ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

PYMBLE LADIES COLLEGE

ON

PRELIMINARY STAGE 2 ENVIRONMENTAL SITE ASSESSMENT

FOR

PROPOSED DEVELOPMENT (STAGE 1 WORKS)

AT

PYMBLE LADIES COLLEGE, 20-64 AVON ROAD, PYMBLE, NSW

OCTOBER 2012

REF: E25921KPrpt2

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Postal Address: PO Box 976, North Ryde BC NSW 1670
Tel: 02 9888 5000 • Fax: 9888 5004
EIS is a division of Jeffery and Katauskas Pty Ltd • ABN 17 003 550 801

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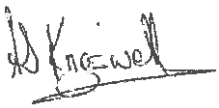
Report prepared by:

Brendan Page
Senior Environmental Scientist

Report reviewed by:



Adrian Kingswell
Principal

EXECUTIVE SUMMARY

Pymble Ladies College (PLC) commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake a preliminary Stage 2 Environmental Site Assessment (ESA) for the proposed development (Stage 1 Works) at Pymble Ladies College, 20-64 Avon Road, Pymble, NSW.

The proposed Stage 1 development works area (referred to as "the site" within this report) is identified as part of Lot 1 in DP69541 and at the time of this investigation formed part of the wider PLC grounds. The site location is shown on Figure 1 and the ESA was confined to the site boundaries as shown on Figure 2. The various stages of the overall development layout (Stages 1 to 4 inclusive) are shown on Figure 3.

It is understood that this report is to be assessed by the NSW Department of Planning and Infrastructure as part of the development approval process for the Stage 1 works area.

The proposed Stage 1 works will include demolition of the existing outdoor pools, pool plant room and pool concourse areas, followed by construction of a new Aquatic and Fitness Centre building, incorporating a new 50m lap and diving pool.

The objectives of the preliminary Stage 2 ESA are to:

- Make a preliminary assessment of the soil contamination conditions at the site;
- Assign a preliminary waste classification to the soil to be excavated during the proposed development works;
- Assess the requirement to prepare a remedial action plan (RAP) for the proposed development; and
- Prepare a report presenting the results of the ESA.

The scope of work included:

- Review the previous assessment report prepared by EIS;
- Design and implementation of a limited field sampling and laboratory analysis program;
- Interpretation of the analytical results based on the Site Assessment Criteria (SAC) adopted for the ESA; and
- Preparation of a report.

The investigation included soil sampling from three boreholes and the analysis of fill soil and natural soil samples for a range of potential contaminants of concern (PCC).

Elevated concentrations of contaminants, above the SAC, were not encountered in the soil samples analysed for the investigation. Based on these results, EIS are of the opinion that the potential for significant widespread soil contamination at the site is relatively low. A RAP is not considered necessary for the site.

The zinc concentration in one fill soil sample obtained from BH103 (0-0.1m) was above the Provisional Phytotoxicity Investigation Level (PPIL). The PPIL criteria are principally concerned with phytotoxicity (i.e. adverse effects on plant growth in established and proposed areas of landscaping) and are described in NEPM 1999 as *"somewhat arbitrary"*, as the effect of these compounds on plant growth will depend on the soil and plant type.

BH103 was located within an established garden area and the surrounding trees/shrubs showed no obvious signs of stress. However, in the event that the fill material in and around BH103 is to be re-used on-site during the proposed development works, this material should either: be placed in an area where landscaping is not proposed; or further consideration of the zinc concentration would be required by the landscape consultants.

Based on the results of the assessment, the fill soils at the site are classified as 'General Solid Waste (non-putrescible)', in accordance with the Waste Classification Guidelines 2009.

The underlying natural material is classified as Virgin Excavated Natural Material (VENM). Material classed as VENM must not be mixed with any fill material (including building rubble) as this will invalidate the VENM classification. Where doubt exists about the difference between fill and VENM material an environmental/geotechnical engineer should be contacted.

Based on the results of the preliminary Stage 2 ESA, EIS consider the site (Stage 1 Works Area) to be suitable for the proposed development. In the event that anything unexpected is encountered during earthworks, EIS should be contacted for advice.

