idealgeotech
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Acid Sulphate Assessment

Prepared for: Warringah Golf Club

Address: 433 Pittwater Road, North Manly

Job No: 60025-IDF

Date: November 2022

Accredited for compliance
With ISO/IEC 17025
NATA Accreditation No. 19226

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Contents

1.0 INTRODUCTION

Ideal Geotech has undertaken a Preliminary Acid Sulphate Soils Assessment for the proposed commercial development located at Warringah Golf Club; 433 Pittwater Road, North Manly. It is understood that a proposed two-storey commercial development is to be constructed with minimal cut and fill with possible excavation for footings.

2.0 OBJECTIVES AND SCOPE OF WORK

The objectives of the work are outlined below:

- Summarise the relevant environmental characteristics of the site that may impact Actual Acid Sulphate Soils (AASS) and result in the release of acidity and the potential leaching and transport of contaminants.
- Outline potential environmental impacts associated with the proposed works.
- Summarise the presence or the absence of AASS and Potential Acid Sulphate Soils (PASS).
- Summarise soil aggressiveness to steel and concrete.

The scope of work includes the following:

- Review of soils and geological maps.
- A Preliminary soil sampling and analysis program to investigate the presence and distribution of AASS and PASS within the site.
- Analysis (SPOCAS suite) by a NATA accredited laboratory.
- Assessment of the results of the chemical analysis against the appropriate guidelines to assess if management is required so as to minimise potential environmental impacts caused by the disturbance of ASS.

Provide recommendations for the need to undertake an ASS Management Plan.

3.0 SITE DETAILS

Site Address	433 Pittwater Road, North Manly
Client	Warringah Golf Club
Council Area	Northern Beaches Council

3.1 Geology

Reference to the Sydney 1:100,000 geological map (Geological Series Sheet 9130) indicates that the site is underlain by Quaternary Deposits consisting of silty to peaty quartz sand, silt and clay along with Ferruginous and humic cementation in places with common shell layers.

3.2 Site Description

The subject site is roughly rectangular in shape and approximately 1550m^2 in area and is bound by Pittwater Road to the north east, Kentwell Road to the south, Brookvale Creek to the west and by Warringah Golf Course on all remaining sides.

The site is currently occupied by tennis courts and sports facilities. The site is relatively flat with no notable slopes that will impact construction with a line of large mature trees a long the western, northern and eastern boundaries.

4.0 Subsurface Conditions

Fieldwork was undertaken on 26 October 2022 and included drilling two boreholes (BH1 & BH2) using a 4wd mounted drill rig using solid flight spiral augers to a maximum depth of 3.0m at the locations shown on Figure 1, attached in Appendix A.

Borehole logs and field observations are presented in Appendix B.

4.1 Soil Profile

A general summary of the subsurface conditions encountered across the site is presented in Table 2 below.

Table 1: Summary of Subsurface Conditions

Borehole	Depth of fill/topsoil (m)	Depth to water table (m)	Termination depth (m)	Summary of sub-surface profiles
BH1	0.2	NE	3.0	Topsoil- Silty SAND / Natural - Silty SAND
BH2	NE	NE	3.0	Natural - Silty SAND / Silty SAND trace Clay

XW *Extremely Weathered*
NE *Not Encountered*

Groundwater was not observed at the time of investigation. It should be noted that groundwater levels are likely to fluctuate with variations in climatic and site conditions.

4.2 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are naturally occurring and usually form in low lying coastal areas, creeks, rivers and flood plains. The sulphates present in the soil are stable when in the saturated/waterlogged state, but react to form sulphuric acid when disturbed and exposed to oxygen.

Maps showing the areas identified as being affected by ASS have been prepared by the Department of Land and Water Conservation. These maps identify the probability of acid sulphate soils occurring in these areas and as such any areas should be specifically investigated before a particular site is classified.

Disturbance of these soil materials will result in an environmental risk that will vary with elevation and depth of disturbance. Any works below natural ground surface or affecting the water table has a risk of being contaminated with acid sulphate soils.

Reference to the Acid Sulphate Soils Map of Sydney Heads indicates that the site is located on the border between disturbed terrain and no known occurrence of acid sulphate soil materials.

5.0 SAMPLING & ANALYSIS PLAN

Sampling and analysis was undertaken in order to assess the presence or absence, location and likely distribution of any AASS or PASS present at the subject site in the area of the proposed development.

5.1 Sampling

Soil sampling was undertaken in general accordance with the Acid Sulphate Soil Guidelines (Refer to Figure 1 for the borehole locations). Test results were compared to the relevant New South Wales Environment Protection Authority (NSW EPA) criteria.

