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TCG PLANNING

PROPOSED LIFE CITY WOLLONGONG

WARWICK STREET BERKELEY

LIMITED STAGE 2 CONTAMINATION INVESTIGATION

REPORT G09/1100-B JANUARY 2014

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G09/1100-B VDS:RS
28 January, 2014

TCG Planning
5-174/182 Gipps Road
GWYNNEVILLE NSW 2500

Attention: Elaine Treglown

Dear Sir

Re: Proposed Life City Wollongong, Warwick Street, Berkeley: Limited Stage 2 Contamination Assessment.

Please find enclosed our report for a Limited Stage 2 Contamination Assessment of above site.

The report includes site history review based on Clearsafe Environmental Solutions Phase 1 Contamination Assessment (Project 1357-01-LC dated November, 2012), subsurface investigation results and analytical test results for samples recovered during the investigation. Report recommendations cover an assessment of risk of site contamination in relation to the proposed development.

The report was prepared in accordance with NSW Government Office of Environment & Heritage (OEH) Guidelines for Consultants Reporting on Contaminated Sites.

This report should be read in conjunction with the attached General Notes. Please contact the undersigned should you have any queries.

For and on behalf of
Network Geotechnics Pty Ltd

V W de Silva *BScEng, MEng, SMIE Aust, CPEng, NPER*
Principal Geotechnical Engineer

EXECUTIVE SUMMARY

Network Geotechnics Pty Ltd (NG) was commissioned by Delbest Pty Ltd C/- TCG Planning to undertake a Limited Stage 2 Contamination Assessment for proposed Life City Wollongong development, Warwick Street, Berkeley, NSW.

It is understood that Clearsafe carried out the Preliminary Environmental Assessment (Phase 1) Report no. 1357-01-LC dated 20 November 2012. Clearsafe Phase 1 Report has raised some concerns about the site contamination due to the agriculture activities and illegal dumping of asbestos materials in areas of the site.

The purpose of NG Limited Stage 2 Contamination investigation was to identify above areas and to carry out sufficient contamination testing to assess the level of the contaminants. The recorded results were compared with National Environmental Policy Measures (NEPM) Health Based Investigation Levels (HIL) for Residential use with garden/accessible soil (Column 1).

No physical structures were observed during fieldwork and site was mainly covered with thick grass. Shrub and small to large trees were spread around. Fill was encountered in some of the contamination and geotechnical boreholes to a maximum depth of 1.7m below the existing surface level.

Fieldwork for limited Stage 2 contamination analysis was carried out on 19 November, 2013 by NG which included collection of soil samples from thirteen boreholes (BH10 to BH22) and testing of discrete soil samples for a range of contaminants including metals, TPH, BTEX, polyaromatic hydrocarbons and pesticides. In addition to above thirteen boreholes, some soil samples for contamination tests were collected from the geotechnical boreholes (BH1 to BH9) as well. Fieldwork for the geotechnical investigation was carried out on 21 and 29 November, 2013.

None of the samples tested indicated results higher than the National Environmental Policy Measures (NEPM) Health Based Investigation Levels (HIL) for Residential use with garden/accessible soil (Column 1).

Based on the results of the investigation we assess that the risk of site contamination to be low and the site to be suitable for the proposed development.

Any localised contamination that may be uncovered may be managed during earthworks.

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1.0 INTRODUCTION

1.1 General

Network Geotechnics Pty Ltd (NG) was commissioned by TCG Planning to undertake Limited Stage 2 Contamination Assessments for a proposed Life City of Wollongong, Warwick Street, Berkeley, NSW. The investigation was carried out in accordance with NG revised proposal (Ref: G09/1100 dated 04 September 2013).

It is understood that Clearsafe carried out a Preliminary Environmental Assessment (Phase 1) Report no. 1357-01-LC dated 20 November 2012.

This current report includes a summary of site history review, subsurface investigation results and analytical test results for samples recovered during the investigation.

It is understood the proposed development would include:

- Stage 1: Medical Centre and child care centre
- Stage 2: Medical Accommodation
- Stage 3: Hospital Building
- Stage 4: Seniors Independent Living Units
- Stage 5: Seniors Residential Care Facility
- Stage 6: Holistic Health Care Course

Based on the review of Preliminary Contamination Assessment Reports by Clearsafe and the DA drawings, it appears that the site may have contained some contamination due to past activities which include agriculture use and illegal dumping of material at some locations. The proposed development construction may involve reworking of uncontrolled fill and making site stable by construction of retaining walls and drainage.

The objectives of the investigation was to undertake a historical data review, desk study and carry out limited sampling and testing and provide preliminary recommendations on the suitability of the site for a proposed residential development.

1.2 Methodology

The following scope of work was agreed with the client for the Limited Stage 2 contamination assessment:

Limited Stage 2 contamination assessment based on 13 hand augur holes (BH10 to BH22). In addition contamination samples were also collected from nine geotechnical boreholes (BH1 to BH9).

Most of the potential contamination would be in the fill and upper layers of the site. Total numbers of boreholes drilled on site were 22.

The following procedures were used for soil sampling:

- Geotechnical boreholes (BH1 to BH9) were drilled using a truck mounted drilling rig with solid flight augers. Contamination soil samples were collected within 0.0m to 1.7m from all boreholes.
- Soil samples were collected from 0.0-1.0m depth from thirteen (BH10 to BH22) hand augur boreholes.

- Soil samples were tested for metals, pesticides, hydrocarbon and asbestos.
- Quality assurance and Quality Control testing.

2.0 SITE IDENTIFICATION

The proposed site is located at southern end of Warwick Street, Berkley and is bordered by:

- F6 Freeway to the west
- Residential properties to the north, east and south

The site has access from Warwick street and is shown on Locality Map G09/1100-1.

Based on Satellite photographs, the site co-ordinates at Warwick Street access are given below:

Latitude	34º 28′ 06.11" South
Longitude	150º 50′ 24.24" East

3.0 SITE HISTORY

Clearsafe Phase 1 assessment (Report no. 1357-01-LC dated 20 November 2012) provided a site history based on aerial photographs, council and titles records and a site visit.

3.1 Zoning

The site is currently zoned as 'R2' Low Density Residential and 'E3' Environmental Mangament" under the Wollongong Local Environmental Plan 2009.

3.2 Land Use

A preliminary contamination study carried out by Clearsafe indicated the site has been used as agricultural land up until 1951. From 1951 the agricultured uses has been limited or ceased.

3.3 Council Rezoning and Relevant Development Records

Clearsafe state in their Phase 1 report that the lots covered by the site are zoned Residential "R2" and E3" under Section 149(2) Details of the Wollongong Local Environmental Plan 2009.

Cleasafe conducted a review of available council records. No potential for contamination was recorded in the council files.

3.4 Notices under Protection of Environment Operations Act

Review of records showed that no notices have been issued under the *Contaminated Land Management Act 1997* and *Protection of the Environment Operation Act 1997.*

3.5 WorkCover Search

Clearsafe report (Report no. 1357-01-LC) indicates WorkCover search was not successfully made as authorisation was not obtained from the site owner.

3.6 Groundwater Bore Search

A groundwater bore search was conducted through the national resources database and it has been identified there are no registered groundwater bores within a 650m radius of the current site.

3.7 Aerial Photographs

Reference to Clearsafe Phase 1 contamination assessment indicates that most part of the site remained as undeveloped since 1887. Some part of the site has been used for a agriculture purposes but these activities had been ceased by 1951.

3.8 Product Spill and Loss History

There was no evidence of surface staining as a result of product spill within the proposed site.

3.9 Potential for Contamination

Based on Clearsafe documents reviewed from the Phase 1 investigation and the results of walk over assessment, the following site features may be relevant for assessment of contamination:

- Fill was predominantly encountered in the northern part of the site to maximum depths of 1.5m below the existing grade. Some surface rubbish was noted along the existing top ridgeline vehicular track
- The site has a history of agricultural activities which may be associated with potential contamination.
- Cleasafe noted some building material (bricks, concrete etc) due to illegal dumping on areas in the site. It has a potential to be contaminated with asbestos.

4.0 SITE CONDITION & SURROUNDING ENVIRONMENT

4.1 Topography

The site covered about 8.5 hectares. The topography of the site is a ridgeline that bounded a centre valley. The average site slope is between 5° and 10° dipping toward Princes Motorway.

For site description purpose, we have assumed Princes Motorway abutted the site to the west.

At the time of the investigation, the site surface was covered with thick grasses to a height of up to 0.5m. Shrub and small to large size trees were spread around. During our walkover assessment and locating the borehole locations, the site surface appeared uneven sloping ground due to previous weathering and soil erosion. Several soil erosion gullies were present in the centre of the site, running toward the centre valley.

Two vehicular tracks passes through the site in a north-south direction. One located at the top of the ridgeline (east of the site), the other located near the middle of the site.

Natural silty CLAY and Sandstone bedrock were exposed on the northern part of the site surface near northern end of the top ridgeline vehicular track.

A valley is situated at the centre of the site, which is surrounded by land sloping up to 17° when viewed from the valley floor. The valley floor slopes down to the west at about 3°.

Two stockpiles were observed in the area covered by boreholes BH5, BH6 and BH8. The stockpiles comprised concrete boulders and steel fragments. The location of the stockpiles is shown on our borehole location plans. Some surfaced rubbish was noted along the top ridgeline vehicular track.

Residential houses and local roads bounded the site to the north, east and south. High voltage power lines were located on the southern end of the site.

