17 April 2019
Ref: E32217BTlet_ASSMP

Central Coast Council
PO Box 21
GOSFORD NSW 2250

Attention: Mr Warren Brown

ACID SULFATE SOIL MANAGEMENT PLAN
PROPOSED FORESHORE REHABILITATION
RIP ROAD RESERVE, BLACKWALL, NSW

1 INTRODUCTION

Central Coast Council ('the client') commissioned Environmental Investigation Services (EIS)[1] to prepare an acid sulfate soil management plan (ASSMP) for the proposed foreshore rehabilitation at Rip Road Reserve, Blackwall, NSW. The site is part of Lot 94 in DP6327. The site location is shown on Figure 1 and the management plan is confined to the proposed development area as shown on Figure 2.

The ASSMP was prepared generally in accordance with a JK Geotechnics proposal (Ref: P48398R) of 12 November 2018 and written acceptance by Central Coast Council via email of 27 March 2019.

1.1 Proposed Development Details

Based on the information provided, EIS understand that the proposed development includes foreshore rehabilitation works to the public reserve. We assume that minor excavation works will be required to prepare the site.

2 SITE INFORMATION / BACKGROUND

The site is located in a residential part of Blackwall, NSW. The site is located along the northern boundary of Rip Road Reserve where it converges with Brisbane Water. To the immediate south of the site is the remainder of Rip Road Reserve and residential properties. The interface of the reserve and the water is built up in sections with brick and/or timber retaining walls. Parts of the brick retaining walls are eroded and unstable.

[1] Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)

In February 2019, EIS undertook an acid sulfate soil (ASS) assessment at the site. Soil samples were collected from four locations across the site to a maximum depth of 2.4m below ground level (BGL). The natural soils at the site generally comprised of sandy clay, clayey sand, sand or silty clay.

During the site inspection, fibre cement fragments (FCF) were encountered along the length of the retaining wall and foreshore area. It was recommended that an emu-bob was conducted to remove the FCF from the surface of the site and any fill to be removed/excavated as part of the rehabilitation works be classified in accordance with the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014)[2] and disposed off-site.

Eight soil samples from varying depths were analysed using the sPOCAS method. The majority of the soil samples analysed encountered results which exceeded the action criteria adopted for the assessment (0.03% w/w peroxide oxidisable sulfur). Based on the results, and considering the information reviewed for the assessment (ASS risk maps, subsurface conditions, etc), the natural soils at the site were considered to be PASS and an ASSMP is required to manage the soils during the proposed development.

2 ACID SULFATE SOIL MANAGEMENT PLAN (ASSMP)

2.1 Introduction

The most effective management strategy for dealing with PASS is to avoid disturbing the material. If this is not a viable option then the ASSMP should be implemented.

The objective of the ASSMP is to reduce the potential on-site and off-site environmental impacts associated with disturbance of PASS identified at the site. The ASSMP has been prepared generally in accordance with the ASS Manual 1998. Reference has also been made to the Queensland Acid Sulfate Soil Technical Manual v 3.8 (2002)[3].

The following issues are addressed in the ASSMP:

- Strategies for the management of PASS during development;
- Implementation of a soil and groundwater monitoring program; and
- Contingency procedures to be implemented in the event of the failure of management strategies.

2.2 Extent of Management

The investigation identified PASS in the natural soils at the site. Overlying fill material does not require treatment/management in relation to the generation of ASS conditions. However separating the fill soil from the underlying natural soil may not be practical, in which case all of the excavated soil should be considered to be PASS.

[2] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)
[3] Queensland Department of Natural Resources and Mines, (2002). *Queensland Acid Sulfate Soil Technical Manual. Soil Management Guidelines* version 3.8.

2.3 Management Options for ASS/PASS

Management options for ASS/PASS have been outlined and evaluated by EIS in the following table:

Table 2-1: Management of ASS/PASS

Option	Details	EIS Evaluation of Applicability
Option A: Disposal of PASS beneath the water table at a landfill	Immediate transport of natural PASS to landfill for disposal beneath the water table. A number of conditions have to be satisfied for burial beneath the water table to be viable. This option is not suitable for fill material or natural soil that has been impacted by contaminants.	Potential option for the natural soil provided the material is free of contamination. Classification in accordance with the NSW EPA Waste Classification Guidelines (2014)[4] would be required.
Option B: Treatment of PASS, waste classification and disposal to landfill	PASS is excavated and neutralised with lime. A waste classification is assigned for the off-site disposal of the treated PASS to landfill.	Most viable and preferred option considering proposed development details.
Option C: Treatment of PASS and on-site re-use.	PASS is excavated and neutralised with lime. The treated material is re-used on site with adequate capping. This option is not suitable for PASS that has been impacted by contaminants.	Not the preferred option for this project as material is not required for filling.

