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Job No: 13188/1
Our Ref: 13188/1-AA
12 September 2014

Nix Anderson Pty Ltd
17 Chuter Street
MCMAHONS POINT NSW 2060
Email: robert.mcguinness@nxa.com.au

Attention: Mr R McGuinness

Dear Sir

re: **Proposed Redevelopment**
160 Burwood Road, Concord
Preliminary Geotechnical Investigation

This report provides results of a preliminary geotechnical investigation at the above site. The investigation was commissioned by Mr R McGuinness of Nix Anderson through a subcontract agreement and was carried out in general accordance with Geotechnique Pty Ltd proposal Q6614 dated 2 May 2014.

We understand that Nix Anderson has been retained by Propertylink to assist in carrying out feasibility review of the above site to assess the development potential on behalf of the site owners – Freshfood Australia Holdings Pty Ltd. It is also understood that the existing Robert Timms Factory (Bushell's) will be relocated prior to development and the site will be developed as an Urban Regeneration Project – an integrated Residential Community.

A geotechnical investigation was required to assess existing surface and subsurface conditions and develop geotechnical recommendations for feasibility review of the proposed redevelopment.

Regional Geology and Landscape

Reference to the Geological Map of Sydney indicates that the bedrock at the site is likely to be Hawkesbury Sandstone, comprising medium grained quartz sandstone.

Reference to the Soil Landscape Map of Sydney indicates that the landscape at the site belongs to the Gymea Group, which is characterised by undulating to rolling rises and low hills on Hawkesbury Sandstone. However, the site is likely to have been filled in the past to raise levels for development. The acid sulfate soil map indicates high probability of Acid Sulfate soils within nearby areas of the existing site.

Scope of Work

Field work for the investigation was carried out between 7th and 11th August 2014 and comprised of the following:

- Review services plans obtained from "Dial Before You Dig" to assess existing services across the site.
- Conduct an OH&S and walkover survey to assess existing site conditions.
- Scan proposed borehole locations for underground services. We engaged a specialist services locator for this purpose.
- Drill ten (10) boreholes (BH1 to BH10) to depths of 10m, using a using a truck mounted drilling rig fully equipped for geotechnical investigation. Boreholes were drilled at the locations specified at the site by Propertylink. All boreholes were initially drilled to V-Bit or TC-Bit refusal in bedrock and then continued using rock coring. Approximate borehole locations are shown on the attached Drawing 13188/1-AA1. Engineering logs detailing subsurface profiles encountered in boreholes and core photographs are also attached.
- Conduct Standard Penetration Testing (SPT) at regular depth intervals in the boreholes to assess strength characteristics of overburden soils.
- Recovery of representative soil and rock samples for visual assessment and laboratory testing (point load index on rock cores, acid sulfate and contamination testing on soil samples).
- Measure depths to groundwater/seepage level in boreholes, where encountered.

Field work was supervised by a Geotechnical Engineer, responsible for sampling and preparation of borehole logs.

Surface and Sub-surface Conditions

The following observations were made during the field work:

- The site is occupied by the multistorey Robert Timms Factory (Bushell's), administration building and guard room etc. Open areas of the site are covered with asphalt/bitumen seal, grass and scattered trees.
- The site is bound to the south by Burwood Rd, to the north by a Golf Course, to the east by residential building and Exile Bay and to the west by residential buildings and Duke Avenue.
- The topography of the site gently slopes towards the north east direction towards Exile Bay at about 3 to 5 degrees.

Sub-surface conditions encountered in the boreholes are detailed in the attached engineering logs and summarised below in Table 1.

Table 1 – Subsurface Conditions

BH	Top RL (m AHD)*	Termination Depth (m)	Topsoil (m)	Concrete / Asphalt (m)	Fill (m)	Natural (m)	Bedrock (m)
1	5.5	10.3	NE	0.0 – 0.02	0.02 – 3.1	3.1 – 3.3	3.3 –> 10.3
2	5.4	10.5	0.0 – 0.15	NE	0.15 – 5.0	5.0 – 9.6	9.6 –> 10.5
3	5.4	10.0	0.0 – 0.2	NE	0.2 – 2.5	2.5 – 3.0	3.0 –> 10.0

BH	Top RL (m AHD)*	Termination Depth (m)	Topsoil (m)	Concrete / Asphalt (m)	Fill (m)	Natural (m)	Bedrock (m)
4	5.8	10.4	0.0 – 0.2	NE	0.2 – 0.7	0.7 – 1.0	1.0 –> 10.4
5	6.7	10.1	0.0 – 0.1	NE	0.1 – 0.4	0.4 – 1.1	1.1 –> 10.1
6	6.3	10.0	NE	0.0 – 0.2	0.2 – 0.5	0.5 – 1.0	1.0 –> 10.0
7	5.6	10.8	NE	0.0 – 0.02	0.02 – 2.5	2.5 – 3.0	3.0 –> 10.8
8	5.7	9.7	NE	0.0 – 0.2	0.2 – 0.4	0.4 – 1.0	1.0 –> 9.7
9	7.1	9.3	NE	0.0 – 0.2	0.2 – 2.5	2.5 – 3.8	3.8 –> 9.3
10	5.9	10.2	NE	0.0 – 0.2	0.2 – 0.5	0.5 – 1.5	1.5 –> 10.2

** Approximate*

Table 1 indicates that the sub-surface profile across the site comprises a sequence of topsoil/concrete/asphalt overlying, fill overlying, natural soils overlying, bedrock. The fill was found to extend to depths ranging from 0.4m to 5m. Deeper fill was generally found in the north and north eastern portions (BH1, 2, 3, 7 and 9) of the site. The depth to bedrock across the site ranged from about 1m to 3.8m below existing ground surface. However, BH2 bedrock was found at about 9.6m depth.

Fill was classified as silty/sandy clay, medium to high plasticity. Sandstone floaters were also encountered within the fill. The fill was generally found to be well compacted. Natural soils were predominantly medium to high plasticity silty clay and silty sand with some gravel. Bedrock was consisted of sandstone, distinctly weathered to fresh and medium to high strength.

Groundwater/seepage was encountered at depths of about 3m, 5m and 2.5m in BH1, BH5 and BH9 respectively. The use of water for coring in other boreholes precluded measurement of groundwater level at the completion of drilling. It should however be noted that fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors.

Acid Sulfate Soil Material

Laboratory tests were carried out to confirm the presence or otherwise of acid sulfate soils. Laboratory investigation consisted of testing representative soil samples to determine **pH_{KCl}, pH_{ox}, TPA** (Total Peroxide Acidity), **TAA** (Titratable Actual 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 & Sulfate)/Chromium Reducible Sulphur (SCR) methods recommended by the Queensland Department of Natural Resources, Mines and Energy (Qld NRM&E) (Reference 1). The test results are attached and summary is presented below in Table 2.

Table 2 – Acid Sulfate Tests Results

BH	Depth (m)	pH_{KCl} Unit	Material Description	pH_{ox} Unit	TPA mole H^+/t	TAA mole H+/t	S_{POS} % w/w	S_{SCR} % w/w
2	1.5-1.95	4.2	Sand	4.3	**56**	**60**	0.010	<0.005
3	3.0-3.2	6.6	Sandstone	5.2	<5	<5	**0.052**	**0.038**
6	0.5-0.75	5.5	Clay	6.2	<5	12	0.006	<0.005
7	3.0-3.4	5.4	Sandstone	4.7	**89**	27	**0.076**	**0.034**

BH	Depth (m)	pH_{KCl} Unit	Material Description	pH_{ox} Unit	TPA mole H^+/t	TAA mole H+/t	S_{POS} % w/w	S_{SCR} % w/w
10	1.5-1.65	4.4	Sandstone	4.9	**55**	**54**	0.008	<0.005
Action Criteria adopted #					18	18	0.03	0.03

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)*
S_{POS}: *Peroxide Oxidisable Sulphur (% w/w)*
S_{SCR}: *Chromium Reducible Sulphur (% w/w)*
#: *Action Criteria adopted (Reference 2)*

Based on the consideration that the soil to be disturbed would be more than 1000 tonnes and of fine texture (sand/clay), the laboratory test results in the above table indicate the following:

- For soil sample in BH6 (0.5m-0.75m), the TAA and TPA values were below the adopted "Action Criteria" of 18mol H+/tonne. The test results for oxidisable Sulphur SPos and SSCR were also below the adopted "Action Criteria" of 0.03%. The soils at this depth are unlikely to be actual acid sulfate soil or potential acid sulfate soil. Based on the test results, no acid sulfate management plan is required for disturbance of soil at this depth.
- For soil samples in BH2 (1.5m-1.95m) and BH10(1.5m-1.65m), the TAA and TPA values exceeded the adopted "Action Criteria" of 18 mol H+/tonne. The test results for oxidisable Sulphur (SPOs and SSCR) were below the "Action Criteria" of 0.03%. The low peroxide oxidisable sulphur (Spos/SCR) test result indicated that the presence of pyritic sulphur (i.e. inorganic sulphur) is unlikely. The relatively higher values for TAA and TPA indicate that soils to be disturbed at this depth are acidic soil not acid sulfate soil. Based on these test results, it is considered that the soils in the samples analysed are unlikely to be acid sulfate soil (ASS) but are acidic soils (i.e. non-sulfuric and non-sulphidic) which are unlikely to produce significant amount of acid after being exposed to air due to disturbance or oxidation. The local environment is adapted to these soils in undisturbed condition. However, excavation and placement of these soils in conditions with increased rate of soil drainage could contribute for the release of acidic leachates and management of these acidic soils is required, if disturbed. The treatment of acidic soils (non-acid sulfate soils) should be carried out in accordance with processes described in NSW Acid Sulfate Soil Manual 1998 for acid sulfate management plan. The treatment method will include neutralising soils to prevent generation of acidic leachates.
- For soil sample in BH3 (3.0m-3.2m), TAA and TPA were below the adopted "Action Criteria", however the oxidisable sulphur (Spos/SCR) values exceeded the adopted "Action Criteria of 0.03%. For soil sample in BH7 (3.0m-3.4m), TAA was below the action criteria, however TPA and the oxidisable sulphur (Spos/SCR) values exceeded the adopted "Action Criteria". The soils at this depth are considered to potential acid sulfate, and likely to produce acid if disturbed. Acid sulfate soil management plan would be required, if the soils are to be disturbed.