4.2 Flood Potential

There was no evidence of flooding; however the potential for flooding was not investigated. Council records do not indicate risk of flooding.

4.3 Geology & Hydrogeology

The 1:100,000 Geological Series Sheet of Wollongong-Port Hacking indicates the site to be underlain Illawarra Coal Measures, Cumberland Subgroup Pheasant Nest Formation (Pip) comprising interbedded lithic sandstone, grey siltstone, claystone, carbonaceous claystone, clay, laminate and coal and surrounded by Dapto Latite (Psud) comprising coarse grained Latite. The eastern area of the site is shown to be underlain mid-grey Dolerite.

Subsurface conditions encountered in the NG boreholes and Coffey test pits are discussed for each development stage. Reference should be made to the attached engineering logs for details.

Stage 1 Development: NG's Boreholes 9 to 12

LAYER	DESCRIPTION	DEPTH TO BASE OF LAYER (m)
TOPSOIL	Sandy Silt, low plasticity, dark grey, fine grained sand with roots	0.3 – 0.5
FILL	Silty CLAY, medium to high plasticity, dark brown, with fine to medium sandstone and ironstone.	1.0 – 1.5
RESIDUAL	Silty CLAY, high plasticity, light brown and orange	>0.5-2.2
ROCK	Sandstone, fine to medium grained, orange brown	>5.1

Stage 2 Development: NG's Boreholes 6 and 21, Coffey's TPs 11 and 12

LAYER	DESCRIPTION	DEPTH TO BASE OF LAYER (m)
TOPSOIL	Silty Clay, high plasticity, dark brown, with roots and trace of fine to medium grained ironstone gravel	0.2
FILL	Silty CLAY, medium to high plasticity, dark brown, with fine to medium sandstone and ironstone.	1.0 – 1.5
RESIDUAL	Silty CLAY, medium to high plasticity, light brown and orange, trace of fine to medium grained ironstone gravel	1.1-2.65
ROCK	Weathered Sandstone, fine to medium grained, brown	>4.74

Stage 3 Development: NG's Boreholes 1, 2, 3 and 13, Coffey's TPs 1 and 2

LAYER	DESCRIPTION	DEPTH TO BASE OF LAYER (m)
TOPSOIL	Silty Clay, high plasticity, dark brown, with roots	0.2
FILL	Silty CLAY, medium to high plasticity, dark brown, with fine to medium sand, fine to medium grained sandstone and ironstone and latite cobbles and boulders.	0.5 – 1.7
RESIDUAL	Silty CLAY/Sandy CLAY, medium to high plasticity, light brown and orange, trace of fine to medium grained sandstone and ironstone gravel	1.7-2.6
ROCK	Weathered Sandstone/Latite, fine to medium grained, brown	>4.4, >4.5

Stage 4 Development: NG's Borehole 4, Coffey's TP 10

LAYER	DESCRIPTION	DEPTH TO BASE OF LAYER (m)
TOPSOIL	Silty Clay, high plasticity, dark brown, with roots and fine to medium grained ironstone gravel	0.2
RESIDUAL	Silty CLAY, medium to high plasticity, dark brown, with fine to medium sand, fine to medium grained sandstone and ironstone and latite cobbles and boulders.	1.65
RESIDUAL	Sandy CLAY, medium plasticity, orange brown, dark brown and red brown, trace of fine to medium grained sand.	1.5-3.0
ROCK	Weathered Latite, fine to coarse grained, brown	>1.6, >8

Stage 5 Development: NG's Borehole 5

LAYER	DESCRIPTION	DEPTH TO BASE OF LAYER (m)
TOPSOIL	Silty Clay, high plasticity, dark brown, with roots and fine to medium grained ironstone gravel	0.2
RESIDUAL	Silty CLAY, high plasticity, brown, trace of root fibres and with fine grained ironstone gravel	3.4
ROCK	Weathered Latite, fine to coarse grained, brown, with iron indurated band	>4.15

Groundwater monitoring wells were installed into BH3, BH6 and BH8 after completion of core drilling.

Groundwater was measured in BH's 3 and 6 wells at depths of 3.31m and 0.68, respectively after one day of drilling completion. Groundwater was not recorded in BH8 well.

Groundwater measurements carried out on 6/1/14 indicate depth to groundwater in BH3 to be 3.31m and other wells dry.

5.0 SAMPLING & ANALYSIS PLAN

5.1 Sampling Objectives

The site is assessed to be having a low to moderate risk of potential contamination based on Clearsafe Phase 1 investigation. The site area is about 8.5ha. A total of 22 sampling locations were investigated for contamination assessments in Limited Stage 2 investigation. The contamination boreholes were drilled in the hot spot areas identified by Clearsafe report.

Soil sampling was undertaken during the field investigation and was broadly based on the following objectives:

Most of the potential contamination would be in the fill and upper layers of the site.

The following procedures were used for soil sampling:

- Boreholes (BH1 to BH9) were drilled using a truck mounted drilling rig with solid flight augers. Auger head was decontaminated after each sample. Soil samples were collected from a depth ranging from 0.05m to 1.7m from the boreholes.

- Boreholes (BH10 to BH22) were drilled using a hand augur to a depth ranging from 0.3m to 1.0m. Soil samples were collected from a depth ranging from 0.05 to 1.0m.

The soil samples for contamination testing were collected in glass jars sealed, labelled and placed in a large insulated box with ice and transported to the laboratory.

USEPA analytical methods as adopted by Australian Laboratory Service (ALS NATA Registration No 825) were used for testing for the following contaminants of concern (COC):

- Heavy metals including mercury
- Total Petroleum Hydrocarbon (TPH)
- Benzene, Toluene, Ethyl Benzene and Xylene (BTEX)
- Polynuclear Aromatic Hydrocarbon (PAH)
- Asbestos
- OC/OP Pesticides
- pH
- Ec

A total of 49 samples were sent to the laboratory. The first batch comprised 14 samples of which 5 samples suspected of potential hydrocarbon, metals and asbestos contamination were tested as discrete samples. The remaining samples were put on hold in the laboratory. The second batch comprised 35 samples of which one sample was tested as discrete sample for hydrocarbon contamination. 7 discrete samples were composited to 3 composite samples in laboratory to test for metals, pesticides and asbestos. Samples collected included representative samples of fill, some topsoil in former vegetable gardens, some residual soils in contact with the fill and other soils which were assessed to be discoloured.

5.2 Data Quality Objectives

The seven step process for data quality objectives in this investigation included the following:

Step 1 Identify the Problem

- Make an assessment of contamination of soils within the site to identify any contamination hot spots based on the Clearsafe Phase 1 assessment and the site condition at the time of investigation, which may affect human health and the environment.

Step 2 Identify the Decisions

- Assess whether any contamination on site poses a risk to site occupants under low density residential scenario and the protection of the environment.

Step 3 Identify Inputs

- Drill an adequate number of boreholes in areas identified as having a risk of contaminated soil.
- Visually assess all collected samples for site contamination such as odour, colour etc.
- Test a statistically significant number of samples to characterise the area to provide data on average concentration.

Step 4 Project Boundaries

- Project boundary was taken as the whole area covered by the title.

Step 5 Decision Rule

- Analytical methods and detection levels appropriate for contaminated site assessment approved by NSW EPA Guidelines will be used and testing will be carried out by ALS Environmental laboratory.
- Define assessment criteria. For assessment of site contamination National Environmental Protection Measures health based guidelines for residential allotment with accessible garden (NEPM HIL A).
- All parameters exceeding the action criteria are assessed as representing an area where further investigation is needed.

Step 6 Error Tolerances

- Limit of reporting adopted by ALS Laboratory were assessed to be relevant. Error tolerances indicated in Laboratory Quality Control reports were adopted.
- A confidence level of 95% has been adopted for detailed investigation.

Step 7 Optimise Sample Design

- Sample design was based on the need for a reliable data for assessment of site contamination. The horizontal and vertical spacing of sampling was based on expected contamination potential. Sample locations were selected to assess targeted areas and site coverage.

5.3 Sampling & Testing

Field investigations for limited Stage 2 and the geotechnical investigation was carried out on 19, 22 & 29 November 2013 by NG Engineering staff and comprised a walkover assessment as well. Drilling included twelve hand augur holes of 0.2m diameter for contamination testing to a termination depths ranging from 0.3m to 1.0m. Contamination samples were also collected during the geotechnical investigation. Geotechnical drilling was carried out by a truck mounted drilling rig attached to a 125mm auger with TC-bit attachment. Disturbed soil samples were collected in laboratory prepared glass jars and placed in an insulated box with ice and transferred to the laboratory.