The conclusions presented in this report have been made within the limitations of the scope of works undertaken for the investigation. The conclusions and recommendations should be read in conjunction with the limitations presented in the body of the report.

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1 INTRODUCTION

Pymble Ladies College (PLC) commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake a preliminary Stage 2 Environmental Site Assessment (ESA) for the proposed development (Stage 1 Works) at Pymble Ladies College, 20-64 Avon Road, Pymble, NSW.

The proposed Stage 1 development works area (referred to as "the site" within this report) is identified as part of Lot 1 in DP69541 and at the time of this investigation formed part of the wider PLC grounds. The site location is shown on Figure 1 and the ESA was confined to the site boundaries as shown on Figure 2. The various stages of the overall development layout (Stages 1 to 4 inclusive) are shown on Figure 3.

The ESA was undertaken generally in accordance with an EIS proposal (Ref: EP6670KP2) of 10 October 2012 and written acceptance from PLC of 11 October 2012.

A geotechnical investigation was undertaken previously to the preliminary Stage 2 ESA by JK Geotechnics (a division of J&K). The results are presented in a separate report (Ref: 25921ZHrpt, dated 15 August 2012[1]). EIS has also previously undertaken a Stage 1 ESA for the overall development proposal (see **Section 2** for details).

It is understood that this report is to be assessed by the NSW Department of Planning and Infrastructure as part of the development approval process for the Stage 1 works area.

1.1 Proposed Development Details

The proposed Stage 1 works will include demolition of the existing outdoor pools, pool plant room and pool concourse areas, followed by construction of a new Aquatic and Fitness Centre building, incorporating a new 50m lap and diving pool.

The proposed pool concourse will be at a reduced level (RL) of 120.1m, with the base of the 50m lap pool at approximately RL118.1m (i.e. 2m below the pool concourse level). To achieve these levels, the maximum bulk excavation depths will range from approximately 3.0m to 5.6m below the existing ground level.

The proposed pool plant rooms will be constructed at RL116.1m and will be located on the downhill side (i.e. to the west) of the proposed pool. Bulk excavation to a maximum depth of approximately 3.0m will be required.

[1] Referred to as JK Report

The adjacent, proposed learners' pool to the south of the plant rooms will be suspended above existing ground level. The proposed fitness centre slab will also be suspended above the proposed learners' pool.

1.2 Objectives

The objectives of the preliminary Stage 2 ESA are to:

- Make a preliminary assessment of the soil contamination conditions at the site;
- Assign a preliminary waste classification to the soil to be excavated during the proposed development works;
- Assess the requirement to prepare a remedial action plan (RAP) for the proposed development; and
- Prepare a report presenting the results of the ESA.

1.3 Scope of Work

The scope of work included:

- Review the previous assessment report prepared by EIS;
- Design and implementation of a limited field sampling and laboratory analysis program;
- Interpretation of the analytical results based on the Site Assessment Criteria (SAC) adopted for the ESA; and
- Preparation of a report presenting the results of the ESA.

The scope of work was generally undertaken with reference to the regulations/guidelines outlined in the table below. Individual guidelines applicable for this investigation are referenced within the text of the report (as applicable).

Table 1-1: Guidelines

Guidelines/Regulations/Documents
Contaminated Land Management Amendment Act (2008[2])
State Environmental Planning Policy No.55 – Remediation of Land (1998[3])
NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (1997[4])
Guidelines on the Duty to Report Contamination[5]
Guidelines for the NSW Site Auditor Scheme, 2nd Edition (2006[6])

[2] *Contaminated Land Management Amendment Act,* NSW Government Legislation, 2008 (CLM Amendment Act 2008)

[3] *State Environmental Planning Policy No. 55 – Remediation of Land,* NSW Government, 1998 (SEPP55)

[4] *Guidelines for Consultants Reporting on Contaminated Sites,* NSW EPA, 1997 (Reporting Guidelines 1997)

[5] *Guidelines on the Duty to Report Contamination*, NSW EPA, Draft 2011 (Duty to Report Contamination 2011)

