8 October 2025Ref: E35612Plet-ASSrev1

Para Ere Holdings Pty Ltd
22 Raglan Street
Manly NSW 2095

Attention: Mr Lachie Paramor

PRELIMINARY ACID SULFATE SOIL ASSESSMENT
PROPOSED MIXED-USE DEVELOPMENT
22 RAGLAN STREET, MANLY, NSW

1 INTRODUCTION

Para Ere Holdings Pty Ltd ('the client') commissioned JK Environments (JKE) to undertake a preliminary acid sulfate soil (ASS) assessment for the proposed mixed-use development at 22 Raglan Street, Manly ('the site'). The site is identified as Lot 100 in DP1009880. The site location is shown on Figure 1 and the investigation was confined to the site boundaries as shown on Figure 2.

The assessment was undertaken generally in accordance with a JKE proposal (Ref: EP59960P) of 17 January 2024 and written acceptance from the client dated the same. The aims of the assessment were to establish whether ASS may be disturbed during the proposed development works, and to assess whether an ASS management plan (ASSMP) is required.

A geotechnical assessment was undertaken previously to the ASS assessment by JK Geotechnics (JKG) and the results are presented in a separate revised report (Ref: 35612SFrptRev1, dated 1 October 2025). The geotechnical assessment did not include any intrusive investigation on site.

1.1 Assessment Guidelines and Background

The ASS assessment and preparation of this letter were undertaken with reference to the National Acid Sulfate Soil Guidance (2018) documents and the Acid Sulfate Soil Management Advisory Committee (ASSMAC) Acid Sulfate Soil Manual (1998)[1].

ASS materials include potential acid sulfate soils (PASS or sulfidic soil materials) and actual acid sulfate soils (AASS or sulfuric soil materials). These are often found in the same profile, with AASS overlying PASS. AASS and PASS are defined further as follows:

- PASS are soil materials which contain Reduced Inorganic Sulfur (RIS) such as pyrite. The field pH of these soils in their undisturbed state is usually more than pH 4 and is commonly neutral to alkaline (pH

[1] Acid Sulfate Soils Management Advisory Committee (ASSMAC), (1998). *Acid Sulfate Soils Manual* (ASS Manual 1998)

7–9). These soil materials are invariably saturated with water in their natural state. Their texture may be peat, clay, loam, silt or sand and is often dark grey in colour and soft in consistence, but these materials may also exhibit colours that are dark brown, or medium to pale grey to white; and

- AASS are soil materials which contained RIS such as pyrite that have undergone oxidation. This oxidation results in low pH (that is pH less than 4) and often a yellow (jarosite) and/or orange to red mottling (ferric iron oxides) in the soil profile. Actual ASS contains Actual Acidity, and commonly also contains RIS (the source of Potential Sulfuric Acidity) as well as Retained Acidity.

Further background information on ASS and the assessment process is provided in the appendices.

1.2 Proposed Development Details

The proposed development includes the demolition of the existing backpackers' accommodation building, and construction of a mixed-use development comprising a retail and residential flat building for aged or disabled persons housing, over basement parking. Bulk excavation for the proposed development is expected to extend to a depth of approximately 3.9m depth below existing surface levels to accommodate the basement. Deeper soil disturbance will be required for the basement shoring wall, building foundations and lift pits etc. These construction details are yet to be confirmed.

2 SITE INFORMATION

2.1 Site Information and Description

Table 2-1: Site Identification

Site Address:	22 Raglan Street, Manly, NSW 2095
Lot & Deposited Plan:	Lot 100 in DP100980
Current Land Use:	Medium Density Residential
Site Area (m^2):	713
Site Elevation (metres Australian Height Datum – mAHD approx. Sourced from Google Earth)	7
Geographical Location (decimal degrees approx.):	Latitude: -33.795405 Longitude: 151.285502

The site is situated in a mixed-use (residential/commercial) area of Manly, approximately 220m west of Manly Beach. The site lies beyond the toe of an east-facing hillside, and the site and the immediate surrounds are in a relatively flat topographic setting.

At the time of inspection, the site was operating as a hostel/backpackers. A two-storey concrete building and garage occupied the majority of the site. Most of the ground floor was concrete covered, and only small isolated garden beds existed. There were no mangroves or creeks in the immediate vicinity.

Stormwater runoff was expected to travel eastwards towards Manly Beach via the municipal stormwater system.

2.2 Regional Geology

The geological map of Sydney (1983)[2] indicated the site to be underlain Quaternary aged deposits of medium to fine-grained marine sands.

2.3 Acid Sulfate Soil Risk Map

A review of the ASS risk maps prepared by Department of Land and Water Conservation (1997)[3] indicated that the site is located in an area classed as having a 'low probability' of ASS occurrence greater than 3m below the ground surface.

2.4 Manly Council Local Environmental Plan (LEP) 2013

A review of the Manly Local council LEP indicated that the site is located in an ASS risk Class 4 area. Potential environmental risks associated with disturbances of ASS materials for Class 4 risk areas are defined as works at depths beyond 2m below existing ground level, or works by which the water table is likely to be lowered beyond 2m below existing ground level (refer to appendices for further details on each risk class).

3 INVESTIGATION REQUIREMENTS AND ASSESSMENT CRITERIA

3.1 Investigation Requirements

The National Acid Sulfate Soil Guidance (2018) requires sampling to a depth of 1m beyond the depth of disturbance (including the depth of any groundwater disturbance). A summary of the sampling densities and analysis requirements outlined in the *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual* (2018) is provided in the following tables:

Table 3-1: Minimum Soil Sampling Densities for ASS Investigations

Type of disturbance	Extent of site	Sample point frequency
Small volumes (≤ 1000 m^3) – prior to disturbance	Volume of disturbance (m^3)	Number of boreholes
	< 250	2
	251–500	3
	501–1000	4

[2] Department of Mineral Resources, (1983). *1:100,000 Geological Map of Sydney (Series 9130)*

[3] Department of Land and Water Conservation, (1997). *1:25,000 Acid Sulfate Soil Risk Map - Sydney Heads (Series 9130N2, Ed 2)*

Type of disturbance	Extent of site	Sample point frequency
Large volumes (> 1000 m^3) – prior to disturbance	Project area (ha) <1 1-2 2-3 3-4 >4	Number of boreholes 4 6 8 10 10 plus 2 per additional hectare
Linear	Width and volume Minor[1] Major[2]	Intervals (m) 100 50
Existing stockpiles & verification testing	Volume (m^3) <250 251-500 1,000 >1,000	Number of samples 2 3 4 4 plus 1 per additional 500m^3

[1] Minor Linear Disturbance – for example underground services, narrow shallow drains (less than 1 m below ground level).
[2] Major Linear Disturbance – for example roads, railways, canals, deep sewer, wide drains, deep drains and dredging projects[#].
[#] Further guidance is provided in the Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management (Simpson et al. 2017).