A summary of sample composting and testing type is shown in the table below:

Sample Reference	Sample Description	Composite Sample Reference	Testing
BH1 (0.0-0.1m)	Fill: Silty CLAY	Discrete	TPH/BTEX/PAH
BH1 (0.0-0.1m)	Fill: Silty CLAY	C1	8 Metals/Asbestos
BH1 (0.5-0.7m)	Fill: Silty CLAY	C1	8 Metals/Asbestos
BH2 (0.0-0.1m)	Topsoil: Silty CLAY	C1	8 Metals/Asbestos
BH3 (0.0-0.1m)	Topsoil: Silty CLAY	C2	8 Metals/OC/CP/PCB/Asbestos
BH4 (0.0-0.1m)	Topsoil: Silty CLAY	C2	8 Metals/OC/CP/PCB/Asbestos
BH5 (0.0-0.1m)	Topsoil: Silty CLAY	C3	8 Metals/OC/CP/PCB/Asbestos
BH6 (0.0-0.1m)	Topsoil: Silty CLAY	C3	8 Metals/OC/CP/PCB/Asbestos
BH10 (0.8-1.0m)	Fill: Sandy CLAY	Discrete	8 Metals/TPH/BTX/PAH Asbestos
BH12 (0.3-0.5m)	Fill: Silty CLAY	Discrete	8 Metals/TPH/BTX/PAH Asbestos
BH13 (0.4-0.5m)	Fill: Sandy CLAY	Discrete	8 Metals/TPH/BTX/PAH Asbestos
BH14 (0.1-0.2m)	Fill: Sandy CLAY	Discrete	8 Metals/TPH/BTX/PAH Asbestos
BH15 (0.1-0.3m)	Fill: Silty CLAY	Discrete	8 Metals/TPH/BTX/PAH Asbestos

Borehole logs are included in Appendix A and approximate borehole locations are shown on Drawing No. G09/1100-2.

6.0 QUALITY ASSURANCE & QUALITY CONTROL

6.1 Field Quality Assurance & Quality Control

Field quality assurance objectives were designed based on Australian Standard AS4482 and comprised the following:

- Sample collection and dispatch to testing laboratory were carried out by experienced environmental/civil engineers appropriately trained for such tests.

- All sampling tools were decontaminated prior to use. Soil samples were collected from auger cuttings. The borehole was drilled with a clean auger

head to the target depth and the auger was retrieved, cleaned using a rag, washed with clean water, decontaminated with 1% DECON 90 solution and rinsed with distilled water. The auger was advanced by further 150mm and the sample was retrieved from auger using decontaminated hand tools. Water samples were collected from a new Teflon bailer for each monitoring well.

- Chain of custody forms were used in dispatching samples.

- Containers, sampling packaging and holding times were checked prior to dispatch of samples and checked after samples were received by the laboratories.

6.2 Laboratory Quality Assurance & Quality Control

Only NATA accredited laboratories were used for testing. Certificates of analysis and quality control records were reviewed for each batch of test results.

Specific elements that have been checked and assessed include the following:

- Preservation and storage of samples upon collection and during transport to the laboratory;

- Sample holding times;

- Use of appropriate analytical and field sampling procedures;

- Required limits of reporting and;

- The occurrences of apparently unusual or anomalous results, eg laboratory results that appear to be inconsistent with field observations or measurements have been assessed.

On the basis of the analytical data validation procedures employed, the overall quality of the analytical data produced is considered to be of an acceptable standard for interpretive use.

7.0 SITE ASSESSMENT CRITERIA

The assessment of potentially contaminated land involves the evaluation of potential human health hazards and environmental impacts. The receptors (or potential receptors) of concern may be within the site being assessed, or outside the site boundaries due to potential off-site migration of contaminants.

The following assessment criteria were used for assessment of the site soils:

- The Health-Based Investigation Levels (HBIL) summarised in the following Table 1a, which are Schedule B1 of the NEPM and Guidelines May 2013 are used for assessing the risk to human health

The above mentioned levels are presented on the following Tables 1A(1), 1A(2) and 1A(3) below:

Table 1A(1) Health Investigation Levels for soil contaminants (mg/kg)

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
Metals and Inorganics				
Arsenic[2]	100	500	300	3 000
Beryllium	60	90	90	500
Boron	4500	40 000	20 000	300 000
Cadmium	20	150	90	900
Chromium (VI)	100	500	300	3600
Cobalt	100	600	300	4000
Copper	6000	30 000	17 000	240 000
Lead[3]	300	1200	600	1 500
Manganese	3800	14 000	19 000	60 000
Mercury (inorganic)[5]	40	120	80	730
Methyl mercury[4]	10	30	13	180
Nickel	400	1200	1200	6 000
Selenium	200	1400	700	10 000
Zinc	7400	60 000	30 000	400 000
Cyanide (free)	250	300	240	1 500
Polycyclic Aromatic Hydrocarbons (PAHs)				
Carcinogenic PAHs (as BaP TEQ)[6]	3	4	3	40
Total PAHs[7]	300	400	300	4000
Phenols				
Phenol	3000	45 000	40 000	240 000
Pentachlorophenol	100	130	120	660
Cresols	400	4 700	4 000	25 000
Organochlorine Pesticides				
DDT+DDE+DDD	240	600	400	3600
Aldrin and dieldrin	6	10	10	45
Chlordane	50	90	70	530
Endosulfan	270	400	340	2000
Endrin	10	20	20	100
Heptachlor	6	10	10	50
HCB	10	15	10	80
Methoxychlor	300	500	400	2500
Mirex	10	20	20	100
Toxaphene	20	30	30	160
Herbicides				
2,4,5-T	600	900	800	5000
2,4-D	900	1600	1300	9000
MCPA	600	900	800	5000

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
MCPB	600	900	800	5000
Mecoprop	600	900	800	5000
Picloram	4500	6600	5700	35000
Other Pesticides				
Atrazine	320	470	400	2500
Chlorpyrifos	160	340	250	2000
Bifenthrin	600	840	730	4500
Other Organics				
PCBs[8]	1	1	1	7
PBDE Flame Retardants (Br1–Br9)	1	2	2	10

Table 1A(2) Interim soil vapour health investigation levels for volatile organic chlorinated compounds

Chemical	Interim soil vapour HIL (mg/m^3)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial / Industrial[1] D
TCE	0.02	0.02	0.4	0.08
1,1,1-TCA	60	60	1200	230
PCE	2	2	40	8
cis-1,2-dichloroethene	0.08	0.08	2	0.3
Vinyl chloride	0.03	0.03	0.5	0.1

Notes:

1) NEPM Table 1A(2) was used for volatile chlorinated compound.
2) NEPM Table 1A(3) for clay soils were used for assessment of hydrocarbon compounds.

Table 1A(3) Soil HSL's for vapour intrusion (mg/kg)

	HSL A & HSL B Low – high density residential				HSL C recreational / open space				HSL D Commercial / Industrial				
Naphthalene	4	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.6	0.7	1	2	NL	NL	NL	NL	4	4	6	10	440
F1[9]	40	65	100	190	NL	NL	NL	NL	250	360	590	NL	910
F2[10]	230	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	570
CLAY													
Toluene	480	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	630
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	68
Xylenes	110	310	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	330
Naphthalene	5	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.7	1	2	3	NL	NL	NL	NL	4	6	9	20	430
F1[9]	50	90	150	290	NL	NL	NL	NL	310	480	NL	NL	850
F2[10]	280	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	560

Notes:

1) Land use settings are equivalent to those described in Table 1A (1) Footnote 1 and Schedule B7, though secondary school buildings should be assessed using residential 'A/B' for vapour intrusion purposes.
2) Interim HIL's for VOCCs are conservative soil vapour concentrations that can be adopted for the purpose of screening sites where further investigation is required on a site specific basis. They are based on the potential for vapour intrusion using an indoor air-to-soil vapour attenuation factor of 0.1 and an outdoor air-to-soil vapour attenuation factor of 0.05.
3) Application of the interim HIL's is based on a measurement of shallow (to 1m depth) soil vapour (or deeper where the values are to be applied to a future building with a basement) or sub slab soil vapour.

4) The applicability of the interim HIL's needs to be further considered when used for other building types such as homes with crawl space and no slab, which may require site specific assessment.
5) Use of the interim HIL's requires comparison with data that has been collected using appropriate methods and meets appropriate data quality requirements.
6) To obtain F1 subtract the sum of BTEX concentrations from the C6 to C10 fraction.
7) To obtain F2 subtract naphthalene from the >C10-C16 fraction.

The site is assessed under Commercial/Residential use. Consequently, the issues of concern for contamination within the site are considered to be the risk of harm to human health and environmental impacts.

The test results for soils will therefore be assessed against the available Health-Based Investigation Levels (HBIL) for Commercial/Residential 'A' & 'B'.

Based on NEPM and EPA guidelines, the following assessment criteria will be used for the assessment of site contamination and validation:

- The 95% Upper Confidence Level (UCL) of the mean of the data set must be less than the relevant threshold level; ie, it is acceptable to have individual exceedances of the guideline, but the 95% UCL of the mean of the data set of soil sample results should not exceed the threshold level.

- The standard deviation of the data set must be less than 50% of the relevant threshold level.

- No individual test result exceeds 250% of the relevant threshold level.

8.0 RESULTS & DISCUSSION

8.1 Boreholes & Visual Assessment

Samples recovered from boreholes (BH1 to BH22) were examined in the laboratory. There were no visible signs or odours to suspect soil contamination in BH1 to BH22. Fill samples were found to be typically dark brown or grey.

9.0 DISCUSSION AND SITE CHARACTERISATION

9.1 Soils

Test results recorded during the limited Stage 2 investigation are discussed below.

9.1.1 Metals (soil)

Total of 3 composite and 5 discrete soil samples were tested. All samples tested recorded below the Health-Based Investigation Levels (HBIL), for residential sites with accessible gardens (NEHF-A), and the suggested Levels in the EPA service station guidelines.

9.1.2 Total Petroleum Hydrocarbon/BTEX

Six discrete samples were tested for TPH/BTEX. All samples tested recorded TPH/BTEX levels below the laboratory detection level.

9.1.3 Polynuclear Aromatic Hydrocarbon

Six discrete samples were tested for PAH. All samples tested recorded PAH below Laboratory detection level.