[6] *Guidelines for the NSW Site Auditor Scheme, 2nd ed.,* NSW DEC, 2006 (Site Auditor Guidelines 2006)

Guidelines/Regulations/Documents
National Environmental Protection (Assessment of Site Contamination) Measure (1999[7]).
NSW EPA Contaminated Sites Sampling Design Guidelines (1995[8])
NSW DECCW Waste Classification Guidelines - Part 1: Classifying Waste (2009[9])
NSW EPA Contaminated Sites: Guidelines for Assessing Service Station Sites (1994[10])
Working with Asbestos Guide (2008[11])

[7] *National Environmental Protection (Assessment of Site Contamination) Measure,* National Environment Protection Council (NEPC), 1999 (NEPM 1999)

[8] *Contaminated Sites Sampling Design Guidelines,* NSW EPA, 1995 (EPA Sampling Design Guidelines 1995)

[9] *Waste Classification Guidelines, Part 1: Classifying Waste,* NSW DECCW, 2009 (Waste Classification Guidelines 2009)

[10] *Guidelines for Assessing Service Station Sites,* NSW EPA, 1994 (Service Station Guidelines 1994)

[11] *Working with Asbestos Guide,* NSW WorkCover, 2008 (WorkCover Working with Asbestos Guide 2008)

2 BACKGROUND

EIS has previously undertaken a Stage 1 desktop ESA for the wider development site (including development Stages 1 to 4 inclusive). The results are presented in the document titled *"Report to Pymble Ladies College on Stage 1 Preliminary Environmental Site Assessment for Proposed Development at Pymble Ladies College, 20-64 Avon Road, Pymble, NSW"* (Ref: 25921KPrpt, dated August 2012[12]).

A summary of the report is presented below. For the purpose of the summary, "the site" refers to the development Stages 1 to 4 inclusive, as shown on Figure 3.

The primary objectives of the desktop ESA were to:

- Assess the potential risk of significant, widespread soil and groundwater contamination at the site;
- Assess the potential for human health or environmental risks posed by soil and/or groundwater contaminants at the site;
- Address the Data Quality Objectives (DQOs); and
- Prepare a Stage 1 preliminary ESA report.

The scope of work for the ESA included:

- A site history assessment to identify historical land uses that may have resulted in potential site contamination;
- A site inspection to identify potential contamination sources;
- A limited review of the subsurface investigation findings obtained during the JK Geotechnics investigation;
- Preparation of a Conceptual Site Model (CSM) identifying the Potential Contaminants of Concern (PCC) and potential sensitive receptors; and
- Preparation of a report presenting the results of the ESA.

A summary of the historical information is presented in the following table:

Source	Summary
Land Title Records	The records did not indicate any particular land use that may have resulted in significant site contamination. The site formed part of a property owned by the church since at least the early 1900s.
Aerial Photos	The majority of the site appeared grassed in the 1930 to 1943 photographs, and formed part of a larger property. Two small structures (possibly sheds) were demolished at the site during this period. The layout of Molly Dive Field was evident in 1951. The site layout generally appeared similar to the existing (2012) PLC layout from the 1986 photograph onwards.

[12] EIS 2012 desktop assessment

Source	Summary
Local Council Records	The records did not indicate any particular land use or development that may have resulted in significant site contamination. The s149 planning certificate indicated that: • The site does not include or comprise critical habitat; and • The site is not deemed to be: significantly contaminated; subject to a management order; subject of an approved voluntary management proposal; or subject to an on-going management order under the provisions of CLM Act 1997.
WorkCover Records	The records did not indicate the existence of any licences, including underground storage tanks (USTs), at the site. Two depots for pool chemicals and petroleum products were located in down-gradient, off-site areas.
NSW EPA Records	There are no EPA notices for the site. The site is not listed on the CLM register.
Anecdotal Information	The WorkCover records confirmed the anecdotal information regarding the storage of small quantities of fuel and pool chemicals in off-site depots, down-gradient of the subject site.