Point Load Strength Index

Rock cores obtained from the boreholes were photographed and tested at regular depth intervals for determination of Point Load Strength Index (I_{s50}). The point load strength indices for the rock cores and the assessed rock strengths, in accordance with Australian Standard AS1726-1993 (Reference 3) are summarised in the following Table 3.

Table 3 – Point Load Strength Index Test Results

BH	Depth (m)	Diametral $I_{s(50)}$ (MPa)	Axial $I_{s(50)}$ (MPa)	Diametral Assessed Strength	Axial Assessed Strength
1	5.90	1.45	1.86	High	High
	6.70	1.39	1.59	High	High
	7.60	1.20	1.41	High	High
	8.80	1.69	2.01	High	High
	9.20	3.82	3.73	Very High	Very High
3	4.80	0.10	0.50	Low	Medium
	5.60	2.03	2.86	High	High
	6.80	2.43	2.53	High	High
	7.50	1.29	1.14	High	High
	8.60	2.79	3.64	High	Very High
	9.50	3.00	3.62	Very High	Very High
4	3.20	1.25	1.75	High	High
	4.80	1.55	2.83	High	High
	5.60	3.33	4.48	Very High	Very High
	6.40	1.24	2.07	High	High
	7.20	3.22	5.34	Very High	Very High
	8.80	2.81	2.80	High	High
	9.30	3.00	2.50	Very High	High
5	2.00	2.24	1.95	High	High
	3.60	2.31	2.37	High	High
	4.70	1.71	3.28	High	Very High
	5.60	4.42	1.70	Very High	High
	6.60	3.37	3.42	Very High	Very High
	7.70	2.00	3.92	High	Very High
	8.90	2.69	2.00	High	High
	9.90	2.43	2.79	High	High
6	1.40	1.64	1.43	High	High
	2.20	2.27	2.98	High	High
	3.40	1.90	2.10	High	High
	4.40	1.15	2.00	High	High
	5.70	0.75	1.15	Medium	High
	6.40	0.65	1.61	Medium	High
	7.90	2.58	3.56	High	Very High
	8.90	1.84	4.01	High	Very High
7	4.10	2.24	2.19	High	High
	5.50	2.31	0.77	High	Medium
	6.80	1.71	1.46	High	High
	7.70	4.42	3.62	Very High	Very High
	8.50	3.37	3.91	Very High	Very High
	9.40	2.00	1.98	High	High

BH	Depth (m)	Diametral $I_{s(50)}$ (MPa)	Axial $I_{s(50)}$ (MPa)	Diametral Assessed Strength	Axial Assessed Strength
8	1.70	2.30	2.54	High	High
	2.55	1.63	2.83	High	High
	3.60	3.27	3.26	Very High	Very High
	4.60	2.55	3.95	High	Very High
	5.80	0.75	2.50	Medium	High
	6.90	0.94	2.51	Medium	High
	7.80	1.60	2.27	High	High
	8.70	1.10	1.07	High	High
	9.30	2.40	3.06	High	Very High
9	4.70	2.10	2.05	High	High
	5.10	2.50	3.99	High	Very High
	6.10	2.86	3.34	High	Very High
	7.80	3.11	2.17	Very High	High
	8.40	2.30	2.30	High	High
10	2.50	5.65	4.65	Very High	Very High
	3.20	0.38	1.73	Medium	High
	4.46	3.68	5.05	Very High	Very High
	5.45	1.70	1.78	High	High
	6.37	6.45	2.80	Very High	High
	7.32	3.20	2.71	Very High	High
	8.35	4.45	4.15	Very High	Very High
	9.40	4.32	4.75	Very High	Very High
	10.07	1.68	3.87	High	Very High

The point load strength index tests results generally indicate that the rock is high to very high in strength. However, it should be noted that the tests could only be carried out on intact (stronger) portions of the rock cores. Therefore, strength assessments presented in Table 3 indicate the upper limits of rock strengths.

DISCUSSION AND RECOMMENDATIONS

Excavation Conditions

No information regarding cut and fill for the proposed development was available. It is our assessment that excavation of soils (including topsoil, fill and natural soils) and extremely weathered and very low strength sandstone can be achieved using conventional earthmoving equipment such as excavators and dozers. However, excavation in distinctly weathered and medium to high strength sandstone bedrock would be considerably difficult and may require larger equipment (such as a rock saw, Caterpillar D9 or equivalent). Although selection of rock cutting equipment is based on site access, desired smoothness of the excavated rock surface and acceptable ground vibration during rock excavation, we recommend the use of a rock saw for excavation into sandstone bedrock on the site boundaries, in order to minimise ground vibration.

Groundwater/seepage was encountered at depths of about 3m, 5m and 2.5m in BH1, 5 and 9, respectively. The use of water for coring precluded further groundwater measurements in other boreholes. Depending on time of construction groundwater might be at below or above this depth. If excavation extends below the groundwater level (most likely to be at RL 0) extensive dewatering may be required. We recommend that further groundwater monitoring be carried out if it is planned to excavate 3m depth. Installation of piezometers might be required to monitor long term groundwater conditions. Although minor groundwater inflow could be managed by a conventional sump and pump method, we do suggest that a specialist dewatering contractor be contacted if significant groundwater inflow is encountered during basement excavation. It should also be noted that trafficability problems could arise locally during wet weather or if water is allowed to pond at the site.

Fill Placement

We consider that the proposed development works would require only minor fill placement, if any. The following procedures are recommended for placement of controlled fill, where required.

- Strip existing topsoil and stockpile separately for possible future uses. Excess materials should be disposed off the site.
- Undertake proof rolling (using an 8 to 10 tonnes roller) of the exposed natural soils or fill to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of about 300mm and replace with granular fill, compacted as described below. Proof rolling will not be required if stripping of unsuitable materials exposes bedrock. Fill is generally assessed to be well compacted.
- Undertake proof rolling of soft spots backfilled with granular fill, as described above. If the backfilled area shows movement during proof rolling, this office should be contacted for further recommendations.
- Place suitable fill materials on proof rolled residual soils or bedrock. The fill should be placed in horizontal layers of 200mm to 250mm maximum loose thickness and compacted to a Minimum Dry Density Ratio (MDDR) of 98% Standard, at moisture content within 2% of Optimum Moisture Content (OMC). Controlled fill should preferably comprise non-reactive fill (e.g. crushed sandstone), with a maximum particle size not exceeding 75mm, or low plasticity clay. The natural soils and bedrock obtained from excavations within the site may be used in controlled fill after removal of unsuitable materials, if any, crushing to sizes finer than 75mm, proper mixing and moisture conditioning.
- Fill placement should be supervised to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to the specifications. We recommend "Level 2" or better supervision, in accordance with AS3798-2007 – "Guidelines on Earthworks for Commercial and Residential Developments" (Reference 4). It should be noted that a Geotechnical Inspection and Testing Authority will generally provide certification on the quality of entire compacted fill only if Level 1 supervision and testing is carried out.

Batter Slopes and Retaining Structures

Cut and fill slopes during and after development works should be battered for stability or retained by engineered retaining structures. Recommend batter slopes for stability of cut and fill slopes are presented in Table 4.

Table 4 – Recommended Batter Slopes for Excavation Faces

Material	Temporary (Horizontal : Vertical)		Permanent (Horizontal : Vertical)	
	Exposed	Protected	Exposed	Protected
Controlled fill / natural soil	1.5:1.0	1.0:1.0	2.5:1.0	2.0:1.0
Extremely weathered and low strength sandstone	1.0:1.0	0.75:1.0	1.5:1.0	1.0:1.0
Distinctly weathered to fresh and medium to high strength sandstone	Sub-vertical	Sub-vertical	Sub-vertical	Sub-vertical

Surface protection of the slopes can be provided by shotcreting, which may be reinforced. It is also recommended that batter slopes are provided with adequate surface and sub-surface drainage.