9.1.4 Organochlorine and Organo phosphate Pesticides

Two composite samples were tested for OC/OP. All samples tested recorded OC/OP below Laboratory detection level.

9.1.5 Asbestos

No asbestos was detected in any of the eight soils samples tested. It may be noted that all fill samples collected were tested for asbestos.

9.2 Acid Sulphate Soil

9.2.1 Indicators of AASS & PASS

Indicators of acid sulphate materials are as follows:

Screening Tests: Potential Acid Sulphate Soil (PASS) indicators include significant negative pH shifts during screening tests and pH following oxidation (pHFox) below pH 3. Samples with pHF <4.0 indicate that insitu conditions are already acidic. For pHF approximately equal to 7 the soil is considered neutral.

Chromium Suite Tests: Indicators of PASS materials include significant actual acidity (TAA greater than 18 Mole H+/t) and Chromium Reducible Sulphur percentages ScR greater than 0.03%. Samples with pHKCL < 6.5 indicate that insitu conditions are already somewhat acidic, but TAA greater than 18 mole H+/t is required for this to be significant (depending on scale of the job and nature of the soil).

9.2.2 Assessment Criteria

The ASSMAC (1998) action criteria for treatment of ASS based on the percentage of oxidisable sulphur or equivalent Titratable Actual Acidity (TAA) or Titratable Peroxide Acidity (TPA) for broad soil texture categories are presented in Table 6.1. When analysis results exceed the action criteria, a treatment regime and management plan for the materials is triggered. For disturbances of less than 1000 tonnes, the action criteria vary according to the texture of the material, however if more than 1000 tonnes is to be disturbed, all action criteria are the same: S% 0.03% and Acid 18 mole H^+/tonne. For the purposes of this assessment the criteria applicable for disturbing more than 1000 tonnes of soil disturbed has been adopted.

Table 9.1 Action Criteria for Treatment of AASS & PASS

Texture Range	Clay Content	1-1000 tonnes disturbed		>1000 tonnes disturbed	
		Sulfur Content %	Acid Trail mole H^+/tonne	Sulfur Content %	Acid Trail mole H^+/tonne
Coarse (sands-gravels)	<5	0.03	18	0.03	18
Medium (sandy loam-light clay)	5-40	0.06	36	0.03	18
Fine (medium to heavy clays, silty clays)	>40	0.1	62	0.03	18

Source: Ahern *et al.*, 1998

Note: AASS – Actual Acid Sulfate Soils
PASS - Potential Acid Sulfate Soils

9.2.3 Screening Tests

The first stage consisted of the initial qualitative screening of the disturbed samples collected over every 0.5 metres or change of formation. The test is used to determine existing and potential acidity and was conducted by NG using the field pH (pH_F) and oxidised (pH_{FOX}) test method, which is a quick, qualitative assessment of the potential acidity of the soil. Field screening tests were carried out in NG laboratory using the following procedures:

- A soil sample approximately about 5g was placed in a test tube and a soil water suspension was made with 25ml of water.
- A second 5g soil sample was combined with 25ml of hydrogen peroxide buffered to pH 4.5-5.5 range with sodium hydroxide.
- pH readings of both suspensions were taken at the start and about one hour later.

Results of pH_F/pH_{FOX} screening tests are presented in Table 6.2.

It may be noted that ASSMAC Guideline indicates that pHf >4 are unlikely to be actual acid sulphate soils. However, a change of test methods subsequent to 1998 Guidelines requires the actual acidity to be assessed by titrating to pH 6.5. Therefore, many soils previously assessed to be not acid sulphate soils have actual acidity more than the intervention levels.

9.2.4 Results of Laboratory Testing

Results of the laboratory tests (pH_{KCL}) on selected sample is summarised in Table 9.2.

Table 9.2 Results of EAL Testing

Sample site	*Soil Text.*	*Sample Depth (m)*	pH_f	pH_{fox}
BH2	Fine	1.5-1.7	5.4	5.1
BH3	Fine	0.4-0.5	6.1	4.5
BH5	Fine	0.0-0.1	7.2	4.7
BH5	Fine	0.5-0.95	6.5	5.9
BH6	Fine	0.4-0.5	8.2	6.3
BH8	Fine	0.5-0.8	7.9	4.6
BH8	Fine	1.0-1.2	8.0	5.4
BH9	Fine	0.5-0.95	6.9	6.1

Based on the above test results, it is noticed that pH tests in water recorded pH>4.7 and pH tests in Hydrogen Peroxide recorded pH>3.0. Therefore, it is assessed that site soils are neither Actual Acid Sulphate Soils (AASS) nor Potential Acid Sulphate Soil (PASS).

No sample was sent to the external laboratory for TAA and S_{Cr} testing. And no acid sulphate management would be required for the proposed project.

10.0 SITE CHARACTERISATION

Based on the test results for samples tested, site observations, visual assessment of soils exposed in the boreholes and the site history contained in Clearsafe Phase 1 report we assess that the risk of site contamination to be low and the site is suitable for the proposed development.

Clearsafe Phase 1 contamination report identified possible pesticides from agriculture activities, heavy metal, hydrocarbon and asbestos contamination due the unknown source of the fill. The investigation targeted all these aspects and the results indicated contamination levels below the health based guidelines.

Fill was encountered in the site at a number of boreholes. Based on the investigations carried out by NG and others it is unlikely that large volume of fill to be found in the site. However the actual extent of fill present on site could only be assessed after stripping of vegetation and topsoil. It is possible that unexpected contamination hot spots, including asbestos, could be found during construction. Such contamination could be managed during construction. We recommend that an environmental/geotechnical engineer be engaged full time during initial earthworks to identify any contamination hot spots and provide advice on remediation.

11.0 WASTE DISPOSAL

In general, we consider most soils excavated to be Virgin Excavated Natural Material (VENM). This classification applies to residual soils and rock.

Fill to be excavated may need to be classified based on Excavated Natural Materials (ENM) exemption October 2012. As the physical extent of fill is not mapped accurately all fill excavated should be stockpiled in smaller stockpiles each not more than 2000t and assessed based on chemical testing.

While the fill is unlikely to be contaminated with chemicals and asbestos, it may contained process materials (concrete, bricks, ceramics etc) and foreign materials (rubber, plastic, bitumen, paper cloth etc) which may make the fill to be not ENM.

Therefore fill containing such material should be stockpiled separately from cleaner fill based on visual assessment and on the advice from a supervising environmental/geotechnical engineer. Fill assessed to be suitable based on visual assessment may be incorporated on site earthworks.

It is anticipated that there will be excess material. Residual soils or rock encountered may be disposed offsite as Virgin Excavated Natural Material (VENM).

VENM may be disposed offsite for re-use in landfill for residential/commercial developments.

12.0 CONCLUSION & RECOMMENDATIONS

Based on the investigations, it is assessed that site comprises fill to a depth of about 1.7m. The analytical test results did not record any contamination higher than the NEPM Health Based Investigation Levels (HIL) for residential use with garden/accessible soil (Column 1). Therefore the risk of contamination is assessed to be low.

The proposed development includes excavation of fill and residual soils to expose rock over most of the area proposed for development. The potential for encountering contaminated hot spots, including asbestos, is assessed to be low.

If any such contamination hot spot is found during construction, they should be managed appropriately.

Based on the investigation carried out we assess that no further stage 2 contamination assessment to be required.

For and on behalf of
Network Geotechnics Pty Ltd

Raj Singh *BEng Civil*
Geotechnical Engineer

Reviewed By

V W de Silva *MEng, SMIE Aust, CPEng, NPER*
Principal Geotechnical Engineer

GENERAL NOTES

GENERAL
Geotechnical reports present the results of investigations carried out for a specific project and usually for a specific phase of the project (e.g. preliminary design). The report may not be relevant for other phases of the project (e.g. construction), or where project details change.

SOIL AND ROCK DESCRIPTIONS
Soil and rock descriptions are based on AS 1726 – 1993, using visual and tactile assessment except at discrete locations where field and / or laboratory tests have been carried out. Refer to the terms and symbols sheet for definitions.

GROUNDWATER
The water levels indicated on the logs are taken at the time of measurement and depending on material permeability may not reflect the actual groundwater level at those specific locations. Also, groundwater levels can vary with time due to seasonal or tidal fluctuations and construction activities.

INTERPRETATION OF RESULTS
The discussion and recommendations in the accompanying report are based on extrapolation / interpolation from data obtained at discrete locations. The actual interface between the materials may be far more gradual or abrupt than indicated. Also, actual conditions in areas not sampled may differ from those predicted.

CHANGE IN CONDITIONS
Subsurface conditions can change with time and can vary between test locations. Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations can also affect subsurface conditions.

REPRODUCTION OF REPORTS
 Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimise the likelihood of misinterpretation from logs.

FURTHER ADVICE
Network Geotechnics would be pleased to further discuss how any of the above issues could affect your specific project. We would also be pleased to provide further advice or assistance including:

- assessment of suitability of designs and construction techniques;
- contract documentation and specification;
- construction control testing (earthworks, pavement materials, concrete);
- construction advice (foundation assessments, excavation support).

