2.83 | 0.556 |
| 1200 | 10.62 | 2.32 | 0.456 |
| 1500 | 10.20 | 1.90 | 0.373 |
| 1800 | 9.81 | 1.51 | 0.297 |




To = 1512 mins
90720 secs

**Theory:** Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

**Hydraulic Conductivity** **k = 1.1E-08** m/sec
**= 9.2E-04** m/day

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# Permeability Testing - Rising Head Test Report

| | | | |
|---|---|---|---|
| Client: | Homes NSW | Project No: | 233414.03 |
| Project: | HAFF Project | Test date: | 7-Jul-25 |
| Location: | 2 Flide Street, Caringbah | Tested by: | LDS |

**Test Location**

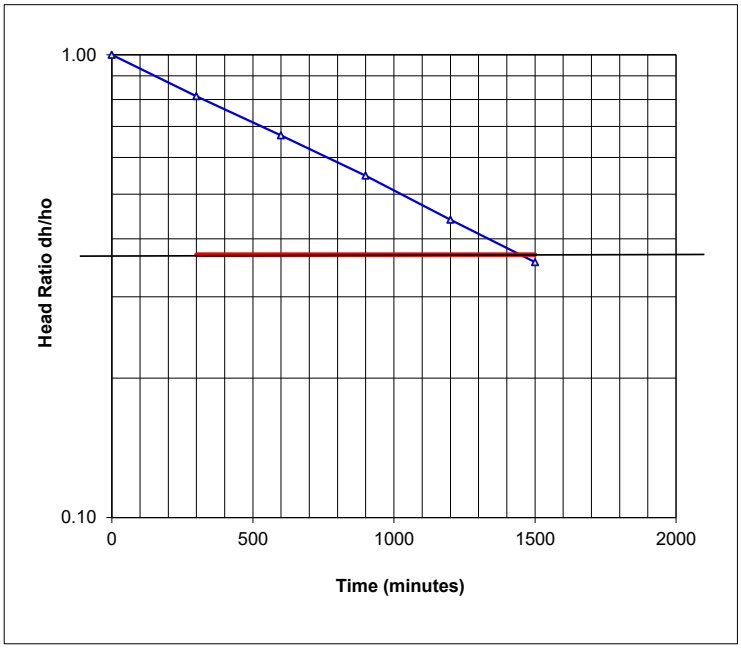
| | | | | |
|---|---|---|---|---|
| Description: | Standpipe in borehole | **Test No.** | BH11 | |
| Material type: | Sandstone | Easting: | 326443.4 | m |
| | | Northing | 6231690.0 | m |
| | | Surface Level: | 33.3 | m AHD |

**Details of Well Installation**

| | | | | | |
|---|---|---|---|---|---|
| Effective diameter (2re) | 96 | mm | Depth to water before test | 8.5 | m |
| borehole diameter (2R) | 96 | mm | Depth to water at start of test | 12.68 | m |
| Effective Length of well screen (Le) | 5.5 | m | Depth of top of gravel pack | 7.50 | m |
| | | | Depth of base of gravel pack | 14.00 | m |

**Test Results**

| Time (min) | Depth (m) | Change in Head δH (m) | δH/Ho |
|---|---|---|---|
| 0 | 12.68 | 4.18 | 1.000 |
| 300 | 11.90 | 3.40 | 0.813 |
| 600 | 11.30 | 2.80 | 0.670 |
| 900 | 10.79 | 2.29 | 0.548 |
| 1200 | 10.34 | 1.84 | 0.440 |
| 1500 | 9.99 | 1.49 | 0.356 |




To = 1450 mins
87000 secs

**Theory:** Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

**Hydraulic Conductivity** **k = 1.1E-08** m/sec
**= 9.9E-04** m/day

## Appendix E

Site Assessment Criteria(groundwater)

# 1. Introduction

## 1.1 Guidelines

The following key guidelines were consulted for deriving the water assessment criteria (WAC):

- ANZG *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018).
- NHMRC *Guidelines for Managing Risks In Recreational Water* (NHMRC, 2025).

## 1.2 Introduction

The water quality acceptance criteria (WAC) should be chosen based on the receiving receptor's water quality, relevant guidelines and regulatory authority's requirements.

Below are WAC with rationale of when each set of criteria should be applied, depending on the receiving receptor. Other potential discharge criteria may be adopted as applicable such as trade waste criteria by Sydney Water for discharge to sewer, or environmental protection licence limits for off-site disposal to a waste facility.

**Table 1: Groundwater investigation level rationale**

| Receptor / beneficial use | WAC | Source | Comments / rationale |
|---|---|---|---|
| Aquatic ecosystem | DGV | ANZG (2018) | For discharge that may impact freshwater surface water bodies.<br>Freshwater<br>99% LOP for bioaccumulative contaminants<br>95% LOP for non-bioaccumulative contaminants<br>Freshwater guidelines have been adopted based on groundwater parameters indicating the groundwater at the site is freshwater, as well as the ecological receptor (Kareena Creek) is a freshwater body. |
| | DTV | ANZECC (2000) | For discharge that may impact freshwater surface water bodies.<br>In lieu of specific water quality parameters in ANZG (2018), values are derived from adopting the upper range of the criteria for lowland rivers in south east Australia for a slightly disturbed ecosystem (ANZECC, 2000). |
| Recreational waters | GV | NHMRC (2025) | For discharge that may impact recreational waters.<br>Based on the NHMRC (2025) Australian drinking water guidelines values x10 (lower limit of recommended 10-20x) to account for ingestion of water whilst undertaking recreational activities. |

Notes: DGV default guideline value / DTV default trigger values / GV guideline value
% LOP percentage level of protection of species

### 1.3 WAC for analytes not covered by published guidelines

Not all analytes will have established WAC (such as hydrocarbons). The analysis of these should be assessed in consideration of the receiving water body and site specific discharge criteria established once the receiving water body is confirmed.

It is recommended that background concentrations of the receiving water body should be adopted as the discharge criteria.

In lieu of guidelines for hydrocarbons, the following is expected:

- Visually free of oil and grease.

### 1.4 WAC for freshwater aquatic ecosystems

The DGV for the protection of aquatic ecosystems derived from ANZG (2018) are in Table 2.

**Table 2: Groundwater investigation levels for protection of aquatic ecosystems (µg/L)**

| Contaminant | Freshwater DGV 95% LOP / DTV | Notes |
|---|---|---|
| **Metals / metalloids** | | |
| Arsenic | 24 / 13 | Levels provided for As III / As IV respectively. Moderate reliability. |
| Cadmium | 0.2 | Very high reliability. |
| Chromium (VI) | 1 | Chromium VI levels adopted as initial screen for total chromium. Very high reliability. |
| Copper | 1.4 | Very high reliability. |
| Lead | 3.4 | Moderate reliability. |
| Mercury (inorganic) | 0.06 | 99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability. |
| Nickel | 11 | Low reliability. |
| Zinc | 8 | Very high reliability. |
| **BTEX** | | |
| Benzene | 950 | Moderate reliability. |
| Ethylbenzene | 80 | Unknown reliability. |
| m-Xylene | 75 | Unknown reliability. |
| o-xylene | 350 | Low reliability. |
| p-Xylene | 200 | Low reliability. |
| Toluene | 180 | Unknown reliability. |

| Contaminant | Freshwater DGV 95% LOP / DTV | Notes |
|---|---|---|
| **PAH** | | |
| Anthracene | 0.01 | 99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability. |
| Benzo(a)pyrene | 0.1 | 99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability. |
| Fluoranthene | 1 | 99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability. |
| Naphthalene | 16 | Low reliability. |
| Phenanthrene | 0.6 | 99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability. |
| **OCP** | | |
| Aldrin | 0.001 | Unknown reliability and LOP. |
| Chlordane | 0.03 | 99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability. |
| DDT | 0.006 | 99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability. |
| Dieldrin | 0.01 | Unknown reliability and LOP. |
| Endosulfan | 0.03 | 99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability. |
| Endrin | 0.01 | 99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability. |
| Heptachlor | 0.01 | 99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability. |
| Methoxychlor | 0.005 | Unknown reliability and LOP. |
| **OPP** | | |
| Chlorpyrifos | 0.01 | Moderate reliability. |
| Diazinon | 0.01 | Moderate reliability. |
| Dimethoate | 0.15 | Low reliability. |
| Fenitrothion | 0.2 | Moderate reliability. |
| Malathion | 0.05 | Moderate reliability. |
| Parathion | 0.004 | Moderate reliability. |
| **PCB** | | |
| Aroclor 1242 | 0.3 | 99% LOP adopted as recommended due to potential for bioaccumulation. Low reliability. |