BH1 was terminated at a depth of approximately 3.0m below ground level with samples collected at 0.5m and 1.5m below ground level. BH2 was terminated at a depth of approximately 3.0m below ground level with samples collected at 1.0m and 2.0m below ground level. The samples were placed directly into labelled clean zip lock bags and placed on ice until delivery to the laboratory for testing. All analyses were performed by a NATA registered laboratory using NATA accredited methods.

6.0 ACID SULPHATE SOILS ASSESSMENT

6.1 Field Screening

The field screening involved the testing of the samples for field pH and peroxide pH, using 30% hydrogen peroxide to oxidise the soil, and comparing both results.

A positive peroxide test, indicating the potential presence of acid sulphate soil, may include one or more of the following.

1. Change in colour from grey tones to brown tones.
2. Effervescence.
3. Release of sulphurous odours.
4. pH following oxidation with H_2O_2 (pH_{fox}) <3.
5. Lowering of the pH (pH_f - pH_{fox}) by 1 or greater.
6. Field pH (pH_f) <4.

The results of the field and peroxide tests are provided in Table 1 below

Table 2: Results of Field Screening Tests

Location/Depth	Field pH	Peroxide pH	Reaction to 30% h_2O_2
BH1/0.5m	6.8	3.2	Strong
BH1/1.5m	6.1	3.0	Strong
BH2/1.0m	6.2	2.6	Strong
BH2/2.0m	6.0	3.6	Slight

Based on findings of the field screenings, indications of PASS were observed. Two samples were tested by quantitative laboratory analysis to confirm the presence or absence of acid sulphate soil.

6.2 Laboratory Test Results

The samples were analysed for SPOCAS to confirm the presence or absence of ASS or PASS in the soil. The samples were dispatched to ALS Environmental services for the quantitative analysis for Suspension Peroxide Oxidation Combined Acidity & Sulphate (SPOCAS).

6.3 Assessment Criteria for Acid Sulphate Soils (Laboratory)

The results of analysis for the soils are compared to the below ASSMAC assessment criteria. It is assumed that <1000 tonnes of material would be disturbed hence the action criteria for less than 1000 tonnes have been applied.

6.4 NSW ASSMAC Action Criteria

The NSW ASSMAC action criteria is detailed in Table 2 below for less than 1000 tonnes of disturbance.

Table 3: NSW ASSMAC Action Criteria

Type of Material Texture	Approx Clay Content (% <0.002mm)	Action Criteria <1000 tonnes Sulfur Trail Spos or Stos%	Action Criteria <1000 tonnes Acid Trail TPA or TSA mole H+/t
Coarse e.g. sands	**< 5**	**0.03**	**18**
Loams/light clays	5 – 40	0.06	36
Fine clays/silts	≥ 40	0.1	62

Note: The assessment values chosen are based on sands which are in bold

6.5 SPOCAS Test Results

The SPOCAS testing identified exceedances of the threshold criteria in both samples which suggests there is a presence of acid sulphate soils. Refer to Table 3 below.

Table 4: Results of SPOCAS Testing

Sample	pH_{ox}	TAA pH 6.5 moles H+/tonne	TPA pH 6.5 moles H+/tonne	TSA pH 6.5 moles H+/tonne	Spos %w/w
BH2/1.0m	3.0	**34**	**214**	**179**	**0.069**
BH2/2.0m	3.9	**27**	**80**	**52**	<0.020

6.6 Aggressiveness to Steel and Concrete

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of pH and types of salts present. In order to determine the degree of aggressiveness, the test values obtained are compared to tables 6.4.2 (C) and 6.5.2 (C) in AS2159 Piling - Design and Installation and tables 5.1 to 5.4 in AS2870-2011 “Residential Slabs and Footings”. The following testing suite was undertaken with results summarised within table 4 below;

- pH
- Electrical Conductivity (EC µS/cm)
- Chloride (Cl)
- Resistivity (ohm.cm)
- Sulphate

Table 5: Results of Aggressivity Testing

Location/Depth	pH	EC_e dS/m	Resistivity Ohm.cm	Cl mg/kg	Sulphate mg/kg
BH1/0.5m	5.9	0.578	5880	<10	20
BH1/1.5m	5.4	0.782	7040	<10	170

Based on test results detailed in Table 4 the soil conditions are considered to be mildly aggressive to concrete and non-aggressive to steel in high permeability soils. An exposure classification of A2 for concrete has been determined.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Ideal Geotech has undertaken a Preliminary Acid Sulphate Soils Assessment for the proposed commercial development at Warringah Golf Club; 433 Pittwater Road, North Manly. Our preliminary site investigation included site observation of the soil retrieved from the borehole and sampling of soil for laboratory testing. Upon completion of our onsite investigation and laboratory analysis the following conclusions are made:

- An exposure classification of A2 for concrete with the soil mildly aggressive to concrete and non-aggressive to steel structures.