Table 3-2: Minimum Number of Soil Samples to be Submitted for Laboratory Analysis (small-scale disturbance)

Volume of disturbed soils	Maximum disturbance depth			
	< 1 m	1–2 m	2-3 m	3-4 m
≤ 250m^3	3	4	5	6
251–500m^3	4	5	6	7
500–1,000m^3	5	6	7	8

Note: Small scale is considered less than or equal to 1,000 m^3 and does not involve dewatering or groundwater pumping (excluding linear disturbances). Number of samples to be analysed per total volume of soil to be disturbed, not per borehole. Depth of disturbance to be measured from ground surface. Borehole depth must be at least 1 m below maximum proposed depth of disturbance.

The investigation component of this assessment was designed as a preliminary investigation and does not meet the minimum sampling density and analysis frequency. The low sampling density is considered reasonable for a preliminary assessment given the site access limitations, and this has been considered in drawing conclusions.

3.2 Action Criteria

The action criteria presented in the *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual* (2018) are summarised in the following table:

Table 3-3: ASS Action Criteria Based on Soil Texture and Volume of Material Being Disturbed

Type of material		**Net Acidity**			
Texture range* (NCST 2009)	Approximate clay content (%)	1–1000 t materials disturbed		> 1000 t materials disturbed	
		% S-equiv. (oven-dried basis)	mol H^+/t (oven-dried basis)	% S-equiv. (oven-dried basis)	mol H^+/t (oven-dried basis)
Fine - light medium to heavy clays	>40	≥0.10	≥62	≥0.03	≥18
Medium - clayey sand to light clays	5–40	≥0.06	≥36	≥0.03	≥18
Coarse and Peats - sands to loamy sands	<5	≥0.03	≥18	≥0.03	≥18

* If bulk density values are not available for the conversion of cubic meters to tonnes of soil, then default bulk densities, based on the soil texture, may be used.

The action criteria for coarse soils were used for this assessment.

3.3 Field Tests

The soil field tests commonly used for investigations for ASS materials include field pH (pH_F) and field pH peroxide (pH_{FOX}) tests. The pH_F test can help identify Actual ASS. While a pH_F of less than or equal to pH 4 is indicative of the presence of Actual ASS, it is not conclusive of the presence of ASS on its own, as naturally occurring, non-ASS soils such as many organic soils (for example peats) and heavily leached soils may also have pH_F less than or equal to pH 4. To identify an Actual ASS other evidence must be presented that indicates the low pH_F has been mainly caused by the oxidation of reduced inorganic sulfur. Such information includes the presence of jarosite in the soil layer/horizon, or the location of other Actual ASS or PASS materials within the sampling location or in the nearby vicinity.

The difference between the pH_F and the pH_{FOX} is helpful in the preliminary identification of PASS. Combined, the pH_F and pH_{FOX} results can be a useful aid with soil sample selection for laboratory analysis. Additional Information in relation to interpretation of the pH field tests is provided in the appendices.

4 INVESTIGATION PROCEDURE

4.1 Subsurface Investigation and Soil Sampling Methods

Field work was undertaken on 23 January, 2024. Soil samples were collected from two locations, to a maximum borehole depth of 1.85mBGL. The sampling locations are shown on the attached Figure 2. The sample locations were drilled using hand equipment due to access restrictions.

Soil samples were obtained at various depths, based on observations made during the field investigation. All samples were placed in plastic bags and sealed with plastic ties with minimal headspace. Each sample was labelled with a unique job number, the sampling location and sampling depth. All samples were recorded on the borehole logs attached in the appendices.

The samples were preserved by immediate storage in an insulated sample container with ice return to the JKE office. Samples were subsequently delivered in the insulated sample container (with ice packs) to a NATA registered laboratory for analysis under standard chain of custody (COC) procedures.

Overhead restrictions and underground services limited our scope to two boreholes, which were positioned relatively close to each other, and extended to a maximum depth of 1.85mBGL.

4.2 Laboratory Analysis

Samples for this assessment were analysed for ASS field tests (including pH_F and pH_{FOX}) and using the chromium reducible sulfur (S_{CR}) acid base accounting analytical methods. All tests/analysis were performed at the laboratory and JKE did not carry out the testing in the field due to time constraints. Samples were Analysed by Envirolab Services (NATA Accreditation Number – 2901). Reference should be made to the laboratory reports (Ref: 342262 and 342262-A) attached in the appendices for further information regarding the laboratory methods used.

5 RESULTS OF THE INVESTIGATION

5.1 Subsurface Conditions

The subsurface conditions encountered generally consisted of concrete pavement to a maximum depth of 0.2m, underlain by fill material to depths of approximately 0.5m to >0.6m (BH2 refused on an obstruction in fill at 0.6m), then natural sandy soil to the maximum termination depth of approximately 1.85m.

The fill material typically consisted of silty sand with inclusions of concrete, glass and ceramic fragments. The natural soil included yellow brown silty sand.

Groundwater was not encountered to the termination depth of BH1 at 1.85m.

5.2 Laboratory Results

The soil laboratory results were assessed against the action criteria adopted for the assessment. The results are presented in the attached Table A and are summarised below.

Table 5-1: Summary of Results

Results	Comments
pH_F and pH_{FOX}	The pH_F results ranged from pH 8 to pH 11. The pH_{FOX} results ranged from 4.8 to 8.1.
pH_{FOX} reaction rates	Reaction rates ranged from medium to extreme and the pF_{FOX} results dropped by up to 3.4 units following oxidation.
Net Acidity % S-equiv.	The net acidity in two samples submitted for analysis did not exceed the action criterion of 0.03%. Both analysed samples were below the Practical Quantitation Limit (PQL).
Net Acidity mol H^+/t	The net acidity in two samples submitted for analysis did not exceed the action criterion of 18 mol H^+/t. Both analysed samples were below the PQL.
S_{CR}%	The S_{CR}% results were below the PQL of 0.005% $SC_{R.}$ These results indicated that the soils did not contain significant oxidisable sulfur concentrations.
Liming Rate	The liming rate required for neutralisation were below the PQL of 0.75kg$CaCO_3$/tonne.

