17 March 2023
Ref: E35645Plet2-UFP

Royal Motor Yacht Club Broken Bay
ABN 70 001 040 811
46 Prince Alfred Parade
Newport NSW 2106

Attention: Jayson McDonald
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UNEXPECTED FINDS PROTOCOL (UFP)
PROPOSED ALTERATIONS AND ADDITIONS
ROYAL MOTOR YACHT CLUB, 46 PRINCE ALFRED PARADE, NEWPORT, NSW

1 INTRODUCTION

Royal Motor Yacht Club Broken Bay ('the client') commissioned JK Environments (JKE) to prepare an Unexpected Finds Protocol (UFP) for the proposed alterations and additions at the Royal Motor Yacht Club, 46 Prince Alfred Parade, Newport, NSW. The UFP applies during the demolition and construction phase of the proposed development works at the site. The proposed development footprint is referred to as 'the site' throughout this report. The site location and approximate boundaries are shown on Figure 1 and Figure 2 attached in the appendices.

JKE has previously undertaken a Preliminary Site Investigation (PSI) and Preliminary Acid Sulfate Soil (ASS) Assessment for the project (Ref: E35645Prpt, dated 25 January 2023)[1], and an ASS Management Plan (ASSMP) has also been prepared (Ref: E35654Plet-ASSMP, dated 17 March 2023)[2]. Summary information from these reports is presented in Section 2.

1.1 Purpose of UFP and Structure of the Plan

The primary aim of the UFP is to provide a framework to be implemented during the proposed development works at the site so that risks associated with the identification of any unexpected, contamination-related finds in ground remain low and acceptable. A secondary aim is to provide guidance on the requirements for managing waste and imported materials in the context of contamination.

[1] JKE, (2023a). *Report to Royal Motor Yacht Club Broken Bay on Preliminary Site Investigation and Preliminary Acid Sulfate Soil Assessment at Royal Motor Yacht Club, 46 Prince Alfred Parade, Newport, NSW.* (referred to as PSI)
[2] JKE, (2023b). *Acid Sulfate Soil Management Plan, Proposed Alterations and Additions, Royal Motor Yacht Club, 46 Prince Alfred Parade, Newport, NSW.* (referred to as ASSMP)

The UFP is structured as follows:

- Section 1- Introduction, proposed development details, aims, roles and responsibilities;
- Section 2 – Summary of previous investigations/results and site details;
- Section 3 – Inspection requirements;
- Section 4 – Unexpected finds procedure;
- Section 5 – Excavated materials and waste classification requirements;
- Section 6 – Imported materials requirements; and
- Section 7 – Documentation requirements.

1.2 Roles and Responsibilities

The primary role and responsible party for implementing this UFP is the construction contractor. The construction contractor is responsible for obtaining a copy of this UFP and taking reasonable steps so that it is adequately implemented. The client or the construction contractor is to engage a suitably qualified contaminated land consultant (environmental consultant) to carry out the required inspections and fulfill the relevant actions and reporting requirements under this UFP. The construction contractor and environmental consultant are also to refer to any specific development consent requirements of the local consent authority.

1.3 Proposed Development Details

JKE understand that the proposed development includes alterations and additions to the existing Royal Motor Yacht Club facility, including:

- Internal refurbishment to improve amenity and upgrade member services;
- Construction of a two-storey extension to the west of the existing clubhouse to provide dining and social facilities for members;
- Provision of improved accessibility and fire safety compliance to existing parts of the building; and
- Upgrade sustainability performance of the new and upgraded building.

It is anticipated that the development will be constructed close to the existing grade. On this basis we have assumed that that soil disturbance will be minor and will largely occur for the installation of the building foundations and trenching for new services. The detailed design has not been finalised, however, the preliminary information supplied indicated that the building may be supported on a series of bored continuous flight auger (CFA) piles. The piles may be in the order of 450mm to 750mm in diameter and will be socketed into bedrock.

2 SITE INFORMATION

2.1 Summary of PSI

The PSI included soil sampling from four boreholes, as shown on the attached Figure 2. The boreholes typically encountered pavement and roadbase overlying imported fill soils to depths of between approximately 0.8m and 1.5m below ground level (BGL). The fill was underlain by alluvial sandy soils and possibly residual silty clay soils, then bedrock. On completion of drilling, groundwater standing water levels in BH3 and BH4 were measured to be approximately 2.2mBGL and 2.0mBGL respectively.

Soil samples were submitted for analysis of heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), petroleum hydrocarbons (referred to as total recoverable hydrocarbons – TRHs), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), polychlorinated biphenyls (PCBs) and asbestos. All analysis results were below the nominated site assessment criteria (SAC) and the PSI concluded that potential risks associated with contamination at the site were low in the context of the proposed development. However, the PSI noted that there was a potential for unexpected finds on site and this was to be be managed via the development and implementation of a suitable UFP so that risks from potential contamination remained low and acceptable.

Due to access constraints, soil sampling for the PSI was limited and the boreholes were located just outside the site boundary. Considering that the historical filling of the site and the immediately adjoining areas occurred concurrently, we considered that that the data obtained for the PSI was likely to be representative of the site conditions.