- Laboratory sample analysis indicates that test levels exceeded the action criteria in SPOCAS testing and it has been determined that an acid sulphate management plan will be required for excavation activities on the site.

This report is based on a limited sampling and testing regime. It is possible that acid sulphate soils and differing ground conditions may be present between sampling locations, or in the remainder of the site not intrusively investigated.

Should you have any queries, please do not hesitate to contact the undersigned.

For and on behalf of Ideal Geotech

D. Dwyer

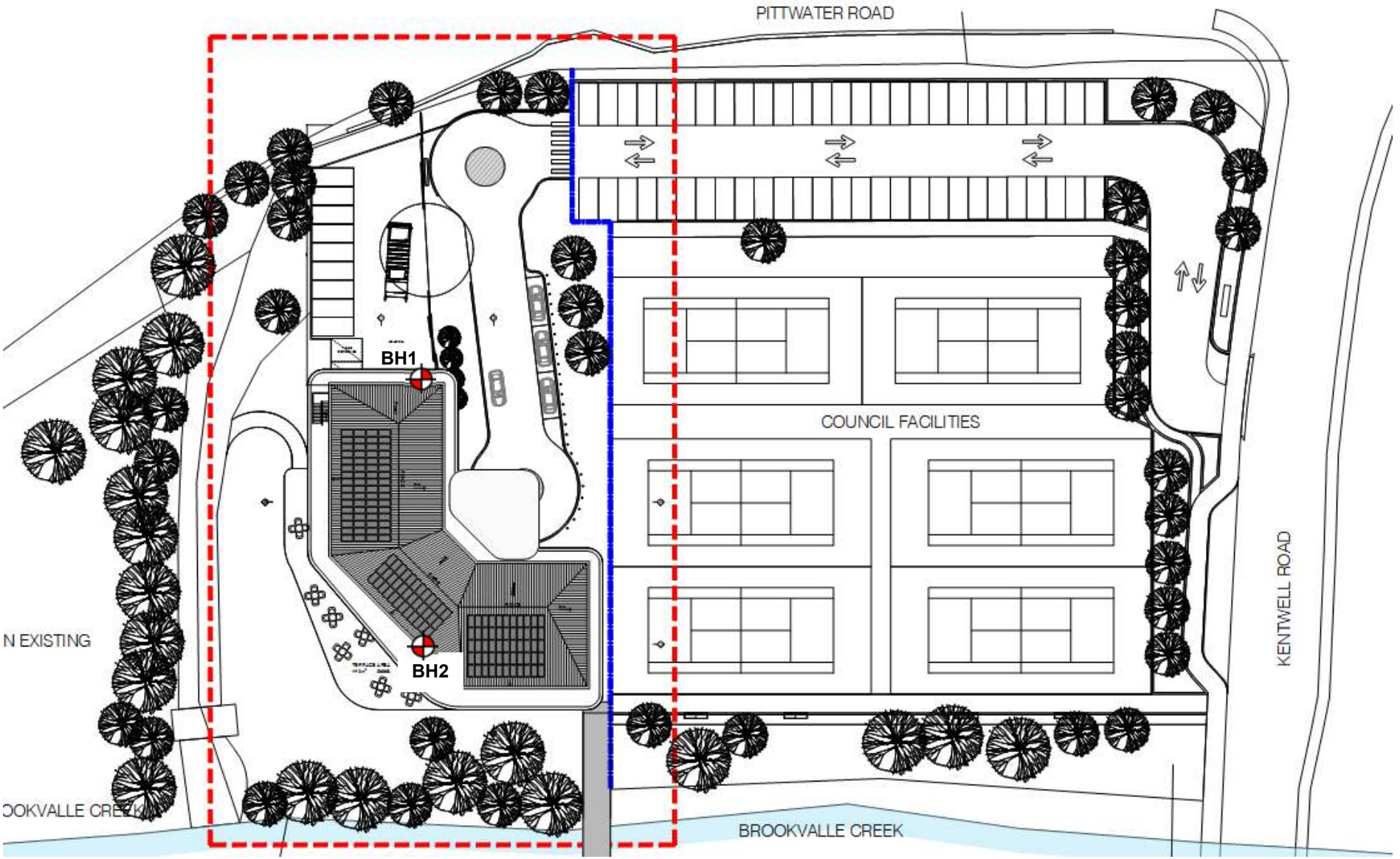
Dane Dwyer
Geotechnical Engineer

8.0 REFERENCES

- *Geological Series Sheet 9130, Map of Sydney, scale 1:100,000*
- *Stone, Y, and Hopkins G (1998). Acid Sulphate Soils Planning Guidelines.* Published by the Acid Sulphate Soil Management Advisory Committee, Wollongbar, NSW, Australia.
- Ahern C R, Stone, Y, and Blunden B (1998). *Acid Sulphate Soils Assessment Guidelines* Published by the Acid Sulphate Soil Management Advisory Committee, Wollongbar, NSW, Australia

9.0 APPENDICES

9.1 Appendix A – Borehole Location Plan



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DRAWING TITLE: Borehole Location Plan
PROJECT NAME: Acid Sulphate Soils Assessment
SITE LOCATION: Warringah Golf Club – North Manly

COUNCIL NAME: Northern Beaches Council
JOB NUMBER: 60025-IDF
FIGURE NUMBER: Figure 1

DRAWN BY: Ben
CHECKED BY: Dane
DATE: November 2022

NORTH

9.2 Appendix B – Borehole Logs

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5.1 FIELD LOG

Date: 26/10/2022
Customer Job: -
Ideal Job: 60025
Site Address: Warringah Golf Club - 397 Condamine Street, NORTH MANLY, NSW, 2100

Borehole: BH1
Surface RL:
Easting:
Northing:

Water	Depth (m)	DCP	PP	Sample	Classification Code	Material Description	Moisture	Density / Consistency	Fill
	0.1				SM	(Topsoil) Silty Sand	Moist	L	
	0.2					Grey			
	0.3				SM	Silty Sand	Very Moist	MD	
	0.4					Grey			
	0.5			Soil Sample 1					
	0.6								