Sub-vertical excavation in distinctly weathered and medium to high strength sandstone, where required, will have a very low risk of instability. However, some local rock bolting or shotcreting would be required, depending on the relative orientation of the rock discontinuities (bedding partings and joint systems) and cut faces Therefore, the excavation faces should be inspected by a Geotechnical Engineer or an Engineering Geologist, as excavation progresses, at about every 1.5m depth interval, to assess localised rock bolting or shotcreting requirements.

Retaining structures, if required, could comprise a contiguous pier wall or secant pier walls installed prior to commencement of basement excavation. Secant pier wall will be required if excavation extends well below groundwater level. Earth pressure distribution on such retaining walls may be assumed to be triangular in shape and estimated as follows.

$$p_h = \gamma k H$$

Where,

p_h = Horizontal active pressure (kN/m^2)
γ = Total density of materials to be retained (kN/m^3)
k = Coefficient of earth pressure (k_a or k_o)
H = Retained height (m)

For design of flexible retaining structures where some lateral movement is acceptable, an active earth pressure coefficient (k_a) is recommended. If it is critical to limit the horizontal deformation of a retaining structure, use of an earth pressure coefficient at rest (k_0) is recommended. Recommended earth pressure coefficients for design of retaining structures are presented in the following Table 5.

Table 5 – Recommended Earth Pressure Parameters for Design of Retaining Structures

Retained Material	Unit Weight (kN/m^3)	Active Earth Pressure Coefficient	Passive Earth Pressure (kPa)	At Rest Earth Pressure Coefficient
Controlled fill / natural soil	18	0.40	Ignore	0.60
Extremely weathered and low strength sandstone	23	0.20	300	0.30
Distinctly weathered to fresh and medium to high strength sandstone	24	-	1000	-

The above coefficients are based on the assumption that ground level behind the retaining structure is horizontal and the retained material is effectively drained. Additional earth pressures resulting from surcharge load (buildings, infrastructures, etc) on retained materials and groundwater pressure, if any, should also be allowed for in design of retaining structures.

If the retaining structures are anchored or strutted the active earth pressure may be assumed to be rectangular and estimated as follows:

Active earth pressure $p_h = 0.8k\gamma H$

If basement excavation extends below groundwater level then the design of retaining structures should allow for groundwater pressure.

The design of any retaining structures should also be checked for bearing capacity, overturning, sliding and overall stability of the slope.

Footings

Footings for the proposed development can consist of shallow (pad or strip) or deep footings (bored piers). The following recommended allowable bearing pressure values can be used for the design of footings.

Table 6 – Recommended Allowable Bearing Pressures

Founding Material	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Controlled fill	100	Ignore
Stiff / Medium dense natural soils	125	Ignore
Very low to low strength sandstone	750	50
Medium to high strength sandstone	5000	500

The recommended allowable shaft adhesions against uplift pressures are halves of the shaft adhesions for compressive loads presented in Table 6.

If footings are founded above and within the 1 Horizontal to 1 Vertical line projected from the base of excavations, the recommended allowable bearing pressures presented in Table 6 are not applicable and appropriate allowable bearing pressure will have to be determined by reassessment of materials exposed in the excavation face.

As depths to natural soils and bedrock with the recommended allowable bearing pressures could vary across the site, the founding depths of footings to be constructed will also vary. Therefore, an experienced Geotechnical Engineer, on the basis of assessment made during footing excavation or pier hole drilling, should confirm founding levels during construction. The engineer should ensure that the design strength of bedrock is achieved.

For footings founded in controlled fill and natural soils the total settlements of footings under the recommended allowable bearing pressures are estimated to be in the range of 15mm to 20mm. However, for footings founded in bedrock total settlements under the recommended allowable bearing pressures are estimated to be about 1% of pier diameter or minimum footing dimension. Differential settlements are estimated to be about half the estimated total settlements.

Floor Slabs
Floor slabs could either be ground supported or suspended on footings. Floor slabs founded on controlled fill or natural soils could be designed for a modulus of subgrade reaction of 20kPa/mm.

Site Classification
Considering the presence of deep fill and existing structures the site is classified as Class "P" (Problematic) as per AS2870-2011 "Residential slabs and footings".

Rock Anchors
It is likely that retaining walls may require anchorage or tie-back, in order to resist lateral pressure. We suggest that all anchors are socketed in bedrock. The allowable grout to rock stress for use in rock anchorage design may be taken as 10% of the allowable bearing pressure given in Table 6. We also suggest that the anchors should have sufficient bond length outside the 1 Vertical to 1 Horizontal line drawn from the base of excavation.

Acid Sulfate Soil Assessment
The soil sample analysed for acid sulfate soil material at depth (0.5m-0.75m) are unlikely to be actual acid sulfate soil or potential acid sulfate soil. Based on the test results, no acid sulfate management plan is required for disturbance of soil at this depth.

The soil samples analysed at depth (1.5m -1.95m) are unlikely to be acid sulfate soil (ASS) but are acidic soils (i.e. non-sulfuric and non-sulfidic). However, excavation and placement of these soils in conditions with increased rate of soil drainage could contribute for the release of acidic leachates and management of these acidic soils is required, if disturbed. The treatment of acidic soils (non-acid sulfate soils) should be carried out in accordance with processes described in NSW Acid Sulfate Soil Manual 1998 for acid sulfate management plan (Reference 2). The treatment method will include neutralising soils to prevent generation of acidic leachates.

The soil samples analysed at depths (3.0m-3.4m) are considered to potential acid sulfate, and likely to produce acid if disturbed. Acid sulfate soil management plan would be required, if the soils are to be disturbed.

Assessment
Based on the investigation results the site is suitable for the proposed residential development. It is important that the recommendations made in this report are followed. If it is planned to construct deep basements, we recommend that further groundwater measurement be carried out prior to excavation.

General
Assessments and recommendations presented in this report are based on site observation and information from only limited number of boreholes. Although we believe that the sub-surface profile presented in this report is indicative of the general profile across the site, it is possible that the sub-surface profile across the site could differ from that encountered in the boreholes. Likewise, comments on depth to groundwater level are based on observation during field work. We recommend that this company is contacted for further advice if actual site conditions encountered during basement excavation differ from those presented in this report.

If you have any questions, please contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

MRIGESH TAMANG
Geotechnical Engineer

ZIAUDDIN AHMED
Senior Geotechnical Engineer

Attached Drawing 13188/1-AA1
Engineering Borehole Logs, Core Photographs & Explanatory Notes
Laboratory Test Results

References

1. Queensland, Department of Natural Resources, Mines and Energy, 2004 – Acid Sulphate Soils – Laboratory Methods Guidelines.
2. New South Wales, Acid Soil Management Advisory Committee, 1988 – Acid Sulphate Soil Manual
3. Australian Standard, Geotechnical Site Investigation, AS1726-1993.
4. Australian Standard AS3798-2007 - Guidelines on Earthworks for Commercial and Residential Developments, 2007.

LEGEND

● Borehole

Imagery ©2014 NearMap.com

0 20 40 60 80 100m

Scale 1:2000

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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

Nix Management Pty Ltd
Proposed Development
Robert Timms Factory Site (Bushell's)
160 Burwood Road, Concord

Borehole Locations

Drawing No: 13188/1-AA1
Job No: 13188/1
Drawn By: MH
Date: 20 August 2014
Checked By: ER

File No: 13188-1
Layers: 0, AA1

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engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 1
Date : 07/08/2014
Logged/Checked by: AN/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.5

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	▼	DS			N=R 6,15,7/50 Ref	0			Asphaltic concrete	M			Well compacted
									Road base Sandy GRAVEL, fine to medium grained, grey	M			
									FILL; Sandstone Gravel, medium to coarse grained, red grey, with sand	M			
						0.5			FILL; Silty Sand, fine grained, brown, with clay and gravel				
		DS			N=8 4,4,4	1			FILL; Silty Clay, medium to high plasticity, grey, trace of ironstone	M<PL			
						1.5							
						2			FILL; Sandy Clay, low plasticity, dark brown, trace of gravel	M<PL			
		DS				2.5							
					N=R 3,25/150	3		SM	Silty SAND, fine grained, dark grey	W	MD		Bedrock
		DS											
									Commenced Coring at 3.3m				
						3.5							
						4							
						4.5							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 1
Date : 11/08/2014
Logged/Checked by : AN

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.5
core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Start coring at 3.3m					
		3.5		CORE LOSS					Core Loss (3.3m to 4.765m)
		4							
		4.5							
		5		SANDSTONE; medium grained, grey and brown	DW	M-H			5.07m - Clay band 5.1-5.8m EW zone
		5.5							
		6		SANDSTONE; fine to medium grained, grey brown	DW	M-H			5.82m B=0° co
		6.5							
		7							
		7.5							7.41m B=5°, st 7.75m B=0°, st, co

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 1
Date : 11/08/2014
Logged/Checked by : AN

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.5

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		8							
		8.5							
		9		SANDSTONE, fine to medium grained, grey	SW- F	H			9.32m B=0° st
		9.5							
		10							
				Borehole No 1 terminated at 10.3m					
		10.5							
		11							
		11.5							
		12							
		12.5							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH1 Started Coring at 3.3m