2.4 Preferred Option for Management of ASS/PASS

As outlined in the above table, the most viable and therefore the preferred option for managing ASS/PASS during the proposed development works is Option B (treatment of ASS/PASS, followed by waste classification and off-site disposal). The management procedure for Option B is outlined in the following subsection.

Procedures for the remaining two options are included in Section 2.5 for reference purposes. These options could be considered further in consultation with a suitably qualified environmental consultant and the relevant contractors if required by the client.

2.4.1 Treatment, Waste Classification and Disposal to Landfill (Option B)

Potential acid generation is typically managed by the addition of lime to neutralise acid that may be generated during and after the excavation works. The treated material should then be assigned a waste classification in accordance with the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste

[4] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

(2014)[5] and Waste Classification Guidelines Part 4: Acid Sulfate Soils (2014)[6], and disposed of to a NSW EPA licensed landfill facility.

The procedures outlined in the following table should be implemented for this option:

Table 2-2: Management Procedure for Option B

Procedure	Details
Step 1: Lime selection	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 mixing. 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 during the proposed development works.
Step 2: Set up treatment area/s	A treatment area for the mixing of excavated soil with agricultural lime should be established. As this site is relatively small this could consist of dusting the treatment surface with lime. The purpose of this guard layer is to minimise the risk of acidic water leaching from the base of the treatment area into the groundwater. Alternatively the treatment could be undertaken in a skip bin. An earthworks strategy should be prepared to ensure that sufficient space is available on–site to accommodate treatment of the PASS.
Step 3: Manage water run-off	Installation of detention tanks or construction of ponds may not be viable on this site therefore all the stockpiles should be covered with builders plastic or similar during rain to prevent the water coming into contact with the stockpiled material. If skip bins are used, bunding should not be necessary. However, the bins should be covered to prevent them from filling with rainwater. The application of neutralising agents into natural water bodies or water courses should be avoided unless carefully planned and approved by council and relevant authorities.
Step 4: Excavation & handling	PASS disturbed during development works should be immediately transferred to the designated treatment area and spread out in 150mm to 300mm thick layers. If possible the layers should be allowed to dry in order to aid the mixing process. The layers should then be interspersed with the appropriate amount of lime to aid in the effective mixing of lime and soil. Lime should be applied to the excavated material within the treatment area as soon as possible. If circumstances prevent the 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

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

Procedure	Details
	infiltration should 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 surface runoff water should also be diverted around the stockpile.
Step 5: Lime treatment & pH testing	The laboratory analysis results have indicated that approximately 65kg lime per tonne of soil is required to adequately stabilise the PASS. An excavator or other suitable equipment (as deemed appropriate by the excavation contractor) should be used to thoroughly mix the lime through the soil. Alternatively use of a pug mill may be considered dependent upon the volume of soil to be treated in a timely fashion. The pH of the soil should be checked using the test method(s) outlined in the ASS Manual 1998 (Methods 21A and or 21Af) to confirm that PASS have been neutralised by lime addition. If required, additional lime should be added to the soil and additional mixing undertaken. Following treatment with lime the pH of the soil should be in the 5.5 to 8.5 range.
Step 6: Monitoring by qualified personnel	Monitoring should be undertaken by qualified personnel to ensure the mixing is undertaken to a suitable extent as the success of the neutralisation method relies on the effectiveness of the mixing process.
Step 7: Waste classification and off-site disposal	Following treatment the material should be tested and assigned a waste classification 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 NSW EPA landfill licensed to accept treated PASS/ASS.

2.5 Alternative Management Options for ASS/PASS

As outlined in Sections 2.3 and 2.4, Option B is considered to be the most viable and appropriate option for managing ASS/PASS during the proposed development works. An outline of the management requirements for the remaining two options have been provided below for reference purposes. These options could be considered further in consultation with a suitably qualified environmental consultant and the relevant contractors if required by the client.