Based on the scope of work undertaken for the EIS 2012 desktop assessment, EIS considered that the potential for significant, widespread soil and/or groundwater contamination at the site was relatively low. No specific, on-site or off-site, point sources of contamination were identified. The primary contamination sources at the site were considered to be: potentially contaminated imported fill soils; and asbestos associated with the demolition of two sheds formerly located at the site (note that the two sheds referred to in the report were not located within the Stage 1 works area).

In general, the potential risks and exposure to the PCC was expected to increase as a result of the proposed development works (i.e. due to exposure of the soils during demolition and excavation). On this basis, an intrusive investigation was recommended prior to the commencement of earthworks in order to better assess the risk of contaminants being present at the site.

The report recommended that the investigation should include soil sampling from a minimum of 12 locations distributed across the site. A subsequent clarification letter prepared by EIS (Ref: E25921KPlet, dated 21 August 2012) indicated that the sampling could be undertaken as a ratio of the surface area for each development stage if required.

An assessment of the groundwater contamination conditions was not considered necessary at the time of the EIS 2012 desktop assessment.

3 DATA QUALITY OBJECTIVES

3.1 DQOs for the Assessment

The DQO process includes a clear statement of the objectives of the study and a methodology for collecting enough data of sufficient quality to support the decisions of the study. The DQOs provide a systematic approach for undertaking the assessment and outlines the criteria against which the data can be assessed.

A methodology for establishing the DQOs is presented in the US EPA document *Data Quality Objectives Process for Hazardous Waste Site Investigations* (2000[13]). This methodology has been adopted by the NEPC in NEPM 1999, AS4482.1-2005[14] and the Site Auditor Guidelines 2006. The main steps involved in preparing the DQOs include:

1. State the problem;
2. Identify the decision;
3. Identify inputs into the decision;
4. Study boundaries;
5. Develop a decision rule;
6. Specify limits on decision errors; and
7. Optimise the design for obtaining data.

The first six steps provide qualitative and quantitative statements which are used in the final step to develop a data collection plan. The data is then assessed against adopted performance criteria.

3.1.1 State the Problem

The EIS August 2012 Desktop Assessment indicated that potentially contaminated, imported fill material may exist at the site. The presence of contaminants in the fill soils may pose a potential risk to human health and the environment.

The primary purpose of the preliminary Stage 2 ESA is to make a preliminary assessment of the soil contamination conditions at the site in relation of the proposed land use.

[13] *Data Quality Objectives Process for Hazardous Waste Site Investigations,* US EPA, *2000* (US EPA 2000)
[14] *Guide to the Investigation and Sampling of sites with Potentially Contaminated Soil,* Standards Australia, 2005 (AS 2005)

3.1.2 Identify the Decision

The ESA aims to address the following decisions:

- Do the site soils contain elevated concentrations of contaminants above the site assessment criteria (SAC); and
- If contamination is encountered: has the contamination source and extent been identified; is it likely that the groundwater has been impacted; is there potential for off-site migration of contamination; and can the site be remediated.

3.1.3 Inputs into the Decision

The following inputs will be used to address the decisions:

Table 3-1: Inputs into the Decision

Inputs	Details
Background Information	Review of previous investigation reports prepared for the site.
Site Inspection & Physical Setting	Undertake a site inspection to identify potential on and off-site contamination sources. Assess the physical setting including a review of regional geology and topography.
Conceptual Site Model	Prepare a CSM identifying the PCC and potential receptors.
Soil Sampling and Laboratory Analysis	Undertake soil sampling from boreholes as outlined in **Section 7.** Soil samples will be analysed for the PCC as outlined in **Section 5.1.**
Assessment of Analytical Data	The Data Quality Indicators (DQIs) that will be used to assess the analytical data are outlined in **Section 3.2.**
Assessment Criteria	Analytical results will be compared to the SAC outlined in **Section 6.**

The information obtained from the above inputs is considered sufficient to make a preliminary assessment of the contamination status of the site and to address the decisions outlined above (see **Section 3.1.2**).

3.1.4 Study Boundary

The assessment will be confined to the site boundaries as shown in Figure 2. This includes the Stage 1 works area only.

