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Job No: 13138/2
Our Ref: 13138/2-AA
29 April 2014

Canterbury City Council
c/- JBA Urban Planning Consultants Pty Ltd
P O Box 375
NORTH SYDNEY NSW 2059
Email: SBallango@jbaurban.com.au

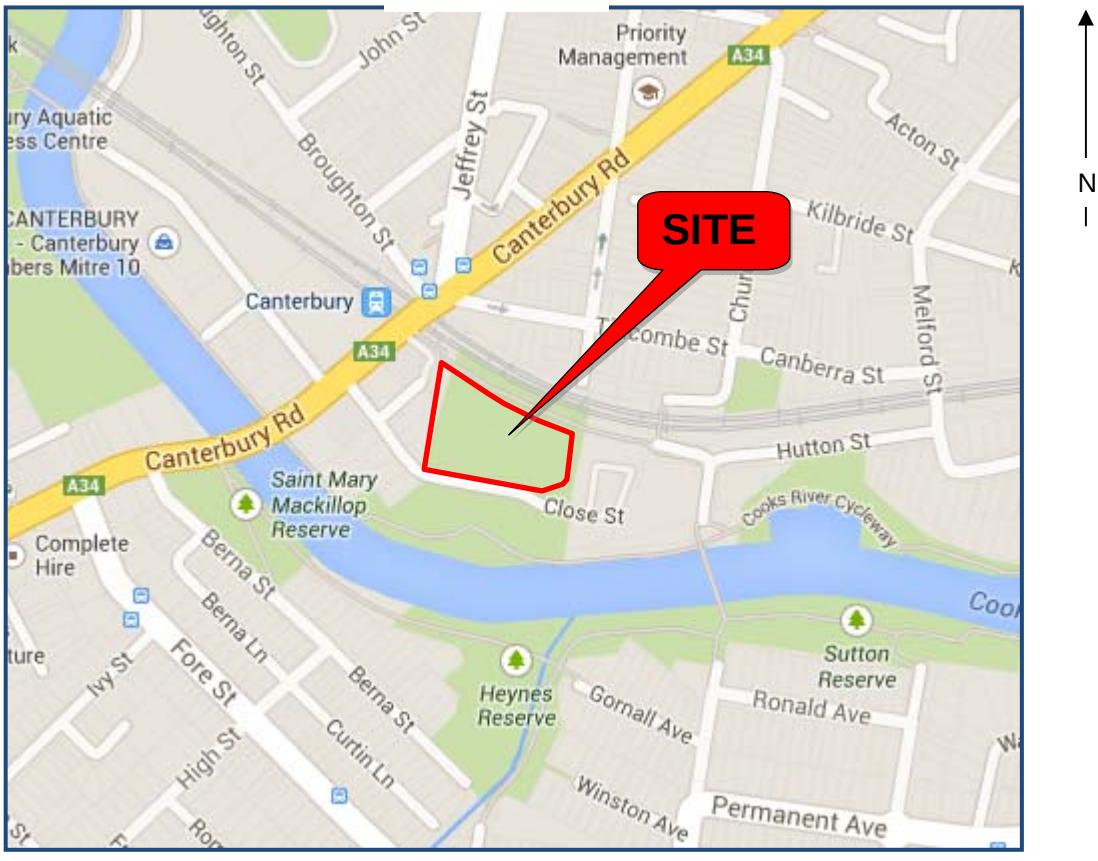
Attention: Ms S Ballango

Dear Madam

Re **Proposed Redevelopment**
Lot 1 in DP818683 - 15 Close Street, Canterbury
Preliminary Acid Sulphate Soil Assessment

This letter report provides a preliminary acid sulphate soil assessment at the above site, as indicated in the Figure 1 below.

FIGURE 1



Map Data ©2014 Google

It is understood that the site is proposed for redevelopment into commercial and residential high-rise buildings, including a multi-purpose community art cultural facility. However, details of the proposed development are unknown at this stage.

A preliminary acid sulphate soil assessment was required to ascertain if the proposed development works will result in disturbance of acid sulphate and / or potential acid sulphate soils.

Site Conditions

At the time of inspection by an Environmental Engineer from Geotechnique Pty Ltd (Geotechnique) on 18 March 2014 the site was part of the bowling club containing a brick building. The remainder of the site was grass covered.

Background Information

The Geological Map of Sydney (Scale 1:100,000), published by the Department of Mineral Resources (1983), indicates that the site is underlain by Hawkesbury Sandstone in the northern portion and stream alluvium and estuarine deposits in the southern portions (Reference 1). Hawkesbury Sandstone comprises medium to coarse grained quartz sandstone, very minor shale and laminite lenses and stream alluvium and estuarine deposits comprise silty to peaty quartz sand, silt and clay, ferruginous and humic in places, with shell layers

The Soil Landscape Map of Sydney (Scale 1:100,000), prepared by the Department of Land & Water Conservation, indicates that the landscape in the northern portion of the site belongs to The Gymea Group, which is characterised by undulating to rolling rises and low hills on Hawkesbury Sandstone (Reference 2). Soils in this area comprise shallow to moderately deep (30-100cm) yellow earths, earthy sand on crests and inside benches, shallow siliceous sand on leading edges of benches. However, the landscape in the southern portion of the site is disturbed.

The Acid Sulphate Soil Risk Map (Edition 2, 1:25,000) of Botany Bay prepared by the Department of Land and Water Conservation also indicates that the site is within disturbed terrain, which might include filled areas, or areas that have undergone heavy ground disturbance through general urban development (Reference 3). The map recommends that soil investigation is carried out to assess the acid sulphate soil potential at the site.

The Planning Certificate (No 28890) under Section 149 Environmental Planning and Assessment Act 1979 for Lot 1 in DP818683 issued by Canterbury City Council on 19 March 2014 indicated that “the land is affected by the Acid Sulphate Soils Assessment Guidelines and Acid Sulphate Soils Planning Guidelines adopted by the Department of Planning and the Department of Environment and Conservation and notified to the council that restricts the development of the land because of the likelihood of acid sulphate soils”.

Field Work

Field work for the acid sulphate soil assessment was carried out on 18 March 2014 and consisted of the following.

- A walk over survey to assess existing site conditions.
- Drilling four boreholes using a bobcat mounted with an auger. Approximate borehole locations are shown on the attached Drawing No 13138/2-AA1.
- Recovery of representative soil samples for laboratory testing.

Sub-surface Conditions

Sub-surface conditions encountered at the borehole locations are detailed in the attached Table A and summarised below in Table1

TABLE 1

Borehole	Termination Depth (m)	Depth Range for Topsoil/Fill (m)	Depth Range for Residual Soil (m)	Depth to Bedrock(m)
BH1	4.0	0.0-0.12	0.2->4.0	Not Encountered
BH4	0.8	0.0-0.50	0.5-0.8	0.8
BH18	3.0	0.0-0.20	0.2-3.0	3.0
BH21	3.8	0.0-1.85	0.8->3.8	Not Encountered

Table 1 indicates that the sub-surface profile across the site comprises a sequence of topsoil/fill underlain by natural soils and bedrock. The natural soils in the northern portion of the site (BH4 and BH18) are anticipated to be residual soils and that in the southern portion of the site (BH1 and BH21) is assessed to be alluvium and estuarine deposits. Bedrock in the northern portion of the site is sandstone and the depth to sandstone varies from about 0.8m to 3.0m. Bedrock was not encountered in the southern portion of the site to a depth of about 4.0m. Information in Table 1 is generalised as follows.