2.5.1 Disposal of PASS beneath the Water Table at a Landfill (Option A)

Natural soil classed as PASS may be disposed of below the water table at a landfill facility without lime treatment provided that the following conditions are met:

- The material is disposed below the water table within **24 hours** of excavation;
- The material meets the definition of 'virgin excavated natural material' (VENM) under the *Protection of the Environment Operations Act* (1997[7]), even though it contains sulfidic ores;

[7] *Protection of Environment Operations Act,* NSW Government, 1997 (POEO Act 1997)

- The receiving landfill is licensed by the NSW EPA to dispose of PASS below the water table; and
- The material meets the highly stringent pH criteria.

The procedures outlined in the following table should be implemented for this option:

Table 2-3: Management Procedure for Option A

Procedure	Details
Step 1: Contact Landfill	Prior to commencement of excavation works, the landfill should be contacted and the necessary approvals should be obtained for disposal.
Step 2: Excavation & Handling	Natural soil classed as PASS should be excavated/disturbed in stages. PASS must be kept wet at all times during excavation and subsequent handling, transport and storage until they can be disposed of safely.
Step 3: pH testing	The pH of the soil should be checked using the test method(s) outlined in the ASS Manual 1998 (Methods 21A and or 21Af). The pH of each load and the time of extraction should be recorded and forwarded to the landfill. If the pH **is less than 5.5** then the material is not suitable for burial beneath the water and Option B should be implemented.
Step 4: Transport	Provided that the pH of the excavated PASS is **not less than 5.5** the material can be loaded onto trucks and transported immediately to the landfill. Prior to burial the landfill will check the pH of each load. Any loads that do not meet the acceptance pH criteria will be turned away.

2.5.2 Treatment of PASS and On-site Re-use (Option C)

Potential acid generation is typically managed by the addition of lime to neutralise acid that may be generated during and after the excavation works. The treated material may be re-used on-site provided it is capped and not left exposed. The procedures outlined in the following table should be implemented for this option:

Table 2-4: Management Procedure for Option C

Procedure	Details
Steps 1 to 6	As outlined for Option B.
Step 7: On-site Re-use	Treated PASS should not be spread over sensitive areas (e.g. mangroves) or directly adjacent to waterways. The area where the treated PASS is going to be placed should be cleared and, if present, the turf should be removed. The area should be dusted with lime. The neutralised PASS should then be spread across the placement area in layers. Care should be taken not to disturb the underlying soil. On completion, the surface of the neutralised PASS should be dusted with additional lime prior to capping. A suitable capping layer (such as a clay liner or crushed sandstone)

	should be placed over the neutralised PASS. The finished surface should be turfed or paved to minimise the potential for erosion.

2.6 Groundwater Seepage and Dewatering

The procedure for managing water seepage and dewatering during works in the reserve and foreshore is outlined in the following table:

Table 3 5: Procedure for Managing Water Seepage and Monitoring

Procedure	Details
Step 1: Minimise the depth of dewatering	Where possible the material in the foreshore being excavated should be kept submerged to reduce the generation of ASS and/or acidic conditions. Where excavation works are in the foreshore bank, works should be staged over short durations to reduce the time and volume of PASS exposed to oxidation.
Step 2: Approvals for Groundwater Disposal	Reference should be made to the local council, NSW Office of Water / WaterNSW, Sydney Water and other relevant authority's approval requirements for further information in relation to disposal of water to either the sewer or stormwater systems.
Step 2: pH Testing and Neutralisation	Any water pumped from excavations in the foreshore bank should be placed in a portable tank, or appropriate holding facility, where samples can be obtained for testing. Prior to commencing site works a baseline pH should be established for the adjacent waterway. The pH of the adjacent waterway should be measured at the start and end of the working day. If the pH of the adjacent waterway deviates more than +/- 1pH unit from the baseline value, an experienced environmental consultant should be contacted immediately. The cause of the pH deviation should be established and corrective action taken. The water should be in the pH range of 6.5 to 8.5 (Schedule 5 of Protection of the Environment Operations (General) Regulation 2009[8]). If the pH is outside of this range, treatment will be necessary prior to disposal. Based on the disposal option chosen for the development, additional screening for contaminants may be required by the relevant authorities prior to disposal.
Step 3: On-going groundwater monitoring	In the event that extended pumping of water is necessary during the construction period, the quality of the groundwater should be monitored on a regular basis over the entire construction period. The pH should be measured and recorded on a regular basis. Immediate advice is to be sought from an experienced consultant if the pH at any location is not within 10% of the initial pH at the commencement of pumping. If required, corrective action should be taken as soon as possible. Laboratory analysis will be required on water samples as part of the corrective action to assess the quantity of neutralising agents required if treatment is necessary.

