



REPORT TO
PATHWAYS RESIDENCES CREMORNE

ON
**PRELIMINARY GROUNDWATER QUALITY
SCREENING**

FOR
PROPOSED SENIORS LIVING DEVELOPMENT

AT
**50-88 PARRAWEEEN STREET AND 59-67 GERARD
STREET, CREMORNE, NSW**

Date: 8 December 2023

Ref: E35736PTrpt4

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Abbreviations

Australian Drinking Water Guidelines	ADWG
Area of Environmental Concern	AEC
Australian Height Datum	AHD
Acid Sulfate Soil	ASS
Above-Ground Storage Tank	AST
Below Ground Level	BGL
Benzene, Toluene, Ethylbenzene, Xylene	BTEX
Chain of Custody	COC
Development Application	DA
Environment Protection Authority	EPA
Environmental Site Assessment	ESA
Hardness Modified Trigger Values	HMTV
International Organisation of Standardisation	ISO
JK Environments	JKE
JK Geotechnics	JKG
Lab Control Spike	LCS
Light Non-Aqueous Phase Liquid	LNAPL
Map Grid of Australia	MGA
National Association of Testing Authorities	NATA
National Environmental Protection Measure	NEPM
Organochlorine Pesticides	OCP
Organophosphate Pesticides	OPP
Polycyclic Aromatic Hydrocarbons	PAH
Potential ASS	PASS
Photo-ionisation Detector	PID
Protection of the Environment Operations	POEO
Practical Quantitation Limit	PQL
Quality Assurance	QA
Quality Control	QC
Relative Percentage Difference	RPD
Site Assessment Criteria	SAC
Sampling, Analysis and Quality Plan	SAQP
Standing Water Level	SWL
Standard Sampling Procedure	SSP
Trip Blank	TB
Total Recoverable Hydrocarbons	TRH
Trip Spike	TS
United States Environmental Protection Agency	USEPA
Underground Storage Tank	UST
Volatile Organic Compounds	VOC
Work Health and Safety	WHS
<i>Units</i>	
Litres	L
Metres BGL	mBGL
Metres	m
Micrograms per litre	µg/L



1 INTRODUCTION

Pathways Residence Cremorne ('the client') commissioned JK Environments (JKE) to undertake a preliminary groundwater quality screening for the proposed seniors living development at 50-88 Parraween Street and 59-67 Gerard Street, Cremorne, NSW ('the site'). The site location is shown on Figure 1 and the screening was confined to the site boundaries as shown on Figure 2 attached in the appendices.

Our geotechnical division, JK Geotechnics (JKG) undertook a geotechnical investigation concurrently for the proposed development (Project reference 35736B). This report should be read in conjunction with the JKE/JKG reports.

JKE have previously undertaken a Preliminary Site Investigation (PSI)¹, a Detailed Site Investigation (DSI)² and prepared a Remediation Action Plan (RAP)³ for the site. A summary of relevant information is provided in Section 2.1.

1.1 Proposed Development Details

It is understood that the proposed development includes demolition of a majority of the existing houses and apartment building, and construction of four buildings of between four and eight levels over two basements for a seniors living development. The lowest basement level has a proposed finished floor level (FFL) of 76.8m, which will require excavation to a maximum depth of approximately 9m. Localised deeper excavation may be required for lift pits and/or services trenches. The basement typically extends to within 3m to 7m of the boundaries except along most of the street frontage with Parraween Street where the basement will extend up to the boundary and in the south-west and north-east corners of the Parraween Street portion where the setbacks are between 9m and 12m. No.52, 54 and 56 Parraween Street are to be retained and reconstructed.

1.2 Objectives

The primary objective of this screening was to provide preliminary groundwater quality data that could be used to support an application for a temporary construction dewatering license.

1.3 Scope of Work

The screening was undertaken generally in accordance with a JK proposal (Ref: 35736Sprop Hydro) of 23 October 2023 and written acceptance from the client of 24 October 2023. The scope of work included the following:

- Sampling from four monitoring wells previously installed at the site;

¹ JKE, (2023a). *Report to Pathways Residences Cremorne on Preliminary (Stage 1) Site Investigation for Proposed Seniors Living Development at 50-88 Parraween Street and 59-67 Gerard Street, Cremorne, NSW.* (Report ref: E35736PTrptRev2, dated 14 July 2023) (referred to as PSI).

² JKE, (2023b). *Report to Pathways Residences Cremorne on Detailed Site Investigation (DSI) for Proposed Seniors Living Development at 50-88 Parraween Street and 59-67 Gerard Street, Cremorne, NSW.* (Report ref: E35736PTrpt2Rev2, dated 14 July 2023) (referred to as DSI).

³ JKE, (2023c). *Report to Pathways Residences Cremorne on Remediation Action Plan (RAP) for Proposed Seniors Living Development at 50-88 Parraween Street and 59-67 Gerard Street, Cremorne, NSW.* (Report ref: E35736PTrpt3Rev2, dated 14 July 2023) (referred to as RAP).



-
- Analysis of groundwater samples for a range of contaminants and parameters;
 - Interpretation of the results with reference to relevant screening criteria;
 - Data quality assessment; and
 - Preparation of a report.

The analytical schedule was selected with reference to the 'mandatory' testing requirements outlined in the NSW DPIE Minimum requirements for building site groundwater investigations and reporting (2022)⁴ document.

⁴ NSW DPIE, (2022). *Minimum requirements for building site groundwater investigations and reporting*. (Referred to as DPIE 2022).



2 SITE INFORMATION

2.1 Summary of Previous Reports

JKE has undertaken several phases of investigation at the site. Relevant information from these investigations and reports has been summarised in the following table:

Table 2-1: Summary of Previous Investigations and Relevant Findings

Investigation Phase / Report	Relevant Findings to the Screening
PSI, 2023	<p>JKE was engaged to undertake a PSI at the site in early 2023. The scope of works included: a review of site history and other site information; a site walkover inspection; soil sampling from eight boreholes; and groundwater sampling from four monitoring wells at the site. The following potential contamination sources/areas of environmental concern (AEC) were identified: imported fill material; use of pesticides; hazardous building materials; and off-site land uses (including dry cleaners and motor garages/service stations).</p> <p>The boreholes encountered fill materials (i.e. historically imported soils) to depths of approximately 0.3m below ground level (BGL) to 1.0mBGL, underlain by clayey and sandy residual soils and sandstone bedrock.</p> <p>Polycyclic aromatic hydrocarbons (PAHs) and total recoverable hydrocarbons (TRHs) F2 were identified in fill soils at concentrations that exceeded the health-based SAC, and copper, zinc and TRHs were identified in fill soils at concentrations that exceeded the ecological SAC. In groundwater, benzene and TRHs were reported above the health based SAC and ethyl benzene, m+p-xylene, arsenic, copper, nickel, and zinc were encountered above the ecological SAC.</p> <p>The PSI did not identify contamination that would preclude the proposed development/use of the site. However, a Detailed Site Investigation (DSI) was considered to be required to facilitate development of a RAP, and we anticipated that remediation will be required to render the site suitable for the proposed development.</p>
DSI, 2023	<p>The DSI included a review of existing project information, a site inspection, soil sampling from 14 boreholes and groundwater sampling from six monitoring wells (two new and four existing). The boreholes generally encountered fill materials to depths of approximately 0.1m to 1.2mBGL, underlain by natural residual sandy soils and sandstone bedrock. The fill contained inclusions of igneous, ironstone and sandstone gravel, ceramic and brick fragments, sand, ash, slag, organic matter and root fibres. No fibre cement fragments (FCF)/asbestos containing material (ACM) were encountered in the fill material during fieldwork.</p> <p>A selection of soil and groundwater samples were analysed for the Contaminants of Potential Concern (CoPC) identified in the Conceptual Site Model (CSM). Lead, PAHs and TRH F2 were reported above the health-based SAC in fill/soil, and zinc and TRHs were reported above the ecological SAC in fill/soil. Copper, nickel and zinc were reported above the ecological SAC in groundwater. Elevated concentrations, above the SAC, of the remaining CoPC were not encountered above the adopted SAC in any media.</p> <p>The Tier 1 risk assessment indicated that there is a potentially complete Source-Pathway-Receptor (SPR) linkage to the lead and PAH impacted fill and interim management of the site will be required to manage the risk to current site users until development occurs.</p> <p>The DSI concluded that remediation of the site is required to address the contamination in fill soil. Remediation of the contaminants of concern in fill was considered to be straight forward and we considered that the site can be made suitable for the proposed development via remediation. It was expected that remediation would include the removal/off-site disposal of</p>



Investigation Phase / Report	Relevant Findings to the Screening
	fill where practicable, and management of any residual contaminated fill on-site where it cannot be removed (e.g. beneath heritage structures or parts of structures being retained etc).
RAP, 2023	<p>The RAP includes: a methodology to remediate and validate the site; a contingency plan for remediation; site management procedures; and an unexpected finds protocol (UFP) to be implemented during remediation.</p> <p>The proposed remediation strategy includes 'excavation and off-site disposal' of contaminated fill/soil to a suitably licensed landfill. The RAP also includes provisions to 'cap and contain' contaminated material in situ beneath the buildings being retained at No.52, 54 and 56 Parraween Street, and a contingency to 'cap and contain' contaminated material in situ in tree protection zones, should it not be possible to remove all fill from such areas. A long-term Environmental Management Plan (EMP) is required to manage any contamination remaining in the capped areas.</p>

2.2 Site Identification and Description

Table 2-2: Site Identification

Site Address:	50-88 Parraween Street and 59-67 Gerard Street, Cremorne, NSW
Lot & Deposited Plan:	Lot 81 in DP978497, Lots A & B in DP442573, SP95237, Lots 1 to 4 in DP19887, Lots 1 & 2 in DP441402, Lots A & B in DP438187, Lot X & Y in DP442664, Lots 1 & 2 in DP1001062, Lot A & B in DP412718, Lot A & B in DP419832, Lots A to C in DP366345, Lot 1 in DP1050050 and Lot 30 Section 2 in DP4785.
Current Land Use:	Residential
Local Government Authority (LGA):	North Sydney Council
Site Area (m²):	7,350
RL (metres AHD) (approx.):	82-84
Geographical Location (MGA) (approx.):	Latitude: -33.82833 Longitude: 151.22847
Site Plans:	Appendix A

The site is located in a residential area of Cremorne and is bound by Gerard Street to the north-west, Parraween Street to the south-east, Paling Street to the south-west and Langley Avenue to the north-east. The site itself is located approximately 630m to the south of Middle Harbour.

The regional topography is characterised by a ridgeline that extends roughly in a north-east to south-west direction. The land generally falls towards Middle Harbour to the north and Mosman Bay to the south of the ridgeline. The site is located at the top of the northern side of the ridgeline and is relatively flat, with the



eastern end of the site exhibiting a slight slope towards the north-east at approximately 1-3°. Parts of the site appear to have been levelled to account for the slope and accommodate the existing development.

At the time of the screening, the site comprised residential lots including a unit block and number of detached and semi-detached residences. The residential buildings and structures were generally of brick construction with ceramic tile or metal rooves, on concrete slab. Each residential lot generally included a brick or concrete paved driveway. A number of the properties on Parraween Street included a predominantly paved area adjacent to the driveway, with landscaped areas limited to the fence lines. The unit block on Gerard Street was generally grass covered outside of the building footprint and driveway area.

2.3 Regional Geology

Regional geological information reviewed for the previous investigations. The information indicated that the site is underlain by Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses.

A summary of the subsurface conditions encountered during the DSI is presented in the following table:

Table 2-3: Summary of Subsurface Conditions

Profile	Description
Pavement	Concrete pavement or brick pavers were encountered at the surface in BH104 and BH106 and were approximately 50mm to 100mm in thickness.
Fill	<p>Fill was encountered at the surface in all boreholes and extended to depths of approximately 0.1mBGL to 1.2mBGL. BH5, BH6, BH7, BH9, BH101, BH102, BH105, BH108, BH110 were terminated in the fill (due to obstructions) at a maximum depth of 0.65mBGL.</p> <p>The fill typically comprised silty sandy clay, silty sandy gravel, sand, silty clayey sand with inclusions of igneous, ironstone and sandstone gravel, ceramic and brick fragments, sand, ash, slag, organic matter and root fibres.</p> <p>No odours or staining were recorded in the fill material during field work. No FCF/ ACM was encountered in the fill material during fieldwork.</p>
Natural Soil	<p>Natural silty clay, silty sandy clay, sandy clay residual soils were encountered beneath the fill material in BH1-BH5, BH104, BH106, BH107, BH109, BH111 to BH114. The natural soil extended to depths of between 0.5mBGL to 2.4mBGL.</p> <p>No odours or staining were recorded in the natural soils during field work.</p>
Bedrock	<p>Sandstone bedrock was encountered beneath the fill or natural soils in BH103, BH104 and BH112 at depths of between 0.8mBGL to 1.2mBGL.</p> <p>No odours or staining were recorded in the bedrock during field work.</p>
Groundwater	Groundwater seepage was encountered in BH4 during drilling at a depth of approximately 0.4mBGL. The remaining boreholes were dry during and a short time after completion of drilling.

2.3.1 Hydrogeology and Groundwater

Hydrogeological information reviewed for the previous investigations indicated that the regional aquifer on-site and in the areas immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There was a total of 26 registered bores within 2,000m of the site at the time of the search that occurred for the PSI. In summary:

- The nearest registered bore was located approximately 630m north-west of the site. This was registered for irrigation purposes;
- The majority of the bores were registered for monitoring purposes; and
- The drillers log information from the closest registered bores typically identified fill and/or clay soil to depths of approximately 0.8m-11m, underlain by sandstone and/or shale bedrock. Standing water levels (SWLs) in the bores ranged from approximately 0.4mBGL to 110mBGL.

Groundwater seepage was not encountered during and a short time after completion of drilling for the DSI.