6 ASSESSMENT CONCLUSION

Based on the weight of evidence collected and evaluated for this assessment, there is considered to be a negligible risk from disturbing ASS materials (AASS or PASS) down to a depth of approximately 1.85m below existing ground levels. However, due to access constraints, the soil sampling depths were limited and the boreholes did not extend to the anticipated bulk excavated depth for the proposed basement. Therefore, we consider that an ASSMP is required so that potential risks can be managed. The ASSMP is included in the following sections of this letter and is based on the following:

- Preliminary ASS assessment data confirmed that ASS materials will not be disturbed during the demolition works, which are not expected to disturb soils far below the ground surface (i.e. demolition is largely above ground and only minor soil disturbance at shallow depths is expected to occur to remove existing footings etc.);
- Additional investigation will need to occur utilising a suitable drill rig, following demolition of the existing structures when the site is accessible. This is a requirement of the ASSMP; and
- A contingency management measure and other requirements are included for the management of ASS materials, should ASS conditions be encountered during the additional investigation.

7 ACID SULFATE SOIL MANAGEMENT PLAN (ASSMP)

7.1 Conceptual Site Model

ASS conditions were not encountered during the preliminary assessment to a depth of approximately 1.85m below the existing ground level. Groundwater was also not encountered in the boreholes down to this depth.

The risk maps indicate there is a low probability of ASS occurrence beyond a depth of 3m. However, we consider that there is a potential for PASS to occur around and below the groundwater table. The groundwater level is not known, however, based on JK experience on nearby sites, it is possible that groundwater may not be encountered within the bulk excavation depth for the proposed basement (nearby groundwater levels have been recorded at depths greater than 4m below ground). Notwithstanding, this is uncertain, and there is also a high potential for soil disturbance to occur well beyond the bulk excavation depths for the basement to accommodate the basement shoring wall, lift pit and building foundations etc.

Based on JKG's experience on nearby sites, the shoring wall, lift pit and building foundation will likely encounter groundwater, however, some uncertainty remains.

7.2 Roles and Responsibilities

The client or their nominated representative must engage a suitably qualified consultant to undertake further investigation of ASS conditions in soil and groundwater following demolition, as specified in Section 7.3 of this letter.

The primary role and responsibility for implementing the management measures in this ASSMP (or any updated ASSMP) is the construction contractor. The construction contractor is responsible for obtaining a copy of this (or any updated) ASSMP and taking reasonable steps so that it is adequately implemented.

The construction contractor is to engage a validation consultant to monitor the works and validate the implementation of the ASSMP. The construction contractor and validation consultant are also to refer to any specific development consent requirements of the local consent authority. The consent authority must also specify whether any other plans or permits etc are required prior to the commencement of any works under this ASSMP, and the construction contractor/client is to ensure such plans/permits etc are obtained.

7.3 Post-Demolition Investigation Requirements

Following demolition, an additional ASS investigation must be undertaken by a suitably qualified consultant. Soil sampling and analysis must occur from an appropriate number of locations and to the required depths based on the maximum depth of soil disturbance.

In the event that groundwater is encountered above the proposed depth of bulk excavation for the basement or any associated lift pits etc, reference is to be made to Section 7.6 and the additional investigation must also consider potential implication relating to dewatering ASS materials during the work.

On completion of the investigation, a report must be prepared presenting the results and providing an updated ASSMP to reflect the findings.

In the event that the investigation identifies there is no ASS-related risks that require management, a clear conclusion must be drawn in this regard within the report. A copy of the report must be provided to the certifier and Northern Beaches Council (any specific conditions of the development consent must also be adhered to in this regard).

7.4 Preferred Strategies for Management

The preferred strategy for managing environmental risks associated with PASS is to eliminate disturbance of the PASS. Where this cannot occur, disturbance is to be limited to the extent practicable and the disturbance is to be managed under this ASSMP.

At this stage, the strategy for management is conceptual and is based on the assumption that PASS occurs around the groundwater table and below the groundwater table. The strategy for the management of PASS includes ex-situ treatment of excavated PASS followed by waste classification and off-site disposal.

Once the design and construction methodologies are finalised, the validation consultant is to undertake a review of these details in consultation with the client/construction contractor. If the scope of the ASSMP is not considered to be adequate to address the potential environmental risks associated with the disturbance of PASS materials during the development, an addendum or revised ASSMP is to be prepared. This must be submitted to the certifier and Northern Beaches Council prior to commencement of works that disturb or expose PASS.

7.5 Management of PASS

Excavated PASS will be managed by the addition of lime to neutralise acid that may be produced following exposure of the PASS to air. The waste classification of the treated material is then to be confirmed in accordance with the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014)[4] and NSW EPA Waste Classification Guidelines - Part 4: Acid Sulfate Soils (2014)[5], and disposed off-site to landfill.

A slightly alkaline, low solubility product such as agricultural lime should be used. This form of lime is chemically stable and any excess lime takes a significant period of time (years) to influence soil pH beyond the depth of application. The lime particles eventually become coated with an insoluble layer of ferrihydrite (Fe[OH]3) that inhibits further reaction. Long term alteration of groundwater conditions is not expected to occur as a result of the use of lime. Controlled applications of agricultural limes are generally not harmful to plants, humans and most aquatic species and, therefore, are considered suitable for use on the soils for this project.

[4] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Part 1 of the Waste Classification Guidelines 2014)
[5] NSW EPA, (2014). *Waste Classification Guidelines, Part 4: Acid Sulfate Soils.* (referred to as Part 4 of the Waste Classification Guidelines 2014)

The construction contractor is to ensure that an appropriate Work Health and Safety Plan (WHSP) and Construction Environmental Management Plan (CEMP) is prepared prior to the use of lime and commencement of construction/management works.