[8] NSW Government, (2009). *Protection of Environment Operations (General) Regulation,* Schedule 5 Prescribed matter for the definition of water pollution (page 124) (POEO Regulation 2009)

2.7 Contingency Plan

In the event the results of soil neutralisation or groundwater monitoring tests indicate a significant change in acidic conditions, the contingency plan should be implemented.

If soil monitoring indicates the presence of significantly more acidic material than expected or water monitoring indicates that the pH of the pumped water has become significantly more acidic, all excavation works should be placed on hold until further action is taken to limit the oxidation of PASS in the development area. Contingency works will be undertaken as follows:

- The depth to groundwater (i.e. the extent of de-watering) in the area of excavation will be measured;
- The pH of soils exposed to oxygen within the excavation will be measured to establish the source of the acidic conditions;
- Material found to be acidic will be excavated and neutralised in accordance with the methods presented in Section 2.4.1;
- Where suitable, in-place treatment involving lime addition and mixing may by adopted; and
- In the event unacceptable acidic levels are recorded by the groundwater monitoring, installation of a neutralisation trench (or similar) may be required to intercept and treat acidic groundwater prior to discharge. This could consist of an excavation filled with a sand/lime mixture designed to filter, intercept and treat groundwater flowing across the trench.

2.8 Disposal Information

The costs associated with the treatment and off-site disposal of PASS can be significant and may affect project viability. These costs should be assessed at an early stage of the project to avoid significant future unexpected additional costs.

Section 143 of the POEO Act1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. EIS accepts no liability whatsoever for the unlawful disposal of any waste from any site.

3 LIMITATIONS

The report limitations are outlined below:

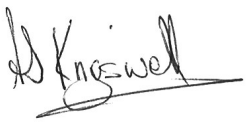
- EIS accepts no responsibility for any unidentified ASS or PASS issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the EIS proposal; and terms of contract between EIS 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, EIS has not undertaken any verification process, except where specifically stated in the report;
- EIS 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;
- EIS 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. EIS should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa;
- 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 EIS. EIS 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 EIS; and
- Any third party who seeks to rely on this report without the express written consent of EIS does so entirely at their own risk and to the fullest extent permitted by law, EIS 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

Katrina Taylor
Senior Environmental Scientist



Adrian Kingswell
Principal Consultant

Appendices:

Appendix A: Report Figures
Appendix B: ASS Assessment Report Tables
Appendix C: Laboratory Reports & Chain of Custody Documents

Appendix A: Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM, 27 DEC 2018.