Table 2-4: Summary of DSI Field Screening information

Aspect	Details																												
Groundwater Depth & Flow	SWLs measured in the monitoring wells installed at the site ranged from approximately 1.82mBGL to 10.42mBGL. Groundwater RLs calculated on these measurements ranged from 74.78 to 82.57.																												
	<table border="1"> <thead> <tr> <th>MW reference</th> <th>Reduced Level (mAHD)</th> <th>SWL (mBGL)</th> <th>SWL (mAHD)</th> </tr> </thead> <tbody> <tr> <td>MW1</td> <td>83.3</td> <td>7.26</td> <td>76.04</td> </tr> <tr> <td>MW2</td> <td>85.2</td> <td>10.42</td> <td>74.78</td> </tr> <tr> <td>MW3</td> <td>84.4</td> <td>1.83</td> <td>82.57</td> </tr> <tr> <td>MW4</td> <td>82.9</td> <td>3.68</td> <td>79.22</td> </tr> <tr> <td>MW103</td> <td>82.9</td> <td>2.18</td> <td>80.72</td> </tr> <tr> <td>MW104</td> <td>83.9</td> <td>1.82</td> <td>82.08</td> </tr> </tbody> </table>	MW reference	Reduced Level (mAHD)	SWL (mBGL)	SWL (mAHD)	MW1	83.3	7.26	76.04	MW2	85.2	10.42	74.78	MW3	84.4	1.83	82.57	MW4	82.9	3.68	79.22	MW103	82.9	2.18	80.72	MW104	83.9	1.82	82.08
	MW reference	Reduced Level (mAHD)	SWL (mBGL)	SWL (mAHD)																									
	MW1	83.3	7.26	76.04																									
	MW2	85.2	10.42	74.78																									
	MW3	84.4	1.83	82.57																									
	MW4	82.9	3.68	79.22																									
	MW103	82.9	2.18	80.72																									
MW104	83.9	1.82	82.08																										
The groundwater RLs indicated that excavation for the proposed basement may intercept groundwater. Based on the variability in groundwater levels, JKE was of the opinion that the groundwater appeared to be perched aquifer associated with fractured and/or weathered bedrock.																													
A contour plot was prepared for the DSI based on the recorded groundwater levels as shown on Figure 3 (refer to Appendix A). Groundwater flow generally occurs in a down gradient direction perpendicular to the groundwater elevation contours. The contour plot indicates that groundwater generally trends in a northerly direction. We were of the opinion that the plot was influenced by the variable perched groundwater levels recorded in the wells, most notably the shallower SWLs in MW3 and MW104.																													



Aspect	Details
Groundwater Field Parameters	<p>Field measurements recorded during sampling for the DSI were as follows:</p> <ul style="list-style-type: none">- pH ranged from 3.62 to 5.57;- EC ranged from 100.8μS/cm to 583μS/cm;- Eh ranged from 127.4mV to 175.2mV; and- DO ranged from 1.6mg/L to 5.4mg/L. <p>The PID readings in the monitoring well headspace recorded during sampling ranged from 0ppm in MW1, MW3 and MW4 to 65ppm in MW104. Despite the elevated PID readings in some wells, we note that the elevated PID readings did not correlate with the occurrence of detectable concentrations of petroleum hydrocarbons in the groundwater samples collected for the screening.</p>
LNAPLs petroleum hydrocarbons	Phase separated product (i.e. LNAPL) was not detected using the interphase probe during groundwater sampling.



3 SCREENING CRITERIA

The client should obtain advice from the consent authority regarding specific groundwater disposal criteria based on the preferred disposal method. In the absence of this information, JKE have screened the groundwater against the following criteria in relation to potential disposal to stormwater:

- Groundwater Investigation Levels for 95% protection of marine species were adopted based on the Default Guideline Values in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)⁵. The 99% trigger values were adopted where required to account for bioaccumulation. Low and moderate reliability trigger values were also adopted for some contaminants where high-reliability trigger values don't exist; and
- The Australian Drinking Water Guidelines 2011 (updated 2021)⁶ multiplied by a factor of 10 to assess potential risks associated with incidental/recreational-type exposure to groundwater (e.g. within down-gradient water bodies).

The screening criteria are referred to as Site Assessment Criteria (SAC).

Reference should be made to the attached Table G1 and Table G2 for the specific criteria.

⁵ Australian and New Zealand Governments (ANZG), (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia (referred to as ANZG 2018)

⁶ National Health and Medical Research Council (NHMRC), (2021). *National Water Quality Management Strategy, Australian Drinking Water Guidelines 2011* (referred to as ADWG 2011)



4 INVESTIGATION PROCEDURE

4.1 Subsurface Investigation and Groundwater Sampling

Four groundwater monitoring wells (MW1, MW2, MW3 and MW4) were previously installed at the site by JKG in early 2023. The sampling locations are shown on Figure 2 attached in the appendices. The figure also show the additional monitoring wells MW103 and MW104 installed during the DSI. JKE note that groundwater sampling for the screening was limited to the four wells (MW1, MW2, MW3 and MW4) installed by JKG only. A summary of the DSI groundwater results is outlined in Section 2.1.

A summary of the sampling/screening methodology is presented in the following table:

Table 4-1: Groundwater Sampling/Screening Methodology

Aspect	Input
Sampling Plan	Assuming that groundwater flow is likely to be towards the north (based on the topography and the nearest surface water body). RLs for the wells were taken from the survey plan provided by the client to provide confirmation of the groundwater flow and direction over the site. A contour map is attached (Figure 3). The wells were positioned in both up-gradient and down-gradient areas.
Monitoring Well Installation Procedure	The monitoring well construction details are documented on the appropriate borehole logs attached in the appendices. The monitoring wells were installed to depths of approximately 10m to 14.99mBGL. The wells were generally constructed as follows: <ul style="list-style-type: none"> • 50mm diameter Class 18 PVC (machine slotted screen) was installed in the lower section of the well to intersect groundwater; • 50mm diameter Class 18 PVC casing was installed in the upper section of the well (screw fixed); • A 2mm sand filter pack was used around the screen section for groundwater infiltration; • A hydrated bentonite seal/plug was used on top of the sand pack to seal the well; and • A gatic cover was installed at the surface with a concrete plug to limit the inflow of surface water.
Monitoring Well Development	The monitoring wells were developed on 1 November 2023 using a submersible electrical pump. A minimum of three well volumes was removed and the following parameters were monitored using calibrated field instruments: <ul style="list-style-type: none"> • Standing water level (SWL) using an electronic dip meter; and • pH, temperature, electrical conductivity (EC), dissolved oxygen (DO) and redox potential (Eh) using a YSI Multi-probe water quality meter. <p>The field monitoring records are attached in the appendices. Calibration data is retained on file by JKE.</p>
Groundwater Sampling	Groundwater samples were obtained on date 8 November 2023. Prior to sampling, the monitoring wells were checked for the presence of Light Non-Aqueous Phase Liquids (LNAPLs) using an inter-phase probe electronic dip meter. <p>The samples were obtained using a micro-purge pump. During sampling, parameters were recorded as outlined in the development step in order to assess steady state conditions. Groundwater samples were obtained directly from the single use tubing and placed in the sample containers.</p> <p>Groundwater removed from the wells during development and sampling was transported to JKE in jerry cans and stored in holding drums prior to collection by a licensed waste water contractor for off-site disposal.</p>

Aspect	Input
	The field monitoring records are attached in the appendices. Calibration data is retained on file by JKE.
Sample Preservation	The samples were placed in appropriate plastic and glass containers (preserved as required). Samples for heavy metals analysis were field filtered. On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures.

4.2 Laboratory Analysis

Samples were analysed for a range of potential contaminants and water quality parameters based on the 'mandatory' analysis suite outlined in DPIE 2022. The analytes are outlined below:

- Heavy metals including: arsenic, cadmium, chromium (total), copper, lead, mercury, nickel, zinc, aluminium, antimony, boron, beryllium, cobalt, iron, lithium, manganese, molybdenum, selenium, silver, strontium, uranium and vanadium;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Total Recoverable Hydrocarbons (TRHs);
- Monocyclic aromatic hydrocarbons including benzene, toluene, ethylbenzene and xylene (BTEX);
- EC, pH, redox potential, dissolved oxygen (DO) and hardness;
- Total dissolved solids (TDS), total suspended solids (TSS) and turbidity;
- Total organic carbon (TOC), sodium adsorption ratio (SAR) and silica (SiO₂);
- Ammonia, nitrate, nitrite, total nitrogen and nitrogen oxides (NO_x);
- Phosphorus and phosphate;
- Ionic balance including: calcium, potassium, sodium, magnesium, alkalinity, chloride and sulphate; and
- Faecal coliforms and Escherichia coli (E coli).

Samples were analysed by Envirolab Services (NATA Accreditation Number – 2901. Reference should be made to the laboratory report (Ref: 337373) attached in the appendices for further information regarding the laboratory methods and practical quantitation limits (PQLs) for each analyte.

5 RESULTS

5.1 Groundwater Levels and Screening

SWLs recorded during development and sampling ranged from approximately 2m to 10.61m BGL. LNAPL was not detected during development or sampling and there were no hydrocarbon odours or other obvious visual or olfactory indicators of contamination observed.

5.2 Laboratory Results

Reference should be made to the attached Table G1 and G2 for a summary of the laboratory results compared to the screening criteria presented in Section 3. The following results were above the SAC:

- The copper, nickel and zinc concentrations in all four wells exceeded the ecological SAC;
- The lead concentration in MW3 exceeded the ecological SAC;
- The cobalt concentration in MW2, MW3 and MW4 exceeded the ecological SAC; and
- The pH in all four wells was outside the range for marine waters (7-8.5) and recreational use (6.5-8.5).



6 ASSESSMENT OF DATA QUALITY

For the purpose of the screening, JKE have undertaken a preliminary assessment of the data quality against the following Data Quality Indicators (DQIs): precision, accuracy, representativeness, completeness and comparability. In this regard, we are of the opinion that the data quality is suitable for the purpose of the screening based on the following:

- Standard sampling procedures (SSP) were complied with. The SSP is attached in the appendices;
- Representative groundwater samples were analysed for a broad range of potential contaminants;
- Field indicators were used as a screening tool;
- Samples were analysed by a NATA registered laboratory. Laboratory quality control/quality assurance (QA/QC) samples were analysed and were generally within the acceptance criteria adopted by the laboratory;
- The analytical methods implemented by the laboratory were performed in accordance with their NATA accreditation and were consistent with Schedule B(3) of NEPM (2013). The frequency of data reported for the laboratory QA/QC (i.e. duplicates, spikes, blanks, LCS) was considered to be acceptable for the purpose of this investigation. A review of the laboratory QA/QC data identified the following minor non-conformances:
 - Turbidity was not tested in one sample due to high sediments present;
 - Percent recovery was not applicable due to the high concentration of the element/s in the sample/s. However, an acceptable recovery was obtained for the LCS; and
 - Samples were out of the recommended holding time for DO analysis.

JKE is of the opinion that the data are adequately precise, accurate, representative, comparable and complete to serve as a basis for interpretation to achieve the screening objectives. We note that additional monitoring is required to fulfill the requirements of the DPE 2022 document (such monitoring is outside the scope of this report).

Non-conformances were reported for some laboratory QA/QC analysis. These non-conformances were considered to be sporadic and minor, and were not considered to be indicative of systematic sampling or analytical errors. All samples were preserved on ice when in the field and during transportation to the laboratory. On this basis, these non-conformances are not considered to materially impact the report findings.

7 DISCUSSION AND RECOMMENDATIONS

Based on the results of the screening, the groundwater samples identified concentrations of heavy metal (copper, lead, nickel, zinc and cobalt) above the screening criteria adopted for potential disposal to stormwater. The pH of the samples was also outside the acceptable range for marine water ecosystems and recreational use.

Treatment of the groundwater prior to discharge to stormwater will be required. Council approval should be obtained prior to discharge to stormwater and conditions imposed by Council on the discharge should be complied with.

7.1 Recommendations

A specialist contractor must be engaged to design an appropriate water treatment system to facilitate the disposal of groundwater during temporary construction dewatering, should off-site disposal of groundwater to stormwater be required. Use of a 'WETSEP' system or equivalent to treat water prior to discharge could be considered to achieve the water quality standards imposed by the authority (e.g. Council) permitting the discharge of groundwater. The 'WETSEP' system combines treatment processes including flocculation which may reduce concentrations of heavy metals which are likely to be at least partly associated with sediment particles in the groundwater and the pH can be adjusted by passing through a dosing unit. The client will need to consider these site-specific factors, in addition to the potential volume of water being extracted, in consultation with the dewatering contractor and the manufacturers of any treatment system to be utilised for the project.

The relevant consent authorities should be contacted to clarify the requirements to obtain disposal approval to stormwater or sewer. In addition, it is anticipated that a licence from the WaterNSW will be required for temporary construction dewatering. JKE recommend that the client contact WaterNSW well before the start of construction in order to commence the application process.

In the event unexpected conditions are encountered during development work or during dewatering that may pose a contamination risk, all works should stop and an environmental consultant should be engaged to inspect the site and address the issue.



8 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Groundwater conditions may vary, especially after climatic changes and wet/dry periods;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. JKE should be contacted immediately in such circumstances;
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose;
- Copyright in this report is the property of JKE. JKE has used a degree of care, skill and diligence normally exercised by consulting professionals in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report;
- If the client, or any person, provides a copy of this report to any third party, such third party must not rely on this report except with the express written consent of JKE; and
- Any third party who seeks to rely on this report without the express written consent of JKE does so entirely at their own risk and to the fullest extent permitted by law, JKE accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.



Important Information about this Report

These notes have been prepared by JKE to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors

This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

JKE/J&K will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions

Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data

Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations

Although information provided by a site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.