The laboratory analysis identified potential ASS (PASS) conditions in the fill and natural soils. The conditions were variable across the site. Management of disturbed PASS is required in accordance of the ASSMP, which must be implemented alongside this UFP.

A copy of the borehole logs and laboratory results summary tables is attached in the appendices.

2.2 Site Information and Description

Table 2-1: Site Identification

Current Site Owner (certificate of title):	Royal Motor Yacht Club Broken Bay New South Wales
Site Address:	Royal Motor Yacht Club, 46 Prince Alfred Parade, Newport, NSW
Lot & Deposited Plan:	Parts of Lot 6 in DP110670, Lot 5 Section 1 in DP4689 and Lot 262 in DP752046
Current Land Use:	Yacht Club
Proposed Land Use:	Yacht Club
Local Government Authority:	Northern Beaches Council
Current Zoning:	RE2: Private Recreation
Site Area (m^2) (approx.):	700

Geographical Location (decimal degrees) (approx.):	Latitude: -33.6483483 Longitude: 151.3055902
Site Plans:	Supplied in the attachments

2.3 Summary of Site Description

The wider Royal Motor Yacht Club property is located in a predominantly residential area of Newport and is bound by Prince Alfred Parade to the north-east. The site itself occupies part of the eastern portion of the property and is located approximately 50m to the north and east of the water body of Pittwater (and Salt Pan Cove).

The regional topography is characterised by a south and west-facing hillside that falls towards Pittwater/Salt Pan Cove. The site is relatively level and is located towards the toe of the hillside, with a gentle slope of approximately 1-2° towards the south. The site and wider yacht club property appeared to have been levelled via land reclamation along the foreshore.

The previous site inspection indicated that the majority of the site was occupied by an indoor and outdoor bistro/dining area utilised by the Royal Motor Yacht Club. There were no sensitive environments on site or in the adjoining surrounds. The areas of Pittwater (and Salt Pan Cove) further to the south and west of the site appeared to largely be manmade ground formed by land reclamation and these areas did not include any mangroves. There were no obvious/actual contamination sources identified on site in relation to land contamination.

3 INSPECTION REQUIREMENTS

The following inspections must be undertaken and documented by the environmental consultant, and a hold point must remain until the inspection occurs and the consultant provides interim advice regarding the outcome of the inspection:

- Inspection 1 – Following demolition of the buildings/above-ground structures (prior to removal of the building floor slabs and pavements/hardstand);
- Inspection 2 – Following the removal/demolition of the building floor slabs and pavements/hardstand; and
- Additional inspection(s) as required – In the event of an unexpected find as documented in Section 4.

There must be a hold point until each inspection occurs and interim advice relating to the inspection findings is provided by the environmental consultant to the client and the construction contractor. The environmental consultant is to document the inspection via photographs and a written summary of the site conditions, noting whether unexpected finds or suspected contamination are identified, and the details of such occurrences where applicable.

4 UNEXPECTED FINDS PROCEDURES

Unexpected, contamination-related finds in-ground at this site may include (but would not necessarily be limited to) the following:

- Suspected asbestos containing materials (ACM) such as fibre cement fragments (i.e. fibro), or suspected friable asbestos such as insulation or lagging;
- Underground storage tanks (USTs);
- Stained soils or soils impacted by hydrocarbon/hydrocarbon-like odours; and/or
- Hydrocarbon/hydrocarbon-like odours in groundwater, or hydrocarbon sheen on groundwater.

The procedure to be followed in the event of an unexpected, contamination-related find is presented below:

- In the event of an unexpected find, all work in the immediate vicinity must cease and the construction contractor must contact the client (or their representative such as their project manager) and the environmental consultant;
- Temporary barricades should be erected to isolate the area from access to workers;
- The environmental consultant is to attend the site, adequately characterise the conditions and any contamination-related impacts, and provide advice in relation to site management/remediation. Any relevant reports or associated documentation must be prepared; and
- The find must be managed in accordance with the environmental consultant's advice. In the event that contamination is identified that warrants remediation, notification/approval of such work must occur with regards to Chapter 4 of State Environmental Planning Policy (Resilience and Hazards) 2021[3] (formerly known as SEPP55). Where remediation is required, a Remediation Action Plan (RAP) must be prepared and the remediation work must be validated in accordance with the RAP to demonstrate that contamination risks are low and acceptable in the context of the proposed development.

5 EXCAVATED MATERIALS / WASTE CLASSIFICATION

Waste materials must be classified in accordance with the relevant legislation and guidelines. Excavated PASS materials must also be managed in accordance with the ASSMP.

A waste classification will be required prior to the off-site disposal of excavated soil/bedrock materials, with regards to the NSW EPA Waste Classification Guidelines (2014). Such waste classification documentation is to be prepared in accordance with the reporting requirements specified by the NSW EPA as outlined in the Consultants Reporting on Contaminated Land (2020)[4] guidelines and the NSW EPA Waste Classification Guidelines (2014).