Reference is to be made to the following table for the ex-situ treatment and management procedure:

Table 7-1: Ex-situ Treatment/Management of PASS

Procedure	Details
Step 1: Lime selection and Liming Rate Calculations	A suitable lime product is to be selected as discussed above. A neutralising value (NV), effective neutralising value (ENV) and overall liming rate for ex-situ treatment of PASS is to be calculated based on the type of lime (and its properties) selected, the acid base accounting results from the additional investigation (Section 7.3 of this letter) and in accordance with the ASS Manual 1998. Liming rates can be confirmed via treatment trials during the initial stage of excavation/piling works, and refined as required. It is also noted that because the piling spoil may include a mixture of PASS (from below the groundwater table) and non-PASS (from above the groundwater) materials, this may reduce the amount of lime needed for adequate neutralisation.
Step 2: Set up treatment area/s	A treatment area for the mixing of excavated PASS with agricultural lime must be established. Treatment must occur either within a leak-proof containment area such as a bunded area on hardstand or within a skip bin, or in a designated area where the ground surface is protected by a guard layer of lime. The pad of lime acting as the guard layer should be at least 100mm thick and this thickness should be maintained for the duration of treatment works. The purpose of this guard layer is to minimise the risk of acidic water leaching from the base of the treatment area into the underlying soils and potentially the groundwater table. Dependent upon the rate of spoil generation, several bunded treatment areas may be necessary for stockpiling and treatment. An earthworks strategy should be prepared to ensure that sufficient space is available to accommodate treatment of the PASS.
Step 3: Manage water run-off/infiltration	PASS will be generated from below the water table and the treated material will be wet. The treatment area must be designed to adequately manage any water run-off from the treated materials. For on ground treatment areas, this could consist of sandbags filled with a mixture of lime and sand, and a lime guard layer at the base. It is anticipated that any water that seeps from the treatment area would be treated to some degree by the guard layer of lime and/or the sandbags. If skip bins are used, bunding should not be necessary provided that the bins are covered to prevent infill from rainfall. Although we note that skip bins are may not be appropriate where larger quantities of spoil require treatment.
Step 4: Excavation & handling	During piling works, separation of PASS and non-PASS material is unlikely to be possible. In this case all piling spoil should be treated as PASS. Segregation of PASS and non-PASS may be possible for bulk excavations. PASS spoil should be immediately transferred to the designated treatment area and spread out in 150mm thick layers. If possible, the layers should be allowed to dry in order to aid the mixing process, although dried PASS must not be left untreated overnight. The layers should then be interspersed with the appropriate amount of lime to aid in the effective

Procedure	Details
	mixing of lime and soil. Lime must be applied to the excavated material within the treatment area as soon as possible. If circumstances prevent the immediate spreading and treatment of the material, the surface area of the stockpile should be minimised by forming a relatively high coned shape and avoiding 'spreading-out' of the stockpile. This will limit the surface area exposed to oxidation. Water infiltration must be minimised by covering the stockpile during wet weather. This will limit the formation and transport of acid leachate due to rainfall. The stockpile should be bunded to prevent erosion of the PASS and any movement of potentially acid leachate. Upstream/up-slope surface runoff water must also be diverted around the stockpile. The earthworks strategy should include adequate consideration and planning for the excavation and handling procedures.
<u>Step 5</u>: Lime treatment & validation testing	An excavator or other suitable equipment (as deemed appropriate by the construction contractor) should be used to thoroughly mix the lime through the soil. Once treatment occurs, samples are to be collected from the treated soil at the rates required in the *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual* (2018). Assuming the works occur progressively, a minimum of one sample is required per batch of treated soil prior to off-site disposal, with no less than three samples in total for the project on the assumption that excavation and disposal will be a rolling process and there will be no more than 500m^3 of material to be treated. The guidance recommends that samples be collected of the treated soil at the following rates: • <250m^3 – two samples; • 251-500m^3 – three samples; • 1,000m^3 – four samples; and • >1,000m^3 – four samples plus 1 per additional 500m^3. Field pH may be used as a preliminary indicator where deemed appropriate by the validation consultant. Validation testing is to occur at a NATA accredited laboratory and will include acid base accounting using the chromium reducible sulfur method described in the *National Acid Sulfate Soil Guidance: National acid sulfate soils identification and laboratory methods manual* (2018). The validation net acidity results should be zero or less than the laboratory practical quantitation limits (PQL), depending on how the laboratory report their results. It is noted that the validation testing takes at least 3-5 business days, therefore suitable allowances should be incorporated into the project timeline and earthworks plan.
<u>Step 6:</u> Waste classification and off-site disposal	Following treatment, the material must be tested and the waste classification should be confirmed in accordance with the Parts 1 and 4 of the Waste Classification Guidelines 2014. All neutralised material should be disposed of off-site to a facility licensed by the NSW EPA to accept treated PASS.

7.6 Dewatering

Based on the proposed development details and our understanding of the groundwater levels in the vicinity of the site, dewatering is not anticipated to be required for bulk excavation of the proposed single-level basement. This however must be reassessed as part of the additional investigation process specified in Section 7.3.

In the event that investigations establish that dewatering of ASS materials may occur, prior to commencement of any dewatering, a hydrogeological investigation must occur to establish the extent of dewatering (depths, methods, water volumes, drawdown/cone of depression etc) and potential impacts to PASS. Groundwater quality information must also be obtained in order to establish groundwater disposal and treatment options.

Once the details of dewatering are confirmed and the hydrogeological and water quality information is available, an *Acid Sulfate Soil Dewatering Management Plan* is to be prepared by the validation consultant and it must be implemented concurrently with this ASSMP. This is to be designed with reference to the *National Acid Sulfate Soil Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (2018) and must consider the site-specific requirements of the dewatering.

The dewatering plan is to be submitted to the relevant consent authorities as required. We note that Water NSW should be contacted for advice in relation to obtaining relevant approvals for dewatering, prior to preparation of the management plan. The NSW Government *Minimum requirements for building site groundwater investigations and reporting, information for developers and consultants* (2022) document is expected to apply. There are various assessment requirements within this document that will also facilitate the preparation of the *Acid Sulfate Soil Dewatering Management Plan* and we recommend that the associated geotechnical and hydrogeological investigations (and hydrogeological modelling) occur concurrently to the extent practicable.