3.0m — 3.3m — Core Loss 3.3m to 4.765m

4.0m — Core Loss 3.3m to 4.765m

5.0m

6.0m

7.0m

8.0m

9.0m

10.0m — BH1 terminated at 10.3m

MT.mh/04.09.2014

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 2
Date : 11/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.4

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
		DS				0			TOPSOIL; Silty Sand, fine grained, grey, with inclusion of root fibre				
									FILL; Silty Sand, fine grained, grey, with inclusion of gravel				Well compacted
		DS			N=4 4,2,2	0.5							
						1							
		DS			N=11 5,6,5	1.5			FILL: Gravelly Sandy Clay, low plasticity, brown				Well compacted
						2							
						2.5							
		DS			N=4 2,2,2	3							
						3.5							
									FILL; Silty Clay, medium plasticity, dark grey, with inclusion of timber				Well compacted
		DS			N=3 2,1,2	4							
						4.5							

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 2
Date : 11/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.4

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger		DS			N=11 4,5,6	5 5.5 6 6.5 7 7.5 8 8.5 9 9.5		CH	Sandy CLAY, high plasticity, brown and grey	M>PL	St-H		Residual
									SANDSTONE; extremely weathered, extremely low strength, brown and grey				Bedrock

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 2
Date : 11/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.4

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
	Dry					10							
						10.5			Borehole 2 terminated at 10.5m				
						11							
						11.5							
						12							
						12.5							
						13							
						13.5							
						14							
						14.5							

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 3
Date : 12/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.4

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION (soil type, plasticity or particle characteristic, colour, secondary and minor components.)	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	Dry					0			TOPSOIL; Silty Sand, fine grained, grey, with root fibre				
		DS							FILL; Clayey Sand, medium grained, brown, with gravel				Well compacted
					N=R 11/50 Ref	0.5			Sandstone floater				
		DS				1			FILL; Sandy Clay, medium plasticity, brown				Well compacted
		DS			N=5 2,2,3	1.5			FILL; Sandy Clay, high plasticity, dark grey				Well compacted
						2							
						2.5		SM	Silty SAND, fine to medium grained, grey	M	L-VD		Alluvial
					N=R 10,10/50	3			SANDSTONE; extremely weathered, grey				Bedrock
						3.5							
						4							
						4.5			Coring commenced at 4.1m				

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 3
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.4

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		4		Start coring at 4.1m					
		4.5		SANDSTONE; medium to coarse grained, brown grey	DW-SW	H			4.1-4.14m clay band 4.78m B=5° st 5.2m B=5°, st 5.4m B=0° st 5.45m B=0° st
		5							
		5.5							
		6		CORE LOSS					
		6.5		SANDSTONE; fine to medium grained, grey	DW-SW	H			6.74m B=0° st 7.24-7.26m = B5°x2, st
		7							
		7.5							
		8		SANDSTONE; fine to medium grained, red brown	DW-SW	H			7.91m=B0° st 7.97m - clay seam (10mm)
		8.5							8.54m B=5°, st

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 3
Date : 11/08/2014
Logged/Checked by : LY/MT

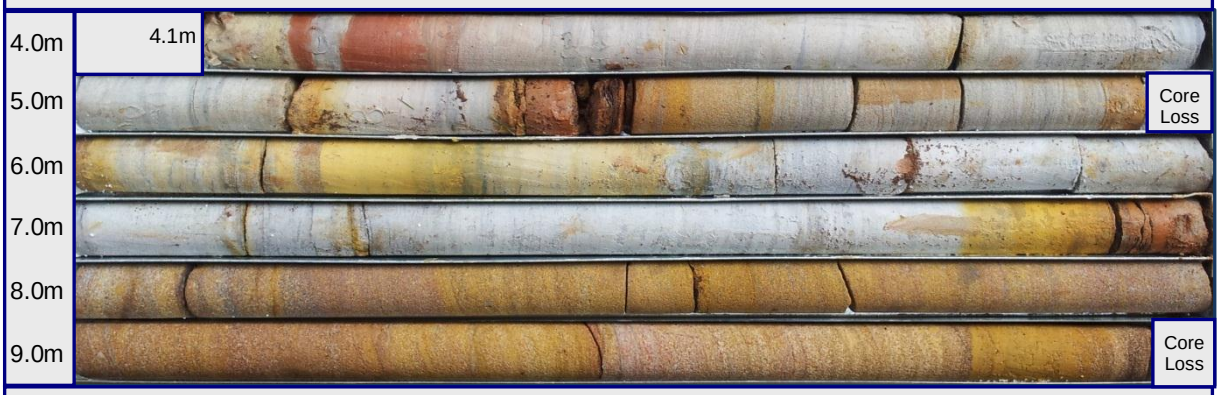
drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.4

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		9							
		9.5					×		
		10		CORE LOSS Borehole No 3 terminated at 10.0m					
		10.5							
		11							
		11.5							
		12							
		12.5							
		13							
		13.5							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH3 Started Coring at 4.1m



BH3 terminated at 10.0m

MT.mh/04.09.2014

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 4
Date : 12/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.8

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			TOPSOIL; Silty Sand, medium grained, grey, with root fibre				
		DS							FILL; Gravelly Sand, medium grained, brown				Well compacted
					N=R 15/150 Ref	0.5			SANDSTONE; floater				
								SM	Silty SAND, fine to medium grained, brown grey	M	VD		Alluvial
						1			SANDSTONE; extremely weathered. extremely low strength, brown and grey				Bedrock
	Dry					1.5							
						2							
						2.5			Commenced Coring at 2.5m				
						3							
						3.5							
						4							
						4.5							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 4
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.8

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Start coring at 2.5m					
		2.5		SANDSTONE; medium grained, grey brown	SW-Fr	H			2.5-2.8m - fragmented
		3							2.91m B=0° st
		3.5							
		4							4.21m B=5° st
				SANDSTONE; medium grained, red brown to grey	SW	H			4.31m B=5°, st
		4.5							
		5							
		5.5							5.62m B=5° st
				SANDSTONE; fine to medium grained, grey	F	H-VH			5.75m = B=0° Co
		6							5.9m = clay seam (5mm)
		6.5							6.17m - 6.24m B=10°x3,co
		7							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 4
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.8

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		7.5							7.5m - clay seam (10mm)
		8							
		8.5							
		9							
		9.5							
		10							
		10.5		Borehole No 4 terminated at 10.42m					
		11							
		11.5							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH4 Started Coring at 2.5m

BH4 terminated at 10.42m

MT.mh/04.09.2014

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 5
Date : 13/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅6.7

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	Dry	DS			N=4 4,2,2	0 0.5 1 1.5		CH	TOPSOIL; Silty Clay, medium plasticity, grey, with root fibre FILL; Sandy Gravelly Clay, medium plasticity, grey, with inclusion of sandstone fragments Silty CLAY, high plasticity, grey SANDSTONE; extremely weathered, extremely low strength, brown	M>PL	S		Well compacted Residual Bedrock
						2 2.5 3 3.5 4 4.5			Commenced Coring at 1.6m				

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 5
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅6.7

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		1.5		Start coring at 1.6m					
		2		SANDSTONE, medium grained, grey with mottled brown	DW-SW				2.77m B=0° st 2.83-2.94m - Clayey sand band
		2.5							3.15m B=5° st 3.22m J=45°, st, pl
		3							
		3.5							3.46m J=30° pl, st 3.7m - clay seam (5mm)
		4							
		4.5							4.72m B=5° st
		5							
		5.5							5.48m J=45°, co, pl
		6		SANDSTONE; ,medium to coarse grained, red brown	SW	H			5.76m B=0° co 5.83m B=0° co

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 5
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅6.7

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		6.5							6.68m B=5° st
		7							
		7.5							7.7m = clay band 7.7m B=0° st, co
				SHALE: grey	EW	EL L			
		8		SANDSTONE; medium grained, slightly weathered to fresh, grey	SW-Fr	H			
		8.5							
		9							8.91m B=0° co
		9.5							
		10							
				Borehole No 5 terminated at 10.1m					
		10.5							
		11							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH5 Started Coring at 1.6m

BH5 terminated at 10.1m

MT.mh/04.09.2014

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 6
Date : 13/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅6.3

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			CONCRETE				
		DS							ROADBASE, gravel FILL; Gravelly Clay, medium plasticity, grey				Well compacted
		DS			N=R 7,20/100, Ref	0.5		Cl	Sandy CLAY, medium plasticity, brown, with inclusion of ironstone	M>PL	H		Residual
	Dry					1			SANDSTONE; extremely weathered, extremely low strength, brown, with some ironstone				Bedrock
									Commenced Coring at 1.2m				
						1.5							
						2							
						2.5							
						3							
						3.5							
						4							
						4.5							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 6
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅6.3
core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		1		Coring start at 1.2m					
		1.5		SANDSTONE; medium to coarse grained, reddish brown to grey	SW-Fr	H			1.78m B=0°, co
		2							
		2.5		SANDSTONE; fine to coarse grained, red to grey, with some minor clay bands	DW - SW	H			2.5m B=0°co 2.66m B=5° st 2.82-2.85m B=5°x2 st 2.91m B=0° co
		3							
		3.5							
		4							3.94m B=5° st
		4.5							4.37m B=5° st
		5							5.19m B=0° co St 2.24-5.3m B=5°x2, co, st 5.37m = clay seam (10mm) 5.4-5.75m Clay infill
		5.5							5.58m B=0° st 5.64m J=60° pl co