3.1.5 Develop a Decision Rule

The analytical results will be compared with the SAC as outlined in **Section 6**. Statistical analysis will be undertaken on the analytical results (if required) as outlined in the EPA Sampling Design Guidelines 1995. The following criteria will be adopted for the assessment:

- The 95% Upper Confidence Limit (UCL) value of the arithmetic mean concentration of each contaminant should be less than the SAC;
- The standard deviation (SD) of the results must be less than 50% of the SAC; and
- No single value exceeds 250% of the relevant SAC.

UCL calculations may not be required if all results are below the SAC. Further assessment or remediation will be required when the concentration of contaminants exceed the above criteria.

A review of the field and laboratory DQIs will be undertaken as outlined in **Section 3.2**.

3.1.6 Specify Limits on Decision Errors

Decision errors are false positive (i.e. stating the site is free of contamination when it is not) or false negative (i.e. stating that the site is contaminated when it is not). The more significant is the false positive with potential risks to human health and the environment. To account for this, the ESA has assumed that elevated concentrations of contaminants are present in the samples unless demonstrated otherwise.

3.1.7 Optimise the Design for Obtaining Data

The Site Auditor Guidelines 2006 recommend evaluating the data set as a whole to determine any limitations within the data set. The overall data set will be optimised by reviewing the data as the project proceeded. When necessary, adjustments will be made to the sampling or analytical program.

3.2 DQIs for Analytical Data

The analytical data will be assessed against the following DQIs: precision, accuracy, representativeness, completeness and comparability. Definitions of the individual DQIs are presented in Appendix C. The table below outlines the steps that will be taken to address the DQIs:

Table 3-2: DQIs

Indicator	Methods
Completeness	Data and documentation completeness will be achieved by: • Preparation of sampling and analysis plan; • Preparation of chain of custody (COC) records; • Review the laboratory sample receipt information; • Use of National Association of Testing Authorities (NATA) registered laboratories for all analysis; • Visual and PID screening of samples during the investigation; and • Laboratory analysis to target PCC.
Comparability	Data comparability will be achieved by: • Maintaining consistency in sampling techniques; • Use of appropriate preservation, storage and transport methods; and • Use of consistent analysis techniques and reporting standards by the laboratories.
Representativeness	Data representativeness will be achieved by: • Good coverage of sample locations; and • Representative coverage of analysis for PCC.
Precision	Precision will be achieved by: • Calculating the relative percentage difference (RPD) of duplicate samples; • The following acceptance criteria will be used to assess the RPD results: ➢ results > 10 times the practical quantitation limit (PQL), RPDs < 50% are acceptable; ➢ results between 5 and 10 times PQL, RPDs < 75% are acceptable; ➢ results > 5 times PQL, RPDs < 100% are acceptable; and • An explanation is provided if RPD results are outside the acceptance criteria. As a conservative measure, the higher value is adopted when the value exceeds the SAC.
Accuracy	Accuracy will be achieved by: • Use of trained and qualified field staff; • Appropriate industry standard sampling equipment and decontamination procedures; • Sampling and screening equipment will be factory calibrated on a regular basis. Calibration will be checked internally prior to use; • Sampling and equipment decontamination; • Collection and analysis of field Quality Assurance (QA) and Quality Control (QC) samples for PCC; • The field QA/QC analysis will include:

Indicator	Methods
	➢ One sample as an intra-laboratory duplicate (20% of primary samples); ➢ One trip blank sample per batch; ➢ One rinsate sample of field equipment per day of sampling, and ➢ One trip spike sample per batch; • Acceptable concentrations in trip blanks, trip spikes and rinsate samples. Non-compliance to be documented in the report; • Appropriate sample preservation, handing, holding time and COC procedure; • Review of the primary laboratory QA/QC data including: RPDs, surrogate recovery, repeat analysis, blanks, laboratory control samples (LCS) and matrix spikes; • The following acceptance criteria will be used to assess the primary laboratory QA/QC results. Non-compliance to be documented: ➢ RPDs: o results that are < 5 times the PQL, any RPD is acceptable; and o results > 5 times the PQL, RPDs between 0-50% are acceptable; ➢ LCS recovery and matrix spikes: o 70-130% recovery acceptable for metals and inorganics; o 60-140% recovery acceptable for organics; and o 10-140% recovery acceptable for VOCs; ➢ Surrogate spike recovery: o 60-140% recovery acceptable for general organics; and o 10-140% recovery acceptable for VOCs; ➢ Blanks: All less than PQL (ALTPQL); and • Reporting to industry standards.