| Contaminant | Freshwater DGV 95% LOP / DTV | Notes |
|---|---|---|
| Aroclor 1254 | 0.01 | 99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability. |
| **VOC** | | |
| Tetrachloroethene (PCE) | 70 | Unknown reliability. |
| Trichloroethene (TCE) | 330 | Unknown reliability. |
| cis-1,2-dichloroethene (DCE) | 700 | Unknown reliability. |
| Chloroethene (vinyl chloride / VC) | 100 | Unknown reliability. |
| Tetrachloromethane (carbon tetrachloride / CT) | 240 | Unknown reliability. |
| Trichloromethane (chloroform / TCM) | 370 | 99% LOP adopted as recommended to protect key species from chronic toxicity. Unknown reliability. |
| **Inorganics** | | |
| Ammonia | 900 | Very high reliability. |
| Nitrate | | Very high reliability. |
| **Physical properties from ANZECC (2000) for lowland rivers in south east Australia** | | |
| Turbidity | 50 NTU | Can be assessed using a field probe or testing of total suspended solids (TSS). |
| pH | 6 – 8 pH | |
| Electrical conductivity | 125 – 2200 µS/cm | |

Notes: 95% LOP for non-bioaccumulative contaminants
99% LOP for bioaccumulative contaminants
.

### 1.5 WAC for recreational water

The GV for recreational water derived from NHMRC (2025) are in Table 4.

**Table 3: Groundwater investigation levels for protection of recreational waters (µg/L)**

| Contaminant | Recreational water guideline values |
|---|---|
| **Metals / metalloids** | |
| Arsenic | 100 |
| Cadmium | 20 |
| Chromium (VI) | 500 |
| Copper | 20000 |
| Lead | 50 |
| Manganese | 5000 |
| Mercury (inorganic) | 10 |
| Nickel | 200 |
| **BTEX** | |
| Benzene | 10 |
| Ethylbenzene | 3000 |
| Xylenes | 6000 |
| Toluene | 8000 |
| **PAH** | |
| Benzo(a)pyrene | 0.1 |
| **Phenols** | |
| Pentachlorophenol | 100 |
| **OCP** | |
| Aldrin + Dieldrin | 3 |
| Chlordane | 20 |
| DDT | 90 |
| Endosulfan | 200 |
| Heptachlor | 3 |
| Methoxychlor | 3000 |
| **OPP** | |
| Chlorpyrifos | 100 |
| Diazinon | 40 |
| Dimethoate | 70 |
| Fenitrothion | 70 |
| Malathion | 700 |

| Contaminant | Recreational water guideline values |
|---|---|
| Parathion | 200 |
| **VOC** | |
| Tetrachloroethene (PCE) | 500 |
| cis-1,2-dichloroethene (DCE) | 300 |
| Chloroethene (vinyl chloride / VC) | 3 |
| Tetrachloromethane (carbon tetrachloride / CT) | 30 |
| **Physical properties / aesthetics** | |
| pH | 6.5-8.5 (aesthetic only) |
| Dissolved oxygen | >80% saturation (aesthetic only) |

## 2. References

ANZECC. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australia New Zealand Environment Conservation Council.

ANZG. (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Canberra, ACT: Australian and New Zealand Governments and Australian state and territory governments.

NHMRC. (2025). *Guidelines for Managing Risks In Recreational Water.*

## Appendix F

Summary of Laboratory Test Results

Table F2: Summary of Laboratory Results – Groundwater Assessment

| Sample ID | | | | ANZG (2018) 95% LOP Fresh | NHMRC (2012) Recreation | NEPC (2013) HSL 2-4m | BH03 | BD1/20250509 | BH08 | BH11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | PQL | Units | | | | 08/05/25 | 08/05/25 | 08/05/25 | 08/05/25 |
| Metals & Metalloids - Dissolved | Total Arsenic | 1 | µg/L | 13 | 100 | | <1 | <1 | <1 | **1** |
| | Cadmium | 0.1 | µg/L | 0.2 | 20 | | <0.1 | <0.1 | <0.1 | <0.1 |
| | Total Chromium | 1 | µg/L | 1 | | | <1 | <1 | **1** | <1 |
| | Copper | 1 | µg/L | 1.4 | 20,000 | | **2** | **2** | **7** | **2** |
| | Lead | 1 | µg/L | 3.4 | 50 | | <1 | <1 | <1 | <1 |
| | Mercury (inorganic) | 0.05 | µg/L | 0.06 | 10 | | <0.05 | <0.05 | <0.05 | <0.05 |
| | Nickel | 1 | µg/L | 11 | 200 | | **3** | **3** | **9** | **24** |
| | Zinc | 1 | µg/L | 8 | | | **18** | **17** | **39** | **89** |
| Non-metallic Inorganics | Cyanide (total) | 4 | µg/L | 7 | 800 | | <4 | <4 | <4 | <4 |
| TRH | F1 ((C6-C10)-BTEX) | 10 | µg/L | | | NL | **10** | <10 | <10 | **26** |
| | F2 ( >C10-C16 less Naphthalene) | 50 | µg/L | | | NL | <50 | <50 | <50 | <50 |
| | F3 (>C16-C34) | 100 | µg/L | | | | <100 | <100 | <100 | <100 |
| | F4 (>C34-C40) | 100 | µg/L | | | | <100 | <100 | <100 | <100 |
| BTEX | Benzene | 1 | µg/L | 950 | 10 | 5,000 | <1 | <1 | <1 | <1 |
| | Toluene | 1 | µg/L | 180 | 8,000 | NL | <1 | <1 | <1 | <1 |
| | Ethylbenzene | 1 | µg/L | 80 | 3,000 | NL | <1 | <1 | <1 | <1 |
| | o-Xylene | 1 | µg/L | 350 | | | <1 | <1 | <1 | <1 |
| | m+p-Xylene | 2 | µg/L | 75 | | | <2 | <2 | <2 | <2 |
| | Total Xylenes | 1 | µg/L | | 6,000 | NL | <1 | <1 | <1 | <1 |
| Phenolics | Total Phenolics | 50 | µg/L | 320 | | | <50 | <50 | <50 | <50 |
| PAH | Sum of detected PAH | 0.1 | µg/L | 0.01 | | | <0.1 | <0.1 | <0.1 | <0.1 |
| OCP | Sum of detected OCP | 0.2 | µg/L | 0.0004 | | | <0.2 | <0.2 | <0.2 | <0.2 |
| OPP | Sum of detected OPP | 0.2 | µg/L | | | | <0.2 | <0.2 | <0.2 | <0.2 |
| PCB | Sum of detected PCB | 2 | µg/L | | | | <2 | <2 | <2 | <2 |
| VOC (excluding BTEX) | Bromodichloromethane | 1 | µg/L | | | | **2** | **2** | <1 | **3** |
| | Chloroethane | 10 | µg/L | | | | <10 | <10 | <10 | <10 |
| | Chloroethene (vinyl chloride / VC) | 10 | µg/L | 100 | 3 | | <10 | <10 | <10 | <10 |
| | Trichloromethane (chloroform / TCM) | 1 | µg/L | 770 | | | **7** | **6** | **1** | **23** |
| | Chloromethane | 10 | µg/L | | | | <10 | <10 | <10 | <10 |
| | Cyclohexane | 1 | µg/L | | | | <1 | <1 | <1 | **2** |
| | Dichlorodifluoromethane | 10 | µg/L | | | | <10 | <10 | <10 | <10 |
| | Bromomethane | 10 | µg/L | | 10 | | <10 | <10 | <10 | <10 |
| | Trichlorofluoromethane | 10 | µg/L | | | | <10 | <10 | <10 | <10 |
| | All other VOCs excluding BTEX analysed | 1 | µg/L | | | | <1 | <1 | <1 | <1 |
| | Sum of detected VOC | 1 | µg/L | | | | **9** | **8** | **1** | **28** |
| Nutrients | Nitrogen | 100 | µg/L | | | | **200** | - | **7,400** | **200** |
| | Ammonia as N | 5 | µg/L | 900 | | | **20** | - | **20** | **10** |
| | TKN in water | 100 | µg/L | | | | **100** | - | **6,800** | **100** |
| | Nitrate as N | 5 | µg/L | 2,600 | 500,000 | | **53** | - | **530** | **20** |
| | Nitrite as N | 5 | µg/L | | 30,000 | | **5** | - | **30** | **20** |
| | NOx as N | 5 | µg/L | | | | **58** | - | **560** | **30** |
| | Organic Nitrogen as N | 200 | µg/L | | | | <200 | - | **6,900** | <200 |
| | Phosphorous | 50 | µg/L | | | | <50 | - | <50 | <50 |
| Anions & Cations | Bicarbonate Alkalinity as CaCO3 | 5,000 | µg/L | | | | **13,000** | **11,000** | **10,000** | **30,000** |
| | Chloride | 1000 | µg/L | | | | **56,000** | **54,000** | **99,000** | **230,000** |
| | Hydroxide Alkalinity (OH-) as CaCO3 | 5,000 | µg/L | | | | <5000 | <5000 | <5000 | <5000 |
| | Ionic Balance | | mg/kg | | | | **-10,000** | **10,000** | **70,000** | **30,000** |
| | Sulphate | 1000 | µg/L | | | | **48,000** | **47,000** | **88,000** | **40,000** |
| | Total Alkalinity as CaCO3 | 5,000 | µg/L | | | | **13,000** | **11,000** | **10,000** | **30,000** |
| | Calcium | 500 | µg/L | | | | **6,100** | **6,400** | **3,000** | **15,000** |
| | Magnesium | 500 | µg/L | | | | **5,000** | **5,000** | **6,800** | **17,000** |
| | Potassium | 500 | µg/L | | | | **2,000** | **2,000** | **1000** | **3,000** |
| | Sodium | 500 | µg/L | | | | **46,000** | **46,000** | **110,000** | **140,000** |
| Faecal Coliforms | E.Coli | 5,000 | cfu/100ml | | | | <18 | <18 | <100 | <1000 |
| | Faecal Coliforms | 5,000 | cfu/100ml | | | | <18 | <18 | <100 | <1000 |
| Other Parameters | Total dissolved solids | 5,000 | µg/L | | | | **190,000** | - | **490,000** | **660,000** |
| | Total suspended solids | 5,000 | µg/L | | | | **460,000** | - | **170,000** | **66,000** |
| | pH | - | pH units | | | | **5.6** | - | **5.4** | **6.1** |
| | Electrical conductivity | 1 | µS/cm | | | | **370** | - | **710** | **1100** |