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

Title: **SITE LOCATION PLAN**

Location: RIP ROAD RESERVE
BLACKWALL, NSW

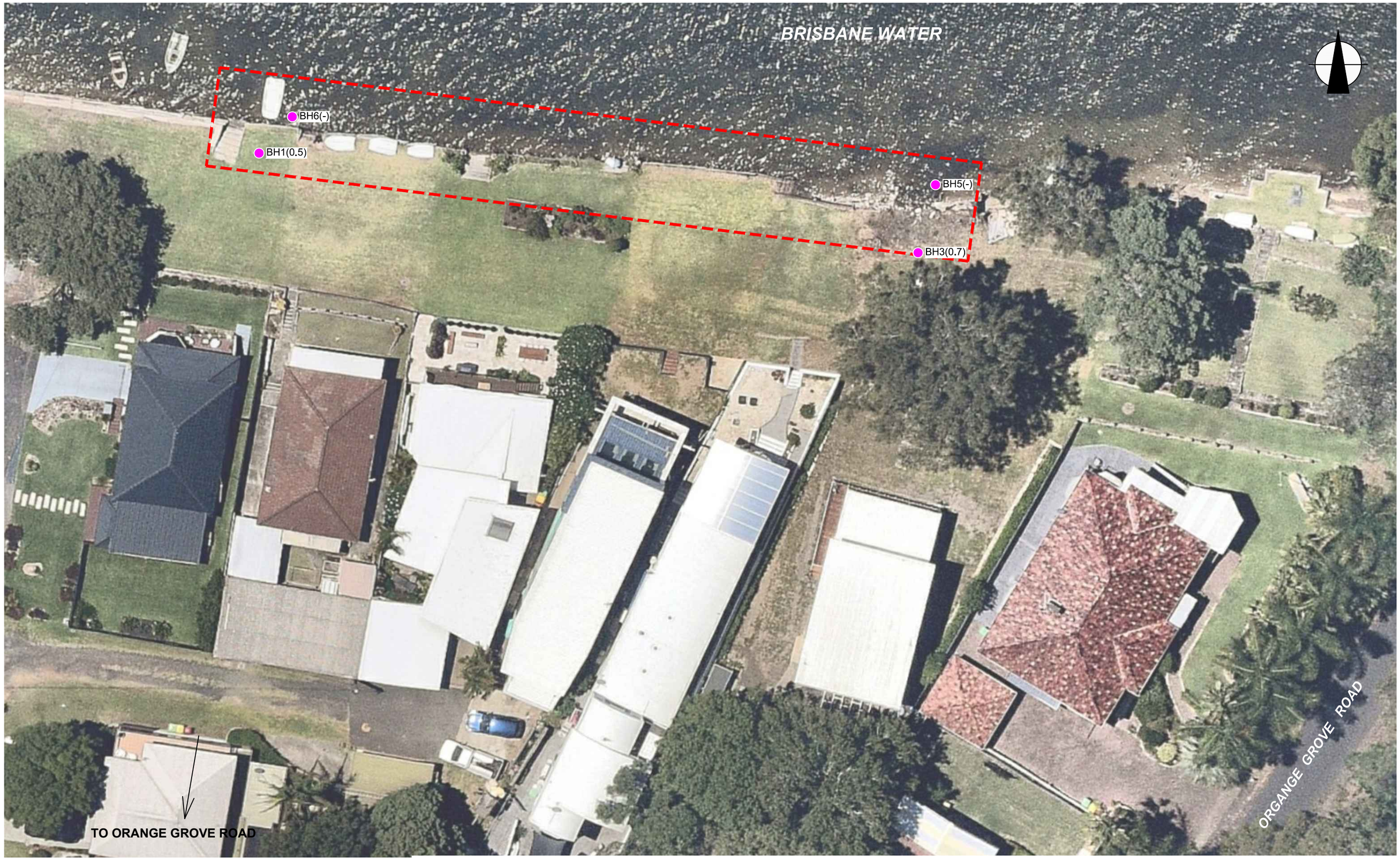
Report No: E32217BT

Figure No: 1

JKEnvironments

PLOT DATE: 5/04/2019 12:48:11 PM DWG FILE: S:\5 EIS\5C EIS JOBS\32000\SIE32217BT BLACKWALL\CADE32217BT.DWG

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM, 27 DEC 2018.



LEGEND

APPROXIMATE SITE BOUNDARY

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

0 3 6 9 12 15

SCALE 1:300 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: RIP ROAD RESERVE
BLACKWALL, NSW

Report No: E32217BT

Figure No: 2

JKEnvironments

PLOT DATE: 5/04/2019 12:52:43 PM DWG FILE: S:\5 EIS\5C EIS JOBS\32000\SIE32217BT BLACKWALL\CAD\E32217BT.DWG

Appendix B: ASS Assessment Report Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

NA: Not Analysed
NC: Not Calculated
NL: Not Limiting
NSL: No Set Limit
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
SAC: Site Assessment Criteria
S_{Cr}: Chromium reducible sulfur
S_{POS}: Peroxide oxidisable Sulfur
TAA: Total Actual Acidity in 1M KCL extract titrated to pH6.5
TPA: Total Potential Acidity, 1M KCL peroxide digest
TSA: Total Sulfide Acidity (TPA-TAA)

TABLE A

SUMMARY OF LABORATORY RESULTS - ACID SULFATE SOIL ANALYSIS (sPOCAS)