	0.7								
	0.8								
	0.9								
	1.0								
	1.1								
	1.2								
	1.3								
	1.4								
	1.5			Soil Sample 2					
	1.6								
	1.7								
	1.8								
	1.9								
	2.0								
	2.1								
	2.2								
	2.3								
	2.4								
	2.5								
	2.6								
	2.7								
	2.8								
	2.9								
	3.0								
	3.1					End Bore 3m			
	3.2								
	3.3								

▼ Water Table **UTP** - Unable to penetrate **DCP** - 9kg Dynamic Cone Penetrometer **PP** - Pocket Penetrometer

AND – Density Index vs Approx. Penetrometer results

	DENSITY	Density Index	DCP Blow Count (blows/100mm)
VL	Very Loose	< 15 %	< 1
L	Loose	15 – 35 %	1 – 3
MD	Medium Dense	35 – 65 %	3 – 9
D	Dense	65 – 85 %	9 – 15
VD	Very Dense	> 85 %	> 15

SILTS & CLAY – Cu vs Approx. Penetrometer results

	CONSISTENCY	Undrained Shear Strength (kPa)	DCP Blow Count (blows/100mm)	PP Dial Indicator
VS	Very Soft	0 – 12	< 1	0 – 0.2
S	Soft	12 – 25	1 – 2	0.2 – 0.5
F	Firm	25 – 50	2 – 3	0.5 – 1.0
St	Stiff	50 – 100	3 – 5	1.0 – 2.0
VSt	Very Stiff	100 – 200	5 – 8	3.0 – 4.0
H	Hard	> 200	> 8	> 4.0

MOISTURE

D	Dry
M	Moist
W	Wet
W_P	Plastic Limit
W_L	Liquid Limit

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5.2 FIELD LOG

Date: 26/10/2022
Customer Job: -
Ideal Job: 60025
Site Address: Warringah Golf Club - 397 Condamine Street, NORTH MANLY, NSW, 2100

Borehole: BH2
Surface RL:
Easting:
Northing:

Water	Depth (m)	DCP	PP	Sample	Classification Code	Material Description	Moisture	Density / Consistency	Fill
	0.1				SM	Silty Sand	Very Moist	MD	
	0.2					Grey			
	0.3								
	0.4								
	0.5								
	0.6								
	0.7								
	0.8								
	0.9								
	1.0			Soil Sample 1					
	1.1								
	1.2								
	1.3								
	1.4								
	1.5								
	1.6								
	1.7								
	1.8								
	1.9								
	2.0			Soil Sample 2					
	2.1				SM	Silty Sand with trace Clay	Very Moist	MD	
	2.2					Grey			
	2.3								
	2.4								
	2.5								
	2.6								
	2.7								
	2.8								
	2.9								
	3.0								
	3.1					End Bore 3m			
	3.2								
	3.3								