4 SITE INFORMATION AND PHYSICAL SETTING

Table 4-1: Site Identification Information

Site Owner:	The Uniting Church in Australia Property Trust (N.S.W)
Site Address:	20-64 Avon Road, Pymble, NSW
Lot & Deposited Plan:	Part Lot 1 in DP69541
Current Land Use:	Private College catering for kindergarten to year 12
Proposed Land Use:	Unchanged
Local Government Authority:	Ku-ring-gai Council
Current Zoning:	Special Uses 5(a) (School)
Site Area (m^2):	3,000
RL (AHD in m) (approx.):	120
Geographical Location (MGA) (approx.):	N: 6264178 E: 327242
Site Location Plan:	Figure 1
Borehole Location Plan:	Figure 2
Proposed Development Layout:	Figure 3

4.1 Site Location and Topography

The site is located towards the southern end of PLC on the lower reaches of a gently sloping, south-west facing hillside. The site is located on the north-eastern flank of a densely vegetated gully feature. The general hillside slopes in the vicinity of the site are in the order of 2° to 3° down towards the south-west. The site is accessed via Avon Road which is located approximately 70m to the west.

4.2 Site Inspection

At the time of the site inspection, the site was occupied by the existing brick and concrete swimming pool complex. The concourse level on the eastern side of the swimming pool was suspended above existing grade on concrete columns.

A grassed, cut batter slope fell away from the pool towards the west. The areas around the pool and at the top of the batter were vegetated with various trees and shrubs.

The area to the west of the site was occupied by the existing synthetic surfaced Mollie Dive Field ("the field"). Cut and fill earthworks would have been required in the east and west sections of the field respectively, in order to create the desired levels.

The remaining areas around the site were associated with the wider college grounds and included: two to three storey buildings to the north; tennis courts to the south; two to three storey buildings to the east; and the field to the west.

During rain events, the site is expected to drain towards the west, with the majority of surface water flows being intercepted by the on-site stormwater system. Some rainwater would be expected to infiltrate the grassed areas and garden beds.

4.3 Regional Geology

The geological map of Sydney (1983[15]) indicates the site to be underlain by Ashfield Shale of the Wianamatta Group, which typically consists of black to dark grey shale and laminite.

4.4 Acid Sulfate Soil (ASS) Risk Map

The site is not located within an ASS risk area.

[15] *1:100,000 Geological Map of Sydney (Series 9130),* Department of Mineral Resources (1983)

5 CONCEPTUAL SITE MODEL (CSM)

The following CSM is based on the EIS 2012 desktop assessment:

5.1 Contamination Sources and Potential Contaminants of Concern (PCC)

The potential contamination sources and PCC identified at the site are outlined in the following table:

Table 5-1: PCC

Source	Land Use	PCC
Fill material	**On-site:** Fill material historically imported to achieve existing site levels may contain elevated concentrations of contaminants. Elevated contaminants have the potential to impact the groundwater by leaching.	HM, TPH, BTEX, VOCs, PAHs, OCPs, OPPs, PCBs and asbestos
	Off-site: Fill material contaminated by mobile contaminants in off-site, up-gradient areas may impact on the soils and groundwater at the site.	PCC in groundwater (if present) would be based on the soil contaminants present.