7.7 Contingency Plan

If soil monitoring indicates the presence of significantly more acidic material than expected and if the established liming rate appears inadequate, the following is to occur:

- The pH of soils exposed to oxygen in the treatment area will be measured to establish the source of the acidic conditions; and
- Under the direction of the validation consultant, material found to be acidic may be selectively excavated and neutralised with additional lime in accordance with the ex-situ treatment methods in Section 7.5.

7.8 Documentation

On completion of the works requiring management under the ASSMP, a validation report is to be prepared by the validation consultant. The validation report is to document the works completed, present the validation testing results and comment on the adequacy of the overall compliance with the ASSMP. Any other specific conditions imposed in the development consent must also be adequately addressed.

8 LIMITATIONS

The letter limitations are outlined below:

- JKE accepts no responsibility for any unidentified AASS or PASS 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;
- The ASSMP includes provisions for further investigation to occur following demolition when the site is accessible. These investigations must occur in order to confirm the requirements for management of the site in relation to ASS materials;
- This letter 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 letter 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 letter;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- Overhead height restrictions on site limited the access and depth of the boreholes.
- The investigation and preparation of this letter 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 letter;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the letter;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- 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 letter has been prepared for the particular project described and no responsibility is accepted for the use of any part of this letter in any other context or for any other purpose;
- Copyright in this letter 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 letter;
- If the client, or any person, provides a copy of this letter to any third party, such third party must not rely on this letter except with the express written consent of JKE; and
- Any third party who seeks to rely on this letter 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.

If you have any questions concerning the contents of this letter, please do not hesitate to contact us.

Kind Regards

Brendan Page
Principal Environmental Scientist
CEnvP SC

Appendices:

Appendix A: Figures

Appendix B: Laboratory Results Summary Table

Appendix C: Information on Acid Sulfate Soils

Appendix D: Borehole Logs

Appendix E: Laboratory Reports & COC Documents

Appendix A: Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title:	**SITE LOCATION PLAN**
Location:	22 RAGLAN STREET, MANLY, NSW
Project No: E35612P	Figure No: 1

JKEnvironments

PLOT DATE: 31/01/2024 11:04:38 AM   DWG FILE: K:\5C EIS JOBS\35000'S\E35612P MANLY\CAD\E35612P.DWG

LEGEND

- - - -	APPROXIMATE SITE BOUNDARY
● BH(Fill Depth)	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 2 4 6 8 10

SCALE 1:200 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: 22 RAGLAN STREET, MANLY, NSW

Project No: E35612P

Figure No: 2

JKEnvironments

PLOT DATE: 31/01/2024 11:04:45 AM DWG FILE: K:\5C EIS JOBS\35000'S\E35612P MANLY\CAD\E35612P.DWG

Appendix B: Laboratory Results Summary Table

ABBREVIATIONS AND EXPLANATIONS FOR ACID SULFATE SOIL TABLE

Abbreviations used in the Tables:

ANC_{BT}	Acid Neutralising Capacity - Back Titration
ANCE	Excess Acid Neutralising Capacity
$CaCO_3$	Calcium Carbonate
kg	kilogram
mol H^+/t	moles hydrogen per tonne
pHF	Field pH
pHFOX	Field peroxide pH
pH_{KCl}	Pottasium chloride pH
S	Sulfur
SCr	The symbol given to the result from the Chromium Reducible Sulfur method
S_{NAS}	Net Acid Soluble Sulfur
% w/w	Percentage by mass

Results have been assessed against the criteria specified in Table 1.1 of National Acid sulfate Soil Guidance - National acid sulfate soil identification and laboratory method manual. Water Quality Australia. June 2018

Preliminary Acid Sulfate Soil Assessment
22 Raglan Street, Manly NSW
E35612P

TABLE A
SUMMARY OF LABORATORY RESULTS - ACID SULFATE SOIL ANALYSIS

Soil Texture: Coarse		Analysis	pH_F and pH_{FOX}					Actual Acidity (Titratable Actual Acidity - TAA)	Potential Sulfidic Acidity		Retained Acidity	Acid Neutralising Capacity (ANC_{BT})	a-Net Acidity without ANCE	s-Net Acidity without ANCE	Liming Rate - without ANCE
			pH_F	pH_{FOX}	Reaction	pH_F - pH_{FOX}	pH_{KCL}	(mol H^+/t)	(% SCr)	(mol H^+/t)	(%S_{NAS})	(% $CaCO_3$)	(mol H^+/t)	(%w/w S)	(kg $CaCO_3$/tonne)
National Acid Sulfate Soils Guidance (2018)			-	-	-	-	-	-	-	-	-	-	18	0.03	-
Sample Reference	**Sample Depth (m)**	**Sample Description**													
BH1	0.2-0.23	F: Silty Sand	11	8.1	Extreme reaction	2.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.3-0.32	F: Silty Sand	9.2	6.5	Medium reaction	2.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.48-0.58	Silty Sand	8.2	4.8	High reaction	3.4	8	<5	<0.005	<3	[NT]	0.8	<5	<0.005	<0.75
BH1	0.83-0.9	Silty Sand	8	5.1	Medium reaction	2.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	1.19-1.5	Silty Sand	8	5.1	Medium reaction	2.9	6.6	<5	<0.005	<3	[NT]	0.35	<5	<0.005	<0.75
BH1	1.7-1.85	Silty Sand	8.1	5.3	Medium reaction	2.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH2	0.17-0.19	F: Silty Sand	8.7	5.7	Medium reaction	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH2	0.28-0.3	F: Silty Sand	8.4	5.9	Extreme reaction	2.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			8	8	-	8	2	2	2	2	2	2	2	2	2
Minimum Value			8.0	4.8	-	2.5	6.6	<PQL	<PQL	<PQL	<PQL	0.35	<PQL	<PQL	<PQL
Maximum Value			11.0	8.1	-	3.4	8	<PQL	<PQL	<PQL	<PQL	0.8	<PQL	<PQL	<PQL

Values Exceeding Action Criteria

Appendix C: Information on Acid Sulfate Soils

A. Background

Acid Sulfate Soil (ASS) is formed from iron rich alluvial sediments and sulfate (found in seawater) in the presence of sulfate reducing bacteria and plentiful organic matter. These conditions are generally found in mangroves, salt marsh vegetation or tidal areas and at the bottom of coastal rivers and lakes. ASS materials are distinguished from other soil or sediment materials (referred to as 'soil materials' throughout the National Acid Sulfate Soils Guidance) by having properties and behaviour that have either:

1) Been affected considerably by the oxidation of Reduced Inorganic Sulfur (RIS), or
2) The capacity to be affected considerably by the oxidation of their RIS constituents.