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 6
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅6.3

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		6							5.91m B=0° st
				SANDSTONE; fine to medium grained, grey	F	H			6.27-6.3m Clay infill
		6.5							
		7							
		7.5							
		8							7.86m B=0° co
		8.5							
		9							
		9.5							9.15m B=5° co
									9.76m = clay seam (5mm)
				CORE LOSS					9.86mm B=0° co
		10		Borehole No 6 terminated at 10.0m					
		10.5							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH6 Started Coring at 1.2m

BH6 terminated at 10.0m

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 7
Date : 11/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.6

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	Dry					0			ASPHALTIC CONCRETE				
									ROADBASE; sandy gravel, fine to medium grained, grey				Well compacted
		DS			N=14 9,10,4	0.5			FILL; Silty Sand, fine grained, brown, with inclusion of gravel				
						1			FILL; Sandy Clay, high plasticity, dark grey				Well compacted
		DS			N=5 5,3,2	1.5			FILL; Sandy Clay, medium plasticity, brown, with inclusion of gravel				Well compacted
		DS				2			FILL; Silty Clay, high plasticity, grey				Well compacted
						2.5		SM	Silty SAND, fine to medium grained, grey brown	M	D-VD		Alluvial
					N=R 2,2,10/ 100	3			SANDSTONE; fine to medium grained, grey brown				Bedrock
						3.5							
									Commenced Coring at 3.8m				
						4							
						4.5							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 7
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.6

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Start coring at 3.8m					
		4		SANDSTONE; coarse grained, brown to red, with some orange staining	DW	M-H			
		4.5							
		5							5.15m B=0° co st
		5.5							5.34m B=5° st 5.38m J=60° co cu 5.48m B=5° st 5.55m B=5° st
		6							
		6.5							6.65m B=5° st 6.7m = clay seam (10mm) 6.76m = clay seam (5mm)
		7							
		7.5		SHALE: slightly weathered, grey	SW	L			
				SANDSTONE; coarse grained, red brown then grey	SW				7.71m B=5° st
		8							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 7
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.6

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		8.5							8.46m B=0° st
		9							9.0M J=30° PL ST
				SANDSTONE; fine to medium grained, grey	SW- F	H			
		9.5							
		10							9.86m B=5° co
									10.22m B=0° co st
		10.5							
				Borehole No 7 terminated at 10.75m					
		11							
		11.5							
		12							
		12.5							
		13							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH7 Started Coring at 3.8m

BH7 terminated at 10.75m

MT.mh/04.09.2014

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 8
Date : 14/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.7

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			Concrete Pavement 200mm				
		DS							FILL; Silty Sand, fine to medium grained, brown, with some gravel				
					N=19 5,10,9	0.5		SM	Silty SAND, fine to medium grained, brown, with some ironstone	M	MD		
	Dry					1		SM	SANDSTONE; fine to medium grained, brown, extremely weathered				Bedrock
						1.5			Commenced Coring at 1.4m				
						2							
						2.5							
						3							
						3.5							
						4							
						4.5							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 8
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.7

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Started coring at 1.4m					
		1.5		SANDSTONE; medium to coarse grained, grey yellow to red	DW	H			1.6m B=0° stepped
		2							2.17m B=5° planar
		2.5							2.6m B=10° stepped
		3							3.1m B=0° planar
		3.5							3.6m B=2° planar
		4							
		4.5		SANDSTONE; fine to medium grained, grey red, with some clay bands	DW-SW	H			4.48-4.51m clay seam (30mm)
		5							5.25-5.3m (EW zone) 5.3-5.45m (EW zone)
		5.5							
		6							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 8
Date : 11/08/2014
Logged/Checked by : LY/MT

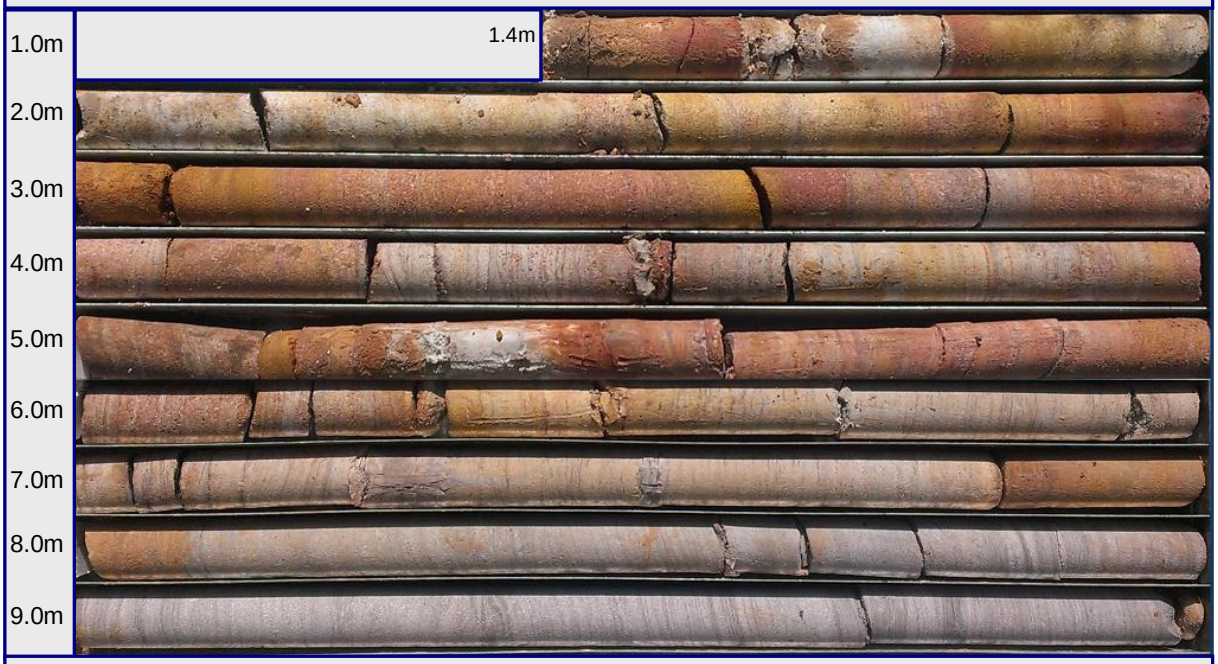
drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.7

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				SANDSTONE; fine to medium grained, grey, with some clay bands	SW	H			6.3m B=0 planar 6.45m clay seam 6.65m clay seam 6.93m B=5° plannar 7.24m clay seam 7.3m 60mm 7.5m clay seam 20mm
		6.5 7 7.5							
				SANDSTONE; fine to medium grained, grey	SW- F	H			8.55m clay seam 5mm 9.65m B=5° planar
		8 8.5 9 9.5							
				Borehole No 8 terminated at 9. 7m					
		10 10.5							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH8 Started Coring at 1.4m



BH8 terminated at 10.0m

GEOTECHNIQUE PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 9
Date : 14/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅7.16

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			Bitumen Pavement				
		DS							FILL; Silty Gravelly Clay, medium plasticity, grey, with some gravel	M<PL			
					N=13 5,3,10	0.5			FILL; Silty Gravelly Clay, medium to high plasticity, grey brown to dark brown, with gravel	M<PL			
		DS				1			FILL; Silty Gravelly Clay, medium to high plasticity, grey brown to dark brown with ironstone	M<PL			
					N=5 2,2,3	1.5							
		DS				2			FILL; Silty Clay, medium to high plasticity, dark brown	M<PL	F		
						2.5		CI-CH	Silty CLAY, medium to high plasticity, orange to grey, with some ironstone	M>PL	St		Residual
					N=8 2,3,5	3							
						3.5							
	Dry					4			SANDSTONE; fine to medium grained, grey red				Bedrock
						4.5			Commenced Coring at 4.5m				

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 9
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅7.16
core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Start coring at 4.5m					
		4.5		SANDSTONE: fine to medium grained, pink to grey	DW-SW	H			4.58m B=10° planar 4.67m B=10° stepped
				SANDSTONE; fine to medium grained, with minor red staining, pink to grey	SW	H			4.83m B=5° planar
		5							
		5.5							5.45m clay seam
									5.74m J=20° planar
		6							6.10 B=50° curved
		6.5							
		7							7.17m clay seam 5mm
		7.5							7.42m B=0° planar
		8		SANDSTONE; fine to medium grained	SW- F	H			8.25m B=5° planar
		8.5							
		9							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 9
Date : 11/08/2014
Logged/Checked by : LY/MT