**Notes:**

| | |
|---|---|
| - | No criterion / not defined / not tested / not applicable |
| * | QA/QC replicate of sample listed directly below the primary sample |
| NL | Not limiting |
| PQL | Practical quantitation limit |
| | Shaded cell is exceedance of guideline value |
| | Where one or more guideline value is exceeded, the cell is shaded to the colour of the highest guideline value exceeded |
| | NEPC (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013), health screening level Clay 2-4m |
| | ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 95% level of protection of species for Fresh aquatic ecosystems [NB: 99% level of protection adopted for bioaccumulative chemicals] |
| | ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 95% level of protection of species for Fresh aquatic ecosystems [NB: 99% level of protection adopted for bioaccumulative chemicals] |
| | NHMRC (2008) Guidelines for Managing Risk in Recreational Water |
| | ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, orange text is 'unknown' level of protection |
| | Underlining of ANZG (2018) criteria indicates a criteria with an 'unknown' level of protection. |
| | ANZG (2018) DGV adopted for most conservative species of following analytes: DGV for xylene (m) adopted for xylene (m+p); DGV for CrVI adopted for total chromium; DGV for AsV adopted for total arsenic |
| | ANZG (2018) DGV adopted for aluminium in freshwater is for receiving waters with pH >6.5. For receiving waters with pH <6.5 suitability of the more conservative, low reliability DGV of unknown LOP should be considered |
| | ANZG (2018) Ammonia DGV is pH and temperature dependant. DGV for a pH of 8 provided in table. |

**Appendix G**

Laboratory Reports

**Envirolab Services Pty Ltd**
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

# CERTIFICATE OF ANALYSIS 380179

## Client Details

| | |
|---|---|
| **Client** | Douglas Partners Pty Ltd |
| **Attention** | Lisa Teng |
| **Address** | 96 Hermitage Rd, West Ryde, NSW, 2114 |

## Sample Details

| | |
|---|---|
| **Your Reference** | **233414.04 CARINGBAH** |
| **Number of Samples** | 6 Water |
| **Date samples received** | 09/05/2025 |
| **Date completed instructions received** | 09/05/2025 |

## Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

**Please refer to the last page of this report for any comments relating to the results.**

## Report Details

| | |
|---|---|
| **Date results requested by** | 16/05/2025 |
| **Date of Issue** | 16/05/2025 |

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

**Results Approved By**
Diego Bigolin, Inorganics Supervisor
Giovanni Agosti, Group Technical Manager
Greta Petzold, Operation Manager
Jenny He, Inorganic Team Leader
Timothy Toll, Senior Chemist

**Authorised By**
Nancy Zhang, Laboratory Manager

| VOCs in water | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date Extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 14/05/2025 |
| Date Analysed | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 15/05/2025 |
| Dichlorodifluoromethane | µg/L | <10 | <10 | <10 | <10 |
| Chloromethane | µg/L | <10 | <10 | <10 | <10 |
| Vinyl Chloride | µg/L | <10 | <10 | <10 | <10 |
| Bromomethane | µg/L | <10 | <10 | <10 | <10 |
| Chloroethane | µg/L | <10 | <10 | <10 | <10 |
| Trichlorofluoromethane | µg/L | <10 | <10 | <10 | <10 |
| 1,1-Dichloroethene | µg/L | <1 | <1 | <1 | <1 |
| Trans-1,2-dichloroethene | µg/L | <1 | <1 | <1 | <1 |
| 1,1-dichloroethane | µg/L | <1 | <1 | <1 | <1 |
| Cis-1,2-dichloroethene | µg/L | <1 | <1 | <1 | <1 |
| Bromochloromethane | µg/L | <1 | <1 | <1 | <1 |
| Chloroform | µg/L | 7 | 1 | 23 | 6 |
| 2,2-dichloropropane | µg/L | <1 | <1 | <1 | <1 |
| 1,2-dichloroethane | µg/L | <1 | <1 | <1 | <1 |
| 1,1,1-trichloroethane | µg/L | <1 | <1 | <1 | <1 |
| 1,1-dichloropropene | µg/L | <1 | <1 | <1 | <1 |
| Cyclohexane | µg/L | <1 | <1 | 2 | <1 |
| Carbon tetrachloride | µg/L | <1 | <1 | <1 | <1 |
| Benzene | µg/L | <1 | <1 | <1 | <1 |
| Dibromomethane | µg/L | <1 | <1 | <1 | <1 |
| 1,2-dichloropropane | µg/L | <1 | <1 | <1 | <1 |
| Trichloroethene | µg/L | <1 | <1 | <1 | <1 |
| Bromodichloromethane | µg/L | 2 | <1 | 3 | 2 |
| trans-1,3-dichloropropene | µg/L | <1 | <1 | <1 | <1 |
| cis-1,3-dichloropropene | µg/L | <1 | <1 | <1 | <1 |
| 1,1,2-trichloroethane | µg/L | <1 | <1 | <1 | <1 |
| Toluene | µg/L | <1 | <1 | <1 | <1 |
| 1,3-dichloropropane | µg/L | <1 | <1 | <1 | <1 |
| Dibromochloromethane | µg/L | <1 | <1 | <1 | <1 |
| 1,2-dibromoethane | µg/L | <1 | <1 | <1 | <1 |
| Tetrachloroethene | µg/L | <1 | <1 | <1 | <1 |
| 1,1,1,2-tetrachloroethane | µg/L | <1 | <1 | <1 | <1 |
| Chlorobenzene | µg/L | <1 | <1 | <1 | <1 |
| Ethylbenzene | µg/L | <1 | <1 | <1 | <1 |