		Analysis	pH_{KCL}	TAA	pH_{ox}	TPA	TSA	S_{POS}	Liming Rate
				pH 6.5		pH 6.5	pH 6.5	%w/w	kg $CaCO_3$/tonne
Acid Sulfate Soil Manual (1998) -Action Criteria		Coarse Textured Soil	pH 5.0	18molH+/ tonne	pH 5.0	18molH+/ tonne	18molH+/ tonne	0.03% w/w	
Sample Reference	**Sample Depth (m)**	**Sample Description**							
BH1	1.5-1.7	Clayey Sand	4.0	30	3.8	82	52	0.03	3.9
BH1	1.5-1.7	Laboratory Duplicate	4.0	30	3.7	78	48	0.04	4.1
BH1	2.3-2.4	Sandy Clay	3.7	61	4.3	68	6	0.009	5.2
BH3	0.9-1.0	Silty Clay	6.0	<5	4.4	25	24	0.009	<0.75
BH3	1.5-1.6	Silty Clay	4.3	14	4.1	30	16	0.009	1.5
BH5	0.3-0.4	Sand	9.4	<5	7.1	<5	<5	0.04	<0.75
BH5	0.9-1.0	Clay	7.6	<5	2.7	90	90	0.27	8.7
BH6	0.1-0.2	Sandy Clay	5.6	<5	2.1	810	810	1.4	65
BH6	0.9-1.0	Clay	6.7	<5	2.6	140	140	0.31	12
Total Number of Samples			9	9	9	9	9	9	9
Minimum Value			3.7	14	2.1	25	6	0.009	1.5
Maximum Value			9.4	61	7.1	810	810	1.4	65

Values Exceeding Action Criteria **VALUE**

Appendix C: Laboratory Reports & Chain of Custody 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 212614

Client Details

Client	Environmental Investigation Services
Attention	Katrina Taylor
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E32217BT, Blackwall**
Number of Samples	13 Soil
Date samples received	04/03/2019
Date completed instructions received	04/03/2019

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	11/03/2019
Date of Issue	11/03/2019

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

Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

sPOCAS + %S w/w						
Our Reference		212614-4	212614-5	212614-7	212614-8	212614-10
Your Reference	UNITS	BH1	BH1	BH3	BH3	BH5
Depth		1.5-1.7	2.3-2.4	0.9-1.0	1.5-1.6	0.3-0.4
Date Sampled		28/02/2019	28/02/2019	28/02/2019	28/02/2019	28/02/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/03/2019	06/03/2019	06/03/2019	06/03/2019	06/03/2019
Date analysed	-	06/03/2019	06/03/2019	06/03/2019	06/03/2019	06/03/2019
pH $_{kcl}$	pH units	4.0	3.7	6.0	4.3	9.4
TAA pH 6.5	moles H^+ /t	30	61	<5	14	<5
s-TAA pH 6.5	%w/w S	0.05	0.1	<0.01	0.02	<0.01
pH $_{Ox}$	pH units	3.8	4.3	4.4	4.1	7.1
TPA pH 6.5	moles H^+ /t	82	68	25	30	<5
s-TPA pH 6.5	%w/w S	0.13	0.11	0.04	0.05	<0.01
TSA pH 6.5	moles H^+ /t	52	6	24	16	<5
s-TSA pH 6.5	%w/w S	0.08	0.01	0.04	0.03	<0.01
ANC_E	% $CaCO_3$	<0.05	<0.05	<0.05	<0.05	0.25
a-ANC_E	moles H^+ /t	<5	<5	<5	<5	50
s-ANC_E	%w/w S	<0.05	<0.05	<0.05	<0.05	0.08
S_{KCl}	%w/w S	<0.005	<0.005	<0.005	0.007	0.02
S_P	%w/w	0.03	0.01	0.01	0.02	0.06
S_{POS}	%w/w	0.03	0.009	0.009	0.009	0.04
a-S_{POS}	moles H^+ /t	20	6	6	5	26
Ca_{KCl}	%w/w	0.15	0.03	0.25	0.19	0.05
Ca_P	%w/w	0.18	0.04	0.31	0.25	0.18
Ca_A	%w/w	0.028	0.007	0.061	0.052	0.13
Mg_{KCl}	%w/w	0.029	0.034	0.017	0.021	0.019
Mg_P	%w/w	0.035	0.042	0.019	0.024	0.037
Mg_A	%w/w	0.006	0.008	<0.005	<0.005	0.019
S_{HCl}	%w/w S	0.008	0.008	<0.005	0.008	<0.005
S_{NAS}	%w/w S	0.006	0.005	<0.005	<0.005	<0.005
a-S_{NAS}	moles H^+ /t	<5	<5	<5	<5	<5
s-S_{NAS}	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
Fineness Factor	-	1.5	1.5	1.5	1.5	1.5
a-Net Acidity	moles H^+ /t	52	69	7	20	<5
s-Net Acidity	%w/w S	0.08	0.11	0.01	0.03	<0.01
Liming rate	kg $CaCO_3$ /t	3.9	5.2	<0.75	1.5	<0.75
s-Net Acidity without -ANCE	%w/w S	0.084	0.11	0.011	0.032	0.042
a-Net Acidity without ANCE	moles H^+ /t	52	69	7.0	20	26
Liming rate without ANCE	kg $CaCO_3$ /t	3.9	5.2	<0.75	1.5	2.0