- Fill in BH1 included 50mm thick asphalt and medium grained gravelly sand with clay, and natural soils comprised medium plasticity sandy clay with inclusion of ironstone gravels.
- Fill in BH4 included sandy gravel with ash and natural soils comprised medium plasticity sandy clay with inclusion of ironstone gravels.
- Topsoil in BH18 comprised medium grained silty sand with root fibres, and clay and natural soils consisted of medium plasticity sandy clay with inclusion on ironstone gravels.
- Topsoil in BH21 comprised medium grained silty sand with root fibres, and clay and fill comprised fine grained sand and medium plasticity silty clay with inclusions of shale and sandstone fragments. Natural soils consisted of medium plasticity sandy clay with inclusion on ironstone gravels.

Groundwater seepage was not encountered to borehole termination depths of 0.8m (BH4) to 4.0m (BH1) from existing ground surface. It should be noted that fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors.

Field pH Testing

As a first step to assess whether acid sulphate or potential acid sulphate soils are unlikely to be present in a site, tests that determine the actual field pH (pHf) and pHf_{ox} after oxidation are considered appropriate In accordance with the Acid Sulphate Management Advisory Committee, New South Wales, an actual pHf less than 4 indicates a likelihood of actual acid sulphate soils, whilst pHf_{ox} values after oxidation generally indicate the following (Reference 4).

- A pH_{ox} of less than 3 generally indicates a high likelihood of potential acid sulphate soils.
- A pH_{ox} of 3 to 4 generally indicates a likelihood of potential acid sulphate soils, but needs to be confirmed with additional testing.
- A pH_{ox} of 4 to 5 generally indicates a possibility of potential acid sulphate soils.

- A pH_{ox} of greater than 5, with little reduction from actual pH, generally indicates little acid generating ability in the soil.

Soil samples were submitted to the laboratory for screening of actual field pH (pHf) and pH after oxidation (pHf_{ox}). The test results are shown in Table 2.

TABLE 2

Borehole	Depth (m)	Material Description	pHf, Unit	pHf_{ox}, Unit	Drop in pH
BH1	0.05-0.2	Gravelly sand	8.4	8.5	-0.1
BH1	0.5-0.8	Sandy clay	6.9	4.1	2.8
BH1	1.5-1.8	Sandy clay	4.8	2.6	2.2
BH1	2.5-2.8	Sandy clay	4.2	3.0	1.2
BH1	3.5-3.8	Sandy clay	4.2	3.5	0.7
BH4	0-0.3	Sandy gravel	6.9	5.6	1.3
BH18	0.5-0.8	Sandy clay	6.1	5.1	1.0
BH18	2.5-2.8	Sandy clay	5.9	5.1	0.8
BH21	1.0-1.3	Silty clay	4.3	3.7	0.6
BH21	2.0-2.3	Sandy clay	6.9	4.8	2.1
BH21	3.0-3.3	Sandy clay	7.5	6.7	0.8

Table 2 indicates the following.

- For samples from all boreholes, pHf values vary from 4.2 to 8.4 units, indicating that the presence of acid sulphate soil is unlikely.
- For BH1, pHf_{ox} of 2.6 and 3.0 (1.5-1.8m and 2.5m-2.8m) and drop in pH after oxidation of 1.2 to 2.8 units indicates a high likelihood of potential acid sulphate soils in the depth range of 0.2m to 3.5m. However, at depths exceeding 3.5m, pHf_{ox} is 3.5 and drop in pH after oxidation is only 0.7 units, indicating the likelihood of potential acid sulphate soils, although this needs to be confirmed by additional testing.
- For BH4, pHf_{ox} of 5.6 indicates that the presence of acid sulphate soil is unlikely. However, drop in pH after oxidation of 1.3 units indicates the likelihood of the presence of sulphate which could produce acid during oxidation. This indicates a likelihood potential acid sulphate soils, but needs to be confirmed by additional testing.
- For BH18, pHf_{ox} of 5.1 and drop in pH after oxidation of 0.8 to 1.0 units indicate that the presence of potential acid sulphate soil is unlikely.
- For BH21, pHf_{ox} of 3.7 to 6.7 and drop in pH after oxidation of 0.6 to 2.1 units indicates a possibility of the presence of sulphate which could produce some acid during oxidation at a depth range of 1.5m to 2.5m, but needs to be confirmed by additional testing.

Laboratory Testing

As field pH testing indicated a possibility of the presence of potential acid sulphate soils, further laboratory tests were carried out to confirm the presence or otherwise of acid sulphate soils. Laboratory investigation consisted of testing representative soil samples to determine **pH_{KCl}, pH_{ox}, TPA** (Total Peroxide Acidity), **TAA** (Titratable Actual Acidity), **TSA** (Titratable Sulphidic Acidity), **S_{POS}%** (Percent Peroxide Oxidisable Sulphur) and **S_{SCR}%** (Chromium Reducible Sulphur).

Laboratory tests were carried out by SGS Australia Pty Ltd (NATA accredited) in accordance with SPOCAS (Suspension Peroxide Oxidation Combined Acidity & Sulphate)/Chromium Reducible Sulphur (SCR) methods recommended by the Queensland Department of Natural Resources, Mines and Energy (Qld NRM&E) (Reference 5). The test results are attached and summary is presented below in Table 3.

TABLE 3

Borehole No	Depth (m)	pH_{KCl} Unit	pH_{ox} Unit	TPA mole H^+/t	TAA mole H+/t	TSA mole H+/t	S_{POS} % w/w	S_{SCR} % w/w
BH1	0.05-0.2	8.8	8.7	<5	<5	<5	0.029	0.017
BH1	0.5-0.8	6.7	6.3	<5	<5	<5	0.094	0.020
BH1	1.0-1.3	4.9	3.4	131	27	104	0.170	0.130
BH1	1.5-1.8	5.0	3.6	17	17	<5	0.130	0.094
BH1	2.0-2.3	4.6	5.6	16	41	<5	<0.005	<0.005
BH1	2.5-2.8	4.5	4.8	45	45	<5	0.017	0.010
BH1	3.0-3.3	4.5	5.2	46	44	<5	0.007	<0.005
BH1	3.5-3.8	4.5	4.9	47	47	<5	0.016	0.006
BH4	0-0.3.0	8.3	8.5	<5	<5	<5	0.029	0.010
BH4	0.5-0.8	6.5	5.8	<5	<5	<5	0.057	0.049
BH18	0.5-0.8	5.5	4.8	7	7	<5	0.008	<0.005
BH18	2.5-2.8	5.3	5.2	12	12	<5	0.008	<0.005
BH21	1.0-1.3	4.5	4.2	60	60	<5	0.008	<0.005
BH21	2.0-2.3	7.7	7.7	<5	<5	<5	0.032	0.010
BH21	3.0-3.3	8.7	8.0	<5	<5	<5	0.010	<0.005

Notes

pH_{KCl} = pH in a 1:40 (W/V) suspension of soil in a solution of 1M K_{Cl} extract
pH_{ox} = pH in a suspension of soil in a solution after peroxide digestion in SPOCAS method
TPA = Titratable Peroxidel Acidity (moles H^+/tonne)
TAA = Titratable Actual Acidity (moles H^+/tonne)
TSA = Titratable Sulphidic Acidity (moles H^+/tonne)
S_{POS} = Peroxide Oxidisable Sulphur (% w/w)
S_{SCR} = Chromium Reducible Sulphur (% w/w)

Acid Sulphate Soil Assessment Methods

The Acid Sulphate Management Advisory Committee, New South Wales, recommends that assessment of acid sulphate soils and/or potentially acid sulphate soils at a site is carried out in stages, as follows.