Acid sulfate soil materials include potential acid sulfate soils (PASS or sulfidic soil materials) and actual acid sulfate soils (AASS or sulfuric soil materials). These are often found in the same profile, with AASS overlying PASS. PASS and AASS are defined further below:

- PASS are soil materials which contain RIS such as pyrite. The field pH of these soils in their undisturbed state is usually more than pH 4 and is commonly neutral to alkaline (pH 7–9). These soil materials are invariably saturated with water in their natural state. Their texture may be peat, clay, loam, silt or sand and is often dark grey in colour and soft in consistence, but these materials may also exhibit colours that are dark brown, or medium to pale grey to white; and
- AASS are soil materials which contained RIS such as pyrite that have undergone oxidation. This oxidation results in low pH (that is pH less than 4) and often a yellow (jarosite) and/or orange to red mottling (ferric iron oxides) in the soil profile. Actual ASS contains Actual Acidity, and commonly also contains RIS (the source of Potential Sulfuric Acidity) as well as Retained Acidity.

B. The ASS Planning Maps

The ASS planning maps provide an indication of the relative potential for disturbance of ASS to occur at locations within the council area. These maps do not provide an indication of the actual occurrence of ASS at a site or the likely severity of the conditions.

The maps are divided into five classes dependent upon the type of activities/works that if undertaken, may represent an environmental risk through the development of acidic conditions associated with ASS:

Table 1: Risk Classes

Risk Class	Description
Class 1	All works.
Class 2	All works below existing ground level and works by which the water table is likely to be lowered.
Class 3	Works at depths beyond 1m below existing ground level or works by which the water table is likely to be lowered beyond 1m below existing ground level.
Class 4	Works at depths beyond 2m below existing ground level or works by which the water table is likely to be lowered beyond 2m below existing ground level.
Class 5	Works within 500m of adjacent Class 1, 2, 3, 4 land which are likely to lower the water table below 1m AHD on the adjacent land.

C. The ASS Risk Maps

The ASS risk maps provide an indication of the probability of occurrence of ASS materials at a particular location based on interpretation from geological and soil landscape maps. The maps provide classes based on high probability, low probability, no known occurrence and areas of disturbed terrain (site specific assessment necessary) and the likely depth at which ASS materials are likely to be encountered.

D. Interpretation of ASS Field Tests

Tables A1 and A2 below provide some guidance on the interpretation of pH_F and pH_{FOX} test results, as detailed in the *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual* (2018):

Table A1: Interpretation of some pH_F test ranges

pH value	Result	Comments
$pH_F \leq 4$, jarosite not observed in the soil layer/horizon	May indicate an AASS indicating previous oxidation of RIS or may indicate naturally occurring, non ASS soils.	Generally not conclusive as naturally occurring, non ASS soils, such as many organic soils (for example peats) and heavily leached soils, often also return $pH_F \leq 4$.
$pH_F \leq 4$, jarosite observed in the soil layer/horizon	The soil material is an AASS.	Jarosite and other iron precipitate minerals in ASS such as schwertmannite require a pH < 4 to form and indicate prior oxidation of RIS.
$pH_F > 7$	Expected in waterlogged, unoxidised, or poorly drained soils.	Marine muds commonly have a pH > 7 which reflects a seawater (pH 8.2) influence. Oxidation of samples with H_2O_2 can help indicate if the soil materials contain RIS.

Source: Adapted from DER (2015a).

Table A2: Interpretation of pH_{FOX} test results

pH value and reaction	Result	Comments
Strong reaction of soil with H_2O_2 (that is X or V)	Useful indicator of the presence of RIS but cannot be used alone	Organic rich substrates such as peat and coffee rock, and soil constituents like manganese oxides, can also cause a reaction. Care must be exercised in interpreting these results. Laboratory analyses are required to confirm if appreciable RIS is present.
pH_{FOX} value at least one unit below field pH_F and strong reaction with H_2O_2 (that is X or V)	May indicate PASS	The difference between pH_F and pH_{FOX} is termed the ΔpH. Generally the larger the ΔpH the more indicative of PASS. The lower the final pH_{FOX} the better the likelihood of an appreciable RIS content. For example, a change from pH_F of 8 to pH_{FOX} of 7 (that is a ΔpH of 1) would not indicate PASS, however, a unit change from pH_F of 3.5 to pH_{FOX} of 2.5 would be indicative of PASS. Laboratory analyses are required to confirm if appreciable RIS is present.
$pH_{FOX} < 3$, large ΔpH and a strong reaction with H_2O_2 (that is X or V)	Strongly indicates PASS	The lower the pH_{FOX} below 3, the greater the likelihood that appreciable RIS is present. A combination of all three parameters – pH_{FOX}, ΔpH and reaction strength – gives the

pH value and reaction	Result	Comments
		best indication of PASS. Laboratory analyses are required to confirm that appreciable RIS is present.
A pH_{FOX} 3–4 and Low, Medium or Strong reaction with H_2O_2	Inconclusive	RIS may be present; however, organic matter may also be responsible for the decrease in pH. Laboratory analyses are required to confirm the presence of RIS.
pH_{FOX} 4–5	Inconclusive	RIS may be present in small quantities, or poorly reactive under rapid oxidation, or the sample may contain shell/ carbonate which neutralises some or all acid produced on oxidation. Equally, the pH_{FOX} value may be due to the production of organic acids with no RIS present. Laboratory analyses are required to confirm if appreciable RIS is present.
pH_{FOX} > 5, small or no ΔpH, but Low, Medium or Strong reaction with H_2O_2	Inconclusive	For neutral to alkaline pHF with shell or white concretions, the fizz test with 1 M HCl can be used to identify the presence of carbonates. Laboratory analyses are required to confirm if appreciable RIS is present and further testing is required to confirm that effective self-neutralising materials are present.

Source: Adapted from DER (2015a).