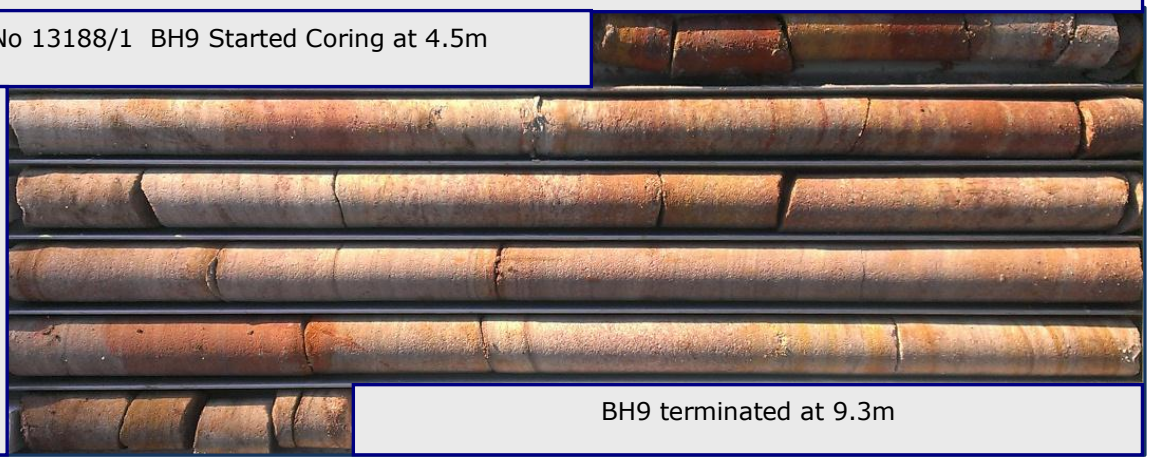
drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅7.16

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS: defect spacing (mm) 2000 1000 600 300 100 50	DEFECT DETAILS: DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
									9.15m B=10 planar
				Borehole No 9 terminated at 9. 3m					
		9.5							
		10							
		10.5							
		11							
		11.5							
		12							
		12.5							
		13							
		13.5							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH9 Started Coring at 4.5m



BH9 terminated at 9.3m

MT.mh/04.09.2014

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 10
Date : 14/08/2014
Logged/Checked by: LY/MT

drill model and mounting : Edson Truck Mounted **slope :** **deg.** **R.L. surface :** ≅5.9

hole diameter : 125 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	Dry					0			Concrete				
		DS							Road base/gravel FILL; Gravelly Clay, medium plasticity, grey with inclusion of sand				Well compacted
		DS			N=16 7,7,8	0.5		CH	Shaley CLAY, high plasticity, grey and red brown	M>PL	VSt-H		Residual
					N=R 30/150, Ref	1.5			SANDSTONE; extremely weathered, extremely low strength, brown with ironstone bands				Bedrock
						2.5			Commenced coring at 2.4m				

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 10
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.9

core size: NMLC **bearing :** **deg.** **datum :** AHD

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
				Coring start at 2.4m					
		2.5		SANDSTONE; medium grained, brown and grey with some red staining	DW-SW	M-H			2.45m B=0° clay coat st 2.6m B=0° clay coat st 2.9m B=0° co st 2.96m B=0° co st 3.04m B=0° co 3.43m B=0° st 3.44m B=0° st 3.45m J=30° st pl 3.66m B=0° st 4.17m B=0° co st
		3							
		3.5							
		4							
		4.5		SANDSTONE; fine to medium grained, grey	SW-FR	M-H			
		5							
		5.5							
		6							
		6.5							6.4m B=0° co
		7							

GEOTECHNIQUE
PTY LTD

engineering log
cored borehole

Client : Nix Anderson Pty Ltd
Project : Proposed Development
Location : 160 Burwood Road, Concord

Job No. : 13188/1
Borehole No. : 10
Date : 11/08/2014
Logged/Checked by : LY/MT

drill model and mounting : Edson Truck Mounted **slope :** 90 **deg.** **R.L. surface :** ≅5.9

core size: NMLC **bearing :** **deg.** **datum :** AHD

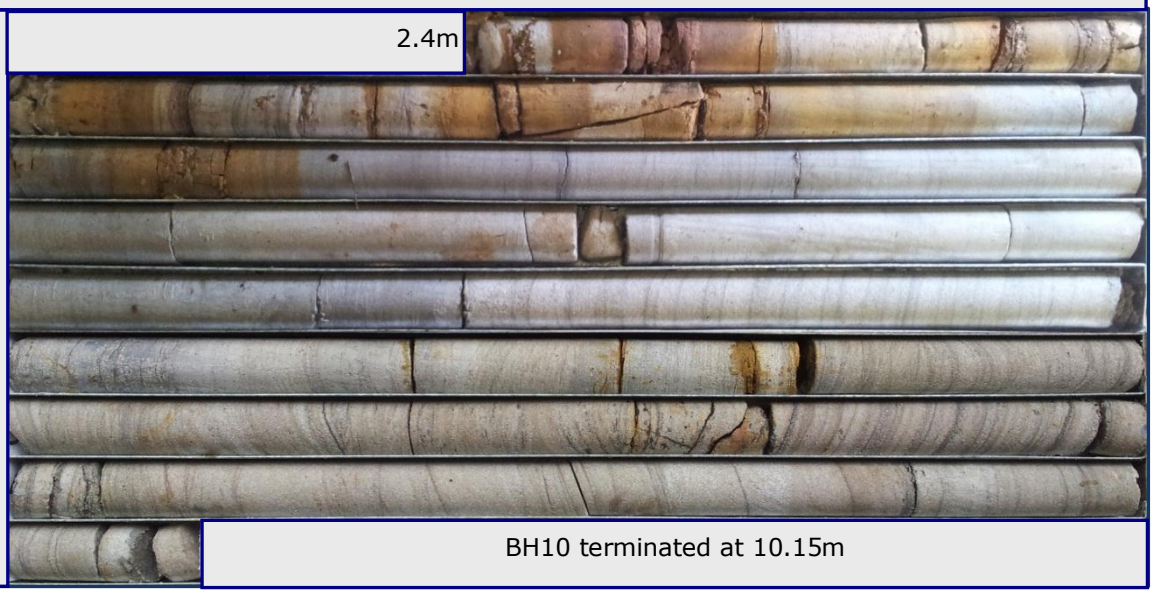
barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS: defect spacing (mm) 2000 1000 500 300 100 50	DEFECT DETAILS: DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		7.5							7.35m B=0° st 7.54m B=0° st 7.66m B=0° co st 7.7m B=0° st
		8							
		8.5							8.55m B=0° st 8.62m B=0° st 8.63m J=45° co 8.67m B=0° st
		9							9.05m B=5° 9.09m B=5°
		9.5							
		10							10.12m B=5° co
				Borehole No 10 terminated at 10.15m					
		10.5							
		11							
		11.5							

GEOTECHNIQUE
PTY LTD

Job No 13188/1 BH10 Started Coring at 2.4m

2.0m
3.0m
4.0m
5.0m
6.0m
7.0m
8.0m
9.0m
10.0m

2.4m



BH10 terminated at 10.15m

MT.mh/04.09.2014

EXPLANATORY NOTES

Introduction
These notes have been provided to simplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments section. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods
The methods of description and classification of soils and rocks used in this report are based on AS1726 - 1993 "Geotechnical Site Investigations". In general, descriptions cover the following properties; strength or density, colour, structure, soil or rock type, and inclusions. Identification and classification of soil and rock involves, to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, qualified by the grading or other particles present (e.g. sandy clay) on the following basis:

Soil Classification	Particle Size
Clay	Less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2.00mm
Gravel	2.00mm to 60.00mm

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very Soft	Less than 12
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT), as below:

Relative Density	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c-MPQ)
Very Loose	Less than 5	Less than 2
Loose	5 – 10	2 – 5
Medium Dense	10 – 30	5 – 15
Dense	30 – 50	15 – 25
Very Dense	>50	>25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering, strength, defects and other minor components. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling
Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally known as U_{50}) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods
The following is a brief summary of investigation methods currently carried out by this Company and comments on their use and application.

Hand Auger Drilling
The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits
These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure to accommodate the poorly compacted backfill.

Large Diameter Auger (e.g. Pengo)
The hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

Continuous Spiral Flight Augers
The hole is advanced by using 90mm-115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively lower reliability due to remoulding, mixing or softening of samples by groundwater, resulting in uncertainties of the original sample depth.

The spiral augers are usually advanced by using a V-bit through the soil profile to refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of recovered rock fragments and through observation of the drilling penetration resistance.

Non-core Rotary Drilling (Wash Boring)
The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the feel and rate of penetration.

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (e.g. SPT and U_{50}) samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances, a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in AS1289 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blow counts for each 150mm of, say 4, 6 and 7 blows as;

  N = 13
  4,6,7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm as;

  15, 30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test method is used to obtain samples in 50mm diameter thin walled sample tubes in clays. In these circumstances, the test results are shown on the bore logs in brackets.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in AS1289 6.5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in MPa *
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (MPa)} = (0.4 \text{ to } 0.6)\ N \text{ (blows per 300mm)}$$

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c=(12 \text{ to } 18)C_u$$

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values, to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (DCP)
Portable Dynamic Cone Penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows per successive 100mm increment of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) AS1289 6.3.2 and the Perth Sand Penetrometer AS1289 6.3.3. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS1289 Test P3.2).