Misinterpretation of Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Assessment Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

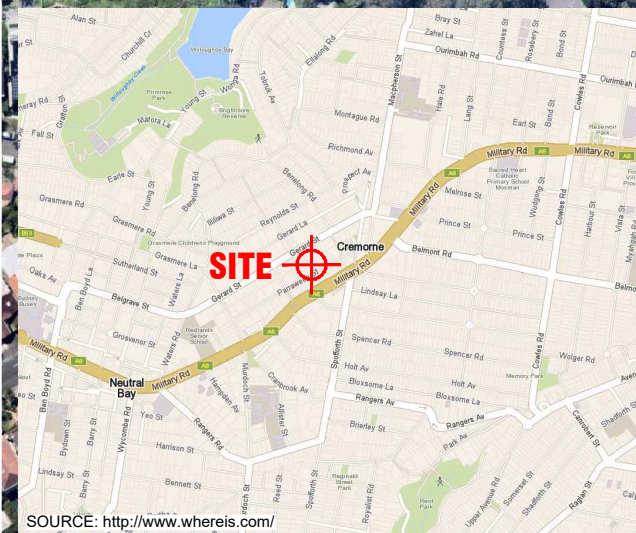
To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

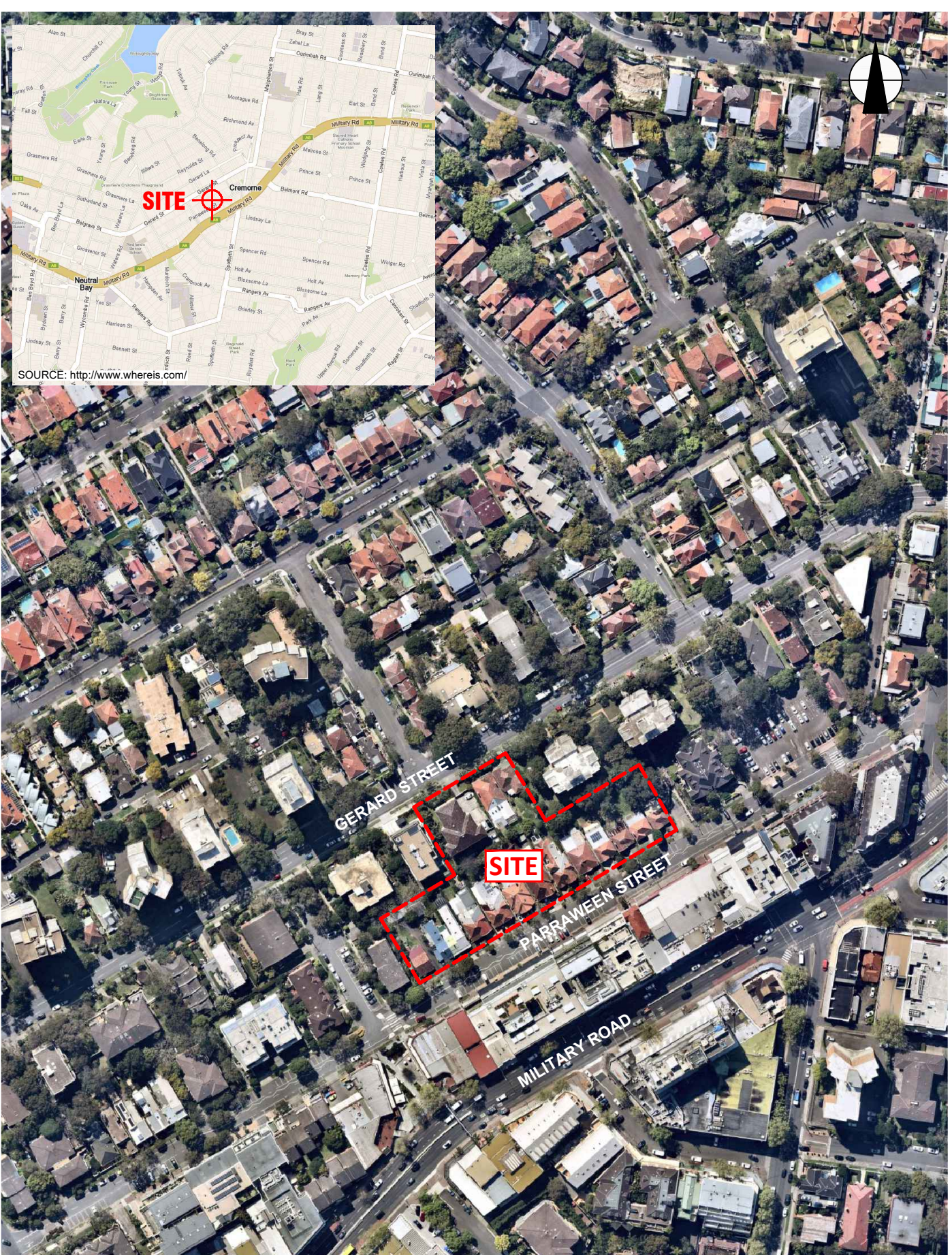
Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.



Appendix A: Report Figures



SOURCE: <http://www.wherereis.com/>



AERIAL IMAGE SOURCE: [MAPS.AU.NEARMAP.COM](https://maps.au.nearmap.com)

Title:		SITE LOCATION PLAN	
Location:		50-88 PARRAWEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW	
Project No:	E35736PT	Figure No:	1



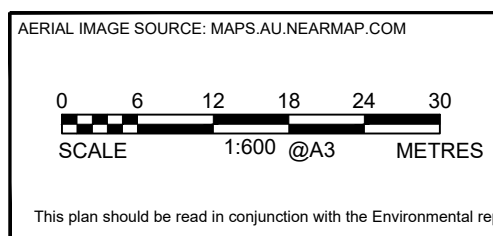
This plan should be read in conjunction with the Environmental report.

JK Environments

PLOT DATE: 22/04/2023 10:58:56 AM DWG FILE: K:\SC EIS_JOBS\360005\E35736PT_CREMORNE\CA\DESIGN\36PT.DWG



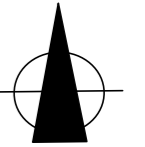
LEGEND	
	APPROXIMATE SITE BOUNDARY
	BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE PSI, 2023)
	BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKG/JKE)
	BH/MW(Fill Depth) BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m) (JKG/JKE)
	BH101 BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
	BH/MW104 BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)
	FCF(Surface) FIBRE CEMENT FRAGMENT LOCATION, NUMBER AND DEPTH (Surface/m)



Title: SAMPLE LOCATION PLAN	
Location: 50-88 PARRAWEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW	
Project No: E35736PT	Figure No: 2
JKEnvironments	

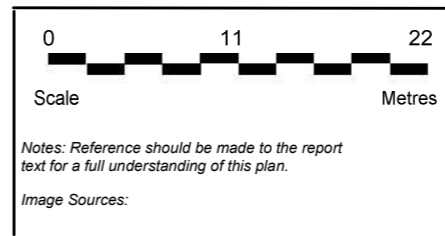


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LEGEND

- - - APPROXIMATE SITE BOUNDARY
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE PSI, 2023)
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKG/JKE)
- ⊕ BH/MW(Fill Depth) BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m) (JKG/JKE)
- BH101 BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
- ⊕ BH/MW104 BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)
- ✕ FCF(Surface) FIBRE CEMENT FRAGMENT LOCATION, NUMBER AND DEPTH (Surface/m)
- ~ 75.00 GROUNDWATER CONTOUR INTERVALS (m)
- INFERRED GROUNDWATER FLOW DIRECTION



Title: GROUNDWATER CONTOUR PLOT	
Location: 50-88 PARRAWEEN STREET & 59-67 GERARD STREET, CREMORNE, NSW	
Project No: E35736PT	Figure No: 3
JK ENVIRONMENTS	





Appendix B: Laboratory Results Summary Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ADWG:	Australian Drinking Water Guidelines	PCBs:	Polychlorinated Biphenyls
ANZG	Australian and New Zealand Guidelines	PCE:	Perchloroethylene (Tetrachloroethylene or Tetrachloroethene)
B(a)P:	Benzo(a)pyrene	PQL:	Practical Quantitation Limit
CRC:	Cooperative Research Centre	RS:	Rinsate Sample
ESLs:	Ecological Screening Levels	RSL:	Regional Screening Levels
GIL:	Groundwater Investigation Levels	SAC:	Site Assessment Criteria
HILs:	Health Investigation Levels	SSA:	Site Specific Assessment
HSLs:	Health Screening Levels	SSHSLs:	Site Specific Health Screening Levels
HSL-SSA:	Health Screening Level-Site Specific Assessment	TB:	Trip Blank
NA:	Not Analysed	TCA:	1,1,1 Trichloroethane (methyl chloroform)
NC:	Not Calculated	TCE:	Trichloroethylene (Trichloroethene)
NEPM:	National Environmental Protection Measure	TS:	Trip Spike
NHMRC:	National Health and Medical Research Council	TRH:	Total Recoverable Hydrocarbons
NL:	Not Limiting	UCL:	Upper Level Confidence Limit on Mean Value
NSL:	No Set Limit	USEPA	United States Environmental Protection Agency
OCP:	Organochlorine Pesticides	VOCC:	Volatile Organic Chlorinated Compounds
OPP:	Organophosphorus Pesticides	WHO:	World Health Organisation
PAHs:	Polycyclic Aromatic Hydrocarbons		
ppm:	Parts per million		

TABLE G1 SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO ECOLOGICAL GILs SAC All results in µg/L unless stated otherwise.								
	PQL Envirolab Services	ANZG 2018 Marine Waters	MW1	MW1 [LAB_DUP]	MW2	MW3	MW4	MW4 [LAB_DUP]
Inorganic Compounds and Parameters								
pH		7 - 8.5	4	[NT]	4.2	5	4.5	NA
Electrical Conductivity (µS/cm)	1	NSL	340	[NT]	660	130	420	NA
Turbidity (NTU)		NSL	350	350	560	480	[NT]	NA
Redox Potential (Eh)	-	NSL	177	168	205	233	275	NA
Total Dissolved Solids (TDS) (mg/L)	5	NSL	280	300	330	59	190	NA
Total Suspended Solids (TSS) (mg/L)	5	NSL	410	410	550	720	9100	NA
Total Organic Carbon (TOC) (mg/L)	1	NSL	3	2	3	3	4	NA
Dissolved Oxygen (mg/L)	0.1	NSL	7.5	7.5	6.5	6.5	8.5	NA
Total Hardness (mg/L)	3	NSL	28	NA	67	23	42	NA
Silica (SiO2) (mg/L)	0.1	NSL	9.1	9.2	11	3.5	12	NA
Phosphorus (mg/L)	0.05	NSL	<0.05	NA	<0.05	<0.05	0.3	0.3
Metals and Metalloids								
Arsenic (As III)	1	2.3	<1	<1	<1	<1	<1	NA
Cadmium	0.1	0.7	<0.1	0.2	<0.1	<0.1	0.1	NA
Chromium (total)	1	27	<1	<1	<1	<1	<1	NA
Copper	1	1.3	40	40	34	14	8	NA
Lead	1	4.4	3	3	3	15	3	NA
Total Mercury (inorganic)	0.05	0.1	<0.05	[NT]	<0.05	<0.05	<0.05	NA
Nickel	1	7	33	34	61	62	42	NA
Zinc	1	15	160	170	240	88	120	NA
Aluminium	10	NSL	1900	2000	100	40	130	NA
Antimony	1	NSL	<1	<1	<1	<1	<1	NA
Barium	1	NSL	8	9	160	16	41	NA
Boron	20	NSL	100	100	30	20	<20	NA
Beryllium	0.05	NSL	<0.5	<0.5	4	<0.5	0.7	NA
Cobalt	1	1	<1	<1	13	5	7	NA
Iron	10	NSL	30	30	7000	120	2600	NA
Lithium	1	NSL	<1	<1	4	<1	3	NA
Manganese	5	NSL	10	10	500	31	190	NA
Molybdenum	1	NSL	<1	<1	<1	<1	<1	NA
Selenium	1	NSL	<1	<1	<1	<1	<1	NA
Silver	1	1.4	<1	<1	<1	<1	<1	NA
Strontium	1	NSL	4	5	33	24	49	NA
Uranium	0.5	NSL	<0.5	<0.5	<0.5	1.1	<0.5	NA
Vanadium	1	100	<1	<1	<1	<1	<1	NA
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)								
Benzene	1	500	<1	NA	<1	<1	<1	<1
Toluene	1	180	<1	NA	<1	<1	<1	<1
Ethylbenzene	1	5	<1	NA	<1	<1	<1	<1
m+p-xylene	2	75	<2	NA	<2	<2	<2	<2
o-xylene	1	350	<1	NA	<1	<1	<1	<1
Total xylenes	2	NSL	<2	NA	<2	<2	<2	<2
Total Recoverable Hydrocarbons (TRHs)								
TRH F1	10	NSL	<10	NA	<10	<10	<10	<10
TRH F2	50	NSL	<50	[NT]	<50	<50	<50	NA
TRH F3	100	NSL	<100	<100	<100	<100	<100	NA
TRH F4	100	NSL	<100	<100	<100	<100	<100	NA
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	0.2	50	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Phenanthrene	0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Anthracene	0.1	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Fluoranthene	0.1	1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	NA
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Anions and Cations								
Calcium (mg/L)	0.5	NSL	0.7	NA	3	6.8	5.7	NA
Potassium (mg/L)	0.5	NSL	0.6	NA	2	0.7	1	NA
Sodium (mg/L)	0.5	NSL	46	NA	99	16	62	NA
Magnesium (mg/L)	0.5	NSL	6.4	NA	14	1	6.7	NA
Hydroxide Alkalinity (as CaCO3) (mg/L)	5	NSL	<5	NA	<5	<5	<5	NA
Bicarbonate Alkalinity (as CaCO3) (mg/L)	5	NSL	<5	NA	<5	10	<5	NA
Carbonate Alkalinity (as CaCO3) (mg/L)	5	NSL	<5	NA	<5	<5	<5	NA
Total Alkalinity (as CaCO3) (mg/L)	5	NSL	<5	NA	<5	10	<5	NA
Sulphate (mg/L)	1	NSL	52	NA	29	23	14	NA
Chloride (mg/L)	1	NSL	47	NA	190	19	100	NA
Ionic Balance (%)	-	NSL	3	NA	-1	-2	7	NA
Sodium Adsorption Ratio (SAR)	0.01	NSL	3.8	[NT]	5.2	1.5	4.1	NA
Nutrients								
Ammonia (mg/L) (pH dependent)	0.005	5.29 (pH 6.5) 4.55 (pH 6.8) 4.83 (pH 6.7)	<0.005	<0.005	<0.005	<0.005	0.017	NA
Nitrate (mg/L)	0.005	NSL	7.7	7.7	0.02	0.22	5.5	NA
Nitrite (mg/L)	0.005	NSL	<0.005	<0.005	<0.005	<0.005	0.008	NA
Nitrogen Oxides (NOX) (mg/L)	0.005	NSL	7.7	7.7	0.02	0.2	5.5	NA
Total Nitrogen (mg/L)	0.1	NSL	9.4	9.4	0.1	0.2	6.5	NA
Phosphate (mg/L)	0.005	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	NA
Microbiological Organisms								
Faecal Coliforms (MPN/100mL)	1	NSL	<18	NA	<18	<18	<18	NA
E Coli (MPN/100mL)	1	NSL	<18	NA	<18	<18	<18	NA
Concentration above the SAC		Bold						
Positive result		Bold						
GIL >PQL		Red						