It is recommended that the construction contractor maintains adequate records and retains all documentation for waste disposal activities for the duration of the project, including:

[3] *State Environmental Planning Policy (Resilience and Hazards) 2021* (NSW) (referred to as SEPP Resilience and Hazards 2021)

[4] NSW EPA, (2020). *Consultants reporting on contaminated land, Contaminated Land Guidelines.* (referred to as Consultants Reporting Guidelines)

- A summary register (in Microsoft Excel format) including details such as waste disposal dates, waste materials descriptions, disposal locations (i.e. facility details) and reconciliation of this information with the associated waste classification documentation and the waste disposal docket numbers;
- Waste tracking records and transport certificates (where waste is required to be tracked/transported in accordance with the regulations); and
- Disposal dockets for the waste (i.e. weighbridge dockets for each load).

An example register is attached in the appendices.

Reference must also be made to any specific conditions in the development consent regarding waste materials.

6 IMPORTED MATERIALS

The construction contractor should implement procedures to minimise the potential for contaminated materials to be imported onto the site. We recommend the following in this regard:

- Any imported materials for general earthworks/filling or backfilling trenches should comprise only virgin excavated natural material (VENM), or a suitable, commercially available engineered product from a reputable supplier. Where engineered products are used, preference should be given to using products made solely from natural quarried (i.e. not recycled) material. If products made from recycled materials are used, these products must be produced by the supplier in accordance with a relevant Resource Recovery Exemption;
- Landscaping materials should not contain anthropogenic inclusions;
- Documentation should be sought from the supplier confirming the above; and
- The construction contractor should inspect all materials upon importation to ensure there are no unexpected finds and the material is consistent with expectations.

Examples of imported materials for this project may include (but would not be limited to): site preparation materials (e.g. DGB, 40/70); general fill to level/raise the site; engineered materials for basecourse beneath buildings floor slabs and hardstand areas; backfill for the service trenches; landscaping materials etc.

It is recommended that the construction contractor maintains, for the duration of the project, an imported material register. This should include a register (in Microsoft Excel format) with details of each imported material type, supplier details, summary record of where the imported materials were placed on site, and importation docket numbers and a tally of quantities (separated for each import stream). Dockets for imported materials are to be provided electronically so these can be reconciled with the register. An example register is attached in the appendices.

Reference must also be made to any specific conditions in the development consent regarding imported materials.

7 DOCUMENTATION

Reference must be made to the development consent conditions for any specific documentation requirements for the project. Notwithstanding such requirements, the following subsections outline the documentation requirements applicable to the environmental consultant and the construction contractor with regards to this plan.

7.1 Environmental Consultant

The environmental consultant must provide the following documentation:

- Interim advice following each site inspection (preferably this is to be in the form of a Site Inspection Report);
- Additional inspection reports and any associated reports triggered under the unexpected finds procedure in Section 4; and
- A final UFP compliance report on completion of all in-ground works (i.e. once all excavation work is complete and the new building floor slab and pavements are constructed). The UFP compliance report is to consolidate and discuss the information from the various inspections, and any actions triggered as a result of unexpected finds. The report must provide an overall assessment of the compliance with the UFP.

7.2 Construction Contractor

The construction contractor must supply any records kept in relation to waste classification/waste disposal and imported materials to the client and the environmental consultant. If there are no unexpected finds, the construction contractor must provide a letter to the client/environmental consultant confirming this.

8 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- 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;

- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE 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 report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose;
- Copyright in this report is the property of JKE. JKE has used a degree of care, skill and diligence normally exercised by consulting professionals in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report;
- If the client, or any person, provides a copy of this report to any third party, such third party must not rely on this report except with the express written consent of JKE; and
- Any third party who seeks to rely on this report without the express written consent of JKE does so entirely at their own risk and to the fullest extent permitted by law, JKE accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

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

Kind Regards

Brendan Page
Principal Associate | Environmental Scientist
CEnvP SC

Appendices:

Appendix A: Report Figures
Appendix B: PSI Results Summary Tables and Borehole logs
Appendix C: Example Waste and Imported Materials Registers

Appendix A: Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title:	**SITE LOCATION PLAN**
Location:	ROYAL MOTOR YACHT CLUB, 46 PRINCE ALFRED PARADE, NEWPORT, NSW
Project No:	E35645P
Figure No:	1

JKEnvironments

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LEGEND

APPROXIMATE SITE BOUNDARY

BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 4 8 12 16 20

SCALE 1:400 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: ROYAL MOTOR YACHT CLUB, 46 PRINCE ALFRED PARADE, NEWPORT, NSW

Project No: E35645P

Figure No: 2

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Appendix B: PSI Results Summary Tables and Borehole logs