Laboratory Testing
Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

Engineering Logs
The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Groundwater
Where groundwater levels are measured in boreholes, there are several potential problems:

- in low permeability soils groundwater, although present, may enter the hole slowly or perhaps not at all during the investigation period
- a localised perched water table may lead to an erroneous indication of the true water table
- water table levels will vary from time to time due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report
- the use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if water observations are to be made

More reliable measurements can be achieved by installing standpipes that are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be advisable in low permeability soils, or where there may be interference from a perched water table or surface water.

Engineering Reports
Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, perhaps a three-storey building, the information and interpretation may not be relevant if the design proposal is changed, say to a twenty-storey building. If this occurs, the Company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies
In the event that conditions encountered on-site during construction appear to vary from those that were expected from the information contained in the report, the Company requests immediate notification. Most problems are much more easily resolved when conditions are exposed rather than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes
Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institute of Engineers Australia. Where information obtained from this Investigation is provided for tendering purposes; it is recommended that all information, including the written report and discussion, be made available.

In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purposes, at a nominal charge.

Site Inspection
The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site.

Review of Design
Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.

ANALYTICAL REPORT

WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Emged Rizkalla	Manager	Jon Dicker
Client	Geotechnique	Laboratory	SGS Cairns Environmental
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Email	edward.ibrahim@sgs.com	Email	AU.Environmental.Cairns@sgs.com
Project	**SE130657 13188-1 - Concord**	SGS Reference	**CE111357 R0**
Order Number	(Not specified)	Report Number	0000019640
Samples	5	Date Reported	25 Aug 2014
Date Started	21 Aug 2014	Date Received	20 Aug 2014

COMMENTS

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

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE111357.001 Soil 11 Aug 2014 BH2 1.5-1.95	CE111357.002 Soil 12 Aug 2014 BH3 3.0-3.2	CE111357.003 Soil 13 Aug 2014 BH6 0.5-0.75	CE111357.004 Soil 11 Aug 2014 BH7 3.0-3.4
Moisture Content Method: AN002						
% Moisture	%	0.5	**15**	**22**	**19**	**30**
TAA (Titratable Actual Acidity) Method: AN219						
pH KCl	pH Units	-	**4.2**	**6.6**	**5.5**	**5.4**
Titratable Actual Acidity	kg H2SO4/T	0.25	**2.9**	<0.25	**0.61**	**1.3**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	**60**	<5	**12**	**27**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	**0.10**	<0.01	**0.02**	**0.04**
Sulphur (SKCl)	%w/w	0.005	**0.031**	<0.005	<0.005	<0.005
Calcium (CaKCl)	%w/w	0.005	**0.032**	**0.17**	**0.11**	**0.095**
Magnesium (MgKCl)	%w/w	0.005	**0.039**	**0.016**	**0.012**	**0.024**
TPA (Titratable Peroxide Acidity) Method: AN218						
Peroxide pH (pH Ox)	pH Units	-	**4.3**	**5.2**	**6.2**	**4.7**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25	**2.8**	<0.25	<0.25	**4.3**
TPA as moles H+/tonne	moles H+/T	5	**56**	<5	<5	**89**
TPA as S % W/W	%w/w S	0.01	**0.09**	<0.01	<0.01	**0.14**
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5	<5	<5	<5	**61**
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25	<0.25	<0.25	<0.25	**3.0**
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01	<0.01	<0.01	<0.01	**0.10**
ANCE as % $CaCO_3$	% CaCO3	0.01	<0.01	<0.01	<0.01	<0.01
ANCE as moles H+/tonne	moles H+/T	5	<5	<5	<5	<5
ANCE as S % W/W	%w/w S	0.01	<0.01	<0.01	<0.01	<0.01
Peroxide Oxidisable Sulphur (Spos)	%w/w	0.005	**0.010**	**0.052**	**0.006**	**0.076**
Peroxide Oxidisable Sulphur as moles H+/tonne	moles H+/T	5	**6**	**33**	<5	**47**
Sulphur (Sp)	%w/w	0.005	**0.041**	**0.054**	**0.006**	**0.078**
Calcium (Cap)	%w/w	0.005	**0.032**	**0.20**	**0.12**	**0.11**
Reacted Calcium (CaA)	%w/w	0.005	<0.005	**0.027**	**0.005**	**0.017**
Reacted Calcium (CaA)	moles H+/T	5	<5	**13**	<5	**9**
Magnesium (Mgp)	%w/w	0.005	**0.040**	**0.016**	**0.013**	**0.029**
Reacted Magnesium (MgA)	%w/w	0.005	<0.005	<0.005	<0.005	<0.005
Reacted Magnesium (MgA)	moles H+/T	5	<5	<5	<5	<5
Net Acid Soluble Sulphur as % w/w	%w/w	0.005	**0.011**	-	-	-
Net Acid Soluble Sulphur as moles H+/tonne	moles H+/T	5	**7**	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE111357.001 Soil 11 Aug 2014 BH2 1.5-1.95	CE111357.002 Soil 12 Aug 2014 BH3 3.0-3.2	CE111357.003 Soil 13 Aug 2014 BH6 0.5-0.75	CE111357.004 Soil 11 Aug 2014 BH7 3.0-3.4
HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014						
Acid Soluble Sulphur (SHCl)	%w/w	0.005	**0.042**	-	-	-
SPOCAS Net Acidity Calculations Method: AN220						
s-Net Acidity	%w/w S	0.01	**0.11**	**0.02**	**0.02**	**0.07**
a-Net Acidity	moles H+/T	5	**67**	**11**	**14**	**43**
Liming Rate	kg CaCO3/T	0.1	**5.0**	NA	NA	**3.2**
Verification s-Net Acidity	%w/w S	-20	NA	**0.02**	NA	**0.03**
a-Net Acidity without ANCE	moles H+/T	5	**71**	**33**	**16**	**75**
Liming Rate without ANCE	kg CaCO3/T	0.1	**5.3**	**2.4**	NA	**5.6**
Chromium Reducible Sulphur (CRS) Method: AN217						
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	**0.038**	<0.005	**0.034**
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	**24**	<5	**21**

Parameter	Units	LOR	Sample Number CE111357.005 Sample Matrix Soil Sample Date 12 Aug 2014 Sample Name BH10 1.5-1.65
Moisture Content Method: AN002			
% Moisture	%	0.5	**17**
TAA (Titratable Actual Acidity) Method: AN219			
pH KCl	pH Units	-	**4.4**
Titratable Actual Acidity	kg H2SO4/T	0.25	**2.6**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	**54**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	**0.09**
Sulphur (SKCl)	%w/w	0.005	**0.007**
Calcium (CaKCl)	%w/w	0.005	**0.010**
Magnesium (MgKCl)	%w/w	0.005	**0.025**
TPA (Titratable Peroxide Acidity) Method: AN218			
Peroxide pH (pH Ox)	pH Units	-	**4.9**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25	**2.7**
TPA as moles H+/tonne	moles H+/T	5	**55**
TPA as S % W/W	%w/w S	0.01	**0.09**
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5	<5
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25	<0.25
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01	<0.01
ANCE as % $CaCO_3$	% CaCO3	0.01	<0.01
ANCE as moles H+/tonne	moles H+/T	5	<5
ANCE as S % W/W	%w/w S	0.01	<0.01
Peroxide Oxidisable Sulphur (Spos)	%w/w	0.005	**0.008**
Peroxide Oxidisable Sulphur as moles H+/tonne	moles H+/T	5	**5**
Sulphur (Sp)	%w/w	0.005	**0.015**
Calcium (Cap)	%w/w	0.005	**0.012**
Reacted Calcium (CaA)	%w/w	0.005	<0.005
Reacted Calcium (CaA)	moles H+/T	5	<5
Magnesium (Mgp)	%w/w	0.005	**0.026**
Reacted Magnesium (MgA)	%w/w	0.005	<0.005
Reacted Magnesium (MgA)	moles H+/T	5	<5
Net Acid Soluble Sulphur as % w/w	%w/w	0.005	**0.012**
Net Acid Soluble Sulphur as moles H+/tonne	moles H+/T	5	**8**

Parameter	Units	LOR	Sample Number CE111357.005 Sample Matrix Soil Sample Date 12 Aug 2014 Sample Name BH10 1.5-1.65
HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014			
Acid Soluble Sulphur (SHCl)	%w/w	0.005	**0.019**
SPOCAS Net Acidity Calculations Method: AN220			
s-Net Acidity	%w/w S	0.01	**0.10**
a-Net Acidity	moles H+/T	5	**61**
Liming Rate	kg CaCO3/T	0.1	**4.6**
Verification s-Net Acidity	%w/w S	-20	NA
a-Net Acidity without ANCE	moles H+/T	5	**65**
Liming Rate without ANCE	kg CaCO3/T	0.1	**4.8**
Chromium Reducible Sulphur (CRS) Method: AN217			
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<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.