TABLE G2 SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO HUMAN CONTACT GILs All results in µg/L unless stated otherwise.								
	PQL Envirolab Services	Recreational (10 x NHMRC ADWG)	MW1	MW1 [LAB_DUP]	MW2	MW3	MW4	MW4 [LAB_DUP]
Inorganic Compounds and Parameters								
pH		6.5 - 8.5	4	[NT]	4.2	5	4.5	NA
Electrical Conductivity (µS/cm)	1	NSL	340	[NT]	660	130	420	NA
Turbidity (NTU)		NSL	350	350	560	480	[NT]	NA
Redox Potential (Eh)	-	NSL	177	168	205	233	275	NA
Total Dissolved Solids (TDS) (mg/L)	5	NSL	280	300	330	59	190	NA
Total Suspended Solids (TSS) (mg/L)	5	NSL	410	410	550	720	9100	NA
Total Organic Carbon (TOC) (mg/L)	1	NSL	3	2	3	3	4	NA
Dissolved Oxygen (mg/L)	0.1	NSL	7.5	7.5	6.5	6.5	8.5	NA
Total Hardness (mg/L)	3	NSL	28	NA	67	23	42	NA
Silica (SiO ₂) (mg/L)	0.1	NSL	9.1	9.2	11	3.5	12	NA
Phosphorus (mg/L)	0.05	NSL	<0.05	NA	<0.05	<0.05	0.3	0.3
Acidity (as CaCO ₃)	5	NSL						
Metals and Metalloids								
Arsenic (As III)	1	100	<1	<1	<1	<1	<1	NA
Cadmium	0.1	20	<0.1	0.2	<0.1	<0.1	0.1	NA
Chromium (total)	1	500	<1	<1	<1	<1	<1	NA
Copper	1	20000	40	40	34	14	8	NA
Lead	1	100	3	3	3	15	3	NA
Total Mercury (inorganic)	0.05	10	<0.05	[NT]	<0.05	<0.05	<0.05	NA
Nickel	1	200	33	34	61	62	42	NA
Zinc	1	30000	160	170	240	88	120	NA
Aluminium	10	NSL	1900	2000	100	40	130	NA
Antimony	1	30	<1	<1	<1	<1	<1	NA
Barium	1	20000	8	9	160	16	41	NA
Boron	20	40000	100	100	30	20	<20	NA
Beryllium	0.05	600	<0.5	<0.5	4	<0.5	0.7	NA
Cobalt	1	NSL	<1	<1	13	5	7	NA
Iron	10	NSL	30	30	7000	120	2600	NA
Lithium	1	NSL	<1	<1	4	<1	3	NA
Manganese	5	5000	10	10	500	31	190	NA
Molybdenum	1	500	<1	<1	<1	<1	<1	NA
Selenium	1	100	<1	<1	<1	<1	<1	NA
Silver	1	1000	<1	<1	<1	<1	<1	NA
Strontium	1	NSL	4	5	33	24	49	NA
Uranium	0.5	200	<0.5	<0.5	<0.5	1.1	<0.5	NA
Vanadium	1	NSL	<1	<1	<1	<1	<1	NA
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)								
Benzene	1	10	<1	NA	<1	<1	<1	<1
Toluene	1	8000	<1	NA	<1	<1	<1	<1
Ethylbenzene	1	3000	<1	NA	<1	<1	<1	<1
m+p-xylene	2	NSL	<2	NA	<2	<2	<2	<2
o-xylene	1	NSL	<1	NA	<1	<1	<1	<1
Total xylenes	2	6000	<2	NA	<2	<2	<2	<2
Total Recoverable Hydrocarbons (TRHs)								
TRH F1	10	NSL	<10	NA	<10	<10	<10	<10
TRH F2	50	NSL	<50	[NT]	<50	<50	<50	NA
TRH F3	100	NSL	<100	<100	<100	<100	<100	NA
TRH F4	100	NSL	<100	<100	<100	<100	<100	NA
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	0.2	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Phenanthrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Fluoranthene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(b,j,k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	NA
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Anions and Cations								
Calcium (mg/L)	0.5	NSL	0.7	NA	3	6.8	5.7	NA
Potassium (mg/L)	0.5	NSL	0.6	NA	2	0.7	1	NA
Sodium (mg/L)	0.5	NSL	46	NA	99	16	62	NA
Magnesium (mg/L)	0.5	NSL	6.4	NA	14	1	6.7	NA
Hydroxide Alkalinity (as CaCO ₃) (mg/L)	5	NSL	<5	NA	<5	<5	<5	NA
Bicarbonate Alkalinity (as CaCO ₃) (mg/L)	5	NSL	<5	NA	<5	10	<5	NA
Carbonate Alkalinity (as CaCO ₃) (mg/L)	5	NSL	<5	NA	<5	<5	<5	NA
Total Alkalinity (as CaCO ₃) (mg/L)	5	NSL	<5	NA	<5	10	<5	NA
Sulphate (mg/L)	1	NSL	52	NA	29	23	14	NA
Chloride (mg/L)	1	NSL	47	NA	190	19	100	NA
Ionic Balance (%)	-	NSL	3	NA	-1	-2	7	NA
Sodium Adsorption Ratio (SAR)	0.01	NSL	3.8	[NT]	5.2	1.5	4.1	NA
Nutrients								
Ammonia (mg/L) (pH dependent)	0.005	NSL	<0.005	<0.005	<0.005	<0.005	0.017	NA
Nitrate (mg/L)	0.005	500000	7.7	7.7	0.02	0.22	5.5	NA
Nitrite (mg/L)	0.005	30000	<0.005	<0.005	<0.005	<0.005	0.008	NA
Nitrogen Oxides (NOX) (mg/L)	0.005	NSL	7.7	7.7	0.02	0.2	5.5	NA
Total Nitrogen (mg/L)	0.1	NSL	9.4	9.4	0.1	0.2	6.5	NA
Phosphate (mg/L)	0.005	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	NA
Microbiological Organisms								
Faecal Coliforms (MPN/100mL)	1	NA	<18	NA	<18	<18	<18	NA
E Coli (MPN/100mL)	1	NA	<18	NA	<18	<18	<18	NA
Concentration above the SAC Bold Positive result Bold GIL >PQL Red								



Appendix C: Borehole Logs

CORED BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Core Size:** NMLC **R.L. Surface:** ~83.3 m
Date: 18/1/23 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK205 **Bearing:** N/A **Logged/Checked By:** T.F./P.S.

Water Loss/Level Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_p(50)$	SPACING (mm)	DEFECT DETAILS		Formation
									Specific	General	
	80			START CORING AT 3.40m							
				NO CORE 0.22m							
		4		SANDSTONE: fine to medium grained, red brown.	MW	L	+0.20			(3.78m) Be, 2°, P, R, Fe Sn	Hawkesbury Sandstone
		79		as above, but light grey, bedded at 0-10°.	SW		+0.10			(4.30m) Be, 2°, P, R, Fe Sn	
		5					+0.10			(5.01m) CS, 0°, 160 mm.t	
		78					+0.090			(5.17m) XWS, 170 mm.t	
							+0.10			(5.34m) CS, 110 mm.t	
		6					+0.10			(5.68m) CS, 70 mm.t	
		77				L - M	+0.10			(6.06m) CS, 0°, 15 mm.t	
							+0.10			(6.19m) XWS, 50 mm.t	
		7					+0.20			(6.40m) Be, 0°, P, R, Clay Ct, 2 mm.t	
		76					+0.40			(7.15m) Be, 2°, P, R, Fe Cn	
							+0.30			(7.31m) CS, 0°, 20 mm.t	
							+0.30			(7.42m) XWS, 80 mm.t	
		8					+0.30			(7.56m) XWS, 40 mm.t	
							+0.30			(7.60m) CS, 0°, 50 mm.t	
		75					+0.30			(7.81m) Be, 4°, P, R, Fe Sn	
							+0.30			(7.90m) Be, 4°, St, R, Fe Sn	
							+0.30			(8.08m) Be, 2°, P, R, Clay Vn	
							+0.30			(8.26m) XWS, 5 mm.t	
		9					+0.30			(9.40m) XWS, 80 mm.t	
		74					+0.40			(9.72m) XWS, 20 mm.t	

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER - 35736S CREMORNE.GPJ <-DrawingFile>> 24/03/2023 10:18 10:01.00.01 Dajjal Lab and In Situ Tool - DCD Lib JK 9.02.4 2019-05-31 P1j JK 0.01.0 2019-05-20



Borehole No.
1
3 / 3

CORED BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Core Size:** NMLC **R.L. Surface:** ~83.3 m
Date: 18/1/23 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK205 **Bearing:** N/A **Logged/Checked By:** T.F./P.S.

Water Loss Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_p(50)$	DEFECT DETAILS		Formation
									SPACING (mm)	DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness	
		73			SANDSTONE: fine to medium grained, light grey, bedded at 0-10°. END OF BOREHOLE AT 10.10 m	SW	L - M	30.90	600 200 60 20	Specific General	
			11								
		72									
			12								
		71									
			13								
		70									
			14								
		69									
			15								
		68									
			16								
		67									

JK 0.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER - 35736S CREMORNE.GPJ <-DrawingFile>> 24/03/2023 10:18 10.01.00.01 Dajigi Lab and In Situ Tool - DCD [Lib:JK 0.02.4 2019.05.31 Proj:JK 0.01.0 2018.05.20]

BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Method:** SPIRAL AUGER **R.L. Surface:** ~85.2 m
Date: 20/2/23 **Datum:** AHD
Plant Type: JK205 **Logged/Checked By:** T.F./P.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
DRY ON COMPLETION OF AUGERING					N = 11 5,8,3	85				FILL: Silty sand, fine to medium grained, dark grey and brown, trace of fine to medium grained igneous and sandstone gravel, root fibres and ash.	M			GRASS COVER APPEARS MODERATELY COMPACTED
						84	1	CL-CI		FILL: Silty sand, fine to medium grained, brown, with fine to medium grained sandstone and ironstone gravel, and ash. Silty CLAY: low to medium plasticity, orange brown, with fine to medium grained sand, trace of fine to coarse grained ironstone gravel.	w-PL	(St)		RESIDUAL ORGANIC ODOUR
					N = 15 3,3,12	83	2	CL		Silty SANDY CLAY: low plasticity, light grey, with fine to coarse grained ironstone gravel.	w<PL	St	150 180 170	
					N=SPT 16/ 150mm REFUSAL	82	3		-	Extremely Weathered sandstone: silty CLAY, low to medium plasticity, light grey and red brown, with fine to coarse grained iron indurated bands.	XW	Hd		HAWKESBURY SANDSTONE VERY LOW 'TC' BIT RESISTANCE
						81	4			SANDSTONE: fine to medium grained, light grey and red brown, with extremely weathered bands and iron indurated bands.	DW	VL		VERY LOW TO LOW STRENGTH BANDS
						80	5			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 14.99m. HAND SLOTTED 50mm DIA. PVC STANDPIPE 14.99m TO 11.99m. CASING 11.99m TO 0m. 2mm SAND FILTER PACK 14.99m TO 11.5m. BENTONITE SEAL 11.5m TO 6m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						79	6							

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 35736S CREMORNE.GPJ <-DrawingFile>> 24/03/2023 10:18 10.01.00.01 Dwgpl Lab and In Situ Tool - DCD Lib: JK 9.02.4 2019-05-31 Pj: JK 9.01.02019-05-20

CORED BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Core Size:** NMLC **R.L. Surface:** ~85.2 m
Date: 20/2/23 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK205 **Bearing:** N/A **Logged/Checked By:** T.F./P.S.

Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_p(50)$	SPACING (mm)	DEFECT DETAILS		Formation
										Specific	General	
		81			START CORING AT 4.28m							
					NO CORE 0.05m	MW	L					
	90% RETURN		5		SANDSTONE: fine to medium grained, orange brown, red brown and light grey, bedded at 0-15°.			0.30			(4.80m) Be, Ir, R, Fe Sn	Hawkesbury Sandstone
			80					0.10			(5.44m) XWS, 5 mm.t	
								0.30			(5.63m) XWS, 4 mm.t	
			6					0.20			(6.21m) XWS, 3 mm.t	
			79		SANDSTONE: fine to medium grained, light grey and orange brown, bedded at 0-10°.	SW		0.050			(6.31m) XWS, 4 mm.t	
			7					0.10				
			78					0.30			(7.27m) XWS, 8 mm.t	
			8					0.30				
			77		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-15°.	FR	M - H	0.30			(8.28m) Be, 0°, P, R, Fe Sn	
			9					0.50			(8.53m) Be, 0°, P, R, Fe Sn	
	100% RETURN		76					1.1				
								1.2				
			10					1.1				
			75		SANDSTONE: fine to medium grained, light grey, massive.			0.60			(10.76m) CS, 0°, 6 mm.t	

JK 9.02.4.LIB.GLB Log_JK_CORED BOREHOLE - MASTER_35736S CREMORNE.GPJ <DrawingFile>> 24/03/2023 10:18 10.01.00.01 Dajigi Lab and In Situ Tool - DCD Lib - JK 9.02.4.2019.05.31 P1; JK 9.01.0.2019.05.20

CORED BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Core Size:** NMLC **R.L. Surface:** ~85.2 m
Date: 20/2/23 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK205 **Bearing:** N/A **Logged/Checked By:** T.F./P.S.

Water Loss/Level Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_p(50)$	DEFECT DETAILS		Formation
								SPACING (mm)	DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness	
							600 200 60 20	Specific	General	
100% RETURN	74	12	[Dotted pattern]	SANDSTONE: fine to medium grained, light grey, massive. <i>(continued)</i>	FR	H	1.8		(11.21m) J, 20°, P, R, Fe Sn	Hawkesbury Sandstone
	73	13		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-15°.			1.4			
	72	14					1.5			
	71	15					1.4			
	70	16		END OF BOREHOLE AT 14.99 m			1.2			
	69	17					1.2			
	68						1.6			
							1.7			

JK 0.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER - 35736S CREMORNE.GPJ <-DrawingFile>> 24/03/2023 10:18 10.01.00.01 Dajigi Lab and In Situ Tool - DCD [Lib:JK 0.02.4 2019-05-31 Pj:JK 0.01.0 2019-05-20]

BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Method:** SPIRAL AUGER **R.L. Surface:** ~84.4 m
Date: 17/1/23 **Datum:** AHD
Plant Type: JK205 **Logged/Checked By:** T.F./P.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
DRY ON COMPLETION OF AUGERING N > 12 4,3,9/ 130mm REFUSAL N=SPT 13/ 0mm REFUSAL						84		-	CONCRETE: 70mm.t	M				
								CL-CI	FILL: Gravel, fine to medium grained, orange brown and brown, igneous.	w>PL	Hd			RESIDUAL
								CL	Sandy Silty CLAY: low to medium plasticity, orange brown, fine to medium grained sand, trace of fine to medium grained ironstone gravel.	w<PL				TOO FRIABLE FOR HP TESTING AND IRONSTONE
							83			as above, but light grey mottled orange brown.		VSt - Hd	350 300 320 450 420 400	HIGH RESISTANCE ON IRONSTONE BAND
								2						HIGH RESISTANCE BANDS
							82		-	Extremely Weathered sandstone: sandy CLAY, low plasticity, fine to medium grained, with iron indurated bands.	XW	Hd		
									SANDSTONE: fine to medium grained, orange brown and red brown, with iron indurated bands.	DW	VL - L			LOW 'TC' BIT RESISTANCE WITH HIGH RESISTANCE BANDS
							3		REFER TO CORED BOREHOLE LOG					LOW TO MODERATE RESISTANCE WITH HIGH RESISTANCE BANDS
						81								GROUNDWATER MONITORING WELL INSTALLED TO 11.1m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 11.1m TO 8.1m. CASING 8.1m TO 0m. 2mm SAND FILTER PACK 11.1m TO 7.5m. BENTONITE SEAL 7.5m TO 0.8m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						80								
						79								
						78								

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 35736S CREMORNE.GPJ <-DrawingFile>> 24/03/2023 10:18 10.01.00.01 Dalziel Lab and In Situ Tool - DCD Lib: JK 9.02.4 2019-05-31 Proj: JK 9.01.0.2019-05-20

CORED BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Core Size:** NMLC **R.L. Surface:** ~84.4 m
Date: 17/1/23 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK205 **Bearing:** N/A **Logged/Checked By:** T.F./P.S.