Step 1 – Check the Acid Sulphate Soils Map.

Step 2 – Check if the area meets the geomorphic or site criteria.

Step 3 – Analyse soil and water indicators.

Step 4 – Chemical analysis to confirm Acid Sulphate Soil and action level.

The New South Wales Acid Sulphate Soils Management Advisory Committee also recommends "Action Criteria" based on laboratory test results for three broad soil texture categories. Works in soils that exceed these "Action Criteria" (as shown in the following Table 4) must prepare an Acid Sulphate Soils Management Plan and possibly obtain development consent.

TABLE 4

Type of Material		**Action Criteria 1-1000 tonnes of soil is disturbed**		**Action Criteria More than 1000 tonnes of soil is disturbed**	
Texture Range	**Approx Clay Content** (%<0.002mm)	**Sulphur Trail** % S oxidisable (oven dry basis) e.g. S_{TOS} or S_{POS}	**Acid Trail** mol H^+/tonne (oven dry basis) e.g. TPA or TSA	**Sulphur Trail** % S oxidisable (oven dry basis) e.g. S_{TOS} or S_{POS}	**Acid Trail** mol H^+/tonne (oven dry basis) e.g. TPA or TSA
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture Sandy loams to light clays	5-40	0.06	36	0.03	18
Fine Texture Medium to heavy clays and silty clays	≥40	0.10	62	0.03	18

Assessment Results

Review of background information and results of field and laboratory tests indicate the following.

- The Acid Sulphate Soil Risk Map of Botany Bay indicates that the site is within disturbed terrain and therefore soil investigation should be carried out to assess if acid sulphate or potentially acid sulphate soils are likely to be present across the site.
- The ground surface elevation across the site varies from about RL5.0m AHD in the southern portion to RL 10.0m AHD in the northern portion. The natural soils in the northern portion of the site are residual soils and those in the southern portion include alluvium and estuarine deposits. Therefore, based on geomorphology and anticipated sub-surface soils, topsoil and fill as well as alluvium and estuarine deposits might be acid sulphate and potential acid sulphate soils.
- Field pH tests also indicate that the topsoil and fill, as well as alluvium and estuarine deposits, might be acid sulphate and potential acid sulphate soils.
- Considering the volume of soils likely to be disturbed would be more than 1000 tonnes, the laboratory test results and "Action Criteria" presented in Table 4 indicate the following.

- For BH1, Titratable Actual Acidity (TAA) of samples from depths exceeding 0.5m exceeds the "Action Criteria". However, Oxidisable Sulphur of samples from only a depth range of 1.0 to 1.8m exceeds the "Action Criteria".
- For BH4 and BH18, Titratable Actual Acidity and Oxidisable Sulphur of all samples are lower than the "Action Criteria".
- For BH21, Titratable Actual Acidity of samples from depths shallower than 1.3m exceeds the "Action Criteria". However, Oxidisable Sulphur is lower than the "Action Criteria".

The above assessments indicate that the topsoil/fill across the site and alluvium and estuarine deposits in the southern portions of the site are likely to be acid sulphate and potentially acid sulphate soils and therefore, disturbance and excavation of these soils at 15 Close Street, Canterbury, should be carried out in accordance with an approved "Acid Sulphate Soil Management Plan (ASSMP)." A draft ASSMP is attached for approval by Council and implementation during proposed development works.

General

As assessments and recommendations presented in this report are based on information from four boreholes to depths of 0.8m to 3.8m from existing ground surface, actual sub-surface conditions across the site might differ from those expected (interpreted) between the borehole locations. Additional sampling and testing might be required if soils encountered during any future excavations differ to those encountered in the boreholes drilled during this present assessment.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

DANDA SAPKOTA
Senior Environmental Engineer

Reviewed By

INDRA JWORCHAN
Principal Geotechnical Engineer

Attached
Drawing No 13138/2-AA1 – Borehole Locations
Table 1 Soil Description
SGS Laboratory Test Results (SE125987 and SE125987A)

References

1. NSW Department of Mineral Resources (1983). Geology of Sydney, Sheet (9130), Scale 1:100,000. Geological Survey of New South Wales Department of Mineral Resources, Sydney.
2. Chapman, G. A., Murphy C. L., Tillie, P. J., and Morse, R. J. (2002). Soil Landscape Sheet 9130(Scale 1:100,000, 2nd edition) of Sydney. Department of Land and Water Conservation, NSW, Sydney
3. Department of Land and Water Conservation, 1997, Acid Sulphate Soil Risk Map (Edition 2, 1:25,000) of Botany Bay, Sydney.
4. New South Wales, Acid Soil Management Advisory Committee, 1988 – Acid Sulphate Soil Manual.
5. Queensland, Department of Natural Resources, Mines and Energy, 2004 – Acid Sulphate Soils – Laboratory Methods Guidelines.

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DRAFT ACID SULPHATE SOILS MANAGEMENT PLAN (ASSMP)

PROPOSED DEVELOPMENT
15 CLOSE STREET, CANTERBURY

Background
Preliminary acid sulphate soil assessment indicates that the topsoil/fill across the site and alluvium and estuarine deposits in the southern portions of the site are likely to be acid sulphate and potentially acid sulphate soils and therefore, disturbance and excavation of these soils at 15 Close Street, Canterbury should be carried out in accordance with an approved ASSMP. It is possible to delineate the boundary between acid sulphate and non-acid sulphate soils by conducting a large number of laboratory tests, but this is deemed to be uneconomical, impractical and unnecessary at this preliminary stage. Therefore, disturbance and excavation of soils across the site should be carried out with an approved ASSMP.

Scope
This draft ASSMP is for a proposed commercial and residential high-rise development, including a multi-purpose community art cultural facility. Details of the proposed development are unknown at this stage, but this draft ASSMP is for works that will involve up to about 4.0m deep excavations. The purpose of this draft plan is to identify the project goals with regard to acid sulphate soil related issues and to detail procedures for undertaking the work to achieve the goals.

Reference Document
This draft plan is based on the "Acid Sulphate Soil Manual" prepared by the New South Wales, Acid Sulphate Soil Management Advisory Committee, 1988.