| VOCs in water | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Bromoform | µg/L | <1 | <1 | <1 | <1 |
| m+p-xylene | µg/L | <2 | <2 | <2 | <2 |
| Styrene | µg/L | <1 | <1 | <1 | <1 |
| 1,1,2,2-tetrachloroethane | µg/L | <1 | <1 | <1 | <1 |
| o-xylene | µg/L | <1 | <1 | <1 | <1 |
| 1,2,3-trichloropropane | µg/L | <1 | <1 | <1 | <1 |
| Isopropylbenzene | µg/L | <1 | <1 | <1 | <1 |
| Bromobenzene | µg/L | <1 | <1 | <1 | <1 |
| n-propyl benzene | µg/L | <1 | <1 | <1 | <1 |
| 2-chlorotoluene | µg/L | <1 | <1 | <1 | <1 |
| 4-chlorotoluene | µg/L | <1 | <1 | <1 | <1 |
| 1,3,5-trimethyl benzene | µg/L | <1 | <1 | <1 | <1 |
| Tert-butyl benzene | µg/L | <1 | <1 | <1 | <1 |
| 1,2,4-trimethyl benzene | µg/L | <1 | <1 | <1 | <1 |
| 1,3-dichlorobenzene | µg/L | <1 | <1 | <1 | <1 |
| Sec-butyl benzene | µg/L | <1 | <1 | <1 | <1 |
| 1,4-dichlorobenzene | µg/L | <1 | <1 | <1 | <1 |
| 4-isopropyl toluene | µg/L | <1 | <1 | <1 | <1 |
| 1,2-dichlorobenzene | µg/L | <1 | <1 | <1 | <1 |
| n-butyl benzene | µg/L | <1 | <1 | <1 | <1 |
| 1,2-dibromo-3-chloropropane | µg/L | <1 | <1 | <1 | <1 |
| 1,2,4-trichlorobenzene | µg/L | <1 | <1 | <1 | <1 |
| Hexachlorobutadiene | µg/L | <1 | <1 | <1 | <1 |
| 1,2,3-trichlorobenzene | µg/L | <1 | <1 | <1 | <1 |
| *Surrogate* Dibromofluoromethane | % | 102 | 102 | 103 | 103 |
| *Surrogate* Toluene-d8 | % | 101 | 100 | 101 | 100 |
| *Surrogate* 4-Bromofluorobenzene | % | 95 | 94 | 95 | 97 |

| vTRH(C6-C10)/BTEXN in Water | | | | | | |
|---|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 | 380179-5 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 | TS/20250508 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water | Water |
| Date extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 14/05/2025 | 12/05/2025 |
| Date analysed | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 15/05/2025 | 13/05/2025 |
| TRH $C_6$ - $C_9$ | µg/L | <10 | <10 | 22 | <10 | [NA] |
| TRH $C_6$ - $C_{10}$ | µg/L | 10 | <10 | 26 | <10 | [NA] |
| TRH $C_6$ - $C_{10}$ less BTEX (F1) | µg/L | 10 | <10 | 26 | <10 | [NA] |
| Benzene | µg/L | <1 | <1 | <1 | <1 | 87% |
| Toluene | µg/L | <1 | <1 | <1 | <1 | 91% |
| Ethylbenzene | µg/L | <1 | <1 | <1 | <1 | 89% |
| m+p-xylene | µg/L | <2 | <2 | <2 | <2 | 90% |
| o-xylene | µg/L | <1 | <1 | <1 | <1 | 89% |
| Naphthalene | µg/L | <1 | <1 | <1 | <1 | [NA] |
| *Surrogate* Dibromofluoromethane | % | 102 | 102 | 103 | 103 | 100 |
| *Surrogate* Toluene-d8 | % | 101 | 100 | 101 | 100 | 100 |
| *Surrogate* 4-Bromofluorobenzene | % | 95 | 94 | 95 | 97 | 100 |

| vTRH(C6-C10)/BTEXN in Water | | |
|---|---|---|
| Our Reference | | 380179-6 |
| Your Reference | UNITS | TB/20250508 |
| Date Sampled | | 08/05/2025 |
| Type of sample | | Water |
| Date extracted | - | 12/05/2025 |
| Date analysed | - | 13/05/2025 |
| TRH $C_6$ - $C_9$ | µg/L | <10 |
| TRH $C_6$ - $C_{10}$ | µg/L | <10 |
| TRH $C_6$ - $C_{10}$ less BTEX (F1) | µg/L | <10 |
| Benzene | µg/L | <1 |
| Toluene | µg/L | <1 |
| Ethylbenzene | µg/L | <1 |
| m+p-xylene | µg/L | <2 |
| o-xylene | µg/L | <1 |
| Naphthalene | µg/L | <1 |
| *Surrogate* Dibromofluoromethane | % | 102 |
| *Surrogate* Toluene-d8 | % | 101 |
| *Surrogate* 4-Bromofluorobenzene | % | 96 |

| svTRH (C10-C40) in Water | | | | | |
|---|---|---|---|---|---|
| Our Reference | UNITS | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| TRH $C_{10}$ - $C_{14}$ | µg/L | <50 | <50 | <50 | <50 |
| TRH $C_{15}$ - $C_{28}$ | µg/L | <100 | <100 | <100 | <100 |
| TRH $C_{29}$ - $C_{36}$ | µg/L | <100 | <100 | <100 | <100 |
| Total +ve TRH (C10-C36) | µg/L | <50 | <50 | <50 | <50 |
| TRH >$C_{10}$ - $C_{16}$ | µg/L | <50 | <50 | <50 | <50 |
| TRH >$C_{10}$ - $C_{16}$ less Naphthalene (F2) | µg/L | <50 | <50 | <50 | <50 |
| TRH >$C_{16}$ - $C_{34}$ | µg/L | <100 | <100 | <100 | <100 |
| TRH >$C_{34}$ - $C_{40}$ | µg/L | <100 | <100 | <100 | <100 |
| Total +ve TRH (>C10-C40) | µg/L | <50 | <50 | <50 | <50 |
| *Surrogate* o-Terphenyl | % | 82 | 83 | 85 | 83 |

| PAHs in Water | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 13/05/2025 |
| Naphthalene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Acenaphthylene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Acenaphthene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Fluorene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Phenanthrene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Anthracene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Fluoranthene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Pyrene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Benzo(a)anthracene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Chrysene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Benzo(b,j+k)fluoranthene | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Benzo(a)pyrene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Indeno(1,2,3-c,d)pyrene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Dibenzo(a,h)anthracene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Benzo(g,h,i)perylene | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Benzo(a)pyrene TEQ | µg/L | <0.5 | <0.5 | <0.5 | <0.5 |
| Total +ve PAH's | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| *Surrogate p*-Terphenyl-d14 | % | 80 | 68 | 72 | 92 |

| Organochlorine Pesticides in Water | | | | | |
|---|---|---|---|---|---|
| Our Reference | UNITS | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 13/05/2025 |
| alpha-BHC | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| HCB | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| beta-BHC | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| gamma-BHC | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Heptachlor | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| delta-BHC | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Aldrin | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Heptachlor Epoxide | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| gamma-Chlordane | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| alpha-Chlordane | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Endosulfan I | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| pp-DDE | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Dieldrin | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Endrin | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Endosulfan II | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| pp-DDD | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Endrin Aldehyde | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| pp-DDT | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Endosulfan Sulphate | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Methoxychlor | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Mirex | ug/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Surrogate 4-Chloro-3-NBTF | % | 106 | 79 | 92 | 109 |

| OP Pesticides in Water | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 13/05/2025 |
| Dichlorvos | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Mevinphos | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Phorate | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Dimethoate | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Diazinon | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Disulfoton | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Chlorpyriphos-methyl | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Parathion-Methyl | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Ronnel | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Fenitrothion | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Malathion | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Chlorpyriphos | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Fenthion | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Parathion | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Bromophos ethyl | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Methidathion | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Fenamiphos | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Ethion | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Phosalone | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Azinphos-methyl (Guthion) | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| Coumaphos | µg/L | <0.2 | <0.2 | <0.2 | <0.2 |
| *Surrogate* 4-Chloro-3-NBTF | % | 106 | 79 | 92 | 109 |

| PCBs in Water | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 13/05/2025 |
| Aroclor 1016 | µg/L | <2 | <2 | <2 | <2 |
| Aroclor 1221 | µg/L | <2 | <2 | <2 | <2 |
| Aroclor 1232 | µg/L | <2 | <2 | <2 | <2 |
| Aroclor 1242 | µg/L | <2 | <2 | <2 | <2 |
| Aroclor 1248 | µg/L | <2 | <2 | <2 | <2 |
| Aroclor 1254 | µg/L | <2 | <2 | <2 | <2 |
| Aroclor 1260 | µg/L | <2 | <2 | <2 | <2 |
| *Surrogate* 2-Fluorobiphenyl | % | 106 | 80 | 87 | 110 |

| Total Phenolics in Water | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date extracted | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Total Phenolics (as Phenol) | mg/L | <0.05 | <0.05 | <0.05 | <0.05 |