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC: Ambient Background Concentration
ACM: Asbestos Containing Material
ADWG: AustralianDrinking Water Guidelines
AF: Asbestos Fines
ANZG Australian and New Zealand Guidelines
B(a)P: Benzo(a)pyrene
CEC: Cation Exchange Capacity
CRC: Cooperative Research Centre
CT: Contaminant Threshold
EILs: Ecological Investigation Levels
ESLs: Ecological Screening Levels
FA: Fibrous Asbestos
GIL: Groundwater Investigation Levels
GSW: General Solid Waste
HILs: Health Investigation Levels
HSLs: Health Screening Levels
HSL-SSA: Health Screening Level-SiteSpecific Assessment
kg/L kilograms per litre
NA: Not Analysed
NC: Not Calculated
NEPM: National Environmental Protection Measure
NHMRC: National Health and Medical Research Council
NL: Not Limiting
NSL: No Set Limit
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PAHs: Polycyclic Aromatic Hydrocarbons
%w/w: weight per weight
ppm: Parts per million
PCBs: Polychlorinated Biphenyls
PCE: Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
pH_{KCL} : pH of filtered 1:20, 1M KCL extract, shaken overnight
pH_{ox} : pH of filtered 1:20 1M KCl after peroxide digestion
PQL: Practical Quantitation Limit
RS: Rinsate Sample
RSL: Regional Screening Levels
RSW: Restricted Solid Waste
SAC: Site Assessment Criteria
SCC: Specific Contaminant Concentration
S_{Cr}: Chromium reducible sulfur
S_{POS}: Peroxide oxidisable Sulfur
SSA: Site Specific Assessment
SSHSLs: Site Specific Health Screening Levels
TAA: Total Actual Acidity in 1M KCL extract titrated to pH6.5
TB: Trip Blank
TCA: 1,1,1 Trichloroethane (methyl chloroform)
TCE: Trichloroethylene (Trichloroethene)
TCLP: Toxicity Characteristics Leaching Procedure
TPA: Total Potential Acidity, 1M KCL peroxide digest
TS: Trip Spike
TRH: Total Recoverable Hydrocarbons
TSA: Total Sulfide Acidity (TPA-TAA)
UCL: Upper Level Confidence Limit on Mean Value
USEPA United States Environmental Protection Agency
VOCC: Volatile Organic Chlorinated Compounds
WHO: World Health Organisation

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).
- Statistical calculations are undertaken using ProUCL (USEPA). Statistical calculation is usually undertaken using data from fill samples.

EIL/ESL Table:

- ABC Values for selected metals have been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with low traffic have been quoted).

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

QA/QC Table:

- Field blank, Inter and Intra laboratory duplicate results are reported in mg/kg.
- Trip spike results are reported as percentage recovery.
- Field rinsate results are reported in µg/L.

TABLE S1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-D: 'Commercial/Industrial'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Site Assessment Criteria (SAC)			3000	900	3600	240000	1500	730	6000	400000	4000	40	80	2000	2500	45	530	3600	50	2000	7	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH1	0.1-0.2	F: Clayey Gravelly Sand	<4	<0.4	**70**	**43**	**10**	<0.1	**44**	**45**	**31**	**4.4**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH1 [LAB DUP]	0.1-0.2	Lab Duplicate	<4	<0.4	**66**	**35**	**11**	<0.1	**45**	**37**	**22**	**3.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH1	0.2-0.4	F: Silty Sandy Clay	<8	<0.4	**38**	<1	**4**	<0.1	**2**	**3**	**0.72**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH2	0.1-0.2	F: Clayey Gravelly Sand	<4	<0.4	**71**	**32**	**5**	<0.1	**47**	**30**	**8.3**	**1.5**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH3	0.08-0.2	F: Clayey Gravelly Sand	<4	<0.4	**50**	**8**	**6**	<0.1	**12**	**10**	**12**	**2.6**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH4	0.05-0.2	F: Clayey Gravelly Sand	<4	<0.4	**68**	**36**	**6**	<0.1	**56**	**34**	**5.4**	**1.3**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH4	1.3-1.6	Silty Clay	<4	<0.4	**33**	**7**	**4**	<0.1	**3**	**3**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
SDUP1	0.1-0.2	Duplicate of BH2	<4	<0.4	**68**	**31**	**6**	<0.1	**44**	**29**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SDUP2	0.1-0.2	Duplicate of BH1	<4	<0.4	**50**	**43**	**14**	<0.1	**40**	**30**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			9	9	9	9	9	9	9	9	7	7	7	7	7	7	7	7	7	7	7	4
Maximum Value			<PQL	<PQL	71	43	14	<PQL	56	45	31	4.4	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	Not Detected

Concentration above the SAC — VALUE
Concentration above the PQL — **Bold**

TABLE S2
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					HSL-D: COMMERCIAL/INDUSTRIAL							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH1	0.1-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	<25	**72**	<0.2	<0.5	<1	<1	<1	3.3
BH1 [LAB DUP]	0.1-0.2	Lab Duplicate	0m to <1m	Sand	<25	**64**	<0.2	<0.5	<1	<1	<1	NA
BH1	0.2-0.4	F: Silty Sandy Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	2.9
BH2	0.1-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	6
BH3	0.08-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	2.7
BH4	0.05-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	2
BH4	1.3-1.6	Silty Clay	1m to <2m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	2.2
SDUP2	0.1-0.2	Duplicate of BH1	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples					7	7	7	7	7	7	7	6
Maximum Value					<PQL	72	<PQL	<PQL	<PQL	<PQL	<PQL	6