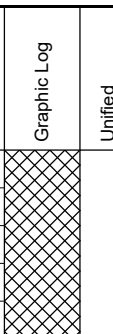
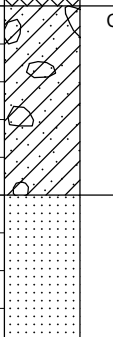
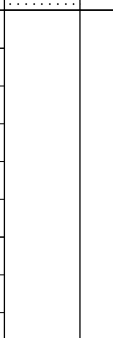
Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_p(50)$	DEFECT DETAILS			Formation		
									SPACING (mm)		DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness			
								600	200	60	20	Specific	General	
		82			START CORING AT 2.84m									
		81	3		NO CORE 0.04m SANDSTONE: fine to medium grained, light grey, bedded at 0-15°.	HW	L							
		80	4					0.30					(3.29m) Be, 4°, P, R, Fe Sn (3.39m) Be, 0°, P, R, Clay Vn (3.58m) Be, 0°, P, R, Fe Sn	
		79	5					0.20					(4.16m) CS, 30 mm.t (4.55m) CS, 30 mm.t (4.65m) CS, 40 mm.t (4.69m) XWS, 140 mm.t	
		78	6		END OF BOREHOLE AT 5.82 m			0.20					(5.08m) CS, 220 mm.t (5.44m) CS, 110 mm.t	
		77	7											
		76	8											

JK 0.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER - 35736S CREMORNE.GPJ <-DrawingFile>> 24/02/2023 10:18 1001.00.01 Dajigi Lab and In Situ Tool - DCD [Lib:JK 0.02.4 2019.05.31 Pj:JK 0.01.0 2019.05.20]

BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Method:** SPIRAL AUGER **R.L. Surface:** 82.9 m
Date: 22/2/23 **Datum:** AHD
Plant Type: JK205 **Logged/Checked By:** T.F./P.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
ON COMPLETION OF AUGERING	█	█	█	█	N = 5 4,3,2	82	1			FILL: Silty sand, fine to medium grained, brown and grey, trace of fine to coarse grained ironstone gravel, and root fibres.	M			GRASS COVER APPEARS POORLY COMPACTED
	█	█	█	█						FILL: Gravelly clayey sand, fine to medium grained, grey and brown, fine to coarse grained ironstone gravel.	W			
	█	█	█	█	N=SPT 7/ 20mm REFUSAL	81	2		CL	Sandy Gravelly CLAY: low plasticity, light brown, fine to coarse grained ironstone gravel, fine to medium grained sand.	w>PL	Hd		RESIDUAL TOO GRAVELLY FOR HP READING
	█	█	█	█					-	Extremely Weathered sandstone: silty CLAY, low plasticity, red brown, with iron indurated bands.	XW	Hd		HAWKESBURY SANDSTONE VERY LOW 'TC' BIT RESISTANCE WITH HIGH BANDS (IRONSTONE?)
	█	█	█	█		80	3			SANDSTONE: fine to medium grained, red brown.	DW	VL - L		VERY LOW TO LOW RESISTANCE WITH HIGH BANDS
	█	█	█	█					REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 10.0m. CLASS 18 MACHINE SLOTTED/HAND SLOTTED 50mm DIA. PVC STANDPIPE 10.0m TO 7.0m. CASING 7.0m TO 0m. 2mm SAND FILTER PACK 10.0m TO 6.5m. BENTONITE SEAL 6.5m TO 0.5m. COMPLETED WITH A CONCRETED GATIC COVER.	
					79	4								
					78	5								
					77	6								
					76									

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 35736S CREMORNE.GPJ <DrawingFile>> 24/03/2023 10:19 10.01.00.01 Dalziel Lab and In Situ Tool - DCD Lib JK 9.02.4 2019-05-31 Proj JK 9.01.0.2019-02-20

CORED BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Core Size:** NMLC **R.L. Surface:** 82.9 m
Date: 22/2/23 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK205 **Bearing:** N/A **Logged/Checked By:** T.F./P.S.

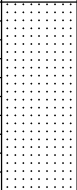
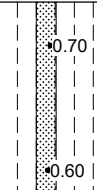
Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_p(50)$	SPACING (mm)	DEFECT DETAILS		Formation
										Specific	General	
					START CORING AT 2.80m							
		80	3		NO CORE 0.20m							
					SANDSTONE: fine to medium grained, red brown and light grey, bedded at 0-15°.	MW	L	+0.20			(3.30m) CS, 0°, 72 mm.t (3.43m) Be, 0°, Ir, R, Fe Sn (3.46m) CS, 0°, 85 mm.t	
		79	4		SANDSTONE: fine to medium grained, light grey, bedded at 0-15°.		VL - L	+0.10			(3.69m) Be, 0°, P, R, Fe Sn (4.12m) XWS, 120 mm.t	
							L	+0.10			(4.45m) Be, 0°, P, R, Fe Sn (4.48m) XWS, 90 mm.t	
		78	5					+0.10			(5.08m) CS, 0°, 20 mm.t	
								+0.20				
								+0.30				
								+0.40				
		77	6				VL				(5.90m) XWS, 15 mm.t (5.93m) XWS, 90 mm.t (6.02m) CS, 280 mm.t	
											(6.30m) XWS, 40 mm.t	
							L - M	+0.10				
								+0.30				
								+0.30				
								+0.10				
								+0.10				
		75	8								(7.79m) Be, 0°, P, R, Clay Vn	
								+0.40				
								+0.60				
		74									(8.80m) CS, 10°, 10 mm.t	

JK 0.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER - 35736S CREMORNE.GPJ <DrawingFiles> 24/03/2023 10:19:10.01.00.01 Dajigi Lab and In Situ Tool - DCD Lib JK 0.02.4 2019.05.31 Pj JK 0.01.0 2019.05.20

CORED BOREHOLE LOG

Client: PATHWAYS RESIDENCES CREMORNE
Project: PROPOSED SENIORS LIVING DEVELOPMENT
Location: 50-88 PARRAWEEEN STREET AND 59-67 GERARD STREET, CREMORNE, NSW

Job No.: 35736S **Core Size:** NMLC **R.L. Surface:** 82.9 m
Date: 22/2/23 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK205 **Bearing:** N/A **Logged/Checked By:** T.F./P.S.

Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_p(50)$	DEFECT DETAILS			Formation	
									SPACING (mm)		DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness		
								600	200	60	20	Specific	General
00% RETURN			73		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-20°. (continued)	FR	M						
			10		END OF BOREHOLE AT 10.00 m								
			72										
			11										
			71										
			12										
			70										
			13										
			69										
			14										
			68										
			15										
			67										

JK 0.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER - 35736S CREMORNE.GPJ <-DrawingFile>> 24/02/2023 10:19 10.01.00.01 Dajigi Lab and In Situ Tool - DCD [Lib:JK 0.02.4 2019.05.31 Pj:JK 0.01.0 2019.05.20]



ENVIRONMENTAL LOGS EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the environmental report in regard to classification methods, field procedures and certain matters relating to the logging of soil and rock. Not all notes are necessarily relevant to all reports.

Where geotechnical borehole logs are utilised for environmental purpose, reference should also be made to the explanatory notes included in the geotechnical report. Environmental logs are not suitable for geotechnical purposes.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Environmental studies include gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 'Geotechnical Site Investigations'. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geoenvironmental practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) are referred to as 'laminite'.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the

structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from “feel” and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term ‘mud’ encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is

described in Australian Standard 1289.6.3.1–2004 (R2016) ‘*Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)*’.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the ‘N’ value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

N = 13
4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

N > 30
15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as ‘N_c’ on the borehole logs, together with the number of blows per 150mm penetration.

LOGS

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

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than ‘straight line’ variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it 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 and may not be the same at the time of construction.
- 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 be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to 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 perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse environmental characteristics or behaviour. If the volume and nature of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing has not been undertaken to confirm the soil classification and rock strengths indicated on the environmental logs unless noted in the report.

SYMBOL LEGENDS

SOIL



FILL



TOPSOIL



CLAY (CL, CI, CH)



SILT (ML, MH)



SAND (SP, SW)



GRAVEL (GP, GW)



SANDY CLAY (CL, CI, CH)



SILTY CLAY (CL, CI, CH)



CLAYEY SAND (SC)



SILTY SAND (SM)



GRAVELLY CLAY (CL, CI, CH)



CLAYEY GRAVEL (GC)



SANDY SILT (ML, MH)



PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK



CONGLOMERATE



SANDSTONE



SHALE/MUDSTONE



SILTSTONE



CLAYSTONE



COAL



LAMINITE



LIMESTONE



PHYLLITE, SCHIST



TUFF



GRANITE, GABBRO



DOLERITE, DIORITE



BASALT, ANDESITE



QUARTZITE

OTHER MATERIALS



BRICKS OR PAVERS



CONCRETE



ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 68% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm)	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Laboratory Classification Criteria

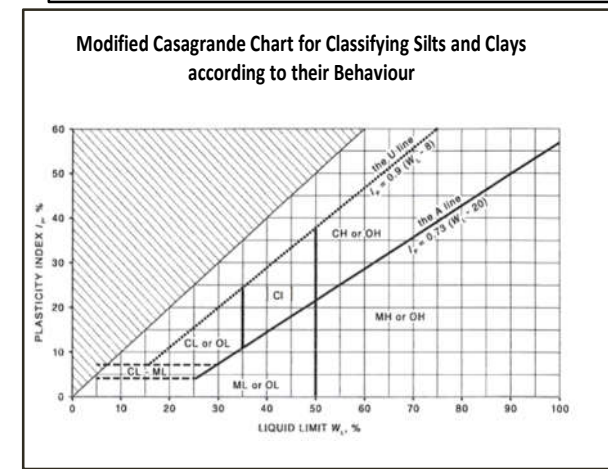
A well graded coarse grained soil is one for which the coefficient of uniformity $C_u > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_u = \frac{D_{60}}{D_{10}} \quad \text{and} \quad C_c = \frac{(D_{30})^2}{D_{10} D_{60}}$$

Where D_{10} , D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

- NOTES:**
- For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.
 - Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.
 - Clay soils with liquid limits $> 35\%$ and $\leq 50\%$ may be classified as being of medium plasticity.
 - The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Major Divisions	Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification	
			Dry Strength	Dilatancy	Toughness		
fine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–





LOG SYMBOLS

Log Column	Symbol	Definition		
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.		
		Extent of borehole/test pit collapse shortly after drilling/excavation.		
		Groundwater seepage into borehole or test pit noted during drilling or excavation.		
Samples	ES	Sample taken over depth indicated, for environmental analysis.		
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.		
	DB	Bulk disturbed sample taken over depth indicated.		
	DS	Small disturbed bag sample taken over depth indicated.		
	ASB	Soil sample taken over depth indicated, for asbestos analysis.		
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.		
	SAL	Soil sample taken over depth indicated, for salinity analysis.		
	PFAS	Soil sample taken over depth indicated, for analysis of Per- and Polyfluoroalkyl Substances.		
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.		
	N _c =	5	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.	
		7		
		3R		
VNS = 25 PID = 100	Vane shear reading in kPa of undrained shear strength. Photoionisation detector reading in ppm (soil sample headspace test).			
Moisture Condition (Fine Grained Soils)	w > PL	Moisture content estimated to be greater than plastic limit.		
	w ≈ PL	Moisture content estimated to be approximately equal to plastic limit.		
	w < PL	Moisture content estimated to be less than plastic limit.		
	w ≈ LL	Moisture content estimated to be near liquid limit.		
	w > LL	Moisture content estimated to be wet of liquid limit.		
	(Coarse Grained Soils)	D	DRY – runs freely through fingers.	
M		MOIST – does not run freely but no free water visible on soil surface.		
W		WET – free water visible on soil surface.		
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – unconfined compressive strength ≤ 25kPa.		
	S	SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.		
	F	FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.		
	St	STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.		
	VSt	VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.		
	Hd	HARD – unconfined compressive strength > 400kPa.		
	Fr	FRIABLE – strength not attainable, soil crumbles.		
	()	Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.		
Density Index/ Relative Density (Cohesionless Soils)		Density Index (I_D) Range (%)	SPT 'N' Value Range (Blows/300mm)	
	VL	VERY LOOSE	≤ 15	0 – 4
	L	LOOSE	> 15 and ≤ 35	4 – 10
	MD	MEDIUM DENSE	> 35 and ≤ 65	10 – 30
	D	DENSE	> 65 and ≤ 85	30 – 50
	VD	VERY DENSE	> 85	> 50
	()	Bracketed symbol indicates estimated density based on ease of drilling or other assessment.		



Log Column	Symbol	Definition
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.
Remarks	'V' bit 'TC' bit T ₆₀ Soil Origin	<p>Hardened steel 'V' shaped bit.</p> <p>Twin pronged tungsten carbide bit.</p> <p>Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.</p> <p>The geological origin of the soil can generally be described as:</p> <p>RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock.</p> <p>EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock.</p> <p>ALLUVIAL – soil deposited by creeks and rivers.</p> <p>ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents.</p> <p>MARINE – soil deposited in a marine environment.</p> <p>AEOLIAN – soil carried and deposited by wind.</p> <p>COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits.</p> <p>LITTORAL – beach deposited soil.</p>



Classification of Material Weathering

Term	Abbreviation	Definition
Residual Soil	RS	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.
Extremely Weathered	XW	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.
Highly Weathered	Distinctly Weathered (Note 1)	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.
Moderately Weathered		
Slightly Weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: '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 weathering products in pores'. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.