Project Goals
The project goal is to avoid adverse effects on the surrounding environment as a result of the proposed development works. It is intended to achieve this goal by containing and treating any potential or actual acid sulphate soils that might be disturbed or excavated during the proposed development works.

Management Options
These work procedures are in addition to any other work procedures or methods. All works should be carried out in accordance with all applicable regulatory requirements. There are two options to deal with acid sulphate soils.

Option 1 Dispose of the untreated acid sulphate and potential acid sulphate soils at a disposal facility licensed to receive acid sulphate soils.

Option 2 Neutralise the acid sulphate soils by mixing with lime. The amount of lime to be used to neutralise the soils depends on the concentration of acidity and volume of acid sulphate soils disturbed. When estimating lime requirements, a factor of at least 1.5-2.0 should be applied to allow for inefficient mixing of the lime and low reactivity. Based on results of laboratory tests on representative soils samples, the quantity of lime required to neutralise acid sulphate soils is anticipated to be about 5kg of aglime for every tonne of soil. For disposal of acid sulphate soils neutralised with aglime we recommend following options;

- Re-use the neutralised soils as controlled fill, if required, provided the soils meet other geotechnical and environmental requirements.
- Following neutralisation of the soils, dispose of on-site or at a licensed disposal facility.

These procedures are based on requirements for acid sulphate soils only and might be overridden or added to by other contamination and/or constraints. Such issues are not dealt with in this plan.

Work Procedures - Soils

As indicated earlier, untreated acid sulphate soils may be disposed of at a disposal facility licensed to receive acid sulphate soils. For treatment of acid sulphate soils with lime we recommend the following procedures;

- Strip acid sulphate and/or potential acid sulphate soils in layers of 1.0m and stockpile in a bunded area to contain any leachate and/or run-off. Stockpiles should be limited to 1.5m high.
- Stockpiles should be covered with plastic sheeting to prevent drying and/or wetting when not being worked.
- If practical, stockpiled materials should be sorted by material type during excavation to assist in identification or possible segregation of acid and non-acid producing soils.
- Treat stockpiled materials with a recommended dose of aglime. Spread soils in layers of about 300mm for lime application and properly mix lime and soils.
- Test lime treated soils to ascertain that acid sulphate soils are neutralised adequately. A pH value higher than 5.5 indicates that the soil is adequately neutralised. If not, further lime treatment will be required.
- Acid sulphate soils neutralised with lime may be re-used within the site or disposed off-site.

Work Procedures - Water

The pH of water is usually around neutral, approximately between pH 7 and 8. When water has pH of 5.5 or below it can kill fish, restrict plant growth and reduce agricultural productivity, corrode metal and damage concrete foundations and engineering structures. Any acid leachate is to be neutralised to pH 6.5 to 7.5 by dosing with lime before disposal.

Any water pumped from excavations is to be pumped into holding tanks. The water should be tested and treated as appropriate. Water is not to be discharged until the level of turbidity is acceptable (dose with lime to flocculate) and pH levels are acceptable.

Preparation of Final Acid Sulphate Soil Management Plan

This is a “Draft ASSMP” to be submitted to statutory authority (Council) for review, comment and approval. It is envisaged that the draft plan would be adequate for lodgement of the development application. Once the draft plan is approved, a final ASSMP should be prepared with, or in conjunction with the contractor undertaking the work. The final ASSMP should be submitted to the statutory authority for endorsement prior to undertaking the work. We recommend that the proposed excavation should be carried out in accordance with an approved ASSMP, which should also show the following.

- Locations of bunded areas for stockpiles
- Preferred disposal or re-use method for dealing with excavated materials
- Duration and timing of excavation and lime treatment
- Contact details and responsibilities of the contractor

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N

LEGEND

Borehole

0 10 20 30 40 50m

Scale 1:1000

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NOTES

1. Site features are indicative and are not to scale.
2. This drawing has been produced using a base plan provided by others to which additional information e.g test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing

JBA Urban Development Services
Lot 1 in DP818683
15 Close Street
Canterbury

Borehole Locations

Drawing No: 13138/2-AA1
Job No: 13138/2
Drawn By: MH
Date: 24 March 2014
Checked By: DS

File No: 13138-2
Layers: 0, AA1

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Project	**Proposed Redevelopment**	**Job No**	**13138/2**
Location	**15 Close Street Canterbury**	**Refer to Drawing No**	**13138/2-AA1**
		Logged & Sampled by	**LY**

TABLE 1

BH	Depth (m)	Sample Depth (m)	Date	Time	Material Description	Remarks*
1	0.0 - 0.05	No Sample (NS)	18.3.14		Bitumen	
	0.05 - 0.2	0.05 - 0.12	"		FILL: Gravelly Sand, medium grained, grey, with inclusion of clay	
	0.2 - 1.5	0.5 - 0.8	"		(Cl) Sandy CLAY, medium plasticity, dark grey	
		1.0 - 1.3	"		(Cl) Sandy CLAY, medium plasticity, dark grey	
	1.5 - 4.0	1.5 - 1.8	"		(Cl) Sandy CLAY, medium plasticity, brown and grey with inclusions of ironstone gravel	
		2.0 - 2.3	"		(Cl) Sandy CLAY, medium plasticity, brown and grey with inclusions of ironstone gravel	
		2.5 - 2.8	"		(Cl) Sandy CLAY, medium plasticity, brown and grey with inclusions of ironstone gravel	
		3.0 - 3.3	"		(Cl) Sandy CLAY, medium plasticity, brown and grey with inclusions of ironstone gravel	
		3.5 - 3.8	"		(Cl) Sandy CLAY, medium plasticity, brown and grey with inclusions of ironstone gravel	
4	0.0 - 0.5	0.0 - 0.3	"		FILL: Sandy gravel, dark grey with black with inclusions of ash material	
	0.5 - 0.8	0.5 - 0.8	"		(Cl) Sandy CLAY, medium plasticity, brown and grey, with inclusions of ironstone gravel	
	0.8 -	-	"		Auger refusal at 0.8m in SANDSTONE	
18	0.0 - 0.2	NS	"		TOPSOIL: Silty Sand, medium grained, grey with inclusions of root fibres and clay	
	0.2 - 3.0	0.5 - 0.8	"		(Cl) Sandy CLAY, medium plasticity, brown and grey, with inclusions of ironstone gravel	
		1.5 - 1.58	"		(Cl) Sandy CLAY, medium plasticity, brown and grey with inclusions of ironstone gravel	
		2.5 - 2.8	"		(Cl) Sandy CLAY, medium plasticity, brown and grey with inclusions of ironstone gravel	
	3.0		"		Refusal	

*Odour (O), Discolouration (D), Petroleum Hydrocarbon Staining (PHS), Asbestos Containing Material (ACM), Ash Material (ASHM), Demolition Waste (DW), Groundwater (GW), Perched Water (PW) PID reading etc.