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH1	0.1-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH1 [LAB DUP]	0.1-0.2	Lab Duplicate	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH1	0.2-0.4	F: Silty Sandy Clay	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH2	0.1-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH3	0.08-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH4	0.05-0.2	F: Clayey Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH4	1.3-1.6	Silty Clay	1m to <2m	Sand	370	NL	3	NL	NL	NL	NL
SDUP2	0.1-0.2	Duplicate of BH1	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA

TABLE S3
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**COMMERCIAL/INDUSTRIAL**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH1	0.1-0.2	Coarse	<25	**72**	**800**	**460**
BH1 [LAB DUP]	0.1-0.2	Coarse	<25	**64**	**790**	**540**
BH1	0.2-0.4	Coarse	<25	<50	<100	<100
BH2	0.1-0.2	Coarse	<25	<50	**300**	**380**
BH3	0.08-0.2	Coarse	<25	<50	**330**	**320**
BH4	0.05-0.2	Coarse	<25	<50	**290**	**500**
BH4	1.3-1.6	Coarse	<25	<50	<100	<100
SDUP2	0.1-0.2	Coarse	NA	NA	NA	NA
Total Number of Samples			7	7	7	7
Maximum Value			<PQL	72	800	540

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
BH1	0.1-0.2	Coarse	700	1000	3500	10000
BH1 [LAB DUP]	0.1-0.2	Coarse	700	1000	3500	10000
BH1	0.2-0.4	Coarse	700	1000	3500	10000
BH2	0.1-0.2	Coarse	700	1000	3500	10000
BH3	0.08-0.2	Coarse	700	1000	3500	10000
BH4	0.05-0.2	Coarse	700	1000	3500	10000
BH4	1.3-1.6	Coarse	700	1000	3500	10000
SDUP2	0.1-0.2	Coarse	NA	NA	NA	NA

TABLE S4
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1	
CRC 2011 -Direct contact Criteria		26,000	20,000	27,000	38,000	430	99,000	27,000	81,000	11,000	
Site Use		**COMMERCIAL/INDUSTRIAL - DIRECT SOIL CONTACT**									
Sample Reference	**Sample Depth**										
BH1	0.1-0.2	<25	**72**	**800**	**460**	<0.2	<0.5	<1	<1	<1	**3.3**
BH1 [LAB DUP]	0.1-0.2	<25	**64**	**790**	**540**	<0.2	<0.5	<1	<1	<1	NA
BH1	0.2-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**2.9**
BH2	0.1-0.2	<25	<50	**300**	**380**	<0.2	<0.5	<1	<1	<1	**6**
BH3	0.08-0.2	<25	<50	**330**	**320**	<0.2	<0.5	<1	<1	<1	**2.7**
BH4	0.05-0.2	<25	<50	**290**	**500**	<0.2	<0.5	<1	<1	<1	**2**
BH4	1.3-1.6	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**2.2**
SDUP2	0.1-0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples		7	7	7	7	7	7	7	7	7	6
Maximum Value		<PQL	72	800	540	<PQL	<PQL	<PQL	<PQL	<PQL	6

Concentration above the SAC	**VALUE**
Concentration above the PQL	**Bold**

JKEnvironments

TABLE S5
ASBESTOS QUANTIFICATION - FIELD OBSERVATIONS AND LABORATORY RESULTS
HIL-D:Commercial/Industrial

FIELD DATA															LABORATORY DATA													
Date Sampled	Sample reference	Sample Depth	Visible ACM in top 100mm	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass ACM <7mm (g)	Mass Asbestos in ACM <7mm (g)	[Asbestos from ACM <7mm in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	[Asbestos from FA in soil] (%w/w)	Lab Report Number	Sample refeference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
SAC			**No**					**0.05**			**0.001**			**0.001**											**0.05**	**0.001**
5/12/2022	BH1	0.2-1.3	NA		7,500	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	312387	BH1	0.1-0.2	165.13	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
5/12/2022	BH2	0.2-0.8	NA		7,360	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	312387	BH2	0.1-0.2	745.71	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
5/12/2022	BH3	0.3-1.1	NA		7,300	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	312387	BH3	0.08-0.2	661.2	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
5/12/2022	BH4	0.2-0.4	NA		4,160	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	312387	BH4	0.05-0.2	641.93	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
5/12/2022	BH4	0.4-1.3	NA		2,960	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Concentration above the SAC **VALUE**