sPOCAS + %S w/w				
Our Reference		212614-11	212614-12	212614-13
Your Reference	UNITS	BH5	BH6	BH6
Depth		0.9-1.0	0.1-0.2	0.9-1.0
Date Sampled		28/02/2019	28/02/2019	28/02/2019
Type of sample		Soil	Soil	Soil
Date prepared	-	06/03/2019	06/03/2019	06/03/2019
Date analysed	-	06/03/2019	06/03/2019	06/03/2019
pH $_{kcl}$	pH units	7.6	5.6	6.7
TAA pH 6.5	moles H^+ /t	<5	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01
pH $_{Ox}$	pH units	2.7	2.1	2.6
TPA pH 6.5	moles H^+ /t	90	810	140
s-TPA pH 6.5	%w/w S	0.14	1.3	0.22
TSA pH 6.5	moles H^+ /t	90	810	140
s-TSA pH 6.5	%w/w S	0.14	1.3	0.22
ANC_E	% $CaCO_3$	<0.05	<0.05	<0.05
a-ANC_E	moles H^+ /t	<5	<5	<5
s-ANC_E	%w/w S	<0.05	<0.05	<0.05
S_{KCl}	%w/w S	0.04	0.11	0.03
S_P	%w/w	0.31	1.5	0.34
S_{POS}	%w/w	0.27	1.4	0.31
a-S_{POS}	moles H^+ /t	170	860	200
Ca_{KCl}	%w/w	0.05	0.06	0.05
Ca_P	%w/w	0.09	0.09	0.10
Ca_A	%w/w	0.041	0.030	0.052
Mg_{KCl}	%w/w	0.046	0.073	0.056
Mg_P	%w/w	0.058	0.087	0.069
Mg_A	%w/w	0.011	0.014	0.013
S_{HCl}	%w/w S	<0.005	<0.005	<0.005
S_{NAS}	%w/w S	<0.005	<0.005	<0.005
a-S_{NAS}	moles H^+ /t	<5	<5	<5
s-S_{NAS}	%w/w S	<0.01	<0.01	<0.01
Fineness Factor	-	1.5	1.5	1.5
a-Net Acidity	moles H^+ /t	120	860	160
s-Net Acidity	%w/w S	0.19	1.4	0.25
Liming rate	kg $CaCO_3$ /t	8.7	65	12
s-Net Acidity without -ANCE	%w/w S	0.19	1.4	0.25
a-Net Acidity without ANCE	moles H^+ /t	120	860	160
Liming rate without ANCE	kg $CaCO_3$ /t	8.7	65	12