Appendix D: Laboratory Reports & COC Documents

CERTIFICATE OF ANALYSIS 337373

Client Details

Client	JK Environments
Attention	Katrina Taylor
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	<u>E35736PT Cremorne</u>
Number of Samples	4 Water
Date samples received	09/11/2023
Date completed instructions received	09/11/2023

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	16/11/2023
Date of Issue	16/11/2023
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *	

Results Approved By

Diana Korniewicz, Chemist
 Dragana Tomas, Senior Chemist
 Greta Petzold, Operation Manager
 Liam Timmins, Organics Supervisor
 Priya Samarawickrama, Senior Chemist
 Tabitha Roberts, Chemist
 Tim Toll, Chemist (FAS)

Authorised By

Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Water					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date extracted	-	09/11/2023	09/11/2023	09/11/2023	09/11/2023
Date analysed	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
TRH C ₆ - C ₉	µg/L	<10	<10	<10	<10
TRH C ₆ - C ₁₀	µg/L	<10	<10	<10	<10
TRH C ₆ - C ₁₀ less BTEX (F1)	µg/L	<10	<10	<10	<10
Benzene	µg/L	<1	<1	<1	<1
Toluene	µg/L	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1
m+p-xylene	µg/L	<2	<2	<2	<2
o-xylene	µg/L	<1	<1	<1	<1
Naphthalene	µg/L	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%	97	98	99	97
Surrogate Toluene-d8	%	99	99	99	100
Surrogate 4-Bromofluorobenzene	%	102	101	102	101

svTRH (C10-C40) in Water					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date extracted	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
Date analysed	-	11/11/2023	11/11/2023	11/11/2023	11/11/2023
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	%	80	78	71	64

PAHs in Water					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date extracted	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
Date analysed	-	13/11/2023	13/11/2023	13/11/2023	13/11/2023
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 <i>p</i> -Terphenyl-d14	%	92	93	102	90

HM in water - dissolved					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date prepared	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
Date analysed	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
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	40	34	14	8
Lead-Dissolved	µg/L	3	3	15	3
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	33	61	62	42
Zinc-Dissolved	µg/L	160	240	88	120
Aluminium-Dissolved	µg/L	1,900	100	40	130
Silver-Dissolved	µg/L	<1	<1	<1	<1
Antimony-Dissolved	µg/L	<1	<1	<1	<1
Boron-Dissolved	µg/L	100	30	20	<20
Beryllium-Dissolved	µg/L	<0.5	4	<0.5	0.7
Barium-Dissolved	µg/L	8	160	16	41
Cobalt-Dissolved	µg/L	<1	13	5	7
Iron-Dissolved	µg/L	30	7,000	120	2,600
Lithium-Dissolved	µg/L	<1	4	<1	3
Manganese-Dissolved	µg/L	10	500	31	190
Molybdenum-Dissolved	µg/L	<1	<1	<1	<1
Selenium-Dissolved	µg/L	<1	<1	<1	<1
Strontium-Dissolved	µg/L	4	33	24	49
Uranium-Dissolved	µg/L	<0.5	<0.5	1.1	<0.5
Vanadium-Dissolved	µg/L	<1	<1	<1	<1

Ion Balance					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date prepared	-	09/11/2023	09/11/2023	09/11/2023	09/11/2023
Date analysed	-	09/11/2023	09/11/2023	09/11/2023	09/11/2023
Calcium - Dissolved	mg/L	0.7	3	6.8	5.7
Potassium - Dissolved	mg/L	0.6	2	0.7	1
Sodium - Dissolved	mg/L	46	99	16	62
Magnesium - Dissolved	mg/L	6.4	14	1	6.7
Hardness	mgCaCO ₃ /L	28	67	23	42
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO ₃	mg/L	<5	<5	10	<5
Carbonate Alkalinity as CaCO ₃	mg/L	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	<5	<5	10	<5
Sulphate, SO ₄	mg/L	52	29	23	14
Chloride, Cl	mg/L	47	190	19	100
Ionic Balance	%	3.0	-1.0	-2.0	7.0

Miscellaneous Inorganics					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date prepared	-	09/11/2023	09/11/2023	09/11/2023	09/11/2023
Date analysed	-	09/11/2023	09/11/2023	09/11/2023	09/11/2023
pH	pH Units	4.0	4.2	5.0	4.5
Electrical Conductivity	µS/cm	340	660	130	420
Redox Potential*	mV	177	205	233	275
Dissolved Oxygen*	mg/L	7.5	6.5	6.5	8.5
Turbidity	NTU	350	560	480	[NT]
Silica (Reactive - SiO ₂)	mg/L	9.1	11	3.5	12
Total Nitrogen in water	mg/L	9.4	0.1	0.2	6.5
TKN in water	mg/L	1.7	0.1	<0.1	1.1
Nitrate as N in water	mg/L	7.7	0.02	0.22	5.5
Nitrite as N in water	mg/L	<0.005	<0.005	<0.005	0.008
NOx as N in water	mg/L	7.7	0.02	0.2	5.5
Ammonia as N in water	mg/L	<0.005	<0.005	<0.005	0.017
Organic Nitrogen as N	mg/L	1.7	<0.2	<0.2	1.0
Phosphate as P in water	mg/L	<0.005	<0.005	<0.005	<0.005
Total Dissolved Solids (grav)	mg/L	280	330	59	190
Total Suspended Solids	mg/L	410	550	720	9,100
Total Organic Carbon	mg/L	3	3	3	4
Sodium Adsorption Ratio	-	3.8	5.2	1.5	4.1

Metals in Waters - Acid extractable					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date prepared	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
Date analysed	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
Phosphorus - Total	mg/L	<0.05	<0.05	<0.05	0.3

Microbiological Testing					
Our Reference		337373-1	337373-2	337373-3	337373-4
Your Reference	UNITS	MW1	MW2	MW3	MW4
Date Sampled		08/11/2023	08/11/2023	08/11/2023	08/11/2023
Type of sample		Water	Water	Water	Water
Date of testing	-	10/11/2023	10/11/2023	10/11/2023	10/11/2023
E. coli	mpn/100mL	<18	<18	<18	<18
Faecal Coliforms	mpn/100mL	<18	<18	<18	<18

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 in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-10°C. 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:- TDS = EC * 0.6
Inorg-019	Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-5°C.
Inorg-022	Turbidity - measured nephelometrically using a turbidimeter, in accordance with APHA latest edition, 2130-B.
Inorg-035	Analysed using an electrode. Please note that the results for water analyses are indicative only, samples are ideally analysed on collection.
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).
Inorg-079	TOC determined using a TOC analyser using the combustion method. Dissolved requires filtering prior to determination. Analysis using APHA latest edition 5310B.
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. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Inorg-112	Dissolved Oxygen using membrane electrode. Note this analysis should ideally be carried out immediately after sampling.
INORG-120	Reactive Silica (SiO2) determined colorimetrically. Waters samples are filtered on receipt prior to analysis.

Method ID	Methodology Summary
Metals-020	Determination of various metals by ICP-AES.
Metals-020	Calcium and Magnesium analysed by ICP-AES and SAR calculated.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS. 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. Salt forms (e.g. FeO, PbO, ZnO) are determined stoichiometrically from the base metal concentration.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-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.

Client Reference: E35736PT Cremorne

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date extracted	-			09/11/2023	4	09/11/2023	10/11/2023		09/11/2023	[NT]
Date analysed	-			10/11/2023	4	10/11/2023	13/11/2023		10/11/2023	[NT]
TRH C ₆ - C ₉	µg/L	10	Org-023	<10	4	<10	<10	0	83	[NT]
TRH C ₆ - C ₁₀	µg/L	10	Org-023	<10	4	<10	<10	0	83	[NT]
Benzene	µg/L	1	Org-023	<1	4	<1	<1	0	80	[NT]
Toluene	µg/L	1	Org-023	<1	4	<1	<1	0	80	[NT]
Ethylbenzene	µg/L	1	Org-023	<1	4	<1	<1	0	83	[NT]
m+p-xylene	µg/L	2	Org-023	<2	4	<2	<2	0	86	[NT]
o-xylene	µg/L	1	Org-023	<1	4	<1	<1	0	84	[NT]
Naphthalene	µg/L	1	Org-023	<1	4	<1	<1	0	[NT]	[NT]
Surrogate Dibromofluoromethane	%		Org-023	99	4	97	97	0	101	[NT]
Surrogate Toluene-d8	%		Org-023	99	4	100	99	1	97	[NT]
Surrogate 4-Bromofluorobenzene	%		Org-023	100	4	101	98	3	103	[NT]

Client Reference: E35736PT Cremorne

QUALITY CONTROL: svTRH (C10-C40) in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	337373-2
Date extracted	-			10/11/2023	1	10/11/2023	10/11/2023		10/11/2023	10/11/2023
Date analysed	-			11/11/2023	1	11/11/2023	11/11/2023		10/11/2023	11/11/2023
TRH C ₁₀ - C ₁₄	µg/L	50	Org-020	<50	1	<50	<50	0	75	92
TRH C ₁₅ - C ₂₈	µg/L	100	Org-020	<100	1	<100	<100	0	88	106
TRH C ₂₉ - C ₃₆	µg/L	100	Org-020	<100	1	<100	<100	0	86	115
TRH >C ₁₀ - C ₁₆	µg/L	50	Org-020	<50	1	<50	<50	0	75	92
TRH >C ₁₆ - C ₃₄	µg/L	100	Org-020	<100	1	<100	<100	0	88	106
TRH >C ₃₄ - C ₄₀	µg/L	100	Org-020	<100	1	<100	<100	0	86	115
Surrogate o-Terphenyl	%		Org-020	86	1	80	89	11	69	82

Client Reference: E35736PT Cremorne

QUALITY CONTROL: PAHs in Water						Duplicate		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	337373-2
Date extracted	-			10/11/2023	1	10/11/2023	10/11/2023		10/11/2023	10/11/2023
Date analysed	-			13/11/2023	1	13/11/2023	13/11/2023		13/11/2023	13/11/2023
Naphthalene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	96	115
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	84	99
Fluorene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	89	107
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	85	102
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	86	105
Pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	85	105
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	84	99
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	105	130
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	108	1	92	109	17	95	108

Client Reference: E35736PT Cremorne

QUALITY CONTROL: HM in water - dissolved				Duplicate				Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W6	337373-2
Date prepared	-			10/11/2023	1	10/11/2023	10/11/2023		10/11/2023	10/11/2023
Date analysed	-			10/11/2023	1	10/11/2023	10/11/2023		10/11/2023	10/11/2023
Arsenic-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	91	91
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	1	<0.1	0.2	67	93	91
Chromium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	99	98
Copper-Dissolved	µg/L	1	Metals-022	<1	1	40	40	0	96	89
Lead-Dissolved	µg/L	1	Metals-022	<1	1	3	3	0	87	81
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	1	<0.05	[NT]		106	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	1	33	34	3	96	88
Zinc-Dissolved	µg/L	1	Metals-022	<1	1	160	170	6	98	#
Aluminium-Dissolved	µg/L	10	Metals-022	<10	1	1900	2000	5	88	77
Silver-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	90	85
Antimony-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	85	84
Boron-Dissolved	µg/L	20	Metals-022	<20	1	100	100	0	82	87
Beryllium-Dissolved	µg/L	0.5	Metals-022	<0.5	1	<0.5	<0.5	0	88	98
Barium-Dissolved	µg/L	1	Metals-022	<1	1	8	9	12	88	#
Cobalt-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	91	88
Iron-Dissolved	µg/L	10	Metals-022	<10	1	30	30	0	100	#
Lithium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	93	100
Manganese-Dissolved	µg/L	5	Metals-022	<5	1	10	10	0	100	#
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	99	97
Selenium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	83	85
Strontium-Dissolved	µg/L	1	Metals-022	<1	1	4	5	22	99	92
Uranium-Dissolved	µg/L	0.5	Metals-022	<0.5	1	<0.5	<0.5	0	80	76
Vanadium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	103	101

Client Reference: E35736PT Cremorne

QUALITY CONTROL: Ion Balance				Duplicate				Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			09/11/2023	[NT]	[NT]	[NT]	[NT]	09/11/2023	[NT]
Date analysed	-			09/11/2023	[NT]	[NT]	[NT]	[NT]	09/11/2023	[NT]
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	101	[NT]
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	94	[NT]
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	103	[NT]
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	98	[NT]
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Bicarbonate Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Carbonate Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Total Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	98	[NT]
Sulphate, SO ₄	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	112	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	107	[NT]

Client Reference: E35736PT Cremorne

QUALITY CONTROL: Miscellaneous Inorganics				Duplicate				Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	337373-2
Date prepared	-			09/11/2023	1	09/11/2023	09/11/2023		09/11/2023	09/11/2023
Date analysed	-			09/11/2023	1	09/11/2023	09/11/2023		09/11/2023	09/11/2023
pH	pH Units		Inorg-001	[NT]	1	4.0	[NT]		100	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	1	340	[NT]		104	[NT]
Redox Potential*	mV		Inorg-035	[NT]	1	177	168	5	87	[NT]
Dissolved Oxygen*	mg/L	0.1	Inorg-112	<0.1	1	7.5	7.5	0	[NT]	[NT]
Turbidity	NTU	0.1	Inorg-022	<0.1	1	350	350	0	100	[NT]
Silica (Reactive - SiO ₂)	mg/L	0.1	INORG-120	<0.1	1	9.1	9.2	1	98	[NT]
Total Nitrogen in water	mg/L	0.1	Inorg-055/062/127	<0.1	1	9.4	9.4	0	96	110
TKN in water	mg/L	0.1	Inorg-062	<0.1	1	1.7	1.7	0	[NT]	[NT]
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	1	7.7	7.7	0	99	95
Nitrite as N in water	mg/L	0.005	Inorg-055	<0.005	1	<0.005	<0.005	0	105	108
NOx as N in water	mg/L	0.005	Inorg-055	<0.005	1	7.7	7.7	0	99	95
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	<0.005	<0.005	0	94	77
Organic Nitrogen as N	mg/L	0.2	Inorg-055/062/127	<0.2	1	1.7	1.7	0	[NT]	[NT]
Phosphate as P in water	mg/L	0.005	Inorg-060	<0.005	1	<0.005	<0.005	0	111	91
Total Dissolved Solids (grav)	mg/L	5	Inorg-018	<5	1	280	300	7	104	[NT]
Total Suspended Solids	mg/L	5	Inorg-019	<5	1	410	410	0	88	[NT]
Total Organic Carbon	mg/L	1	Inorg-079	<1	1	3	2	40	100	[NT]
Sodium Adsorption Ratio	-	0.01	Metals-020	<0.01	1	3.8	[NT]		103	[NT]

Client Reference: E35736PT Cremorne

QUALITY CONTROL: Metals in Waters - Acid extractable					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date prepared	-			10/11/2023	4	10/11/2023	10/11/2023		10/11/2023	[NT]
Date analysed	-			10/11/2023	4	10/11/2023	10/11/2023		10/11/2023	[NT]
Phosphorus - Total	mg/L	0.05	Metals-020	<0.05	4	0.3	0.3	0	103	[NT]

Result Definitions

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

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	
The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.	
Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2	

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.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

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.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Turbidity cannot be done for sample #4 due to high sediments present.