TABLE S6
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				COMMERCIAL/INDUSTRIAL																			
							AGED HEAVY METALS-EILs						EILs		ESLs								
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	0.1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	8	18	104	5	77	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																				
BH1	0.1-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	<4	**70**	**43**	**10**	**44**	**45**	<1	<0.1	<25	**72**	**800**	**460**	<0.2	<0.5	<1	<1	**3.1**
BH1 [LAB DUP]	0.1-0.2	Lab Duplicate	Coarse	NA	NA	NA	<4	**66**	**35**	**11**	**45**	**37**	<1	<0.1	<25	**64**	**790**	**540**	<0.2	<0.5	<1	<1	**2.2**
BH1	0.2-0.4	F: Silty Sandy Clay	Coarse	NA	NA	NA	<8	**38**	<1	**4**	**2**	**3**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.1**
BH2	0.1-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	<4	**71**	**32**	**5**	**47**	**30**	<1	<0.1	<25	<50	**300**	**380**	<0.2	<0.5	<1	<1	**1.1**
BH3	0.08-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	<4	**50**	**8**	**6**	**12**	**10**	<1	<0.1	<25	<50	**330**	**320**	<0.2	<0.5	<1	<1	**1.9**
BH4	0.05-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	<4	**68**	**36**	**6**	**56**	**34**	<1	<0.1	<25	<50	**290**	**500**	<0.2	<0.5	<1	<1	**0.92**
BH4	1.3-1.6	Silty Clay	Fine	NA	NA	NA	<4	**33**	**7**	**4**	**3**	**3**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
SDUP1	0.1-0.2	Duplicate of BH2	Coarse	NA	NA	NA	<4	**68**	**31**	**6**	**44**	**29**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SDUP2	0.1-0.2	Duplicate of BH1	Coarse	NA	NA	NA	<4	**50**	**43**	**14**	**40**	**30**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples				0	0	0	9	9	9	9	9	9	7	7	7	7	7	7	7	7	7	7	7
Maximum Value				NA	NA	NA	<PQL	71	43	14	56	45	<PQL	<PQL	<PQL	72	800	540	<PQL	<PQL	<PQL	<PQL	3.1

Concentration above the SAC — VALUE
Concentration above the PQL — **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH1	0.1-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	160	320	100	1900	60	190	370	640	215	170	1700	3300	75	135	165	180	72
BH1 [LAB DUP]	0.1-0.2	Lab Duplicate	Coarse	NA	NA	NA	160	320	100	1900	60	190	370	640	215	170	1700	3300	75	135	165	180	72
BH1	0.2-0.4	F: Silty Sandy Clay	Coarse	NA	NA	NA	160	320	100	1900	60	190	370	640	215	170	1700	3300	75	135	165	180	72
BH2	0.1-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	160	320	100	1900	60	190	370	640	215	170	1700	3300	75	135	165	180	72
BH3	0.08-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	160	320	100	1900	60	190	370	640	215	170	1700	3300	75	135	165	180	72
BH4	0.05-0.2	F: Clayey Gravelly Sand	Coarse	NA	NA	NA	160	320	100	1900	60	190	370	640	215	170	1700	3300	75	135	165	180	72
BH4	1.3-1.6	Silty Clay	Fine	NA	NA	NA	160	320	100	1900	60	190	370	640	215	170	2500	6600	95	135	185	95	72
SDUP1	0.1-0.2	Duplicate of BH2	Coarse	NA	NA	NA	160	320	100	1900	60	190	--	--	--	--	--	--	--	--	--	--	--
SDUP2	0.1-0.2	Duplicate of BH1	Coarse	NA	NA	NA	160	320	100	1900	60	190	--	--	--	--	--	--	--	--	--	--	--

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

TABLE S7

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	0.1-0.2	F: Clayey Gravelly Sand	10.4	10.8	Extreme reaction	-0.4	--	--	--	--	--	--	--	--	--
BH1	1.3-1.4	F: Sandy Clay	7.7	7.3	Volcanic reaction	0.4	7.7	<5	0.007	4	[NT]	1.6	<5	0.0070	<0.75
BH2	0.1-0.2	F: Clayey Gravelly Sand	10.7	10.6	High reaction	0.1	--	--	--	--	--	--	--	--	--
BH2	0.4-0.5	F: Silty Sandy Clay	8.5	2.8	High reaction	5.7	5.0	8	0.05	32	[NT]	[NT]	40	0.063	3.0
BH3	0.5-1.0	F: Sandy Clay	8.5	6	High reaction	2.5	--	--	--	--	--	--	--	--	--
BH3	1.7-2.0	Sandy Clay	7.7	6.1	Extreme reaction	1.6	--	--	--	--	--	--	--	--	--
BH3	2.0-2.3	Silty Clay	7.2	3.4	Volcanic reaction	3.8	5.5	<5	0.06	39	[NT]	[NT]	43	0.069	3.2
BH3	2.5-2.6	Silty Clay	7.7	5.3	Low reaction	2.4	--	--	--	--	--	--	--	--	--
BH4	0.2-0.4	F: Silty Sandy Clay	7.1	3.6	Medium reaction	3.5	5.7	<5	<0.005	<3	[NT]	[NT]	<5	0.0060	<0.75
BH4	0.8-1.0	F: Silty Sandy Clay	4.8	2.3	Low reaction	2.5	4.3	27	0.01	8	0.005	[NT]	39	0.062	2.9
BH4	2.0-2.3	XW Sandstone	6.5	3.1	Extreme reaction	3.4	--	--	--	--	--	--	--	--	--
BH4	2.3-2.5	XW Sandstone	6.8	4.8	Low reaction	2	--	--	--	--	--	--	--	--	--
Total Number of Samples			12	12	--	12	5	5	5	5	1	1	5	5	5
Minimum Value			4.8	2.3	--	-0.4	4.3	8	0.007	4	0.005	1.6	39	0.0060	2.9
Maximum Value			10.7	10.8	--	5.7	7.7	27	0.06	39	0.005	1.6	43	0.069	3.2