Method ID	Methodology Summary
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			06/03/2019	4	06/03/2019	06/03/2019		06/03/2019	[NT]
Date analysed	-			06/03/2019	4	06/03/2019	06/03/2019		06/03/2019	[NT]
pH $_{kcl}$	pH units		Inorg-064	[NT]	4	4.0	4.0	0	91	[NT]
TAA pH 6.5	moles H^+ /t	5	Inorg-064	<5	4	30	30	0	95	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	4	0.05	0.05	0	[NT]	[NT]
pH $_{Ox}$	pH units		Inorg-064	[NT]	4	3.8	3.7	3	95	[NT]
TPA pH 6.5	moles H^+ /t	5	Inorg-064	<5	4	82	78	5	117	[NT]
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	4	0.13	0.12	8	[NT]	[NT]
TSA pH 6.5	moles H^+ /t	5	Inorg-064	<5	4	52	48	8	[NT]	[NT]
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	4	0.08	0.08	0	[NT]	[NT]
ANC_E	% $CaCO_3$	0.05	Inorg-064	<0.05	4	<0.05	<0.05	0	[NT]	[NT]
a-ANC_E	moles H^+ /t	5	Inorg-064	<5	4	<5	<5	0	[NT]	[NT]
s-ANC_E	%w/w S	0.05	Inorg-064	<0.05	4	<0.05	<0.05	0	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-064	<0.005	4	<0.005	<0.005	0	[NT]	[NT]
S_P	%w/w	0.005	Inorg-064	<0.005	4	0.03	0.04	29	[NT]	[NT]
S_{POS}	%w/w	0.005	Inorg-064	<0.005	4	0.03	0.04	29	[NT]	[NT]
a-S_{POS}	moles H^+ /t	5	Inorg-064	<5	4	20	22	10	[NT]	[NT]
Ca_{KCl}	%w/w	0.005	Inorg-064	<0.005	4	0.15	0.15	0	[NT]	[NT]
Ca_P	%w/w	0.005	Inorg-064	<0.005	4	0.18	0.19	5	[NT]	[NT]
Ca_A	%w/w	0.005	Inorg-064	<0.005	4	0.028	0.041	38	[NT]	[NT]
Mg_{KCl}	%w/w	0.005	Inorg-064	<0.005	4	0.029	0.028	4	[NT]	[NT]
Mg_P	%w/w	0.005	Inorg-064	<0.005	4	0.035	0.036	3	[NT]	[NT]
Mg_A	%w/w	0.005	Inorg-064	<0.005	4	0.006	0.008	29	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-064	<0.005	4	0.008	0.008	0	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-064	<0.005	4	0.006	0.006	0	[NT]	[NT]
a-S_{NAS}	moles H^+ /t	5	Inorg-064	<5	4	<5	<5	0	[NT]	[NT]
s-S_{NAS}	%w/w S	0.01	Inorg-064	<0.01	4	<0.01	<0.01	0	[NT]	[NT]
Fineness Factor	-	1.5	Inorg-064	<1.5	4	1.5	1.5	0	[NT]	[NT]
a-Net Acidity	moles H^+ /t	5	Inorg-064	<5	4	52	55	6	[NT]	[NT]
s-Net Acidity	%w/w S	0.01	Inorg-064	<0.01	4	0.08	0.09	12	[NT]	[NT]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-064	<0.75	4	3.9	4.1	5	[NT]	[NT]
s-Net Acidity without -ANCE	%w/w S	0.01	Inorg-064	<0.01	4	0.084	0.087	4	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+ /t	5	Inorg-064	<5	4	52	55	6	[NT]	[NT]

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	4	3.9	4.1	5	[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
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.

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; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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	Environmental Investigation Services
Attention	Katrina Taylor

Sample Login Details

Your reference	E32217BT, Blackwall
Envirolab Reference	212614
Date Sample Received	04/03/2019
Date Instructions Received	04/03/2019
Date Results Expected to be Reported	11/03/2019

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	13 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	7.8
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
customerservice@envirolab.com.au
www.envirolab.com.au

Sample ID	sPOCAS + %S w/w	On Hold
BH1-0.2-0.4		✓
BH1-0.6-0.7		✓
BH1-1.0-1.1		✓
BH1-1.5-1.7	✓	
BH1-2.3-2.4	✓	
BH3-0.1-0.2		✓
BH3-0.9-1.0	✓	
BH3-1.5-1.6	✓	
BH5-0-0.1		✓
BH5-0.3-0.4	✓	
BH5-0.9-1.0	✓	
BH6-0.1-0.2	✓	
BH6-0.9-1.0	✓	

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.

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	EIS Job Number: E32217BT Date Results Required: STANDARD Page: ~~1 of~~ 1/1	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Katrina Taylor

Location:	Blackwall					Sample Preserved in Esky on Ice											
Sampler:	JH					Tests Required											
Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	sPOCAS	pH (1:5 water)										
28/02/2019	1	BH1	0.2-0.4	P	FILL												
"	2	"	0.6-0.7	"	"												
"	3	"	1.0-1.1	"	"												
"	4	"	1.5-1.7	"	"	X											
"	5	↓	2.3-2.4	"	↓	X											
"	6	BH3	0.1-0.2	"	FILL												
"	7	"	0.9-1.0	"	"	X											
"	8	↓	1.5-1.6	"	↓	X											
"	9	BH5	0-0.1	"	NATURAL												
"	10	"	0.3-0.4	"	"	X											
"	11	↓	0.9-1.0	"	"	X											
"	12	BH6	0.1-0.2	"	"	X											
↓	13	↓	0.9-1.0	↓	↓	X											

ENVIROLAB GROUP

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 212614

Date Received: 4/3/19
Time Received: 10:45
Received by: LN
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: JH	Date: 1/3/19	Time:	Received By: ELS LILY NOTT	Date: 4/3/19 10:45