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Project	**Proposed Redevelopment**	**Job No**	**13138/2**
Location	**15 Close Street Canterbury**	**Refer to Drawing No**	**13138/2-AA1**
		Logged & Sampled by	**LY**

TABLE 1

BH	Depth (m)	Sample Depth (m)	Date	Time	Material Description	Remarks*
21	0.0 - 0.2	NS	18.3.14		TOPSOIL: Silty Sand, medium grained, grey with inclusions of root fibres and clay	
	0.2 - 0.8	NS	"		FILL: Sand, fine grained, grey	
	0.8 - 1.85	1.0 - 1.3	"		FILL: Silty Clay medium plasticity, grey with inclusions of shale and sandstone fragments and roots	
	1.85 - 3.8	2.0 - 2.3	"		(CI) Sandy CLAY, medium plasticity, dark grey	
		3.0 - 3.3	"		(CI) Sandy CLAY, medium plasticity, dark grey	

*Odour (O), Discolouration (D), Petroleum Hydrocarbon Staining (PHS), Asbestos Containing Material (ACM), Ash Material (ASHM), Demolition Waste (DW), Groundwater (GW), Perched Water (PW) PID reading etc.

ANALYTICAL REPORT

WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Danda Sapkota
Client	Geotechnique
Address	P.O. Box 880 PENRITH NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	danda.sapkota@geotech.com.au
Project	**13138-2 15 Close Street Canterbury**
Order Number	(Not specified)
Samples	11
Date Received	20/3/2014

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE125987 R0**
Report Number	0000079087
Date Reported	31/3/2014

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SPOCAS and SCR subcontracted to SGS Cairns, 2/58 Comport St, Portsmith QLD 4870, NATA Accreditation Number: 2562, Site Number: 3146.

SIGNATORIES

Dong Liang
Metals/Inorganics Team Leader

Ly Kim Ha
Organic Section Head

Field pH for Acid Sulphate Soil [AN104]

PARAMETER	UOM	LOR	BH1 0.05-0.2 SOIL 18/3/2014 SE125987.001	BH1 0.5-0.8 SOIL 18/3/2014 SE125987.002	BH1 1.5-1.8 SOIL 18/3/2014 SE125987.003	BH1 2.5-2.8 SOIL 18/3/2014 SE125987.004	BH1 3.5-3.8 SOIL 18/3/2014 SE125987.005	BH4 0-0.3 SOIL 18/3/2014 SE125987.006
pHf	pH Units	-	**8.4**	**6.9**	**4.8**	**4.2**	**4.2**	**6.9**
pHfox	pH Units	-	**8.5**	**4.1**	**2.6**	**3.0**	**3.5**	**5.6**
Reaction*	No unit	-	XXX	XX	XXX	X	X	X
pH Difference*	pH Units	-10	**-0.1**	**2.8**	**2.2**	**1.3**	**0.7**	**1.3**

PARAMETER	UOM	LOR	BH18 0.5-0.8 SOIL 18/3/2014 SE125987.007	BH18 2.5-2.8 SOIL 18/3/2014 SE125987.008	BH21 1.0-1.3 SOIL 18/3/2014 SE125987.009	BH21 2.0-2.3 SOIL 18/3/2014 SE125987.010	BH21 3.0-3.3 SOIL 18/3/2014 SE125987.011
pHf	pH Units	-	**6.1**	**5.9**	**4.3**	**6.9**	**7.5**
pHfox	pH Units	-	**5.1**	**5.1**	**3.7**	**4.8**	**6.7**
Reaction*	No unit	-	X	X	X	X	X
pH Difference*	pH Units	-10	**1.0**	**0.7**	**0.7**	**2.1**	**0.8**

Moisture Content [AN002]

PARAMETER	UOM	LOR	BH1 0.05-0.2 SOIL 18/3/2014 SE125987.001	BH1 0.5-0.8 SOIL 18/3/2014 SE125987.002	BH1 1.5-1.8 SOIL 18/3/2014 SE125987.003	BH1 2.5-2.8 SOIL 18/3/2014 SE125987.004	BH1 3.5-3.8 SOIL 18/3/2014 SE125987.005	BH4 0-0.3 SOIL 18/3/2014 SE125987.006
% Moisture	%w/w	1.0	10.2	17.1	14.7	19.5	19.9	15.4

PARAMETER	UOM	LOR	BH18 0.5-0.8 SOIL 18/3/2014 SE125987.007	BH18 2.5-2.8 SOIL 18/3/2014 SE125987.008	BH21 1.0-1.3 SOIL 18/3/2014 SE125987.009	BH21 2.0-2.3 SOIL 18/3/2014 SE125987.010	BH21 3.0-3.3 SOIL 18/3/2014 SE125987.011
% Moisture	%w/w	1.0	11.8	13.4	13.5	14.7	8.9

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN104	pHF is determined on an extract of approximately 2g of as received sample in approximately 10 mL of deionised water with pH determined after standing 30 minutes.

FOOTNOTES

*	Analysis not covered by the scope of accreditation.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
^	Performed by outside laboratory.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au.pv.sgsv3/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

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STATEMENT OF QA/QC PERFORMANCE

SE125987 R0

CLIENT DETAILS

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Client	Geotechnique
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Project	**13138-2 15 Close Street Canterbury**
Order Number	(Not specified)
Samples	11

LABORATORY DETAILS

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Laboratory	SGS Alexandria Environmental
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SGS Reference	SE125987 R0
Report Number	0000079088
Date Reported	31 Mar 2014

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

Sample counts by matrix	11 Soils	Type of documentation received	COC
Date documentation received	20/3/14@3:30pm	Samples received in good order	Yes
Samples received without headspace	N/A	Sample temperature upon receipt	4.0°C
Sample container provider	Client	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes		

HOLDING TIME SUMMARY

SE125987 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Field pH for Acid Sulphate Soil — Method: ME-(AU)-[ENV]AN104

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1 0.05-0.2	SE125987.001	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH1 0.5-0.8	SE125987.002	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH1 1.5-1.8	SE125987.003	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH1 2.5-2.8	SE125987.004	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH1 3.5-3.8	SE125987.005	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH4 0-0.3	SE125987.006	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH18 0.5-0.8	SE125987.007	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH18 2.5-2.8	SE125987.008	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH21 1.0-1.3	SE125987.009	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH21 2.0-2.3	SE125987.010	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014
BH21 3.0-3.3	SE125987.011	LB055020	18 Mar 2014	20 Mar 2014	15 Apr 2014	31 Mar 2014	15 Apr 2014	31 Mar 2014

Moisture Content — Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1 0.05-0.2	SE125987.001	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH1 0.5-0.8	SE125987.002	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH1 1.5-1.8	SE125987.003	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH1 2.5-2.8	SE125987.004	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH1 3.5-3.8	SE125987.005	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH4 0-0.3	SE125987.006	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH18 0.5-0.8	SE125987.007	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH18 2.5-2.8	SE125987.008	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH21 1.0-1.3	SE125987.009	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH21 2.0-2.3	SE125987.010	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014
BH21 3.0-3.3	SE125987.011	LB054757	18 Mar 2014	20 Mar 2014	01 Apr 2014	25 Mar 2014	30 Mar 2014	26 Mar 2014

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

No method blanks were required for this job.