Chromium Reducible Sulphur (CRS) **Method: ME-(AU)-[ENV]AN217**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chromium Reducible Sulphur (Scr)	LB019520	%	0.005	<0.005	0%	102%
Chromium Reducible Sulphur (Scr)	LB019520	moles H+/T	5	<5		

TAA (Titratable Actual Acidity) **Method: ME-(AU)-[ENV]AN219**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH KCl	LB019517	pH Units	-	7.0	0%	101%
Titratable Actual Acidity	LB019517	kg H2SO4/T	0.25	<0.25	2 - 3%	NA
Titratable Actual Acidity (TAA) moles H+/tonne	LB019517	moles H+/T	5	<5	2 - 3%	96%
Titratable Actual Acidity (TAA) S%w/w	LB019517	%w/w S	0.01	<0.01	2 - 3%	97%
Sulphur (SKCl)	LB019517	%w/w	0.005	<0.005	1%	93%
Calcium (CaKCl)	LB019517	%w/w	0.005	<0.005	0 - 1%	104%
Magnesium (MgKCl)	LB019517	%w/w	0.005	<0.005	0 - 1%	92%

TPA (Titratable Peroxide Acidity) **Method: ME-(AU)-[ENV]AN218**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Peroxide pH (pH Ox)	LB019518	pH Units	-	6.4	0 - 2%	96%
TPA as kg H_2SO_4/tonne	LB019518	kg H2SO4/T	0.25	<0.25	0 - 2%	98%
TPA as moles H+/tonne	LB019518	moles H+/T	5	<5	0 - 2%	98%
TPA as S % W/W	LB019518	%w/w S	0.01	<0.01	0 - 2%	98%
ANCE as % $CaCO_3$	LB019518	% CaCO3	0.01	<0.01	0%	
ANCE as moles H+/tonne	LB019518	moles H+/T	5	<5	0%	
ANCE as S % W/W	LB019518	%w/w S	0.01	<0.01	0%	
Sulphur (Sp)	LB019518	%w/w	0.005	<0.005	1 - 7%	95%
Calcium (Cap)	LB019518	%w/w	0.005	<0.005	0 - 5%	114%
Magnesium (Mgp)	LB019518	%w/w	0.005	<0.005	0 - 5%	100%

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.
AN014	This method is for the determination of soluble sulphate (SO4-S) by extraction with hydrochloric acid. Sulphides should not react and would normally be expelled. Sulphur is determined by ICP.
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/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

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CERTIFICATE OF ANALYSIS 114771

Client:
Geotechnique Pty Ltd
PO Box 880
Penrith
NSW 2751

Attention: An Nguyen

Sample log in details:

Your Reference:	**13188/2, Concord**		
No. of samples:	1 Soil		
Date samples received / completed instructions received	18/08/14	/	18/08/14

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.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	25/08/14	/	22/08/14
Date of Preliminary Report:	Not Issued		

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

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date extracted	-	19/08/2014
Date analysed	-	20/08/2014
TRHC$_6$ - C$_9$	mg/kg	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25
vTPHC$_6$ - C$_{10}$ less BTEX (F1)	mg/kg	<25
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
naphthalene	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	133

svTRH (C10-C40) in Soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date extracted	-	19/08/2014
Date analysed	-	19/08/2014
TRHC$_{10}$ - C$_{14}$	mg/kg	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100
Surrogate o-Terphenyl	%	90

PAHs in Soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date extracted	-	19/08/2014
Date analysed	-	19/08/2014
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	0.8
Anthracene	mg/kg	0.2
Fluoranthene	mg/kg	1.6
Pyrene	mg/kg	1.7
Benzo(a)anthracene	mg/kg	0.7
Chrysene	mg/kg	0.7
Benzo(b,j+k)fluoranthene	mg/kg	1.4
Benzo(a)pyrene	mg/kg	0.93
Indeno(1,2,3-c,d)pyrene	mg/kg	0.6
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	0.5
Benzo(a)pyrene TEQ NEPM B1	mg/kg	1.0
Total Positive PAHs	mg/kg	9.1
Surrogate p-Terphenyl-d14	%	102

Organochlorine Pesticides in soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date extracted	-	19/08/2014
Date analysed	-	19/08/2014
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Surrogate TCMX	%	85

PCBs in Soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date extracted	-	19/08/2014
Date analysed	-	19/08/2014
Arochlor 1016	mg/kg	<0.1
Arochlor 1221	mg/kg	<0.1
Arochlor 1232	mg/kg	<0.1
Arochlor 1242	mg/kg	<0.1
Arochlor 1248	mg/kg	<0.1
Arochlor 1254	mg/kg	<0.1
Arochlor 1260	mg/kg	<0.1
Surrogate TCLMX	%	85

Total Phenolics in Soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date extracted	-	19/08/2014
Date analysed	-	19/08/2014
Total Phenolics (as Phenol)	mg/kg	<5

Acid Extractable metals in soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date digested	-	19/08/2014
Date analysed	-	20/08/2014
Arsenic	mg/kg	20
Cadmium	mg/kg	<0.4
Chromium	mg/kg	25
Copper	mg/kg	32
Lead	mg/kg	50
Mercury	mg/kg	0.3
Nickel	mg/kg	3
Zinc	mg/kg	100

Miscellaneous Inorg - soil		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date prepared	-	19/08/2014
Date analysed	-	19/08/2014
pH 1:5 soil:water	pH Units	7.2
Total Cyanide	mg/kg	<0.5

Moisture		
Our Reference:	UNITS	114771-1
Your Reference	----------	S1
Date Sampled	----------	14/08/2014
Type of sample		Soil
Date prepared	-	19/08/2014
Date analysed	-	20/08/2014
Moisture	%	22

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 22nd ED, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Date analysed	-			20/08/2014	[NT]	[NT]	LCS-1	20/08/2014
TRHC$_6$ - C$_9$	mg/kg	25	Org-016	<25	[NT]	[NT]	LCS-1	120%
TRHC$_6$ - C$_{10}$	mg/kg	25	Org-016	<25	[NT]	[NT]	LCS-1	120%
Benzene	mg/kg	0.2	Org-016	<0.2	[NT]	[NT]	LCS-1	115%
Toluene	mg/kg	0.5	Org-016	<0.5	[NT]	[NT]	LCS-1	121%
Ethylbenzene	mg/kg	1	Org-016	<1	[NT]	[NT]	LCS-1	120%
m+p-xylene	mg/kg	2	Org-016	<2	[NT]	[NT]	LCS-1	122%
o-Xylene	mg/kg	1	Org-016	<1	[NT]	[NT]	LCS-1	130%
naphthalene	mg/kg	1	Org-014	<1	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	139	[NT]	[NT]	LCS-1	133%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Date analysed	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	[NT]	[NT]	LCS-1	85%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	100%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	86%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	[NT]	[NT]	LCS-1	85%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	100%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	86%
Surrogate o-Terphenyl	%		Org-003	85	[NT]	[NT]	LCS-1	93%
QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Date analysed	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-1	101%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-1	97%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-1	97%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-1	100%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-1	100%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-1	94%
Benzo(b,j+k) fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	[NT]	[NT]	LCS-1	104%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	99	[NT]	[NT]	LCS-1	98%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Date analysed	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
HCB	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	89%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	86%
Heptachlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	86%
delta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	92%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	92%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	95%
Dieldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	82%
Endrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	94%
pp-DDD	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	96%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	90%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%		Org-005	85	[NT]	[NT]	LCS-1	81%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Date analysed	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Arochlor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Arochlor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	LCS-1	106%
Arochlor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%		Org-006	85	[NT]	[NT]	LCS-1	76%
QUALITY CONTROL Total Phenolics in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Date analysed	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	[NT]	[NT]	LCS-1	101%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date digested	-			19/08/2014	[NT]	[NT]	LCS-2	19/08/2014
Date analysed	-			20/08/2014	[NT]	[NT]	LCS-2	20/08/2014
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	[NT]	[NT]	LCS-2	103%
Cadmium	mg/kg	0.4	Metals-020 ICP-AES	<0.4	[NT]	[NT]	LCS-2	110%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-2	108%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-2	106%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-2	104%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	[NT]	[NT]	LCS-2	89%
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-2	107%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-2	106%

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
Date analysed	-			19/08/2014	[NT]	[NT]	LCS-1	19/08/2014
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-1	101%
Total Cyanide	mg/kg	0.5	Inorg-014	<0.5	[NT]	[NT]	LCS-1	87%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

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.

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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC 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.

ENVIROLAB GROUP

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

Job No: 114771

Date Received: 18/8/14.
Time Received: 16:30.
Received by: KW.
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

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: ENVIROLAB SERVICES PTY LD
12 ASHLEY STREET
CHATSWOOD NSW 2067

PH: 02 9910 6200 **FAX:** 02 9910 6201

ATTN: MS AILEEN HIE

Sampling By: AN **Job No:** 13188/2

Project:

Project Manager: AN **Location:** R Concord

Results required by: STANDARD TURNAROUND TIME

Sampling details				Sample type											
Location	Depth (m)	Date	Time	Soil	Water	Metals As, Cd, Cr, Cu, Pb, Hg, Ni and Zn	TPH* & BTEX	PAH	OCP	PCB	PHENOLS	CYANIDE	COMBO NO	pH	KEEP SAMPLE
(1) S1		14/08/2014	-	SG		✓	✓	✓	✓	✓	✓	✓	9	✓	YES

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
AN NGUYEN	AN	18/8/2014	Kevin Wang	KW.	18/8/14.

Legend:

WG Water sample, glass bottle
WP Water sample, plastic bottle
SG Soil sample (glass jar)
SP Soil sample (plastic bag)
✓ Test required
* Purge & Trap