| HM in water - dissolved | | | | | |
|---|---|---|---|---|---|
| Our Reference | UNITS | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date prepared | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 12/05/2025 | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Arsenic-Dissolved | µg/L | <1 | <1 | 1 | <1 |
| Cadmium-Dissolved | µg/L | <0.1 | <0.1 | <0.1 | <0.1 |
| Chromium-Dissolved | µg/L | <1 | 1 | <1 | <1 |
| Copper-Dissolved | µg/L | 2 | 7 | 2 | 2 |
| Lead-Dissolved | µg/L | <1 | <1 | <1 | <1 |
| Mercury-Dissolved | µg/L | <0.05 | <0.05 | <0.05 | <0.05 |
| Nickel-Dissolved | µg/L | 3 | 9 | 24 | 3 |
| Zinc-Dissolved | µg/L | 18 | 39 | 89 | 17 |

| Metals in Waters - Acid extractable | | | | |
|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 |
| Your Reference | UNITS | BH03 | BH08 | BH11 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water |
| Date prepared | - | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Date analysed | - | 12/05/2025 | 12/05/2025 | 12/05/2025 |
| Phosphorus - Total | mg/L | <0.05 | <0.05 | <0.05 |

| Ion Balance | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | UNITS | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date prepared | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 13/05/2025 |
| Date analysed | - | 13/05/2025 | 13/05/2025 | 13/05/2025 | 13/05/2025 |
| Calcium - Dissolved | mg/L | 6.1 | 3 | 15 | 6.4 |
| Potassium - Dissolved | mg/L | 2 | 1 | 3 | 2 |
| Sodium - Dissolved | mg/L | 46 | 110 | 140 | 46 |
| Magnesium - Dissolved | mg/L | 5.0 | 6.8 | 17 | 5 |
| Hardness (calc) equivalent $CaCO_3$ | mg/L | 36 | 36 | 110 | 36 |
| Hydroxide Alkalinity ($OH^-$) as $CaCO_3$ | mg/L | <5 | <5 | <5 | <5 |
| Bicarbonate Alkalinity as $CaCO_3$ | mg/L | 13 | 10 | 30 | 11 |
| Carbonate Alkalinity as $CaCO_3$ | mg/L | <5 | <5 | <5 | <5 |
| Total Alkalinity as $CaCO_3$ | mg/L | 13 | 10 | 30 | 11 |
| Sulphate, SO4 | mg/L | 48 | 88 | 40 | 47 |
| Chloride, Cl | mg/L | 56 | 99 | 230 | 54 |
| Ionic Balance | % | -1.0 | 7.0 | 3.0 | 1.0 |

| Miscellaneous Inorganics | | | | | |
|---|---|---|---|---|---|
| Our Reference | UNITS | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date prepared | - | 09/05/2025 | 09/05/2025 | 09/05/2025 | 09/05/2025 |
| Date analysed | - | 09/05/2025 | 09/05/2025 | 09/05/2025 | 09/05/2025 |
| pH | pH Units | 5.6 | 5.4 | 6.1 | [NA] |
| Electrical Conductivity | µS/cm | 370 | 710 | 1,100 | [NA] |
| Total Suspended Solids | mg/L | 460 | 170 | 66 | [NA] |
| Total Dissolved Solids (grav) | mg/L | 190 | 490 | 660 | [NA] |
| Total Cyanide | mg/L | <0.004 | <0.004 | <0.004 | <0.004 |
| Nitrate as N in water | mg/L | 0.053 | 0.53 | 0.02 | [NA] |
| Nitrite as N in water | mg/L | 0.005 | 0.03 | 0.02 | [NA] |
| NOx as N in water | mg/L | 0.058 | 0.56 | 0.03 | [NA] |
| Ammonia as N in water | mg/L | 0.02 | 0.02 | 0.01 | [NA] |
| Organic Nitrogen as N | mg/L | <0.2 | 6.9 | <0.2 | [NA] |
| TKN in water | mg/L | 0.1 | 6.8 | 0.1 | [NA] |
| Total Nitrogen in water | mg/L | 0.2 | 7.4 | 0.2 | [NA] |
| Phosphate as P in water | mg/L | 0.01 | 0.006 | <0.005 | [NA] |

| Microbiological Testing | | | | | |
|---|---|---|---|---|---|
| Our Reference | UNITS | 380179-1 | 380179-2 | 380179-3 | 380179-4 |
| Your Reference | | BH03 | BH08 | BH11 | BD1/20250509 |
| Date Sampled | | 08/05/2025 | 08/05/2025 | 08/05/2025 | 08/05/2025 |
| Type of sample | | Water | Water | Water | Water |
| Date of testing | - | 10/05/2025 | 10/05/2025 | 10/05/2025 | 10/05/2025 |
| E. coli | cfu/100mL | <18 mpn/100mL | <100 | <1000 | <18 mpn/100mL |
| Faecal Coliforms | cfu/100mL | <18 mpn/100mL | <100 | <1000 | <18 mpn/100mL |

| Method ID | Methodology Summary |
|---|---|
| **Ext-008** | Subcontracted to Sonic Food & Water Testing. NATA Accreditation No. 4034. |
| **Inorg-001** | pH - Measured using pH meter and electrode. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times. |
| **Inorg-002** | Conductivity and Salinity - measured using a conductivity cell. |
| **Inorg-006** | Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B. |
| **Inorg-014** | Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish).<br><br>Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis.<br><br>Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H. |
| **Inorg-018** | Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-10°C.<br><br>NOTE: Where the EC of the sample is <100µS/cm, the TDS will typically be below 70mg/L (as the sample is very likely to be at least drinking water quality). Therefore to ensure data quality for TDS, the TDS is typically calculated as per the equation below:-<br><br>TDS = EC * 0.6 |
| **Inorg-019** | Suspended Solids - determined gravimetricially by filtration of the sample. The samples are dried at 104+/-5°C. |
| **Inorg-031** | Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish).<br>Solids are extracted in a caustic media prior to analysis. |
| **Inorg-040** | The concentrations of the major ions (mg/L) are converted to milliequivalents and summed. The ionic balance should be within +/- 15% ie total anions = total cations +/-15%. |
| **Inorg-055** | Nitrate - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction. |
| **Inorg-055** | Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction. |
| **Inorg-055/062/127** | Total Nitrogen - Calculation sum of TKN and oxidised Nitrogen. Alternatively analysed by combustion and chemiluminescence. |
| **Inorg-057** | Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction. |
| **Inorg-060** | Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction. |
| **Inorg-062** | TKN - determined colourimetrically based on APHA latest edition 4500 Norg. Alternatively, TKN can be derived from calculation (Total N - NOx). |

| Method ID | Methodology Summary |
|---|---|
| **Inorg-081** | Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis.<br>Alternatively determined by colourimetry/turbidity using Discrete Analyser. |
| **Metals-020** | Determination of various metals by ICP-AES.<br><br>Total Phosphate determined stochiometrically from Phosphorus (assumed to be present as Phosphate).<br><br>Where salts (oxides, chlorides etc.) are calculated from the element concentration stoichiometrically there is no guarantee that the salt form is completely soluble in the acids used in the preparation. |
| **Metals-021** | Determination of Mercury by Cold Vapour AAS. |
| **Metals-022** | Determination of various metals by ICP-MS.<br><br>Please note for Bromine and Iodine, any forms of these elements that are present are included together in the one result reported for each of these two elements.<br><br>Where salts (oxides, chlorides etc.) are calculated from the element concentration stoichiometrically there is no guarantee that the salt form is completely soluble in the acids used in the preparation. |
| **Org-020** | Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.<br>F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. |
| **Org-021/022/025** | Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD and/or GC-MS/GC-MSMS.<br>Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs. |
| **Org-022/025** | Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. |
| **Org-022/025** | Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. |
| **Org-023** | Water samples are analysed directly by purge and trap GC-MS. |
| **Org-023** | Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. |