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Field pH for Acid Sulphate Soil — **Method: ME-(AU)-[ENV]AN104**

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE125987.010	LB055020.013	pHf	pH Units	-	6.9	6.891	30	0
		pHfox	pH Units	-	4.8	4.793	30	1
SE126098.001	LB055020.016	pHf	pH Units	-	7.7	7.6	30	1
		pHfox	pH Units	-	6.9	6.9	30	0

LABORATORY CONTROL SAMPLES

SE125987 R0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Sample Number	Parameter	Units	LOR

MATRIX SPIKES

SE125987 R0

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub -sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

*	Non-accredited analysis.
-	Sample not analysed for this analyte.
^	Analysis performed by external laboratory.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	
†	Refer to Analytical Report comments for further information.

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ANALYTICAL REPORT

WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS		LABORATORY DETAILS	
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Project	**13138-2 15 Close St Canterbury**	SGS Reference	**CE108992 R0**
Order Number	**SE125987**	Report Number	0000016039
Samples	11	Date Reported	28 Mar 2014
		Date Received	24 Mar 2014

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

SIGNATORIES

Anthony Nilsson
Operations Manager

Nathan Quinn
Micro Supervisor / Quality Co-ordinator

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE108992.001 Soil 18 Mar 2014 BH1 0.05-0.2	CE108992.002 Soil 18 Mar 2014 BH1 0.5-0.8	CE108992.003 Soil 18 Mar 2014 BH1 1.5-1.8	CE108992.004 Soil 18 Mar 2014 BH1 2.5-2.8
Moisture Content Method: AN002							
% Moisture	%	0.5		**6.3**	**20**	**14**	**19**
TAA (Titratable Actual Acidity) Method: AN219							
pH KCl	pH Units	-		**8.8**	**6.7**	**5.0**	**4.5**
Titratable Actual Acidity	kg H2SO4/T	0.25		<0.25	<0.25	**0.86**	**2.2**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5		<5	<5	**17**	**45**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01		<0.01	<0.01	**0.03**	**0.07**
Sulphur (SKCl)	%w/w	0.005		**0.012**	**0.025**	**0.011**	**0.012**
Calcium (CaKCl)	%w/w	0.005		**0.32**	**0.28**	**0.056**	**0.11**
Magnesium (MgKCl)	%w/w	0.005		**0.051**	**0.034**	**0.007**	**0.026**
TPA (Titratable Peroxide Acidity) Method: AN218							
Peroxide pH (pH Ox)	pH Units	-		**8.7**	**6.3**	**3.6**	**4.8**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25		<0.25	<0.25	**0.86**	**2.2**
TPA as moles H+/tonne	moles H+/T	5		<5	<5	**17**	**45**
TPA as S % W/W	%w/w S	0.01		<0.01	<0.01	**0.03**	**0.07**
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5		<5	<5	<5	<5
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25		<0.25	<0.25	<0.25	<0.25
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01		<0.01	<0.01	<0.01	<0.01
ANCE as % $CaCO_3$	% CaCO3	0.01		**0.55**	<0.01	<0.01	<0.01
ANCE as moles H+/tonne	moles H+/T	5		**110**	<5	<5	<5
ANCE as S % W/W	%w/w S	0.01		**0.18**	<0.01	<0.01	<0.01
Peroxide Oxidisable Sulphur (Spos)	%w/w	0.005		**0.029**	**0.094**	**0.13**	**0.017**
Peroxide Oxidisable Sulphur as moles H+/tonne	moles H+/T	5		**18**	**58**	**80**	**11**
Sulphur (Sp)	%w/w	0.005		**0.041**	**0.12**	**0.14**	**0.029**
Calcium (Cap)	%w/w	0.005		**0.58**	**0.33**	**0.059**	**0.12**
Reacted Calcium (CaA)	%w/w	0.005		**0.26**	**0.047**	<0.005	**0.008**
Reacted Calcium (CaA)	moles H+/T	5		**130**	**24**	<5	<5
Magnesium (Mgp)	%w/w	0.005		**0.053**	**0.042**	**0.010**	**0.030**
Reacted Magnesium (MgA)	%w/w	0.005		<0.005	**0.008**	<0.005	<0.005
Reacted Magnesium (MgA)	moles H+/T	5		<5	**7**	<5	<5
Net Acid Soluble Sulphur as % w/w	%w/w	0.005		-	-	-	-
Net Acid Soluble Sulphur as moles H+/tonne	moles H+/T	5		-	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE108992.001 Soil 18 Mar 2014 BH1 0.05-0.2	CE108992.002 Soil 18 Mar 2014 BH1 0.5-0.8	CE108992.003 Soil 18 Mar 2014 BH1 1.5-1.8	CE108992.004 Soil 18 Mar 2014 BH1 2.5-2.8
SPOCAS Net Acidity Calculations Method: AN220							
s-Net Acidity	%w/w S	0.01		<0.01	**0.03**	**0.09**	**0.13**
a-Net Acidity	moles H+/T	5		<5	**19**	**56**	**78**
Liming Rate	kg CaCO3/T	0.1		<0.1	**1.5**	**4.2**	**5.9**
Verification s-Net Acidity	%w/w S	-20		NA	**0.03**	**0.06**	NA
a-Net Acidity without ANCE	moles H+/T	5		**18**	**58**	**97**	**56**
Liming Rate without ANCE	kg CaCO3/T	0.1		**1.4**	**4.4**	**7.3**	**4.2**
Chromium Reducible Sulphur (CRS) Method: AN217							
Chromium Reducible Sulphur (Scr)	%	0.005		**0.017**	**0.020**	**0.094**	**0.010**
Chromium Reducible Sulphur (Scr)	moles H+/T	5		**11**	**12**	**59**	**6**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE108992.005 Soil 18 Mar 2014 BH1 3.5-3.8	CE108992.006 Soil 18 Mar 2014 BH4 0-0.3	CE108992.007 Soil 18 Mar 2014 BH18 0.5-0.8	CE108992.008 Soil 18 Mar 2014 BH18 2.5-2.8
Moisture Content Method: AN002						
% Moisture	%	0.5	**19**	**11**	**12**	**14**
TAA (Titratable Actual Acidity) Method: AN219						
pH KCl	pH Units	-	**4.5**	**8.3**	**5.5**	**5.3**
Titratable Actual Acidity	kg H2SO4/T	0.25	**2.3**	<0.25	**0.37**	**0.61**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	**47**	<5	**7**	**12**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	**0.08**	<0.01	**0.01**	**0.02**
Sulphur (SKCl)	%w/w	0.005	**0.011**	**0.008**	<0.005	**0.009**
Calcium (CaKCl)	%w/w	0.005	**0.094**	**0.41**	**0.11**	**0.11**
Magnesium (MgKCl)	%w/w	0.005	**0.023**	**0.043**	<0.005	**0.007**
TPA (Titratable Peroxide Acidity) Method: AN218						
Peroxide pH (pH Ox)	pH Units	-	**4.9**	**8.5**	**4.8**	**5.2**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25	**2.3**	<0.25	**0.37**	**0.61**
TPA as moles H+/tonne	moles H+/T	5	**47**	<5	**7**	**12**
TPA as S % W/W	%w/w S	0.01	**0.08**	<0.01	**0.01**	**0.02**
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5	<5	<5	<5	<5
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25	<0.25	<0.25	<0.25	<0.25
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01	<0.01	<0.01	<0.01	<0.01
ANCE as % $CaCO_3$	% CaCO3	0.01	<0.01	**0.60**	<0.01	<0.01
ANCE as moles H+/tonne	moles H+/T	5	<5	**120**	<5	<5
ANCE as S % W/W	%w/w S	0.01	<0.01	**0.19**	<0.01	<0.01
Peroxide Oxidisable Sulphur (Spos)	%w/w	0.005	**0.016**	**0.029**	**0.008**	**0.008**
Peroxide Oxidisable Sulphur as moles H+/tonne	moles H+/T	5	**10**	**18**	<5	**5**
Sulphur (Sp)	%w/w	0.005	**0.027**	**0.037**	**0.011**	**0.017**
Calcium (Cap)	%w/w	0.005	**0.12**	**0.61**	**0.12**	**0.14**
Reacted Calcium (CaA)	%w/w	0.005	**0.026**	**0.20**	**0.007**	**0.026**
Reacted Calcium (CaA)	moles H+/T	5	**13**	**100**	<5	**13**
Magnesium (Mgp)	%w/w	0.005	**0.032**	**0.086**	**0.008**	**0.013**
Reacted Magnesium (MgA)	%w/w	0.005	**0.009**	**0.042**	<0.005	**0.006**
Reacted Magnesium (MgA)	moles H+/T	5	**7**	**35**	<5	<5
Net Acid Soluble Sulphur as % w/w	%w/w	0.005	-	-	-	-
Net Acid Soluble Sulphur as moles H+/tonne	moles H+/T	5	-	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE108992.005 Soil 18 Mar 2014 BH1 3.5-3.8	CE108992.006 Soil 18 Mar 2014 BH4 0-0.3	CE108992.007 Soil 18 Mar 2014 BH18 0.5-0.8	CE108992.008 Soil 18 Mar 2014 BH18 2.5-2.8
SPOCAS Net Acidity Calculations Method: AN220							
s-Net Acidity	%w/w S	0.01		**0.13**	<0.01	**0.02**	**0.04**
a-Net Acidity	moles H+/T	5		**82**	<5	**14**	**22**
Liming Rate	kg CaCO3/T	0.1		**6.2**	<0.1	NA	**1.7**
Verification s-Net Acidity	%w/w S	-20		NA	NA	NA	NA
a-Net Acidity without ANCE	moles H+/T	5		**57**	**18**	**12**	**18**
Liming Rate without ANCE	kg CaCO3/T	0.1		**4.3**	**1.4**	NA	NA
Chromium Reducible Sulphur (CRS) Method: AN217							
Chromium Reducible Sulphur (Scr)	%	0.005		**0.006**	**0.010**	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5		<5	**6**	<5	<5