APPENDIX A

Borehole Logs (BH1 to BH22)
Terms & Symbols

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH01**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	LT
Checked:	VDS
RL Surface:	46.7
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301549E 6183771N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered	D				CH	Silty CLAY : high plasticity, dark brown, with roots and trace of fine to medium grained ironstone and sandstone gravel	>Pl	-	FILL, GRASS COVER
		2, 3, 4 N=7		1.0		CH	Silty CLAY : high plasticity, dark brown, with root fibres	>Pl	St	COLLUVIAL HP READING: 150, 170
		N 7,4/70mm,		2.0		-	SANDSTONE : fine to medium grained, orange brown, red brown and light grey, with occassional iron indurated band, extremely low strength	XW		'V' BIT REFUSED AT 1.8m DEPTH VL 'TC' BIT RESISTANCE
				3.0						
				4.0		-	As above, but low strength	DW	L	L 'TC' BIT RESISTANCE
		D								
				5.0			BH01 Terminated at 4.5 m			'TC' BIT REFUSAL
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH02**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	LT
Checked:	VDS
RL Surface:	45.4
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301498E 6183722N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered	D				CH	Silty CLAY : high plasticity, dark brown, with roots	>Pl	-	TOPSOIL, GRASS COVER
		1, 2, 4 N=6		1.0		CH	Silty CLAY : high plasticity, dark brown and orange brown	>Pl	St/VSt	COLLUVIAL HP READING: 170, 220, 230
		5, 10, 10 N=20		2.0		CL	Sandy Silty CLAY : low to medium plasticity, fine grained, orange brown, red brown and dark brown	<Pl	VSt	HP READING: 250, 300 'V' BIT REFUSAL
						-	SANDSTONE : fine to coarse grained, orange brown and red brown, extremely low strength	XW	-	VERY LOW 'TC' BIT RESISTANCE
		D		3.0		-	As above, but with medium strength iron indurated band			VERY LOW 'TC' BIT RESISTANCE
		D		4.0		-	As above, coarse grained			
				5.0			BH02 Terminated at 4.4 m			'TC' BIT REFUSAL
				6.0						

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

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Job No:	G09/1100 A
Hole No:	**BH03**
Sheet:	PAGE 1 / 3
Started:	21/11/13
Finished:	21/11/13
Logged:	LT
Checked:	VDS
RL Surface:	41.6
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301455E 6183661N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered	D				CH	Silty CLAY : high plasticity, dark brown, with roots	>Pl	-	TOPSOIL, GRASS COVER
		D				CH	Silty CLAY : high plasticity, grey and dark brown, with roots	>Pl	F-St	COLLUVIAL HP READING: 90, 110
		1, 2, 4 N=6		1.0		CH	As above, but brown, with root fibres		St-VSt	
		2, 3, 5 N=8		2.0						HP READING: 190, 210,220
		N>23 15, 8/50mm		3.0		-	Latite, coarse, light brown and orange brown, with medium to high strength red brown iron indurated band, extremely low strength	XW		VERY LOW 'V' BIT RESISTANCE 'V' BIT REFUSAL VERY LOW 'TC' BIT RESISTANCE A 50mm PVC INSTALLED TO THE BOTTOM, MACHINE SLOTTED BETWEEN 4.47m TO 7.47m, 2mm FILTER SAND BACKFILLED TO 0.7m, BENTONITE SEALED BETWEEN 0.2m TO 0.7m. MONUMENT CONCRETED AT SURFACE
				4.0			BH03 continued from 4.49 m on sheet 2 / 3			
				5.0						
				6.0						

BOREHOLE LOG

Network Geotechnics
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02 84380310

Job No:	G09/1100 A
Hole No:	**BH04**
Sheet:	PAGE 1 / 3
Started:	21/11/13
Finished:	22/11/13
Logged:	LT
Checked:	VDS
RL Surface:	47.4
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301395E 6183588N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered	D				CH	Silty CLAY : high plasticity, dark brown, with fine to medium grained ironstone gravel and roots	>PI	-	TOPSOIL, GRASS COVER
		1, 2, 2 N=4				CH	Silty CLAY : high plasticity, dark brown and orange brown, trace of roots and fine grained gravel	>PI	St	COLLUVIAL, HP READING: 150, 170, 180
				1.0						
		D				CH	As above, but orange brown, without roots			
		N=16 10,9,7/50mm				SC	Sandy CLAY : medium plasticity, fine to medium grained, orange brown, red brown and dark brown	<PI		HP READING: 160, 170
				2.0						
				3.0		-	Latite, coarse grained, orange brown and red brown, with clay band, extremely low strength	XW		'V' BIT REFUSAL VERY LOW 'TC' BIT RESISTANCE
				4.0				DW to XW	L-VL	VERY LOW TO LOW 'TC' BIT RESISTANCE
				5.0			BH04 continued from 4.7 m on sheet 2 / 3			
				6.0						

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

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02 84380310

Job No:	G09/1100 A
Hole No:	**BH05**
Sheet:	PAGE 1 / 3
Started:	22/11/13
Finished:	22/11/13
Logged:	LT
Checked:	VDS
RL Surface:	51.0
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301494E 6183551N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered	D				CH	Silty CLAY : high plasticity, dark brown, with roots	>PI	-	TOPSOIL, GRASS COVER
		2, 3, 4 N=7		1.0		CH	Silty CLAY : high plasticity, brown, trace of root fibres and fine grained ironstone gravel	>PI	VSt	COLLUVIAL HP READING: 250, 270, 290
		3, 6, 9 N=15		2.0		CH	Silty CLAY : high plasticity, grey brown, trace of root fibres and fine grained ironstone gravel	<PI		HP READING: 300, 320, 370
		N>18 4,8,10/100mm		3.0		CH	Silty CLAY : high plasticity, grey to dark brown, orange brown and red brown, fine to medium ironstone gravel			HP READING: 370, 380, 380
						-	SANDSTONE : fine to medium grained, orange brown, extremely low strength	XW		VERY LOW 'V' BIT RESISTANCE 'V' BIT REFUSAL
				4.0		-	Latite: dark grey	SW	H	MEDIUM 'TC' BIT RESISTANCE
						-	Latite, coarse grained, orange brown with iron indurated band	HW	L	LOW 'TC' BIT RESISTANCE
							BH05 continued from 4.15 m on sheet 2 / 3			
				5.0						
				6.0						

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

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Job No:	G09/1100 A
Hole No:	**BH06**
Sheet:	PAGE 1 / 2
Started:	21/11/13
Finished:	21/11/13
Logged:	LT
Checked:	VDS
RL Surface:	51.5
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301512E 6183598N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered	D				CH	Silty CLAY : high plasticity, dark brown, with roots and trace of fine to medium grained ironstone gravel	>Pl	-	TOPSOIL, GRASS COVER
		D				CH	Silty CLAY : high plasticity, grey and dark brown, trace of fine to medium grained ironstone gravel	>Pl	St	COLLUVIAL HP READING: 110, 120
		1, 2, 3 N=5		1.0		-	SANDSTONE : fine to medium grained, brown, extremely low strength	XW		VERY LOW 'V' BIT RESISTANCE 'V' BIT REFUSAL
		D						DW	VL	LOW 'TC' BIT RESISTANCE, A 50mm PVC INSTALLED TO THE BOTTOM, MACHINE SLOTTED BETWEEN 3m TO 4.74m, 2mm FILTER SAND BACKFILLED TO 0.7m, BENTONITE SEALED BETWEEN 0.2m TO 0.7m. MONUMENT CONCRETED AT SURFACE
				2.0			BH06 continued from 1.95 m on sheet 2 / 2			
				3.0						
				4.0						
				5.0						
				6.0						

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Job No:	G09/1100 A
Hole No:	**BH07**
Sheet:	PAGE 1 / 1
Started:	21/11/13
Finished:	21/11/13
Logged:	LT
Checked:	VDS
RL Surface:	67.1
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301609E 6183584N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered					CH	Silty CLAY : high plasticity, orange brown	>PI		RESIDUAL
		4, 3, 7 N=10		1.0		CH	As above, but with fine to medium grained very low strength sandstone grave	<PI	St	
		3, 4, 7 N=11		2.0						
		N=R 6, 5,-		3.0						'V' BIT REFUSAL
		D		4.0		-	SANDSTONE : fine to medium grained, orange brown	DW	VL	VERY LOW 'TC' BIT RESISTANCE
				5.0			BH07 Terminated at 4.4 m			'TC' BIT REFUSAL
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH08**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	LT
Checked:	VDS
RL Surface:	43.3
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301461E 6183614N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered					CH	Silty CLAY high plasticity, dark grey and dark brown, with fine grained sand, fine grained ironstone gravel and roots	>Pl	-	TOPSOIL, GRASS COVER
		1, 4, 4 N=8		1.0		CH	Silty CLAY high plasticity, dark brown and dark grey, with root fibres	>Pl	St	COLLUVIAL HP READING: 170, 180, 190
		D				CH	As above, but brown and grey, trace of fine grained ironstone gravel			
		2, 4, 7 N=11		2.0					VSt	HP READING: 270, 290, 300
		N>18 6, 18,-		3.0		-	Latite, coarse grained, orange brown and dark grey, with clay band, extremely low strength	XW		VERY LOW 'V' BIT RESISTANCE
				4.0				XW/DW		'V' BIT REFUSAL VERY LOW 'TC' BIT RESISTANCE
				5.0						
				6.0						
				7.0			BH08 Terminated at 7 m			A 50mm PVC INSTALLED TO THE BOTTOM, MACHINE SLOTTED BETWEEN 4m TO 7m, 2mm FILTER SAND BACKFILLED TO 0.7m, BENTONITE SEALED BETWEEN 0.2m TO 0.7m. MONUMENT CONCRETED AT SURFACE
				8.0						
				9.0						
				10.0						
				11.0						
				12.0						
				13.0						