Values Exceeding Action Criteria

TABLE Q1
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.05*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH2	0.1-0.2	<25	<50	300	380	<0.2	<0.5	<1	<2	<1	0.3	0.1	<0.1	<0.1	0.6	0.1	0.7	1.4	0.5	0.5	2.3	1.1	0.3	<0.1	0.5
laboratory	SDUP1	0.1-0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Intra	BH1	0.1-0.2	<25	72	800	460	<0.2	<0.5	<1	<2	<1	0.7	0.3	0.4	0.4	2.5	0.5	2.9	5.6	2	2.4	6.8	3.1	1.3	0.2	1.6
laboratory	SDUP2	0.1-0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Trip	TS-S1		-	-	-	-	100%	100%	99%	99%	99%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	5/12/22																									

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH2	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP1	0.1-0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Intra	BH1	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP2	0.1-0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Trip	TS-S1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	5/12/22																					

			Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
Intra	BH2	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<4	<0.4	71	32	5	<0.1	47	30
laboratory	SDUP1	0.1-0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4	<0.4	68	31	6	<0.1	44	29
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	69.5	31.5	5.5	nc	45.5	29.5
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	4%	3%	18%	nc	7%	3%
Intra	BH1	0.1-0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<4	<0.4	70	43	10	<0.1	44	45
laboratory	SDUP2	0.1-0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4	<0.4	50	43	14	<0.1	40	30
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	60	43	12	nc	42	37.5
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	33%	0%	33%	nc	10%	40%
Trip	TS-S1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	5/12/22																						

Result outside of QA/QC acceptance criteria

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH1** 1/1

SDUP2: 0.1-0.2m

Client: ROYAL MOTOR YACHT CLUB BROKEN BAY
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: ROYAL MOTOR YACHT CLUB, 46 PRINCE ALFRED PARADE, NEWPORT, NSW

Job No.: E35645P **Method:** PUSHTUBE / SPIRAL AUGER **R.L. Surface:** N/A
Date: 5/12/22 **Datum:** -
Plant Type: EZIPROBE **Logged/Checked by:** A.D./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			ASPHALT: 100mm.t				
					-	FILL: Clayey gravelly sand, fine to medium grained, dark grey, fine to medium grained igneous gravel, trace of asphalt.	M			ROADBASE
			0.5			FILL: Silty sandy clay, medium to high plasticity, red brown, orange brown and light grey, fine to medium grained sand, trace of ash.	w<PL			INSUFFICIENT RETURN FOR BULK SCREEN SCREEN: 7.50kg 0.2-1.3m NO FCF
			1			FILL: Sandy clay, low to medium plasticity, brown and orange brown, trace of sandstone and ironstone gravel and ash.	w≈PL			INSUFFICIENT RETURN FOR BULK SCREEN
			1.5		-	Extremely Weathered sandstone: silty CLAY, medium to high plasticity, yellow brown mottled grey and red, trace of ironstone gravel.	XW			NEWPORT FORMATION
			2			SANDSTONE: fine to medium grained, yellow brown.	DW			
			2.5			END OF BOREHOLE AT 2.6m				EZIPROBE REFUSAL ON SANDSTONE BEDROCK
			3							
			3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH2** 1/1

SDUP1: 0.1-0.2m

Client: ROYAL MOTOR YACHT CLUB BROKEN BAY

Project: PROPOSED ALTERATIONS AND ADDITIONS

Location: ROYAL MOTOR YACHT CLUB, 46 PRINCE ALFRED PARADE, NEWPORT, NSW

Job No.: E35645P **Method:** PUSHTUBE / SPIRAL AUGER **R.L. Surface:** N/A

Date: 5/12/22 **Datum:** -

Plant Type: EZIPROBE **Logged/Checked by:** A.D./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			ASPHALT: 100mm.t				
					-	FILL: Clayey gravelly sand, fine to medium grained, dark grey, fine to medium grained igneous gravel, trace of asphalt.	M			ROADBASE
			0.5			FILL: Silty sandy clay, medium to high plasticity, red brown and light grey, trace of ironstone gravel.	w<PL			INSUFFICIENT RETURN FOR BULK SCREEN SCREEN: 7.36kg 0.2-0.8m NO FCF
					-	SANDSTONE: fine to medium grained, light grey.	DW			NEWPORT FORMATION
			1			END OF BOREHOLE AT 0.9m				EZIPROBE REFUSAL ON SANDSTONE BEDROCK (POSSIBLE BOULDER)
			1.5							
			2							
			2.5							
			3							
			3.5							