▼ Water Table **UTP** - Unable to penetrate **DCP** - 9kg Dynamic Cone Penetrometer **PP** - Pocket Penetrometer

AND – Density Index vs Approx. Penetrometer results

	DENSITY	Density Index	DCP Blow Count (blows/100mm)
VL	Very Loose	< 15 %	< 1
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SILTS & CLAY – Cu vs Approx. Penetrometer results

	CONSISTENCY	Undrained Shear Strength (kPa)	DCP Blow Count (blows/100mm)	PP Dial Indicator
VS	Very Soft	0 – 12	< 1	0 – 0.2
S	Soft	12 – 25	1 – 2	0.2 – 0.5
F	Firm	25 – 50	2 – 3	0.5 – 1.0
St	Stiff	50 – 100	3 – 5	1.0 – 2.0
VSt	Very Stiff	100 – 200	5 – 8	3.0 – 4.0
H	Hard	> 200	> 8	> 4.0

MOISTURE

D	Dry
M	Moist
W	Wet
W_P	Plastic Limit
W_L	Liquid Limit

9.3 Appendix C – Laboratory Test Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2238866**	Page	: 1 of 4
Client	: **IdealCorp Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: DANE DWYER	Contact	: Customer Services ES
Address	: 16-18 Sammut Street SMITHFIELD NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 600255	Date Samples Received	: 28-Oct-2022 15:20
Order number	: ----	Date Analysis Commenced	: 31-Oct-2022
C-O-C number	: ----	Issue Date	: 04-Nov-2022 16:28
Sampler	: MK		
Site	: ----		
Quote number	: SY/386/19 V8		
No. of samples received	: 4		
No. of samples analysed	: 4		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA032 (Saturated Paste EC): NATA accreditation does not cover the performance of this service.
- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA029 (SPOCAS): Excess ANC not required because pH OX less than 6.5.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.
- ASS: EA003 (NATA Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- ALS is not NATA accredited for the calculation of saturated resistivity in a soil.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1-0.5m	BH1-1.5m	BH2-1.0m	BH2-2.0m	----
			Sampling date / time	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	----
Compound	CAS Number	LOR	Unit	ES2238866-001	ES2238866-002	ES2238866-003	ES2238866-004	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.9	5.4	----	----	----
EA003 :pH (field/fox)								
pH (F)	----	0.1	pH Unit	6.8	6.1	6.2	6.0	----
pH (Fox)	----	0.1	pH Unit	3.2	3.0	2.6	3.6	----
Reaction Rate	----	1	Reaction Unit	3	3	3	1	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	34	46	----	----	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	5.0	5.1	----
pH OX (23B)	----	0.1	pH Unit	----	----	3.0	3.9	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	34	27	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	214	80	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	179	52	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	0.055	0.044	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	0.342	0.128	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	0.288	0.084	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	<0.020	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	0.069	<0.020	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	0.069	<0.020	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	43	<10	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	<0.020	<0.020	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	<0.020	<0.020	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	<0.020	<0.020	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	<10	<10	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	<0.020	<0.020	----
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	<0.020	<0.020	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	<0.020	<0.020	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	<0.020	<0.020	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1-0.5m	BH1-1.5m	BH2-1.0m	BH2-2.0m	----
			Sampling date / time	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	----
Compound	CAS Number	LOR	Unit	ES2238866-001	ES2238866-002	ES2238866-003	ES2238866-004	--------
				Result	Result	Result	Result	----
EA029-E: Magnesium Values - Continued								
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	<10	<10	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	<0.020	<0.020	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	**1.5**	**1.5**	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	**0.12**	**0.04**	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	**77**	**27**	----
Liming Rate	----	1	kg CaCO3/t	----	----	**6**	**2**	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	**0.12**	**0.04**	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	**77**	**27**	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	**6**	**2**	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**10.3**	**50.2**	----	----	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**5880**	**7040**	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**20**	**170**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EA029-F: Excess Acid Neutralising Capacity

(SOIL) EA029-H: Acid Base Accounting

(SOIL) EA029-G: Retained Acidity

(SOIL) EA029-A: pH Measurements

(SOIL) EA029-C: Sulfur Trail

(SOIL) EA029-D: Calcium Values

(SOIL) EA029-E: Magnesium Values

(SOIL) EA029-B: Acidity Trail

(SOIL) EA003 :pH (field/fox)