8 HM in water - dissolved - # 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.

Microbiology analysed by Sonic Food & Water Testing. Report No. W2326383

The time between collection and the commencement of testing should not exceed 24 hours. Samples tested outside this time may have their results compromised

DO

Samples were out of the recommended holding time for this analysis.

SAMPLE RECEIPT ADVICE

Client Details

Client	JK Environments
Attention	Katrina Taylor

Sample Login Details

Your reference	E35736PT Cremorne
Envirolab Reference	337373
Date Sample Received	09/11/2023
Date Instructions Received	09/11/2023
Date Results Expected to be Reported	16/11/2023

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	4 Water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	10
Cooling Method	None
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie

Phone: 02 9910 6200
Fax: 02 9910 6201
Email: ahie@envirolab.com.au

Jacinta Hurst

Phone: 02 9910 6200
Fax: 02 9910 6201
Email: jhurst@envirolab.com.au

Analysis Underway, details on the following page:



Sample ID	VTRH(C6-C10)/BTEXN in Water	svTRH (C10-C40) in Water	PAHs in Water	HM in water - dissolved	Calcium - Dissolved	Potassium - Dissolved	Sodium - Dissolved	Magnesium - Dissolved	Hardness	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	Redox Potential*	Dissolved Oxygen*	Turbidity	Silica (Reactive - SiO2)	Total Nitrogen in water	TKN in water	Nitrate as N in water	Nitrite as N in water	NOx as N in water	Ammonia as N in water	Organic Nitrogen as N	Phosphate as P in water	Total Dissolved Solids(grav)	Total Suspended Solids	Total Organic Carbon	Sodium Adsorption Ratio	Metals in Waters -Acid extractable	Microbiological Testing				
MW1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
MW2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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.



Appendix E: Fieldwork Document



PID FIELD CALIBRATION FORM

Client:		Pathways Residences Cremorne	
Project:		Proposed Seniors Living Development	
Location:		50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	
Job Number:		E35736PT	
PID			
Make: <i>Honeywell</i>	Model: <i>MiniRAE Lite+</i>	SN: <i>590-913241</i> Unit: <i>PGM7300</i>	Date of last factory calibration: <i>09.08.23</i>
Date of calibration: <i>01/11/23</i>		Name of Calibrator: <i>PB</i>	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: <i>987</i> ppm		Error in measured reading: \pm <i>0.3</i> ppm	
Measured reading Acceptable (Yes/No):			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: \pm ppm	
Measured reading Acceptable (Yes/No):			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: \pm ppm	
Measured reading Acceptable (Yes/No):			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: \pm ppm	
Measured reading Acceptable (Yes/No):			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: \pm ppm	
Measured reading Acceptable (Yes/No):			



WATER QUALITY METER CALIBRATION FORM

Client:	Pathways Residences Cremorne		
Project:	Proposed Seniors Living Development		
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW		
Job Number:	E35736PT		
DISSOLVED OXYGEN			
Make: YSI5	Model: /		
Date of calibration: 01/11/23	Name of Calibrator: CB		
Span value: 70% to 130%			
Measured value: 124 %			
Measured reading Acceptable (Yes/No): <input checked="" type="checkbox"/>			
pH			
Make: YSI5	Model: /		
Date of calibration: 01/11/23	Name of Calibrator: CB		
Buffer 1: Theoretical pH = 7.01± 0.01	Expiry date: 01/24	Lot No: 8014	
Buffer 2: Theoretical pH = 4.01± 0.01	Expiry date: 12/23	Lot No: DK100123	
Measured reading of Buffer 1: 7.09			
Measured reading of Buffer 2: 4.15			
Slope: /	Measured reading Acceptable (Yes/No): <input checked="" type="checkbox"/>		
EC			
Make: YSI5	Model: /		
Date: 01/11/23	Name of Calibrator: CB	Temperature: 21.9 °C	
Calibration solution: 16 - Conductivity solution	Expiry date: 12/23	Lot No: DE091222	
Theoretical conductivity at temperature (see solution container): 1332 μS/cm			
Measured conductivity: 1317 μS/cm	Measured reading Acceptable (Yes/No): <input checked="" type="checkbox"/>		
REDOX			
Make: YSI5	Model: /		
Date of calibration: 01/11/23	Name of Calibrator: CB		
Calibration solution: Hanna Instruments 240mV	Expiry date: 05/24	Lot No: 3177	
Theoretical redox value: 240mV			
Measured redox reading: 244.4 mV	Measured reading Acceptable (Yes/No): <input checked="" type="checkbox"/>		

JK Environments



Client:	Pathways Residences Cremorne	Job No.:	E35736PT
Project:	Proposed Seniors Living Development	Well No.:	MW1 (1)
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	Depth (m):	10.1

WELL FINISH DETAILS

Gatic Cover <input checked="" type="checkbox"/>	Standpipe <input type="checkbox"/>	Other (describe) <input type="checkbox"/>
-------------------------------------------------	------------------------------------	-------------------------------------------

WELL DEVELOPMENT DETAILS

Method:	Development pump	SWL - Before (m):	804
Date:	01/11/23	Time - Before:	8:20
Undertaken By:	CB	SWL - After (m):	9.00m
Total Vol. Removed:	53L	Time - After:	8:44
PID Reading (ppm):	0.0		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
0.5	19.2	6.0	631	3.31	-55.1
1	19.6	5.9	503	3.70	-47.3
2	19.2	6.0	406.1	3.55	-45.3
4	19.2	5.4	381	3.44	-47.3
6	19.2	44.3	368.0	3.43	-47.16
8	19.2	4.3	365.4	3.52	-49.0
10	19.4	5.1	375.5	3.44	-49.2
12	19.4	4.4	283.6	3.42	-50.0
14	19.3	2.8	294.7	3.47	-55.7
16	19.4	2.1	418.8	3.42	-57.9
18	19.4	1.6	429.3	3.42	-60.8
20	19.4	1.1	425.3	3.41	-64.4
22	19.4	0.8	424.1	3.4	-69.1
24	19.5	2.1	425.6	3.41	-63.0
26	19.4	1.4	423.2	3.42	-65.5
28	19.4	1.7	425.2	3.44	-70.3
30	19.4	2.1	424.1	3.40	-72.3
32	19.5	2.1	423.8	3.42	-75.0
34	19.5	2.1	423.6	3.40	-74.7
36	19.5	2.3	422.7	3.42	-78.3
38	19.5	2.4	422.7	3.42	-79.5
40	19.5	2.4	422.5	3.41	-79.9
42	19.5	2.4	422.7	3.42	-81.3

Comments: Odours (YES / (NO)), NAPL/PSH (YES / (NO)), Sheen (YES / (NO)), Steady State Achieved (YES) / NO

YSI Used: YSI5

Tested By:	CB	Remarks: - Steady state conditions - Difference in the pH less than 0.2 units, difference in the conductivity less than 10% and SWL stable/not in drawdown - Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Date Tested:	01/11/23	
Checked By:	KT	
Date:	2/11/23	



Client:	Pathways Residences Cremorne	Job No.:	E35736PT
Project:	Proposed Seniors Living Development	Well No.:	MW3
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	Depth (m):	11.1

WELL FINISH DETAILS

<input checked="" type="checkbox"/> Gatic Cover	<input type="checkbox"/> Standpipe	<input type="checkbox"/> Other (describe)
-------------------------------------------------	------------------------------------	-------------------------------------------

WELL DEVELOPMENT DETAILS

Method:	Development pump	SWL - Before (m):	3.24
Date:	01/11/23	Time - Before:	9.45
Undertaken By:	CB	SWL - After (m):	10.05
Total Vol. Removed:	28	Time - After:	10am
PID Reading (ppm):	0.0		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	20.1	14.7	193.3	4.95	-92.4
4	20.1	10.8	190.3	5.03	-93.3
6	20.0	9.2	187.6	4.99	-94.6
8	19.9	8.0	186.0	4.96	-96.9
10	19.8	7.7	185.8	4.96	-97.6
12	19.7	7.5	185.6	4.95	-98.2
14	19.7	7.4	185.6	4.95	-98.6
16	19.7	7.3	185.4	4.94	-98.6
18	19.6	7.2	185.9	4.94	-98.5
20	19.7	7.1	184.4	4.90	-98.4
22	19.8	7.1	186.7	4.87	-98.8
24	20.2	6.1	183.5	4.74	-96.3
26	20.0	4.2	186.7	4.86	-98.2
28	20.1	3.6	188.7	4.85	-98.6
Well pumped dry after removing 28L					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)

YSI Used: YSI5

Tested By:	CB	Remarks: - Steady state conditions - Difference in the pH less than 0.2 units, difference in the conductivity less than 10% and SWL stable/not in drawdown - Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry
Date Tested:	01/11/23	
Checked By:	KT	
Date:	2/11/23	



PID FIELD CALIBRATION FORM

Client:		Pathways Residences Cremorne	
Project:		Proposed Seniors Living Development	
Location:		50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	
Job Number:		E35736PT	
PID			
RAE systems Make:	MiniRAE Lite Model:	Unit: SU: 595-001254	Date of last factory calibration: 17/05/23
Date of calibration: 7/11/23		Name of Calibrator: CB	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: 100.3 ppm		Error in measured reading: ± 0.3 ppm	
Measured reading Acceptable (Yes/No): <input checked="" type="checkbox"/> Yes			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			
PID			
Make:	Model:	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration: 100.0 ppm	
Measured reading: ppm		Error in measured reading: ± ppm	
Measured reading Acceptable (Yes/No):			



WATER QUALITY METER CALIBRATION FORM

Client:	Pathways Residences Cremorne		
Project:	Proposed Seniors Living Development		
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW		
Job Number:	E35736PT		
DISSOLVED OXYGEN			
Make: YSI 5	Model: /		
Date of calibration: 8/11/23	Name of Calibrator: CB		
Span value: 70% to 130%			
Measured value: 104			
Measured reading Acceptable (Yes/No):			
pH			
Make: YSI 5	Model: /		
Date of calibration: 8/11/23	Name of Calibrator: CB		
Buffer 1: Theoretical pH = 7.01 ± 0.01	Expiry date: 10/24	Lot No: CE230523	
Buffer 2: Theoretical pH = 4.01 ± 0.01	Expiry date: 03/24	Lot No: CC180523	
Measured reading of Buffer 1: 6.98			
Measured reading of Buffer 2: 3.96			
Slope: /	Measured reading Acceptable (Yes/No):		
EC			
Make: YSI 5	Model: /		
Date: 8/11/23	Name of Calibrator: PK	Temperature: 20.8 °C	
Calibration solution: AR-Conductivity Solution	Expiry date: 02/24	Lot No: CJ210223	
Theoretical conductivity at temperature (see solution container): 1.305 μS/cm			
Measured conductivity: 1315 μS/cm			
Measured reading Acceptable (Yes/No):			
REDOX			
Make: YSI 5	Model: /		
Date of calibration: 8/11/23	Name of Calibrator: CB		
Calibration solution: Hanna Instruments	Expiry date: 05/24	Lot No: 8177	
Theoretical redox value: 240mV			
Measured redox reading: 241.2 mV			
Measured reading Acceptable (Yes/No):			

JK Environments



Client:	Pathways Residences Cremorne	Job No.:	E35736PT
Project:	Proposed Seniors Living Development	Well No.:	MW1
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	Depth (m):	10.1

WELL FINISH

<input checked="" type="checkbox"/> Gatic Cover	<input type="checkbox"/> Standpipe	<input type="checkbox"/> Other (describe)
-------------------------------------------------	------------------------------------	-------------------------------------------

WELL PURGE DETAILS:

Method:	Micro bore pump	SWL - Before:	8.03
Date:	8/11/23	Time - Before:	7.45
Undertaken By:	CB	Total Vol Removed:	9L
Pump Program No:		PID (ppm):	0.1

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
8.34	8.05	0.5		19.4	6.7	287.2	4.09	-142.0
8.38	8.11	1.5		19.3	3.1	312.0	3.44	-149.9
8.42	8.14	3.0		19.3	1.5	349.1	3.35	-170.7
8.46	8.14	4.5		19.3	1.0	351.7	3.35	-178.5
8.50	8.15	6.0		19.3	0.8	352.4	3.35	-183.3
8.54	8.15	7.5		19.3	0.7	352.0	3.33	-187.3
8.58	8.14	9.0		19.3	0.7	351.1	3.30	-189.1
			started sampling					
			- Steady state					
			Quick recharge					

Comments: Odours (YES / NO) NAPL/PSH (YES / NO) Sheen (YES / NO) Steady State Achieved (YES / NO)

Sampling Containers Used: 2 x glass amber, 4 x BTEX vials, 2 x HNO3 plastic, 1 x H2SO4 plastic, 1 x unpreserved plastic

YSI used:

+ 1 micro jaw

Tested By: Celina Brinkmann	Remarks: - Steady state conditions - difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Date Tested: 8/11/23	
Checked By: KE	
Date: 1-11-23	



Client:	Pathways Residences Cremorne	Job No.:	E35736PT
Project:	Proposed Seniors Living Development	Well No.:	4612
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	Depth (m):	15.0m

WELL FINISH

<input checked="" type="checkbox"/> Gatic Cover	<input type="checkbox"/> Standpipe	<input type="checkbox"/> Other (describe)
-------------------------------------------------	------------------------------------	-------------------------------------------

WELL PURGE DETAILS:

Method:	Multiphase pump	SWL - Before:	10.61
Date:	8/11/23	Time - Before:	1.56pm
Undertaken By:	CB	Total Vol Removed:	10.5 L
Pump Program No:	/	PID (ppm):	0.0