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE108992.009 Soil 18 Mar 2014 BH21 1.0-1.3	CE108992.010 Soil 18 Mar 2014 BH21 2.0-2.3	CE108992.011 Soil 18 Mar 2014 BH21 3.0-3.3
Moisture Content Method: AN002						
% Moisture	%	0.5		**19**	**6.5**	**10**
TAA (Titratable Actual Acidity) Method: AN219						
pH KCl	pH Units	-		**4.5**	**7.7**	**8.7**
Titratable Actual Acidity	kg H2SO4/T	0.25		**2.9**	<0.25	<0.25
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5		**60**	<5	<5
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01		**0.10**	<0.01	<0.01
Sulphur (SKCl)	%w/w	0.005		**0.016**	**0.012**	**0.014**
Calcium (CaKCl)	%w/w	0.005		**0.11**	**0.23**	**0.34**
Magnesium (MgKCl)	%w/w	0.005		**0.051**	**0.024**	**0.016**
TPA (Titratable Peroxide Acidity) Method: AN218						
Peroxide pH (pH Ox)	pH Units	-		**4.2**	**7.7**	**8.0**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25		**2.9**	<0.25	<0.25
TPA as moles H+/tonne	moles H+/T	5		**60**	<5	<5
TPA as S % W/W	%w/w S	0.01		**0.10**	<0.01	<0.01
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5		<5	<5	<5
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25		<0.25	<0.25	<0.25
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01		<0.01	<0.01	<0.01
ANCE as % $CaCO_3$	% CaCO3	0.01		<0.01	**0.45**	**0.70**
ANCE as moles H+/tonne	moles H+/T	5		<5	**90**	**140**
ANCE as S % W/W	%w/w S	0.01		<0.01	**0.14**	**0.22**
Peroxide Oxidisable Sulphur (Spos)	%w/w	0.005		**0.008**	**0.032**	**0.010**
Peroxide Oxidisable Sulphur as moles H+/tonne	moles H+/T	5		<5	**20**	**6**
Sulphur (Sp)	%w/w	0.005		**0.024**	**0.044**	**0.024**
Calcium (Cap)	%w/w	0.005		**0.10**	**0.37**	**0.58**
Reacted Calcium (CaA)	%w/w	0.005		<0.005	**0.14**	**0.24**
Reacted Calcium (CaA)	moles H+/T	5		<5	**72**	**120**
Magnesium (Mgp)	%w/w	0.005		**0.055**	**0.039**	**0.029**
Reacted Magnesium (MgA)	%w/w	0.005		<0.005	**0.016**	**0.013**
Reacted Magnesium (MgA)	moles H+/T	5		<5	**13**	**11**
Net Acid Soluble Sulphur as % w/w	%w/w	0.005		-	-	-
Net Acid Soluble Sulphur as moles H+/tonne	moles H+/T	5		-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE108992.009 Soil 18 Mar 2014 BH21 1.0-1.3	CE108992.010 Soil 18 Mar 2014 BH21 2.0-2.3	CE108992.011 Soil 18 Mar 2014 BH21 3.0-3.3
SPOCAS Net Acidity Calculations Method: AN220					
s-Net Acidity	%w/w S	0.01	**0.16**	<0.01	<0.01
a-Net Acidity	moles H+/T	5	**100**	<5	<5
Liming Rate	kg CaCO3/T	0.1	**7.6**	<0.1	<0.1
Verification s-Net Acidity	%w/w S	-20	NA	**-0.09**	NA
a-Net Acidity without ANCE	moles H+/T	5	**65**	**20**	**6**
Liming Rate without ANCE	kg CaCO3/T	0.1	**4.9**	**1.5**	NA
Chromium Reducible Sulphur (CRS) Method: AN217					
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	**0.010**	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	**6**	<5