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH09**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	LT
Checked:	VDS
RL Surface:	46.4
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301582E 6183823N

Equipment Type: MOBILE DRILL B80

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None encountered	D				CL	Silty CLAY : medium plasticity, dark brown, with fine to coarse grained sandstone and ironstone gravel	~Pl	-	TOPSOIL, GRASS COVER
		2, 2, 3 N=5		1.0						
		7, 9, 8 N=17				CH	Silty CLAY : high plasticity, dark brown, with root fibres	>Pl	St	COLLUVIAL
				2.0						'V' BIT REFUSAL
						-	SANDSTONE fine to medium grained, orange brown, extremely low strength	XW		VERY LOW 'TC' BIT RESISTANCE
		D		3.0		-	As above, but orange brown and light grey, medium strength	DW	M	MEDIUM 'TC' BIT RESISTANCE
				4.0						
		D				-	As above, but orange brown			
				5.0				SW	H	HIGH 'TC' BIT RESISTANCE
							BH09 Terminated at 5.1 m			'TC' BIT REFUSAL
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH10**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	45.8
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301600E 6183836N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None encountered	D				SC	Sandy CLAY medium to high plasticity, fine grained, dark grey, sand fine to medium grained	>Pl	-	FILL, GRASS COVER
		D		1.0			BH10 Terminated at 1 m			
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH11**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	46.9
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301596E 6183814N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None encountered during augering					ML	Sandy SILT low plasticity, fine grained, dark grey, with root fibres	W	-	TOPSOIL
						-	SANDSTONE extremely weathered, brown	-	-	ROCK
							BH11 Terminated at 0.2 m			
				1.0						
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH12**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	46.4
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301569E 6183809N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None encountered during augering					ML	Sandy SILT low plasticity, fine grained, dark grey, with root fibres	-	-	TOPSOIL
		D				CI/CH	Silty CLAY medium to high plasticity, dark grey, some gravel	>Wp	-	FILL
				1.0			BH12 Terminated at 0.5 m			
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH13**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	42.2
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301511E 6183772N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D D				CH	Sandy CLAY high plasticity, brown, sand fine to medium grained	>Wp	-	FILL
				1.0			BH13 Terminated at 0.5 m			
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH14**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	38.9
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301459E 6183731N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D				CI/CH	Sandy CLAY medium to high plasticity, dark grey, sand fine to medium grained, some gravel	≥Wp	-	FILL
							BH14 Terminated at 0.3 m			
				1.0						
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH15**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	37.4
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301433E 6183706N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D				SM	Silty SAND fine to medium grained, brown, traces of grass rootlets	-	-	TOPSOIL
						CI	Silty CLAY high plasticity, grey, sand fine to medium grained	>Wp	-	FILL
				1.0			BH15 Terminated at 0.5 m			
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH16**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	37.7
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301420E 6183679N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D				SP	Silty SAND fine to medium grained, brown, traces of grass rootlets	M	-	TOPSOIL
						CH	Silty CLAY medium to high plasticity, grey	>Wp	-	RESIDUAL
				1.0			BH16 Terminated at 0.3 m			
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH17**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	42.3
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301392E 6183635N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D				CI	Silty CLAY low to medium plasticity, dark grey, traces of grass rootlets	<Wp	-	TOPSOIL
						CH	Silty CLAY medium to high plasticity, dark grey	>Wp	-	RESIDUAL
				1.0			BH17 Terminated at 0.3 m			
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH18**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	41.3
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301451E 6183679N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered					ML	Sandy SILT low plasticity, dark grey, some grass rootlets	<Wp	-	TOPSOIL
						CH	Silty CLAY high plasticity, dark grey	≥Wp	-	RESIDUAL
				1.0			BH18 Terminated at 0.3 m			
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH19**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	52.4
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301553E 6183707N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D				CI	Sandy CLAY medium to high plasticity, grey, sand fine to medium grained	<Wp	-	TOPSOIL
						-	SANDSTONE extremely weathered, brown	-	-	ROCK
							BH19 Terminated at 0.3 m			
				1.0						
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH20**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	52.5
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301538E 6183661N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D				CI	Sandy CLAY medium to high plasticity, dark grey, sand fine to medium grained	<Wp	-	TOPSOIL
						-	SANDSTONE extremely weathered, brown	-	-	ROCK
							BH20 Terminated at 0.3 m			
				1.0						
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH21**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	RS
Checked:	VDS
RL Surface:	53.5
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301538E 6183619N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None Encountered	D				ML	Sandy SILT low plasticity, dark grey, sand fine to medium grained, some gravel/ironstone	<Wp		TOPSOIL
						-	SANDSTONE extremely weathered, brown	-		ROCK
							BH21 Terminated at 0.3 m			
				1.0						
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics
ACN 069 211 561
Unit 12/9-15 Gundah Road
Mt Kuring-Gai NSW 2080
02 84380300
02 84380310

Job No:	G09/1100 A
Hole No:	**BH22**
Sheet:	PAGE 1 / 1
Started:	28/11/13
Finished:	28/11/13
Logged:	LT
Checked:	VDS
RL Surface:	65.3
Datum:	A.H.D

Client: TCG PLANNING

Project: LIFE CITY WOLLONONG

Location: Warwick Street, Berkeley
GPS 301611E 6183599N

Equipment Type: HAND AUGER

Borehole Diameter: 100mm (I.D.) Inclination: -90 deg Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
HA	None encountered	D				CL	Silty CLAY : medium plasticity, dark brown, with roots	>PI	-	TOPSOIL, GRASS COVER
						CH	Silty CLAY : high plasticity, orange brown, with fine to medium grained sandstone gravel	<PI	St	RESIDUAL
				1.0			BH22 Terminated at 0.4 m			HAND AUGER REFDUSAL
				2.0						
				3.0						
				4.0						
				5.0						
				6.0						

BOREHOLE LOG G09-1100 LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 3/1/14

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

TERMS AND SYMBOLS

SOIL DESCRIPTIONS

Moisture Condition

D	Dry
M	Moist
W	Wet
Wp	Plastic Limit
Wl	Liquid Limit
MC	Moisture Content

Consistency

		Qu (kPa)
VS	Very Soft	<25
S	Soft	25 – 50
F	Firm	50 – 100
St	Stiff	100 – 200
VSt	Very Stiff	200 – 400
H	Hard	>400
Fb	Friable	

Density Index

		I_D (%)
VL	Very Loose	< 15
L	Loose	15 – 35
MD	Medium Dense	35 – 65
D	Dense	65 – 85
VD	Very Dense	> 85

ROCK DESCRIPTIONS

Weathering

Rs	Residual Soil
XW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
DW	Distinctly Weathered
SW	Slightly Weathered
FR	Fresh

(DW covers both HW & MW)

Strength

		Is (50) MPa
EL	Extremely Low	< 0.03
VL	Very Low	0.03 – 0.1
L	Low	0.1 – 0.3
M	Medium	0.3 – 1
H	High	1 – 3
VH	Very High	3 – 10
EH	Extremely High	> 10

Structure

	Spacing
Thinly Laminated	< 6mm
Laminated	6 – 20mm
Very thinly bedded	20 – 60mm
Thinly bedded	60 – 200mm
Medium bedded	0.2 – 0.6m
Thickly bedded	0.6 – 2.0m
Very thickly bedded	> 2.0m

NOTE: Soil And rock descriptions are based on AS 1726 - 1993

Natural Fractures

Type		Shape	
JT	Joint	pl	Planar
BP	Bedding plane	cu	Curved
SM	Seam	un	Undulose
FZ	Fractured zone	st	Stepped
SZ	Shear zone	ir	Irregular
VN	Vein		

Infill or Coating		Roughness	
Cn	Clean	pol	Polished
Cl	Clay	slk	Slickensided
Ca	Calcite	smo	Smooth
Fe	Iron oxide	rou	Rough
Mi	Micaceous	vro	Very rough
Qz	Quartz		

EXCAVATION / DRILLING METHOD & CASING

BH	Backhoe/excavator bucket
NE	Natural exposure
HE	Hand excavation
AS	Auger Screwing *
AD	Auger Drilling *
R	Roller/Tricone
W	Washbore

** denotes bit shown by suffix*

B	Blank Bit
V	"V" Shaped Bit
T	Tungsten Carbide Bit
LB	Large Bore Push Tube Drilling
MC	Macro Core Push Tube Drilling
DT	Dual Push Tube Drilling

NMLC	NMLC Core Drilling
NQ/HQ	Wireline Core Drilling

C	Casing
M	Mud

SAMPLES / TESTS

B	Bulk sample
D	Disturbed sample
U50	Thin-walled tube sample (50mm diameter)
PP	Pocket penetrometer (kPa)
N*	SPT (blows per 300mm)
	**denotes sample taken*
Nc	SPT with solid cone
R	SPT refusal

VANE SHEAR TESTS

s_U	Vane shear strength Peak/residual (kPa) and Vane size (mm)

WATER MEASUREMENTS

▼	Water level at the time of drilling
—	
▽	Water level after drilling
▲—	Water inflow
—▲	Water outflow

PUSH TUBE DRILLING

Degree of Resistance	Factor
No percussion	0
Fast push with percussion	1
Medium push with percussion	2
Slow push with percussion	3
Very slow – nearing refusal	4