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
1	10.88	0.5		21.6	2.8	721	4.71	-77.5
4	11.36	1.5		20.1	1.7	697	4.43	-104.8
8	12.20	2.0		19.9	1.4	697	4.19	-128.2
12	12.57	4.5		19.8	1.2	694	4.24	-136.5
16	12.90	6.0	pump shared to	19.8	1.1	696	4.12	-142.7
20	13.15	7.0	CPM2	20.0	1.0	702	4.09	-146.4
24	13.36	8.0		19.9	1.0	698	4.02	-148.9
28	13.45	9.0	pump lowered	20.3	1.0	706	3.96	-153.9
32	13.59	9.5	to CPM1	20.2	1.0	706	3.95	-154.8
36	13.66	10.0		20.1	0.8	706	3.88	-156.3
40	13.74	10.5		20.0	0.7	707	3.81	-162.0
			started sampling					

Comments: Odours (YES / (NO)), NAPL/PSH (YES / (NO)), Sheen (YES / (NO)) Steady State Achieved (YES / (NO))

Sampling Containers Used: 2 x glass amber, 4 x BTEX vials, 2 x HNO3 plastic, 1 x H2SO4 plastic, 1 x unpreserved plastic + micro jar

YSI used: YSI5

Tested By: Celina Brinkmann	Remarks: - Steady state conditions - difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Date Tested: 8/11/23	
Checked By: KT	
Date: 9.11.23	

JK Environments



Client:	Pathways Residences Cremorne	Job No.:	E35736PT
Project:	Proposed Seniors Living Development	Well No.:	MW3
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	Depth (m):	11.1m

WELL FINISH

<input checked="" type="checkbox"/> Gatic Cover	<input type="checkbox"/> Standpipe	<input type="checkbox"/> Other (describe)
-------------------------------------------------	------------------------------------	-------------------------------------------

WELL PURGE DETAILS:

Method:	Micro purge pump	SWL - Before:	2.0m
Date:	8/11/23	Time - Before:	12.05
Undertaken By:	CB	Total Vol Removed:	25.5L
Pump Program No:	/	PID (ppm):	0.1

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
1	1.69	1.5		22.2	6.4	142.3	4.99	103.0
4	2.33	3.0		20.6	5.9	148.3	4.86	107.5
8	3.09	4.5		20.4	6.0	147.7	4.88	109.7
12	3.65	6.0		20.4	6.0	146.0	4.88	110.8
16	4.26	7.5		20.3	5.8	142.7	4.87	112.2
20	5.01	9.0		20.4	5.7	137.9	4.88	119.3
24	5.58	10.5		20.5	6.0	136.9	4.95	120.3
28	6.24	12.0		20.5	6.6	139.7	5.13	116.2
32	6.91	13.5		20.4	6.3	141.4	5.12	124.5
36	7.38	15.0	pump slowed to CPU2	21.1	6.1	154.5	4.81	127.6
40	7.55	16.5		21.1	5.6	162.3	4.78	125.4
44	7.72	18.0		21.1	5.8	154.5	4.63	124.3
48	8.06	19.5		21.5	5.4	155.9	4.55	116.4
52	8.34	21.0		21.5	5.6	155.1	4.58	120.1
56	8.40	22.5		21.4	5.3	155.7	4.49	114.3
60	8.49	24.0	pump to CPU1	21.5	5.5	158.3	4.41	112.0
64	8.53	24.5		22.5	5.4	163.0	4.35	111.5
68	8.55	25.0		23.0	4.9	164.6	4.29	109.0
72	8.58	25.5		23.2	4.3	165.1	4.23	105.4
			started sampling					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO) (NO)

Sampling Containers Used: 2 x glass amber, 4 x BTEX vials, 2 x HNO3 plastic, 1 x H2SO4 plastic, 1 x unpreserved plastic

YSI used: YSI5 + 1 micro jar

Tested By: Celina Brinkmann

Remarks:

Date Tested: 8/11/23

- Steady state conditions
- difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown

Checked By: KT

Date: 4.11.23

JK Environments



Client:	Pathways Residences Cremorne	Job No.:	E35736PT
Project:	Proposed Seniors Living Development	Well No.:	MW4
Location:	50-88 Parraween Street and 59-67 Gerard Street, CREMORNE, NSW	Depth (m):	100m

WELL FINISH

<input checked="" type="checkbox"/> Gatic Cover	<input type="checkbox"/> Standpipe	<input type="checkbox"/> Other (describe)
-------------------------------------------------	------------------------------------	-------------------------------------------

WELL PURGE DETAILS:

Method:	Micro piezo pump	SWL - Before:	4.29m
Date:	8/11/23	Time - Before:	9.50am
Undertaken By:	CB	Total Vol Removed:	15.5L
Pump Program No:	/	PID (ppm):	0.1

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	4.33	1.25		20.3	6.0	428.8	3.75	-136.7
4	4.82	2.5		19.6	5.2	422.0	3.64	-139.5
8	5.65	3.75		19.4	4.9	420.3	3.71	-143.2
12	6.23	5.0		19.5	4.9	424.3	3.70	-144.0
14	6.94	6.25		19.7	4.5	430.0	3.70	-146.8
18	7.17	7.5		19.6	4.7	426.4	3.70	-142.7
22	7.50	8.75		19.5	4.5	427.0	3.66	-141.4
26	7.81	10.0	pump slowed to	19.5	4.2	426.0	3.63	-142.9
30	8.11	11.0	CPM2	19.9	3.7	435.3	3.54	-140.9
34	8.29	12.0		20.0	3.9	432.8	3.63	-139.5
38	8.47	13.0	pump slowed down	20.8	8.0	444.7	3.62	-130.5
42	8.52	13.5	CPM1	20.9	4.2	447.4	3.63	-130.5
46	8.61	14.0		21.0	4.1	445.7	3.57	-128.1
50	8.65	14.5		21.1	4.0	448.0	3.56	-127.4
54	8.75	15.0		21.1	3.5	444.7	3.55	-125.0
58	8.85	15.5		20.7	8.8	72.4	3.56	-128.3
			started sampling					

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)

Sampling Containers Used: 2 x glass amber, 4 x BTEX vials, 2 x HNO3 plastic, 1 x H2SO4 plastic, 1 x unpreserved plastic

YSI used: YSI5 + 1 micro jar

Tested By: Celina Brinkmann	Remarks: - Steady state conditions - difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Date Tested: 8/11/23	
Checked By: <i>CB</i>	
Date: 9-11-23	



Appendix F: Report Explanatory Notes



STANDARD SAMPLING PROCEDURE (SSP)

These protocols specify the basic procedures to be used when sampling soils or groundwater for environmental site assessments undertaken by JKE.

The purpose of these protocols is to provide standard methods for: sampling, decontamination procedures for sampling equipment, sample preservation, sample storage and sample handling. Deviations from these procedures must be recorded.

A. **Groundwater Sampling**

Groundwater samples are more sensitive to contamination than soil samples and therefore adherence to this protocol is particularly important to obtain reliable, reproducible results. The recommendations detailed in AS/NZS 5667.1:1998 are considered to form a minimum standard.

The basis of this protocol is to maintain the security of the borehole and obtain accurate and representative groundwater samples. The following procedure should be used for collection of groundwater samples from previously installed groundwater monitoring wells.

- After monitoring well installation, at least three bore volumes should be pumped from the monitoring wells (well development) to remove any water introduced during the drilling process and/or the water that is disturbed during installation of the monitoring well. This should be completed prior to purging and sampling.
- Groundwater monitoring wells should then be left to recharge for at least three days before purging and sampling. Prior to purging or sampling, the condition of each well should be observed and any anomalies recorded on the field data sheets. The following information should be noted: the condition of the well, noting any signs of damage, tampering or complete destruction; the condition and operation of the well lock; the condition of the protective casing and the cement footing (raised or cracked); and, the presence of water between protective casing and well.
- Take the groundwater level from the collar of the piezometer/monitoring well using an electronic dip meter. The collar level should be taken (if required) during the site visit using a dumpy level and staff.
- Purging and sampling of piezometers/monitoring wells is done on the same site visit when using micro-purge (or other low flow) techniques.
- Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:
 - Micropore filtration system or Stericup single-use filters (for heavy metals samples);
 - Filter paper for Micropore filtration system; Bucket with volume increments;
 - Sample containers: teflon bottles with 1 ml nitric acid, 75mL glass vials with 1 mL hydrochloric acid, 1 L amber glass bottles;
 - Bucket with volume increments;
 - Flow cell;
 - pH/EC/Eh/T meters;
 - Plastic drums used for transportation of purged water;
 - Esky and ice;
 - Nitrile gloves;
 - Distilled water (for cleaning);
 - Electronic dip meter;
 - Low flow pump pack and associated tubing; and

➤ Groundwater sampling forms.

- If single-use steripur filtration is not used, clean the Micropore filtration system thoroughly with distilled water prior to use and between each sample. Filter paper should be changed between samples. 0.45um filter paper should be placed below the glass fibre filter paper in the filtration system.
- Ensure all non-disposable sampling equipment is decontaminated or that new disposable equipment is available prior to any work commencing at a new location. The procedure for decontamination of groundwater equipment is outlined at the end of this section.
- Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.
- Groundwater samples are obtained from the monitoring wells using low flow/micro-purge sampling equipment to reduce the disturbance of the water column and loss of volatiles.
- During pumping to purge the well, the pH, temperature, conductivity, dissolved oxygen, redox potential and groundwater levels are monitored (where possible) using calibrated field instruments to assess the development of steady state conditions. Steady state conditions are generally considered to have been achieved when the difference in the pH measurements was less than 0.2 units and the difference in conductivity was less than 10%.
- All measurements are recorded on specific data sheets.
- Once steady state conditions are considered to have been achieved, groundwater samples are obtained directly from the pump tubing and placed in appropriate glass bottles, BTEX vials or plastic bottles.
- All samples are preserved in accordance with water sampling requirements detailed in the NEPM 2013 and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice as outlined in the report text.
- Record the sample on the appropriate log in accordance with AS1726:1993. At the end of each water sampling complete a chain of custody form.

B. Decontamination Procedures for Groundwater Sampling Equipment

- All equipment associated with the groundwater sampling procedure (other than single-use items) should be decontaminated between every sampling location.
- The following equipment and materials are required for the decontamination procedure:
 - Phosphate free detergent;
 - Potable water;
 - Distilled water; and
 - Plastic Sheets or bulk bags (plastic bags).
- Fill one bucket with clean potable water and phosphate free detergent, and one bucket with distilled water.
- Flush potable water and detergent through pump head. Wash sampling equipment and pump head using brushes in the bucket containing detergent until all materials attached to the equipment are removed.
- Flush pump head with distilled water.
- Change water and detergent solution after each sampling location.
- Rinse sampling equipment in the bucket containing distilled water.
- Place cleaned equipment on clean plastic sheets.
- If all materials are not removed by this procedure that equipment should not be used until it has been thoroughly cleaned



QA/QC DEFINITIONS

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994)⁷ methods and those described in *Environmental Sampling and Analysis, A Practical Guide*, (H. Keith 1991)⁸.

A. Practical Quantitation Limit (PQL), Limit of Reporting (LOR) & Estimated Quantitation Limit (EQL)

These terms all refer to the concentration above which results can be expressed with a minimum 95% confidence level. The laboratory reporting limits are generally set at ten times the standard deviation for the Method Detection limit (MDL) for each specific analyte. For the purposes of this report the LOR, PQL, and EQL are considered to be equivalent.

When assessing laboratory data it should be borne in mind that values at or near the PQL have two important limitations.

“The uncertainty of the measurement value can approach, and even equal, the reported value. Secondly, confirmation of the analytes reported is virtually impossible unless identification uses highly selective methods. These issues diminish when reliably measurable amounts of analytes are present. Accordingly, legal and regulatory actions should be limited to data at or above the reliable detection limit” Keith 1991.

B. Precision

The degree to which data generated from repeated measurements differ from one another due to random errors. Precision is measured using the standard deviation or Relative Percent Difference (RPD). Acceptable targets for precision in this report will be less than 50% RPD for concentrations greater than ten times the PQL, less than 75% RPD for concentrations between five and ten times the PQL and less than 100% RPD for concentrations that are less than five times the PQL.

C. Accuracy

Accuracy is a measure of the agreement between an experimental result and the true value of the parameter being measured. The assessment of accuracy for an analysis can be achieved through the analysis of known reference materials or assessed by the analysis of surrogates, field blanks, trip spikes and matrix spikes.

The proximity of an averaged result to the true value, where all random errors have been statistically removed. Accuracy is measured by percent recovery. Acceptable limits for accuracy generally lie between 70% to 130% recoveries. Certain laboratory methods may allow for values that lie outside these limits.

D. Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is primarily dependent upon the design and implementation of the sampling program. Representativeness of the data is partially ensured by the avoidance of contamination, adherence to sample handling and analysis protocols and use of proper chain-of-custody and documentation procedures.

⁷ US EPA, (1994). *SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. (US EPA SW-846)

⁸ Keith., H, (1991). *Environmental Sampling and Analysis, A Practical Guide*



E. Completeness

Completeness is a measure of the number of valid measurements in a data set compared to the total number of measurements made and overall performance against DQIs. The following information is assessed for completeness:

- Chain-of-custody forms; Sample receipt form;
- All sample results reported; All blank data reported;
- All laboratory duplicate and RPDs calculated;
- All surrogate spike data reported;
- All matrix spike and lab control spike (LCS) data reported and RPDs calculated;
- Spike recovery acceptable limits reported; and
- NATA stamp on reports.

F. Comparability

Comparability is the evaluation of the similarity of conditions (eg. sample depth, sample homogeneity) under which separate sets of data are produced. Data comparability checks include a bias assessment that may arise from the following sources:

- Collection and analysis of samples by different personnel; Use of different techniques;
- Collection and analysis by the same personnel using the same methods but at different times; and
- Spatial and temporal changes (due to environmental dynamics).

G. Blanks

The purpose of laboratory and field blanks is to check for artefacts and interferences that may arise during sampling and analysis.

H. Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula below. Acceptable recovery limits are 70% to 130%.

$$\frac{(\text{Spike Sample Result} - \text{Sample Result}) \times 100}{\text{Concentration of Spike Added}}$$

I. Surrogate Spikes

Samples are spiked with a known concentration of compounds that are chemically related to the analyte being investigated but unlikely to be detected in the environment. The purpose of the Surrogate Spikes is to check the accuracy of the analytical technique. Surrogate Spikes are reported as percent recovery.

J. Duplicates

Laboratory duplicates measure precision, expressed as Relative Percent Difference. Duplicates are prepared from a single field sample and analysed as two separate extraction procedures in the laboratory. The RPD is calculated using the formula where D1 is the sample concentration and D2 is the duplicate sample concentration:

$$\frac{(D1 - D2) \times 100}{\{(D1 + D2)/2\}}$$