Note:
HM – Heavy metals including arsenic, cadmium, chromium, copper, lead, mercury, nickel & zinc
TPH – Total petroleum hydrocarbons including light, mid and heavy fractions
BTEX – Monocyclic aromatic hydrocarbons
VOCs - Volatile organic compounds includes BTEX compounds
PAHs - Polycyclic aromatic hydrocarbons
OCPs - Organochlorine pesticides
OPPs - Organophosphorus pesticides
PCBs - Polychlorinated Biphenyls

5.2 Contamination Fate and Transport

The fate of the PCC identified above is summarised in the following table:

Table 5-2: Fate and Transport of PCC

PCC	Fate and Transport
Non-volatile contaminants including metals, heavy fraction PAHs, OCPs, OPPs, PCBs and asbestos	Non-volatile contaminants are expected to be bound within the fill matrix and are hence less mobile. Heavy fraction PAHs (and even TPH) can be associated with the presence of ash and slag in fill. Slag is usually formed as a by-product of combustion at high temperatures which 'lock in' the contaminants within the matrix. Heavy metals like lead can be encountered in ash. The mobility of these contaminants would depend on a range of factors including age of the fill, soil porosity, solubility in water and surface water

PCC	Fate and Transport
	infiltration. Heavy metals can also impact on plant growth. High concentrations of heavy metals in soils within the root zone can be taken up by plants which can result in phyto-toxicity. Asbestos may be encountered bonded in fibre cement sheeting, however, if this material is buried and subject to weathering, the asbestos may be considered friable. A number of studies have found that soils effectively filter out asbestos fibres and retain them near the surface. The studies concluded that there is no significant migration of asbestos fibres, either through soil or groundwater. Therefore, the transport mechanism for asbestos would be during site excavation works.
Volatile contaminants including TPH, BTEX, VOCs and light fraction PAHs	Volatile contaminants are usually more mobile when compared to the non-volatile compounds. The potential for migration of volatile contaminants such as light fraction PAHs and TPH is relatively high in sandy soil with a high water table. At this site, the presence of clayey soils and a deeper water table would limit the migration potential of these contaminants. Volatile contaminants break down rapidly as a result of microbial activity and availability of nutrients including nitrogen, oxygen etc. The mobile contaminants would be expected to move down to the rock surface or groundwater table and migrate down gradient from the source. The mobility would depend on a range of factors like the porosity, confining layers within the aquifer, solubility in groundwater etc.

5.3 Potential Receptors and Exposure Pathways

The potential receptors and exposure pathways identified for the PCC at the site are presented in the following table:

Table 5-3: Potential Receptors and Exposure Pathways

Location	Receptor	Pathway
On-site	On-site human receptors include: - Site occupants and site users - Site visitors - Contractors and workers - Future site occupants	- Exposure by direct contact via dermal, ingestion and inhalation - Inhalation of airborne asbestos fibres

Location	Receptor	Pathway
	On-site environmental receptors include: - Existing and proposed landscaped areas	- Migration of and exposure to contaminated groundwater - Migration of soluble contaminants with surface water flows
Off-site	Off-site human receptors include: - Adjacent landowners - Off-site visitors and students within the wider parts of PLC - Contractors and workers in the adjoining area	- Inhalation of airborne asbestos fibres migrating off-site - Migration of contaminated groundwater - Migration of contaminants via surface water flows
	Off-site environmental receptors include: - The registered groundwater bores used for irrigation down-gradient of the site - The dammed creek located towards the southern section of Rofe Park, approximately 1km to the west of the site	- Extraction and use of groundwater down-gradient from the site

6 SITE ASSESSMENT CRITERIA (SAC)

6.1 Soil

The assessment criteria for soil contamination are derived from NEPM 1999 and the Site Auditor Guidelines 2006.

6.1.1 Health Investigation Levels (HILs)

The NEPM 1999 includes Health Based Investigation Levels (HILs) for a range of contaminants based on the risk of exposure, duration of exposure, toxicity and land use (availability). The HILs are divided into four categories outlined in the following table:

Table 6-1: HILs Categories

Category/Column	Land Use
Column A	'Standard' residential with garden/ accessible soil (home-grown produce contributing less than 10% of vegetable and fruit intake; no poultry); includes children's day-care centres, kindergartens, preschools and primary schools.
Column D	Residential with minimal opportunities for soil access: includes dwellings with fully and permanently paved yard space such as high-rise apartments and flats.
Column E	Parks, recreational open space and playing fields: includes secondary schools.
Column F	Commercial/Industrial: includes premises such as shops and offices as well as factories and industrial sites.