APPENDIX B

Laboratory Contamination Test Results

CERTIFICATE OF ANALYSIS

Work Order	: **ES1326530**	Page	: 1 of 7
Client	: **NETWORK GEOTECHNICS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: LONG TSANG	Contact	: Client Services
Address	: UNIT 1, 140 INDUSTRIAL ROAD OAK FLATS NSW, AUSTRALIA 2529	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ltsang@netgeo.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 4257 5548	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4257 4463	Facsimile	: +61-2-8784 8500
Project	: LIFE OF CITY	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: GO9/1100		
C-O-C number	: ----	Date Samples Received	: 04-DEC-2013
Sampler	: LT	Issue Date	: 13-DEC-2013
Site	: ----		
		No. of samples received	: 24
Quote number	: SY/455/13	No. of samples analysed	: 4

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ALS is not NATA accredited for the analysis of Bifenthrin in soils when performed under ALS Method EP068D**

Analytical Results

Sub-Matrix: COMPOSITE (Matrix: SOIL)			Client sample ID	C1	C2	C3	----	----
			Client sampling date / time	28-NOV-2013 15:00	22-NOV-2013 15:00	21-NOV-2013 15:00	----	----
Compound	CAS Number	LOR	Unit	ES1326530-021	ES1326530-022	ES1326530-023	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	22.9	30.6	31.0	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	6	18	6	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg	28	24	24	----	----
Copper	7440-50-8	5	mg/kg	52	46	51	----	----
Lead	7439-92-1	5	mg/kg	10	26	18	----	----
Nickel	7440-02-0	2	mg/kg	8	9	8	----	----
Zinc	7440-66-6	5	mg/kg	31	78	58	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	<0.1	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	<0.05	<0.05	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	<0.05	<0.05	----	----
beta-BHC	319-85-7	0.05	mg/kg	----	<0.05	<0.05	----	----
gamma-BHC	58-89-9	0.05	mg/kg	----	<0.05	<0.05	----	----
delta-BHC	319-86-8	0.05	mg/kg	----	<0.05	<0.05	----	----
Heptachlor	76-44-8	0.05	mg/kg	----	<0.05	<0.05	----	----
Aldrin	309-00-2	0.05	mg/kg	----	<0.05	<0.05	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	<0.05	<0.05	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	----	<0.05	<0.05	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	----	<0.05	<0.05	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	<0.05	<0.05	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	----	<0.05	<0.05	----	----
Dieldrin	60-57-1	0.05	mg/kg	----	<0.05	<0.05	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	----	<0.05	<0.05	----	----
Endrin	72-20-8	0.05	mg/kg	----	<0.05	<0.05	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	<0.05	<0.05	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	<0.05	<0.05	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	----	<0.05	<0.05	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	<0.05	<0.05	----	----

Analytical Results

Sub-Matrix: **COMPOSITE** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	C1	C2	C3	----	----
				Client sampling date / time	28-NOV-2013 15:00	22-NOV-2013 15:00	21-NOV-2013 15:00	----	----
					ES1326530-021	ES1326530-022	ES1326530-023	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
Endosulfan sulfate	1031-07-8	0.05	mg/kg		----	<0.05	<0.05	----	----
4.4`-DDT	50-29-3	0.2	mg/kg		----	<0.2	<0.2	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		----	<0.05	<0.05	----	----
Methoxychlor	72-43-5	0.2	mg/kg		----	<0.2	<0.2	----	----
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		----	<0.05	<0.05	----	----
^ **Sum of DDD + DDE + DDT**	----	0.05	mg/kg		----	<0.05	<0.05	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		----	<0.05	<0.05	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		----	<0.05	<0.05	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		----	<0.2	<0.2	----	----
Dimethoate	60-51-5	0.05	mg/kg		----	<0.05	<0.05	----	----
Diazinon	333-41-5	0.05	mg/kg		----	<0.05	<0.05	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		----	<0.05	<0.05	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		----	<0.2	<0.2	----	----
Malathion	121-75-5	0.05	mg/kg		----	<0.05	<0.05	----	----
Fenthion	55-38-9	0.05	mg/kg		----	<0.05	<0.05	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	<0.05	<0.05	----	----
Parathion	56-38-2	0.2	mg/kg		----	<0.2	<0.2	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	<0.05	<0.05	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	<0.05	<0.05	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	<0.05	<0.05	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		----	<0.05	<0.05	----	----
Prothiofos	34643-46-4	0.05	mg/kg		----	<0.05	<0.05	----	----
Ethion	563-12-2	0.05	mg/kg		----	<0.05	<0.05	----	----
Carbophenothion	786-19-6	0.05	mg/kg		----	<0.05	<0.05	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		----	<0.05	<0.05	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		----	**60.7**	**60.9**	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		----	**83.0**	**85.6**	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		----	**96.1**	**79.8**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH1 0-0.1	----	----	----	----
			Client sampling date / time	28-NOV-2013 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1326530-001	----	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	22.2	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg	<0.5	----	----	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	0.6	----	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	1.2	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	----	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
>C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg	<100	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BH1 0-0.1	----	----	----	----
				Client sampling date / time	28-NOV-2013 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1326530-001	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 - Continued									
>C34 - C40 Fraction	----	100	mg/kg		<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg		<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	----	----	----	----
^ Sum of BTEX	----	0.2	mg/kg		<0.2	----	----	----	----
^ Total Xylenes	1330-20-7	0.5	mg/kg		<0.5	----	----	----	----
Naphthalene	91-20-3	1	mg/kg		<1	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		**72.2**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		**84.2**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%		**110**	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**89.1**	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%		**83.9**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		**80.4**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**97.3**	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		**106**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		**103**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **COMPOSITE**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	39	149
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	49	147
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	35	143

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	63	123
2-Chlorophenol-D4	93951-73-6	66	122
2.4.6-Tribromophenol	118-79-6	40	138
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	70	122
Anthracene-d10	1719-06-8	66	128
4-Terphenyl-d14	1718-51-0	65	129
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	72.8	133.2
Toluene-D8	2037-26-5	73.9	132.1
4-Bromofluorobenzene	460-00-4	71.6	130.0

CERTIFICATE OF ANALYSIS

Work Order	: **ES1326278**	Page	: 1 of 6
Client	: **NETWORK GEOTECHNICS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR RAJ SINGH	Contact	: Client Services
Address	: 12 / 9-15 Gundah Rd MT KU-RING-GAI NSW, AUSTRALIA 2080	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: rsingh@netgeo.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 8438 0300	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 8438 0310	Facsimile	: +61-2-8784 8500
Project	: G09 1100	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 03-DEC-2013
Sampler	: RAJ SINGH	Issue Date	: 11-DEC-2013
Site	: BERKELEY		
		No. of samples received	: 14
Quote number	: SY/455/13	No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Phalak Inthaksone	Laboratory Manager - Organics	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BH10 0.8-1.0M	BH12 0.3-0.5M	BH13 0.4-0.5M	BH14 0.1-0.2M	BH15 0.1-0.3M
				Client sampling date / time	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00
Compound	CAS Number	LOR	Unit		ES1326278-002	ES1326278-004	ES1326278-005	ES1326278-007	ES1326278-008
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		26.4	29.6	30.1	26.4	29.4
EG005T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		8	18	14	8	8
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		49	26	36	21	20
Copper	7440-50-8	5	mg/kg		79	62	60	37	38
Lead	7439-92-1	5	mg/kg		19	27	22	22	26
Nickel	7440-02-0	2	mg/kg		9	11	11	6	8
Zinc	7440-66-6	5	mg/kg		68	88	46	46	67
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		0.6	0.6	0.6	0.6	0.6
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		1.2	1.2	1.2	1.2	1.2
EP080/071: Total Petroleum Hydrocarbons									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	Client sample ID	BH10 0.8-1.0M	BH12 0.3-0.5M	BH13 0.4-0.5M	BH14 0.1-0.2M	BH15 0.1-0.3M
				Client sampling date / time	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00
					ES1326278-002	ES1326278-004	ES1326278-005	ES1326278-007	ES1326278-008
EP080/071: Total Petroleum Hydrocarbons - Continued									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	>C10_C16	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		**99.1**	**99.5**	**98.2**	**96.2**	**94.0**
2-Chlorophenol-D4	93951-73-6	0.1	%		**106**	**106**	**103**	**100**	**98.6**
2.4.6-Tribromophenol	118-79-6	0.1	%		**87.1**	**82.4**	**81.6**	**79.5**	**73.7**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**114**	**111**	**106**	**105**	**102**
Anthracene-d10	1719-06-8	0.1	%		**94.0**	**89.8**	**90.6**	**88.1**	**84.7**
4-Terphenyl-d14	1718-51-0	0.1	%		**94.6**	**83.8**	**86.4**	**83.3**	**80.4**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**99.4**	**109**	**108**	**107**	**92.7**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH10 0.8-1.0M	BH12 0.3-0.5M	BH13 0.4-0.5M	BH14 0.1-0.2M	BH15 0.1-0.3M
			Client sampling date / time	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00	19-NOV-2013 15:00
Compound	CAS Number	LOR	Unit	ES1326278-002	ES1326278-004	ES1326278-005	ES1326278-007	ES1326278-008
EP080S: TPH(V)/BTEX Surrogates - Continued								
Toluene-D8	2037-26-5	0.1	%	**87.1**	**96.4**	**96.0**	**100**	**82.7**
4-Bromofluorobenzene	460-00-4	0.1	%	**109**	**105**	**103**	**112**	**97.3**

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	63	123
2-Chlorophenol-D4	93951-73-6	66	122
2.4.6-Tribromophenol	118-79-6	40	138
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	70	122
Anthracene-d10	1719-06-8	66	128
4-Terphenyl-d14	1718-51-0	65	129
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	72.8	133.2
Toluene-D8	2037-26-5	73.9	132.1
4-Bromofluorobenzene	460-00-4	71.6	130.0

AUSTRALIAN SAFER ENVIRONMENT & TECHNOLOGY PTY LTD

ABN 36 088 095 112

Our ref : ASET36491/ 39671 / 1 - 3
Your ref : ES1326530
NATA Accreditation No: 14484

12 December 2013

Australian Laboratory Services Pty Ltd
277 - 284 Woodpark Road
Smithfield NSW 2164

Attn: Ms Nanthini Coilparampil

Dear Nanthini

Asbestos Identification
This report presents the results of three samples, forwarded by Australian Laboratory Services Pty Ltd on 10 December 2013, for analysis for asbestos.