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ENVIRONMENTAL LOG

Log No. BH3

1/1

Environmental logs are not to be used for geotechnical purposes

Client: ROYAL MOTOR YACHT CLUB BROKEN BAY

Project: PROPOSED ALTERATIONS AND ADDITIONS

Location: ROYAL MOTOR YACHT CLUB, 46 PRINCE ALFRED PARADE, NEWPORT, NSW

Job No.: E35645P **Method:** PUSHTUBE / SPIRAL AUGER **R.L. Surface:** N/A

Date: 5/12/22 **Datum:** -

Plant Type: EZIPROBE **Logged/Checked by:** M.J. & A.D./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
			0			ASPHALT: 80mm.t				
					-	FILL: Clayey gravelly sand, fine to medium grained, orange brown and red brown, fine to medium grained igneous gravel, trace of ironstone gravel and asphalt.	w<PL			ROADBASE
						FILL: Silty clay, medium to high plasticity, red brown and light grey, trace of sandstone and ironstone gravel.	w<PL			INSUFFICIENT RETURN FOR BULK SCREEN
			0.5			FILL: Sandy clay, medium to high plasticity, brown and red brown, trace of ironstone and sandstone gravel and shell fragments.	w<PL			INSUFFICIENT RETURN FOR BULK SCREEN SCREEN: 7.30kg 0.3-1.1m NO FCF
			1		CL-CI	Sandy CLAY: low to medium plasticity, dark grey and red brown, trace of ironstone gravel and shell fragments.	w≈PL			ALLUVIAL ORGANIC ODOUR
			1.5							
ON COMPLETION			2			Silty CLAY: low to medium plasticity, dark grey, trace of sand and sandstone gravel.	w≈PL w>PL			ALLUVIAL ORGANIC ODOUR
			2.5							
						END OF BOREHOLE AT 2.6m				EZIPROBE REFUSAL ON SANDSTONE BEDROCK OR BOULDER
			3							
			3.5							

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ENVIRONMENTAL LOG

Log No. **BH4** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: ROYAL MOTOR YACHT CLUB BROKEN BAY

Project: PROPOSED ALTERATIONS AND ADDITIONS

Location: ROYAL MOTOR YACHT CLUB, 46 PRINCE ALFRED PARADE, NEWPORT, NSW

Job No.: E35645P **Method:** PUSHTUBE / SPIRAL AUGER **R.L. Surface:** N/A

Date: 5/12/22 **Datum:** -

Plant Type: EZIPROBE **Logged/Checked by:** A.D./B.P.

Groundwater Record	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	0		ASPHALT: 50mm.t				
		-	FILL: Clayey gravelly sand, fine to medium grained, dark grey, fine to medium grained igneous gravel, trace of ironstone gravel and asphalt.	M			ROADBASE
				w<PL			INSUFFICIENT RETURN FOR BULK SCREEN
			FILL: Silty sandy clay, medium to high plasticity, red brown, yellow brown and light grey, fine to medium grained sand, trace of ironstone gravel.	w<PL			SCREEN: 4.16kg 0.2-0.4m NO FCF
	0.5		as above, but yellow brown and grey.				SCREEN: 2.96kg 0.4-1.3m NO FCF
	1						
		CL-CI	Silty CLAY: low to medium plasticity, red brown mottled yellow and grey, trace of sand and ironstone gravel.	w≈PL			POSSIBLY RESIDUAL
	1.5						
5 MINS AFTER COMPLETION	2	-	Extremely Weathered sandstone: silty CLAY, low to medium plasticity, yellow brown mottled grey.	XW			NEWPORT FORMATION
	2.5		END OF BOREHOLE AT 2.5m				EZIPROBE REFUSAL ON SANDSTONE BEDROCK
	3						
	3.5						

Samples: ES | ASS | ASB | SAL | DB

Field Tests

Graphic Log

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:

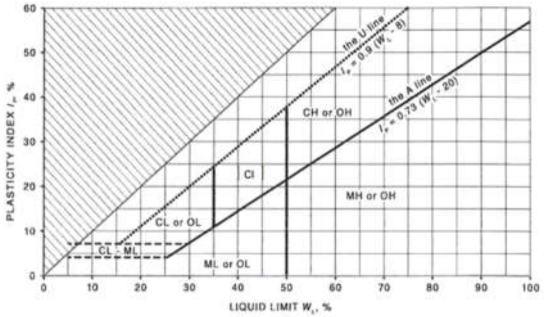
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

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

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

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

			Guide to Strength	
Term	**Abbreviation**	**Uniaxial Compressive Strength (MPa)**	**Point Load Strength Index $I_{s(50)}$ (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 C: Example Waste and Imported Materials Registers

Imported Materials Register

Supplier	Date	Docket/Invoice #	Product Type	Quantity (specify m3 or tonnes)	Area where Material was Placed

Exported (Waste) Materials Register

Load	Date	Material Type / Classification	Site Area where Waste was Generated	Waste Classification Report Reference	Disposal Facility	Tipping Receipt/Docket Number	Tracking Number (where relevant)	Tonnage