| QUALITY CONTROL: VOCs in water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | [NT] |
| Date Extracted | - | | | 14/05/2025 | 1 | 12/05/2025 | 13/05/2025 | | 14/05/2025 | [NT] |
| Date Analysed | - | | | 15/05/2025 | 1 | 13/05/2025 | 14/05/2025 | | 15/05/2025 | [NT] |
| Dichlorodifluoromethane | µg/L | 10 | Org-023 | <10 | 1 | <10 | <10 | 0 | [NT] | [NT] |
| Chloromethane | µg/L | 10 | Org-023 | <10 | 1 | <10 | <10 | 0 | [NT] | [NT] |
| Vinyl Chloride | µg/L | 10 | Org-023 | <10 | 1 | <10 | <10 | 0 | [NT] | [NT] |
| Bromomethane | µg/L | 10 | Org-023 | <10 | 1 | <10 | <10 | 0 | [NT] | [NT] |
| Chloroethane | µg/L | 10 | Org-023 | <10 | 1 | <10 | <10 | 0 | [NT] | [NT] |
| Trichlorofluoromethane | µg/L | 10 | Org-023 | <10 | 1 | <10 | <10 | 0 | [NT] | [NT] |
| 1,1-Dichloroethene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Trans-1,2-dichloroethene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,1-dichloroethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 93 | [NT] |
| Cis-1,2-dichloroethene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Bromochloromethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Chloroform | µg/L | 1 | Org-023 | <1 | 1 | 7 | 9 | 25 | 97 | [NT] |
| 2,2-dichloropropane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,2-dichloroethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 100 | [NT] |
| 1,1,1-trichloroethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 95 | [NT] |
| 1,1-dichloropropene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Cyclohexane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Carbon tetrachloride | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 94 | [NT] |
| Dibromomethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,2-dichloropropane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Trichloroethene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 103 | [NT] |
| Bromodichloromethane | µg/L | 1 | Org-023 | <1 | 1 | 2 | 3 | 40 | 90 | [NT] |
| trans-1,3-dichloropropene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| cis-1,3-dichloropropene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,1,2-trichloroethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Toluene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 96 | [NT] |
| 1,3-dichloropropane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Dibromochloromethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 95 | [NT] |
| 1,2-dibromoethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Tetrachloroethene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 101 | [NT] |
| 1,1,1,2-tetrachloroethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Chlorobenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Ethylbenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 95 | [NT] |
| Bromoform | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| m+p-xylene | µg/L | 2 | Org-023 | <2 | 1 | <2 | <2 | 0 | 97 | [NT] |
| Styrene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,1,2,2-tetrachloroethane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |

| QUALITY CONTROL: VOCs in water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | [NT] |
| o-xylene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 97 | [NT] |
| 1,2,3-trichloropropane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Isopropylbenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Bromobenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| n-propyl benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 2-chlorotoluene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 4-chlorotoluene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,3,5-trimethyl benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Tert-butyl benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,2,4-trimethyl benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,3-dichlorobenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Sec-butyl benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,4-dichlorobenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 4-isopropyl toluene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,2-dichlorobenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| n-butyl benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,2-dibromo-3-chloropropane | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,2,4-trichlorobenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| Hexachlorobutadiene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| 1,2,3-trichlorobenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| *Surrogate* Dibromofluoromethane | % | | Org-023 | 100 | 1 | 102 | 99 | 3 | 101 | [NT] |
| *Surrogate* Toluene-d8 | % | | Org-023 | 100 | 1 | 101 | 99 | 2 | 102 | [NT] |
| *Surrogate* 4-Bromofluorobenzene | % | | Org-023 | 101 | 1 | 95 | 93 | 2 | 109 | [NT] |

| QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | [NT] |
| Date extracted | - | | | 14/05/2025 | 1 | 12/05/2025 | 13/05/2025 | | 14/05/2025 | [NT] |
| Date analysed | - | | | 15/05/2025 | 1 | 13/05/2025 | 14/05/2025 | | 15/05/2025 | [NT] |
| TRH $C_6$ - $C_9$ | µg/L | 10 | Org-023 | <10 | 1 | <10 | <10 | 0 | 96 | [NT] |
| TRH $C_6$ - $C_{10}$ | µg/L | 10 | Org-023 | <10 | 1 | 10 | <10 | 0 | 96 | [NT] |
| Benzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 94 | [NT] |
| Toluene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 96 | [NT] |
| Ethylbenzene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 95 | [NT] |
| m+p-xylene | µg/L | 2 | Org-023 | <2 | 1 | <2 | <2 | 0 | 97 | [NT] |
| o-xylene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | 97 | [NT] |
| Naphthalene | µg/L | 1 | Org-023 | <1 | 1 | <1 | <1 | 0 | [NT] | [NT] |
| *Surrogate* Dibromofluoromethane | % | | Org-023 | 100 | 1 | 102 | 99 | 3 | 101 | [NT] |
| *Surrogate* Toluene-d8 | % | | Org-023 | 100 | 1 | 101 | 99 | 2 | 102 | [NT] |
| *Surrogate* 4-Bromofluorobenzene | % | | Org-023 | 101 | 1 | 95 | 93 | 2 | 109 | [NT] |

| QUALITY CONTROL: svTRH (C10-C40) in Water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | [NT] |
| Date extracted | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | [NT] |
| Date analysed | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | [NT] |
| TRH $C_{10}$ - $C_{14}$ | µg/L | 50 | Org-020 | <50 | 1 | <50 | <50 | 0 | 92 | [NT] |
| TRH $C_{15}$ - $C_{28}$ | µg/L | 100 | Org-020 | <100 | 1 | <100 | <100 | 0 | 99 | [NT] |
| TRH $C_{29}$ - $C_{36}$ | µg/L | 100 | Org-020 | <100 | 1 | <100 | <100 | 0 | 86 | [NT] |
| TRH >$C_{10}$ - $C_{16}$ | µg/L | 50 | Org-020 | <50 | 1 | <50 | <50 | 0 | 92 | [NT] |
| TRH >$C_{16}$ - $C_{34}$ | µg/L | 100 | Org-020 | <100 | 1 | <100 | <100 | 0 | 99 | [NT] |
| TRH >$C_{34}$ - $C_{40}$ | µg/L | 100 | Org-020 | <100 | 1 | <100 | <100 | 0 | 86 | [NT] |
| *Surrogate* o-Terphenyl | % | | Org-020 | 73 | 1 | 82 | 84 | 2 | 103 | [NT] |

| QUALITY CONTROL: PAHs in Water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W3 | 380179-2 |
| Date extracted | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | 12/05/2025 |
| Date analysed | - | | | 13/05/2025 | 1 | 13/05/2025 | 13/05/2025 | | 13/05/2025 | 13/05/2025 |
| Naphthalene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 73 | 78 |
| Acenaphthylene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | [NT] | [NT] |
| Acenaphthene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 72 | 76 |
| Fluorene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 72 | 75 |
| Phenanthrene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 74 | 77 |
| Anthracene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | [NT] | [NT] |
| Fluoranthene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 75 | 74 |
| Pyrene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 76 | 75 |
| Benzo(a)anthracene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | [NT] | [NT] |
| Chrysene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 62 | 64 |
| Benzo(b,j+k)fluoranthene | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Benzo(a)pyrene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | 65 | 68 |
| Indeno(1,2,3-c,d)pyrene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | [NT] | [NT] |
| Dibenzo(a,h)anthracene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | [NT] | [NT] |
| Benzo(g,h,i)perylene | µg/L | 0.1 | Org-022/025 | <0.1 | 1 | <0.1 | <0.1 | 0 | [NT] | [NT] |
| *Surrogate p*-Terphenyl-d14 | % | | Org-022/025 | 87 | 1 | 80 | 78 | 3 | 73 | 76 |

| QUALITY CONTROL: Organochlorine Pesticides in Water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W3 | 380179-2 |
| Date extracted | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | 12/05/2025 |
| Date analysed | - | | | 13/05/2025 | 1 | 13/05/2025 | 13/05/2025 | | 13/05/2025 | 13/05/2025 |
| alpha-BHC | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 79 | 82 |
| HCB | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| beta-BHC | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 86 | 88 |
| gamma-BHC | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Heptachlor | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 76 | 79 |
| delta-BHC | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Aldrin | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 75 | 72 |
| Heptachlor Epoxide | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 82 | 86 |
| gamma-Chlordane | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| alpha-Chlordane | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Endosulfan I | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| pp-DDE | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 83 | 86 |
| Dieldrin | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 83 | 84 |
| Endrin | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 77 | 80 |
| Endosulfan II | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| pp-DDD | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 80 | 83 |
| Endrin Aldehyde | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| pp-DDT | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Endosulfan Sulphate | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 75 | 79 |
| Methoxychlor | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Mirex | ug/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Surrogate 4-Chloro-3-NBTF | % | | Org-022/025 | 95 | 1 | 106 | 87 | 20 | 80 | 87 |