Appendix D: Borehole Logs

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ENVIRONMENTAL LOG

Log No.
BH1
1/1

Environmental logs are not to be used for geotechnical purposes

Client: PARA ERE HOLDINGS PTY LTD
Project: PROPOSED MIXED USE DEVELOPMENT
Location: 22 RAGLAN STREET, MANLY, NSW

Job No.: E35612P **Method:** HAND AUGER **R.L. Surface:** N/A
Date: 23/1/24 **Datum:** -
Plant Type: - **Logged/Checked by:** L.R./B.P.

Groundwater Record	Samples (ES / ASS / ASB / SAL / DB)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION			0			CONCRETE: 200mm.t				
					-	FILL: Silty sand, fine to coarse grained, dark brown, trace of sandstone gravel.	W			SOIL MOISTURE SUSPECTED TO BE FROM CORING PROCESS
							D			
						FILL: Silty sand, fine to coarse grained, grey, orange and yellow, trace of sandstone gravel.	D			
			0.5		SM	Silty SAND: fine to medium grained, yellow brown.				ALLUVIAL
			1							
						as above, but orange brown.	D			
			1.5							
			2			END OF BOREHOLE AT 1.85m				REFUSAL DUE TO HEIGHT RESTRICTIONS (OVERHEAD GARAGE)
			2.5							
			3							
			3.5							

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ENVIRONMENTAL LOG

Log No. **BH2** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: PARA ERE HOLDINGS PTY LTD
Project: PROPOSED MIXED USE DEVELOPMENT
Location: 22 RAGLAN STREET, MANLY, NSW

Job No.: E35612P **Method:** HAND AUGER **R.L. Surface:** N/A
Date: 23/1/24 **Datum:** -
Plant Type: - **Logged/Checked by:** L.R./B.P.

Groundwater Record	SAMPLES ES	ASS	ASB	SAL	DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION							0			CONCRETE: 170mm.t				
									-	FILL: Silty sand, fine to coarse grained, dark brown, trace of sandstone gravel, concrete, ceramic and glass fragments.	D			
										END OF BOREHOLE AT 0.3m				REFUSAL ON OBSTRUCTION IN FILL
							0.5							
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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 65% 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	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine 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	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ 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:

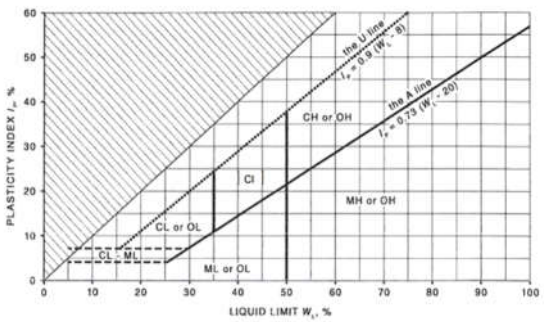
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 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.

3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



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LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
	C	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 7 3R	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.
	VNS = 25	Vane shear reading in kPa of undrained shear strength.
	PID = 100	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.

Log Column	Symbol	Definition	Density Index (I_D) Range (%)	SPT 'N' Value Range (Blows/300mm)
Density Index/ Relative Density (Cohesionless Soils)	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	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. 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. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. 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. LITTORAL – beach deposited soil.

Classification of Material Weathering

<table>
<tr><th colspan="2">Term</th><th colspan="2">Abbreviation</th><th>Definition</th></tr>
<tr><td colspan="2">Residual Soil</td><td colspan="2">RS</td><td>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.</td></tr>
<tr><td colspan="2">Extremely Weathered</td><td colspan="2">XW</td><td>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.</td></tr>
<tr><td>Highly Weathered</td><td rowspan="2">Distinctly Weathered (Note 1)</td><td>HW</td><td rowspan="2">DW</td><td>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.</td></tr>
<tr><td>Moderately Weathered</td><td>MW</td><td>The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.</td></tr>
<tr><td colspan="2">Slightly Weathered</td><td colspan="2">SW</td><td>Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.</td></tr>
<tr><td colspan="2">Fresh</td><td colspan="2">FR</td><td>Rock shows no sign of decomposition of individual minerals or colour changes.</td></tr>
</table>

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

			Guide to Strength	
Term	Abbreviation	Uniaxial Compressive Strength (MPa)	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 E: Laboratory Reports & COC Documents

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

CERTIFICATE OF ANALYSIS 342262

Client Details

Client	JK Environments
Attention	Brendan Page
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E35612P Manly**
Number of Samples	8 Soil
Date samples received	24/01/2024
Date completed instructions received	24/01/2024

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.

Report Details

Date results requested by	25/01/2024
Date of Issue	25/01/2024

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

sPOCAS field test						
Our Reference		342262-1	342262-2	342262-3	342262-4	342262-5
Your Reference	UNITS	BH1	BH1	BH1	BH1	BH1
Depth		0.2-0.23	0.3-0.32	0.48-0.58	0.83-0.9	1.19-1.5
Date Sampled		23/01/2024	23/01/2024	23/01/2024	23/01/2024	23/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	25/01/2024	25/01/2024	25/01/2024	25/01/2024	25/01/2024
pH_F (field pH test)	pH Units	11.0	9.2	8.2	8.0	8.0
pH_{FOX} (field peroxide test)	pH Units	8.1	6.5	4.8	5.1	5.1
Reaction Rate*	-	Extreme reaction	Medium reaction	High reaction	Medium reaction	Medium reaction

sPOCAS field test				
Our Reference		342262-6	342262-7	342262-8
Your Reference	UNITS	BH1	BH2	BH2
Depth		1.7-1.85	0.17-0.19	0.28-0.3
Date Sampled		23/01/2024	23/01/2024	23/01/2024
Type of sample		Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	25/01/2024	25/01/2024	25/01/2024
pH_F (field pH test)	pH Units	8.1	8.7	8.4
pH_{FOX} (field peroxide test)	pH Units	5.3	5.7	5.9
Reaction Rate*	-	Medium reaction	Medium reaction	Extreme reaction

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			24/01/2024	[NT]	[NT]	[NT]	[NT]	24/01/2024	[NT]
Date analysed	-			25/01/2024	[NT]	[NT]	[NT]	[NT]	25/01/2024	[NT]
pH_F (field pH test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]
pH_{FOX} (field peroxide test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	100	[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.