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

No QC samples were reported for this job.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN004	Soils, sediments and sludges are pulverised using an LM2 ringmill. The dry sample is pulverised to a particle size of >90% passing through a -75µm sieve.
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulphide (H2S) which is collected and titrated with iodine (I2(aq)) to measure SCR.
AN218	Soil samples are subjected to extreme oxidising conditions using hydrogen peroxide. Continuous application of heat and peroxide ensure all sulphide is converted to sulphuric acid. Excess peroxide is broken down by a copper catalyst prior to titration for acidity. Calcium, magnesium, and sulphur are determined by ICP-OES. Also included is a carbonate modification step which, depending on pH after the initial oxidation, gives a measure of ANC.
AN219	Dried pulped sample is extracted for 4 hours in a 1 M KCl solution. The ratio of sample to solution is 1:40. The extract is titrated for acidity. Calcium, magnesium, and sulphur are determined by ICP-AES.
AN220	SPOCAS Suite: Scheme for the calculation of net acidities and liming rates using a Fineness Factor of 1.5.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
^	Performed by outside laboratory.	-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au.pv.sgsv3/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions/General-Conditions-of-Services-English.aspx . The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

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COC received 20/3/14 @ 3:30pm

RECEIVED
20 MAR 2014

SB125987

GEOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

P O Box 880
PENRITH NSW 2751

Tel: (02) 4722 2700
Fax: (02) 4722 6161

TO: SGS ENVIRONMENTAL SERVICES
UNIT 16
33 MADDOX STREET
ALEXANDRIA NSW 2015

PH: 02 8594 0400 **FAX:** 02 8594 0499

ATTN: MS EMILY YIN

Sampling By: LY **Job No:** 13138/2

Project:

Project Manager: DS **Location:** 15 Close Street, Canterbury

Results required by: Normal Turnaround Time

	Location	Depth (m)	Date	Time	Sample type: Soil	Sample type: Water	SPOCAS Suite	SCR	pHF							KEEP SAMPLE
1	BH1	0.05-0.2	18/03/2014		SP		✓	✓	✓							YES
2	BH1	0.5-0.8	18/03/2014		SP		✓	✓	✓							YES
	BH1	1.0-1.3	18/03/2014		SP											YES
3	BH1	1.5-1.8	18/03/2014		SP		✓	✓	✓							YES
	BH1	2.0-2.3	18/03/2014		SP											YES
4	BH1	2.5-2.8	18/03/2014		SP		✓	✓	✓							YES
	BH1	3.0-3.3	18/03/2014		SP											YES
5	BH1	3.5-3.8	18/03/2014		SP		✓	✓	✓							YES
6	BH4	0-0.3	18/03/2014		SP		✓	✓	✓							YES
	BH4	0.5-0.8	18/03/2014		SP											YES
7	BH18	0.5-0.8	18/03/2014		SP		✓	✓	✓							YES
	BH18	1.5-1.8	18/03/2014		SP											YES

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
DANDA P SAPKOTA		20/03/2014			20/03/14 @ 1:45

Legend:

WG	Water sample, glass bottle	SG	Soil sample (glass jar)	SP	Soil sample (plastic bag)	✓	Test required
WP	Water sample, plastic bottle	SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulphate			SCR	:Chromium Reducible Sulphur

GEOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

P O Box 880
PENRITH NSW 2751

Tel: (02) 4722 2700
Fax: (02) 4722 6161

TO: SGS ENVIRONMENTAL SERVICES
UNIT 16
33 MADDOX STREET
ALEXANDRIA NSW 2015

PH: 02 8594 0400 **FAX:** 02 8594 0499

ATTN: MS EMILY YIN

Sampling By: LY **Job No:** 13138/2

Project:

Project Manager: DS **Location:** 15 Close Street, Canterbury

Results required by: Normal Turnaround Time

	Location	Depth (m)	Date	Time	Sample type: Soil	Sample type: Water	SPOCAS Suite	SCR	pHF							KEEP SAMPLE
8	BH18	2.5-2.8	18/03/2014		SP		✓	✓	✓							YES
9	BH21	1.0-1.3	18/03/2014		SP		✓	✓	✓							YES
10	BH21	2.0-2.3	18/03/2014		SP		✓	✓	✓							YES
11	BH21	3.0-3.3	18/03/2014		SP		✓	✓	✓							YES

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
DANDA P SAPKOTA		20/03/2014			26/03/14 @ 1:40

Legend:

WG	Water sample, glass bottle	SG	Soil sample (glass jar)	SP	Soil sample (plastic bag)
WP	Water sample, plastic bottle	SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulphate	✓	Test required
				SCR	:Chromium Reducible Sulphur

SAMPLE RECEIPT ADVICE

SE125987

CLIENT DETAILS

Contact	Danda Sapkota
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	danda.sapkota@geotech.com.au
Project	**13138-2 15 Close Street Canterbury**
Order Number	(Not specified)
Samples	11

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Thu 20/3/2014
Report Due	Mon 31/3/2014
SGS Reference	**SE125987**

SUBMISSION DETAILS

This is to confirm that 11 samples were received on Thursday 20/3/2014. Results are expected to be ready by Monday 31/3/2014. Please quote SGS reference SE125987 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	11 Soils	Type of documentation received	COC
Date documentation received	20/3/14@3:30pm	Samples received in good order	Yes
Samples received without headspace	N/A	Sample temperature upon receipt	4.0°C
Sample container provider	Client	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes		

Samples will be held for one month for water samples and two months for soil samples from date of report, unless otherwise instructed.

COMMENTS

SPOCAS and SCR subcontracted to SGS Cairns, 2/58 Comport St, Portsmith QLD 4870, NATA Accreditation Number: 2562, Site Number: 3146.
5x samples have been placed on hold as no tests have been assigned for them by the client. These samples will not be processed.

To the extent not inconsistent with the other provisions of this document and unless specifically agreed otherwise in writing by SGS, all SGS services are rendered in accordance with the applicable SGS General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions/General-Conditions-of-Services-English.aspx as at the date of this document.
Attention is drawn to the limitations of liability and to the clauses of indemnification.

SAMPLE RECEIPT ADVICE

SE125987

CLIENT DETAILS

Client Geotechnique

Project 13138-2 15 Close Street Canterbury

SUMMARY OF ANALYSIS

No.	Sample ID	Acid Neutralising Capacity (ANC)	Chromium Reducible Sulphur (CRS)	Chromium Suite Net Acidity Calculations	Field pH for Acid Sulphate Soil	HCl Extractable S, Ca and Mg in Soil ICP OES	Moisture Content	SPOCAS Net Acidity Calculations	TAA (Titratable Actual Acidity)	TPA (Titratable Peroxide Acidity)
001	BH1 0.05-0.2	6	3	6	4	3	1	6	7	21
002	BH1 0.5-0.8	6	3	6	4	3	1	6	7	21
003	BH1 1.5-1.8	6	3	6	4	3	1	6	7	21
004	BH1 2.5-2.8	6	3	6	4	3	1	6	7	21
005	BH1 3.5-3.8	6	3	6	4	3	1	6	7	21
006	BH4 0-0.3	6	3	6	4	3	1	6	7	21
007	BH18 0.5-0.8	6	3	6	4	3	1	6	7	21
008	BH18 2.5-2.8	6	3	6	4	3	1	6	7	21
009	BH21 1.0-1.3	6	3	6	4	3	1	6	7	21
010	BH21 2.0-2.3	6	3	6	4	3	1	6	7	21
011	BH21 3.0-3.3	6	3	6	4	3	1	6	7	21

The above table represents SGS Environmental Services' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details.
Testing as per this table shall commence immediately unless the client intervenes with a correction.