| QUALITY CONTROL: OP Pesticides in Water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W3 | 380179-2 |
| Date extracted | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | 12/05/2025 |
| Date analysed | - | | | 13/05/2025 | 1 | 13/05/2025 | 13/05/2025 | | 13/05/2025 | 13/05/2025 |
| Dichlorvos | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 90 | 90 |
| Mevinphos | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Phorate | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Dimethoate | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Diazinon | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Disulfoton | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Chlorpyriphos-methyl | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Parathion-Methyl | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Ronnel | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 76 | 78 |
| Fenitrothion | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 85 | 88 |
| Malathion | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 86 | 89 |
| Chlorpyriphos | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 92 | 90 |
| Fenthion | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Parathion | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 85 | 80 |
| Bromophos ethyl | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Methidathion | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Fenamiphos | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Ethion | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | 81 | 83 |
| Phosalone | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Azinphos-methyl (Guthion) | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| Coumaphos | µg/L | 0.2 | Org-022/025 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| *Surrogate* 4-Chloro-3-NBTF | % | | Org-022/025 | 95 | 1 | 106 | 87 | 20 | 80 | 87 |

| QUALITY CONTROL: PCBs in Water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W3 | 380179-2 |
| Date extracted | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | 12/05/2025 |
| Date analysed | - | | | 13/05/2025 | 1 | 13/05/2025 | 13/05/2025 | | 13/05/2025 | 13/05/2025 |
| Aroclor 1016 | µg/L | 2 | Org-021/022/025 | <2 | 1 | <2 | <2 | 0 | [NT] | [NT] |
| Aroclor 1221 | µg/L | 2 | Org-021/022/025 | <2 | 1 | <2 | <2 | 0 | [NT] | [NT] |
| Aroclor 1232 | µg/L | 2 | Org-021/022/025 | <2 | 1 | <2 | <2 | 0 | [NT] | [NT] |
| Aroclor 1242 | µg/L | 2 | Org-021/022/025 | <2 | 1 | <2 | <2 | 0 | [NT] | [NT] |
| Aroclor 1248 | µg/L | 2 | Org-021/022/025 | <2 | 1 | <2 | <2 | 0 | [NT] | [NT] |
| Aroclor 1254 | µg/L | 2 | Org-021/022/025 | <2 | 1 | <2 | <2 | 0 | 92 | 96 |
| Aroclor 1260 | µg/L | 2 | Org-021/022/025 | <2 | 1 | <2 | <2 | 0 | [NT] | [NT] |
| *Surrogate* 2-Fluorobiphenyl | % | | Org-021/022/025 | 96 | 1 | 106 | 90 | 16 | 79 | 89 |

| QUALITY CONTROL: Total Phenolics in Water | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | [NT] |
| Date extracted | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | [NT] |
| Date analysed | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | [NT] |
| Total Phenolics (as Phenol) | mg/L | 0.05 | Inorg-031 | <0.05 | 1 | <0.05 | <0.05 | 0 | 102 | [NT] |

| QUALITY CONTROL: HM in water - dissolved | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W3 | [NT] |
| Date prepared | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | [NT] |
| Date analysed | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | [NT] |
| Arsenic-Dissolved | µg/L | 1 | Metals-022 | <1 | 1 | <1 | <1 | 0 | 104 | [NT] |
| Cadmium-Dissolved | µg/L | 0.1 | Metals-022 | <0.1 | 1 | <0.1 | <0.1 | 0 | 98 | [NT] |
| Chromium-Dissolved | µg/L | 1 | Metals-022 | <1 | 1 | <1 | <1 | 0 | 95 | [NT] |
| Copper-Dissolved | µg/L | 1 | Metals-022 | <1 | 1 | 2 | 1 | 67 | 98 | [NT] |
| Lead-Dissolved | µg/L | 1 | Metals-022 | <1 | 1 | <1 | <1 | 0 | 107 | [NT] |
| Mercury-Dissolved | µg/L | 0.05 | Metals-021 | <0.05 | 1 | <0.05 | [NT] | | 102 | [NT] |
| Nickel-Dissolved | µg/L | 1 | Metals-022 | <1 | 1 | 3 | 3 | 0 | 97 | [NT] |
| Zinc-Dissolved | µg/L | 1 | Metals-022 | <1 | 1 | 18 | 16 | 12 | 96 | [NT] |

| QUALITY CONTROL: Metals in Waters - Acid extractable | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | 380179-2 |
| Date prepared | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | 12/05/2025 |
| Date analysed | - | | | 12/05/2025 | 1 | 12/05/2025 | 12/05/2025 | | 12/05/2025 | 12/05/2025 |
| Phosphorus - Total | mg/L | 0.05 | Metals-020 | <0.05 | 1 | <0.05 | <0.05 | 0 | 99 | 98 |

| QUALITY CONTROL: Ion Balance | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | 380179-2 |
| Date prepared | - | | | 13/05/2025 | 1 | 13/05/2025 | 13/05/2025 | | 13/05/2025 | 13/05/2025 |
| Date analysed | - | | | 13/05/2025 | 1 | 13/05/2025 | 13/05/2025 | | 13/05/2025 | 13/05/2025 |
| Calcium - Dissolved | mg/L | 0.5 | Metals-020 | <0.5 | 1 | 6.1 | 6.1 | 0 | 94 | 94 |
| Potassium - Dissolved | mg/L | 0.5 | Metals-020 | <0.5 | 1 | 2 | 2 | 0 | 94 | 96 |
| Sodium - Dissolved | mg/L | 0.5 | Metals-020 | <0.5 | 1 | 46 | 46 | 0 | 91 | # |
| Magnesium - Dissolved | mg/L | 0.5 | Metals-020 | <0.5 | 1 | 5.0 | 5.0 | 0 | 93 | 92 |
| Hardness (calc) equivalent $CaCO_3$ | mg/L | 3 | Metals-020 | [NT] | 1 | 36 | 36 | 0 | [NT] | [NT] |
| Hydroxide Alkalinity ($OH^-$) as $CaCO_3$ | mg/L | 5 | Inorg-006 | <5 | 1 | <5 | [NT] | | [NT] | [NT] |
| Bicarbonate Alkalinity as $CaCO_3$ | mg/L | 5 | Inorg-006 | <5 | 1 | 13 | [NT] | | [NT] | [NT] |
| Carbonate Alkalinity as $CaCO_3$ | mg/L | 5 | Inorg-006 | <5 | 1 | <5 | [NT] | | [NT] | [NT] |
| Total Alkalinity as $CaCO_3$ | mg/L | 5 | Inorg-006 | <5 | 1 | 13 | [NT] | | 115 | [NT] |
| Sulphate, SO4 | mg/L | 1 | Inorg-081 | <1 | 1 | 48 | 48 | 0 | 108 | [NT] |
| Chloride, Cl | mg/L | 1 | Inorg-081 | <1 | 1 | 56 | 56 | 0 | 118 | [NT] |
| Ionic Balance | % | | Inorg-040 | [NT] | 1 | -1.0 | [NT] | | [NT] | [NT] |

| QUALITY CONTROL: Miscellaneous Inorganics | | | | | | Duplicate | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-W1 | 380179-2 |
| Date prepared | - | | | 09/05/2025 | 1 | 09/05/2025 | 09/05/2025 | | 09/05/2025 | 09/05/2025 |
| Date analysed | - | | | 09/05/2025 | 1 | 09/05/2025 | 09/05/2025 | | 09/05/2025 | 09/05/2025 |
| pH | pH Units | | Inorg-001 | [NT] | 1 | 5.6 | [NT] | | 102 | [NT] |
| Electrical Conductivity | µS/cm | 1 | Inorg-002 | <1 | 1 | 370 | [NT] | | 99 | [NT] |
| Total Suspended Solids | mg/L | 5 | Inorg-019 | <5 | 1 | 460 | [NT] | | 95 | [NT] |
| Total Dissolved Solids (grav) | mg/L | 5 | Inorg-018 | <5 | 1 | 190 | [NT] | | 101 | [NT] |
| Total Cyanide | mg/L | 0.004 | Inorg-014 | <0.004 | 1 | <0.004 | [NT] | | 83 | [NT] |
| Nitrate as N in water | mg/L | 0.005 | Inorg-055 | <0.005 | 1 | 0.053 | 0.05 | 6 | 111 | 104 |
| Nitrite as N in water | mg/L | 0.005 | Inorg-055 | <0.005 | 1 | 0.005 | <0.005 | 0 | 97 | 99 |
| NOx as N in water | mg/L | 0.005 | Inorg-055 | <0.005 | 1 | 0.058 | 0.054 | 7 | 108 | 103 |
| Ammonia as N in water | mg/L | 0.005 | Inorg-057 | <0.005 | 1 | 0.02 | 0.02 | 0 | 103 | 95 |
| Organic Nitrogen as N | mg/L | 0.2 | Inorg-055/062/127 | <0.2 | 1 | <0.2 | <0.2 | 0 | [NT] | [NT] |
| TKN in water | mg/L | 0.1 | Inorg-062 | <0.1 | 1 | 0.1 | 0.1 | 0 | [NT] | [NT] |
| Total Nitrogen in water | mg/L | 0.1 | Inorg-055/062/127 | <0.1 | 1 | 0.2 | 0.2 | 0 | 89 | 79 |
| Phosphate as P in water | mg/L | 0.005 | Inorg-060 | <0.005 | 1 | 0.01 | 0.009 | 11 | 105 | 92 |