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

Client Details	
Client	JK Environments
Attention	Brendan Page

Sample Login Details	
Your reference	E35612P Manly
Envirolab Reference	342262
Date Sample Received	24/01/2024
Date Instructions Received	24/01/2024
Date Results Expected to be Reported	25/01/2024

Sample Condition	
Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	8 Soil
Turnaround Time Requested	1 day
Temperature on Receipt (°C)	14.8
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Nil

Please direct any queries to:

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

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
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12 Ashley St Chatswood NSW 2067
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Sample ID	sPOCAS field test
BH1-0.2-0.23	✓
BH1-0.3-0.32	✓
BH1-0.48-0.58	✓
BH1-0.83-0.9	✓
BH1-1.19-1.5	✓
BH1-1.7-1.85	✓
BH2-0.17-0.19	✓
BH2-0.28-0.3	✓

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.

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E35612P Date Results Required: 1 DAY Page: 1 of 1	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Brendan Page

Location:	Manly, NSW	Sample Preserved in Esky on Ice
Sampler:	LR/VR	Tests Required

	Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	SCr Suite	pH field test (pHF apHFOX)										
1	23.01.2024		BH1	0.2-0.23	P	F: Silty Sand		X										
2	23.01.2024		BH1	0.3-0.32	P	F: Silty Sand		X										
3	23.01.2024		BH1	0.48-0.58	P	Silty Sand		X										
4	23.01.2024		BH1	0.83-0.9	P	Silty Sand		X										
5	23.01.2024		BH1	1.19-1.5	P	Silty Sand		X										
6	23.01.2024		BH1	1.7-1.85	P	Silty Sand		X										
7	23.01.2024		BH2	0.17-0.19	P	F: Silty Sand		X										
8	23.01.2024		BH2	0.28-0.3	P	F: Silty Sand		X										

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 342262
Date Received: 24/1
Time Received: 3:30PM
Received By: KW
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Remarks (comments/detection limits required):		Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag		
Relinquished By: LR	Date: 24.01.2024	Time: 24.1.24	Received By:	Date:

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CERTIFICATE OF ANALYSIS 342262-A

Client Details

Client	JK Environments
Attention	Brendan Page
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E35612P Manly**
Number of Samples	Additional CrS analysis
Date samples received	24/01/2024
Date completed instructions received	25/01/2024

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.

Report Details

Date results requested by	02/02/2024
Date of Issue	02/02/2024

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Chromium Suite			
Our Reference		342262-A-3	342262-A-5
Your Reference	UNITS	BH1	BH1
Depth		0.48-0.58	1.19-1.5
Date Sampled		23/01/2024	23/01/2024
Type of sample		Soil	Soil
Date prepared	-	24/01/2024	24/01/2024
Date analysed	-	29/01/2024	29/01/2024
pH_{kcl}	pH units	8.0	6.6
s-TAA pH 6.5	%w/w S	<0.01	<0.01
TAA pH 6.5	moles H^+ /t	<5	<5
Chromium Reducible Sulfur	%w/w	<0.005	<0.005
a-Chromium Reducible Sulfur	moles H^+ /t	<3	<3
S_{HCl}	%w/w S	[NT]	[NT]
S_{KCl}	%w/w S	[NT]	[NT]
S_{NAS}	%w/w S	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.80	0.35
s-ANC_{BT}	%w/w S	0.26	0.11
s-Net Acidity	%w/w S	<0.005	<0.005
a-Net Acidity	moles H^+ /t	<5	<5
Liming rate	kg $CaCO_3$ /t	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+ /t	<5	<5
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	<0.75
s-Net Acidity without ANCE	%w/w S	<0.005	<0.005

Method ID	Methodology Summary
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Net acidity including ANC has a safety factor of 1.5 applied. Neutralising value (NV) of 100% is assumed for liming rate. The recommendation that the SHCL concentration be multiplied by a factor of 2 to ensure retained acidity is not underestimated, has not been applied in the SHCL result. However, it has been applied in the SNAS calculation: SNAS % = (SHCL-SKCL)x2

QUALITY CONTROL: Chromium Suite						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			24/01/2024	[NT]	[NT]	[NT]	[NT]	24/01/2024	[NT]
Date analysed	-			29/01/2024	[NT]	[NT]	[NT]	[NT]	29/01/2024	[NT]
pH $_{kcl}$	pH units		Inorg-068	[NT]	[NT]	[NT]	[NT]	[NT]	99	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
TAA pH 6.5	moles H^+/t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	99	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	98	[NT]
a-Chromium Reducible Sulfur	moles H^+/t	3	Inorg-068	<3	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	<0.05	[NT]	[NT]	[NT]	[NT]	100	[NT]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity	moles H^+/t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate	kg $CaCO_3$/t	0.75	Inorg-068	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-068	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

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

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

SAMPLE RECEIPT ADVICE

Client Details	
Client	JK Environments
Attention	Brendan Page

Sample Login Details	
Your reference	E35612P Manly
Envirolab Reference	342262-A
Date Sample Received	24/01/2024
Date Instructions Received	25/01/2024
Date Results Expected to be Reported	02/02/2024

Sample Condition	
Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	Additional CrS analysis
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	14.8
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

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

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
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Sample ID	Chromium Suite	On Hold
BH1-0.2-0.23		✓
BH1-0.3-0.32		✓
BH1-0.48-0.58	✓	
BH1-0.83-0.9		✓
BH1-1.19-1.5	✓	
BH1-1.7-1.85		✓
BH2-0.17-0.19		✓
BH2-0.28-0.3		✓

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.

Anna Bui

From: Brendan Page <BPage@jkenvironments.com.au>
Sent: Thursday, 25 January 2024 3:23 PM
To: Samplereceipt
Subject: Additional Analysis Request for Registration 342262 E35612P Manly

Follow Up Flag: Follow up
Flag Status: Flagged

CAUTION: This email originated from outside of the organisation. Do not act on instructions, click links or open attachments unless you recognise the sender and know the content is authentic and safe.

Hi,

Could we please get the following samples analysed for the SCr suite (acid base accounting):

3 • BH1 0.48-0.58
5 • BH1 1.19-1.5

ELS REF: 342262-A
TAT: STANDARD
DUE: 2/2/24
AB.

Standard TAT.

Thanks 😊
Regards
Brendan Page
Principal | Environmental Scientist
CEnvP (Site Contamination Specialist)

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JKEnvironments