1.Introduction: Three samples forwarded were examined and analysed for the presence of asbestos.

2. Methods : The samples were examined under a Stereo Microscope and selected fibres were analysed by Polarized Light Microscopy in conjunction with Dispersion Staining method. **(Safer Environment Method 1.)**

3. Results :

Sample No. 1. ASET36491 / 39671 / 1. ES1326530 - 21 - C1.
Approx dimensions 4.8 cm x 4.5 cm x 4.3 cm
The sample consisted of a mixture of clayish soil, stones and plant matter.
No asbestos detected.

Sample No. 2. ASET36491 / 39671 / 2. ES1326530 - 22 - C2.
Approx dimensions 4.8 cm x 4.6 cm x 4.5 cm
The sample consisted of a mixture of clayish soil, stones and plant matter.
No asbestos detected.

Sample No. 3. ASET36491 / 39671 / 3. ES1326530 - 23 - C3.
Approx dimensions 4.8 cm x 4.6 cm x 3.9 cm
The sample consisted of a mixture of clayish soil, stones and plant matter.
No asbestos detected.

Analysed and reported by,

Laxman Dias. BSc
Analyst / Approved Identifier
Approved Signatory

NATA
WORLD RECOGNISED
ACCREDITATION

This document is issued in accordance with NATA's Accreditation requirements. Accredited for compliance with ISO/IEC 17025.

AUSTRALIAN SAFER ENVIRONMENT & TECHNOLOGY PTY LTD

ABN 36 088 095 112

Our ref: ASET36492/ 39672 / 1 - 5
Your ref: ES1326278
NATA Accreditation No: 14484

11 December 2013

Australian Laboratory Services Pty Ltd
277 – 284 Woodpark Road
Smithfield NSW 2164

Attn: Ms Nanthini Coilparampil

Dear Nanthini,

Asbestos Identification

This report presents the results of five samples, forwarded by Australian Laboratory Services Pty Ltd on 10 December 2013, for analysis for asbestos.

1.Introduction: Five samples forwarded were examined and analysed for the presence of asbestos.

2. Methods : The samples were examined under a Stereo Microscope and selected fibres were analysed by Polarized Light Microscopy in conjunction with Dispersion Staining method **(Safer Environment Method 1.)**

3. Results :

Sample No. 1. ASET36492 / 39672 / 1. ES1326278 - 002 - BH10 - 0.8-1.0.
Approx dimensions 4.2 cm x 4.1 cm x 2.2 cm
The sample consisted of a mixture of soil, stones, plant matter, fragments of plaster and corroded metal.
No asbestos detected.

Sample No. 2. ASET36492 / 39672 / 2. ES1326278 - 004 - BH12 - 0.3-0.5.
Approx dimensions 4.0 cm x 4.0 cm x 2.4 cm
The sample consisted of a mixture of clayish soil, stones, plant matter and fragments of plaster.
No asbestos detected.

Sample No. 3. ASET36492 / 39672 / 3. ES1326278 - 005 - BH13 - 0.4-0.5.
Approx dimensions 4.3 cm x 4.0 cm x 2.3 cm
The sample consisted of a mixture of clayish soil, stones and plant matter.
No asbestos detected.

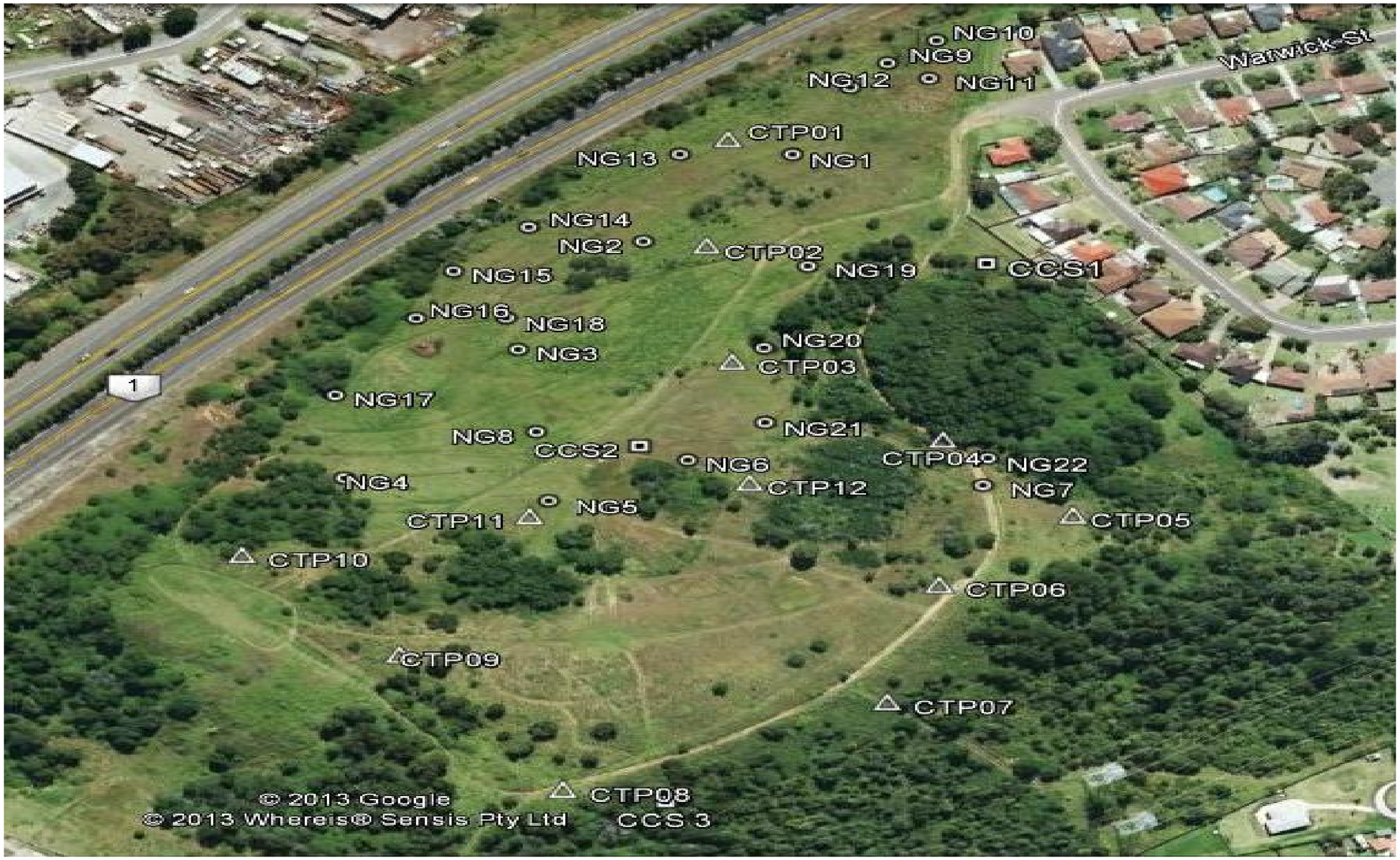
Sample No. 4. ASET36492 / 39672 / 4. ES1326278 - 007 - BH14 - 0.1-0.2.
Approx dimensions 4.5 cm x 4.0 cm x 2.2 cm
The sample consisted of a mixture of clayish soil, stones, plant matter and pieces of corroded metal.
No asbestos detected.

Sample No. 5. ASET36492 / 39672 / 5. ES1326278 - 008 - BH15 - 0.1-0.3.
Approx dimensions 4.1 cm x 4.1 cm x 2.1 cm
The sample consisted of a mixture of clayish soil, stones and plant matter.
No asbestos detected.

Analysed and reported by,

Nisansala Maddage. BSc(Hons)
Environmental Scientist/Approved Identifier
Approved Signatory

This document is issued in accordance with NATA's Accreditation requirements. Accredited for compliance with ISO/IEC 17025.



LEGEND

O NETWORK GEOTECHNICS BOREHOLE 2013

Δ COFFEY GEOTECHNICS TEST PIT 2012

□ CLEARSAFE CONTAMINATION SPOT 2012

Network Geotechnics Pty Ltd
Geotechnical Engineering, Consulting & Testing Services

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Facsimile 61 2 4257 4463
Email southcoast@netgeo.com.au

NOT IN SCALE
DRAWING NO: G09/1100-A

CLIENT: TCG PLANNING

PROJECT: PROPOSED LIFE CITY PROJECT

LOCATION: WARWICK STREET, BERKELEY, NSW

APPROXIMATE TEST LOCATION PLAN