## Result Definitions

| | |
|---|---|
| **NT** | Not tested |
| **NA** | Test not required |
| **INS** | Insufficient sample for this test |
| **PQL** | Practical Quantitation Limit |
| **<** | Less than |
| **>** | Greater than |
| **RPD** | Relative Percent Difference |
| **LCS** | Laboratory Control Sample |
| **NS** | Not specified |
| **NEPM** | National Environmental Protection Measure |
| **NR** | Not Reported |

## Quality Control Definitions

| | |
|---|---|
| **Blank** | This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples. |
| **Duplicate** | This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable. |
| **Matrix Spike** | A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist. |
| **LCS (Laboratory Control Sample)** | This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample. |
| **Surrogate Spike** | Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples. |

## Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Air volumes are typically provided by customers (often as flow rate(s) and sampling time(s) and/or simply volumes) sampled or exposure times (determines 'volume' passive badges are exposed to)). Hence in such circumstances the volume measurement is inevitably not covered by Envirolab's NATA accreditation. An exception may occur where Envirolab Newcastle does the sampling where accreditation exists for certain types of sampling and hence volume determination(s). Note air volumes are often used to determine concentrations for dust and/or analyses on filters, sorbents and in impingers. For canister sampling, the air volume is covered by Envirolab's NATA accreditation.

Urine Analysis - The BEI values listed are taken from the 2022 edition of "TLVs and BEIs Threshold Limits" by ACGIH.

## Report Comments

VOC vials have headspace

Microbiology analysed by Sonic Food & Water Testing. Report No. W2510574 & W2510578
The time between collection and the commencement of testing should not exceed 24 hours. Samples tested outside this time may have their results compromised

VOCs/BTEX in water - No vials were supplied for analysis of sample 380179-4. Subsampled from plastic bottles provided.

Ion Balance - # Percent recovery is not applicable due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Douglas PARTNERS | GROUNDED EXPERTISE

# CHAIN OF CUSTODY DESPATCH SHEET

| | | | | | |
|---|---|---|---|---|---|
| **Project No:** | 233414.04 | **Suburb:** | Caringbah | **To:** | Envirolab Services |
| **Project Manager:** | Lisa Teng | **Order Number:** | | **Sampler:** | NW |
| **Email:** | Lisa.Teng@douglaspartners.com.au | | | **Attn:** | Sample Receipt |
| **Turnaround time:** | ☑ Standard ☐ 72 hour ☐ 48 hour ☐ 24 hour ☐ Same day | | | | 12 Ashley St, Chatswood NSW 2067 |
| **Prior Storage:** | ☐ Fridge ☐ Freezer ☑ Esky ☐ Shelf | **Do samples contain 'potential' HBM?** | ☐ No ☐ Yes (If YES, then handle, transport and store in accordance with FPM HAZID) | | (02) 9910 6200 samplereceipt@envirolab.com |

| Lab ID | Sample ID: Location / Other ID | Depth From | Depth To | Date Sampled | Sample Type: S - soil W - water M - Material | Container Type: G - glass P - plastic | Analytes: Combo 8L | VOC | ionic balance | pH and EC | cyanide | TSS and TDS | nutrients | Faecal coliforms, E. coli | TRH/BTEX | cations and anions | hardness | Notes/ Preservation/ Additional Requirements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BH03 | - | - | 8/05/25 | W | G,P | × | × | × | × | × | × | × | × | | × | × | |
| 2 | BH08 | - | - | 8/05/25 | W | G,P | × | × | × | × | × | × | × | × | | × | × | |
| 3 | BH11 | - | - | 8/05/25 | W | G,P | × | × | × | × | × | × | × | × | | × | × | |
| 4 | BD1/20250509 | - | - | 8/05/25 | W | G,P | × | × | × | | × | | | × | | | | |
| NR | TS/20250508 | - | - | 8/05/25 | W | G,P | | | | | | | | | × | | | |
| NR | TB/20250508 | - | - | 8/05/25 | W | G,P | | | | | | | | | × | | | |
| | | | | | | | | | | | | | | | | | | |
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ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 380179
Date Received: 9/5/25
Time Received: 1420
Received By: a
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

**Metals to analyse:**

| | | | |
|---|---|---|---|
| **Number of samples in container:** | | **Transported to laboratory by:** | Douglas Partners |
| **Send results to:** | Douglas Partners Pty Ltd | | |
| **Address:** | 96 Hermitage Road, West Ryde NSW 211 | **Phone:** | (02) 9809 0666 |
| **Relinquished by:** | Douglas Partners Pty Ltd | **Date:** | **Signed:** |

**LAB RECEIPT**

| | |
|---|---|
| **Lab Ref. No:** | 380179 |
| **Received by:** | Dahyun Lee |
| **Date & Time** | 9/5/25 1420 |
| **Signed:** | |

**Envirolab Services Pty Ltd**
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

# SAMPLE RECEIPT ADVICE

## Client Details

| | |
|---|---|
| **Client** | Douglas Partners Pty Ltd |
| **Attention** | Lisa Teng |

## Sample Login Details

| | |
|---|---|
| **Your reference** | 233414.04 Punchbowl |
| **Envirolab Reference** | 380179 |
| **Date Sample Received** | 09/05/2025 |
| **Date Instructions Received** | 09/05/2025 |
| **Date Results Expected to be Reported** | 16/05/2025 |

## Sample Condition

| | |
|---|---|
| **Samples received in appropriate condition for analysis** | Incorrect Container |
| **No. of Samples Provided** | 4 Water |
| **Turnaround Time Requested** | Standard |
| **Temperature on Receipt (°C)** | 3 |
| **Cooling Method** | Ice |
| **Sampling Date Provided** | YES |

## Comments

TS/TB not received, vials received empty for BD1

Please contact the laboratory within 24 hours if you wish to cancel the aformentioned testing. Otherwise testing will proceed as per the COC and hence invoiced accordingly.

Please direct any queries to:

| Aileen Hie | Jacinta Hurst |
|---|---|
| **Phone: 02 9910 6200** | **Phone: 02 9910 6200** |
| **Fax: 02 9910 6201** | **Fax: 02 9910 6201** |
| **Email: ahie@envirolab.com.au** | **Email: jhurst@envirolab.com.au** |

*Analysis Underway, details on the following page:*

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| Sample ID | VOCs in water | vTRH(C6-C10)/BTEXN in Water | svTRH (C10-C40) in Water | PAHs in Water | Organochlorine Pesticides in Water | OP Pesticides in Water | PCBs in Water | Total Phenolicsin Water | HM in water - dissolved | Metals in Waters -Acid extractable | Calcium - Dissolved | Potassium - Dissolved | Sodium - Dissolved | Magnesium - Dissolved | Hardness (calc) equivalent CaCO3 | Hydroxide Alkalinity (OH-) as CaCO3 | Bicarbonate Alkalinity as CaCO3 | Carbonate Alkalinity as CaCO3 | Total Alkalinity as CaCO3 | Sulphate, SO4 | Chloride, Cl | Ionic Balance | pH | Electrical Conductivity | Total Suspended Solids | Total Dissolved Solids(grav) | Total Cyanide | Nitrate as N in water | Nitrite as N in water | NOx as N in water | Ammonia as N in water | Organic Nitrogen as N | TKN in water | Total Nitrogen in water | Phosphate as P in water | Microbiological Testing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BH03** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **BH08** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **BH11** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **BD1/20250509** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | | | | | | | | | ✓ |

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

## Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.

TAT for Micro is dependent on incubation. This varies from 3 to 6 days.