Where the proposed land use includes more than one land use category (example mixed-use development including residential/retail/commercial land uses) the exposure setting of the most 'sensitive' land use should be adopted for the site.

6.1.2 Petroleum Hydrocarbons in Soil

Threshold concentrations for petroleum hydrocarbon including total TPH and BTEX compounds have been adopted from the Service Station Guidelines 1994 referenced in the Site Auditor Guidelines 2006. Heavy fraction petroleum hydrocarbon aliphatic/aromatic component threshold concentrations have been adopted from NEPM 1999 (as applicable).

Soil samples are initially analysed for total recoverable hydrocarbons (TRH) without a preliminary silica gel clean-up of the sample. Consequently the TRH result may include other compounds such as phthalates, humic acids, fatty acids and sterols (if present).

Silica gel clean-up should remove these other compounds and result in a more accurate result for petroleum hydrocarbons. If undertaken these results have been referred to as TPH_{sgel} within this report.

6.1.3 Provisional Phyto-toxicity Investigation Levels (PPILs)

PPILs are included in the assessment where the proposed land use includes landscaped areas or garden accessible soils. Contaminants above the PPIL threshold may cause phytotoxicity in some plant species. The PPILs are listed in the Site Auditor Guidelines 2006 and are identical to the Ecological Investigation Levels (EILs) specified in NEPM 1999.

6.1.4 Asbestos in Soil

The NEPM 1999 do not provide numeric guidelines for the assessment of asbestos in soil. The draft NEPM[16] guidelines have essentially adopted the Western Australian Asbestos Guidelines 2009[17] which prescribe a site investigative model and asbestos clean-up goals. These guidelines however, have not yet been adopted in NSW and as such are generally only used on a site specific basis.

The general criterion currently used for the assessment of asbestos in soil is the presence/absence of asbestos in soil in accordance with AS4964-2004[18]. If asbestos is found to be present, the status of the asbestos material (friable or bonded/non-friable) is further considered due to the implications associated with site remediation and/or management.

The WorkCover publication *Working with Asbestos Guide* (2008[19]) recommend that the status of the asbestos material in soil should be assessed by an occupational hygienist.

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[16] *Draft National Environmental Protection (Assessment of Site Contamination) Measure,* as varied, National Environment Protection Council (NEPC), 2011 (Draft NEPM 2011)

[17] *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*, WA Department of health, Perth, Australia, May 2009 (Western Australian Asbestos Guidelines 2009)

[18] Australian Standard 4964, *Method for the Qualitative Identification of Asbestos in Bulk Samples*, Australian Standards, 2004

[19] *Working with Asbestos Guide,* NSW WorkCover, 2008 (WorkCover Working with Asbestos Guide 2008)

More recently, the 2011 WHS Regulation[20] and associated Safe Work Australia code of practice, *How to Safely Remove Asbestos*[21] (endorsed by WorkCover NSW) states that the assessment of asbestos contaminated soil is to be undertaken by a licenced asbestos assessor or competent person. WorkCover NSW has not currently issued any licences for asbestos assessors. Correspondence with WorkCover indicates that the licence program is currently being implemented in accordance with the Safe Work Australia Guide for Applicants for Asbestos Assessor Licence[22]. The ACT Planning and Land Authority currently issues licences for asbestos assessor Class A and Class B.

At present, the assessment of asbestos contamination in soil is undertaken in accordance with the NEPM guidelines, the adoption of the draft NEPM is considered only on a site specific basis. Assessment of the contaminant levels and status of asbestos contaminated soil is undertaken by a combination of: site assessment by experienced environmental consultants and ACT accredited asbestos assessors; and soil screening by NATA endorsed laboratories using AS4964-2004.

6.1.5 Soil Assessment Criteria

No specific criteria have been included for the wider list of VOCs, as only a preliminary screening was undertaken for this investigation/assessment as detailed in **Section 8.1.1**. More common VOCs were assessed through the BTEX analysis.

The soil assessment criteria adopted for the ESA is presented in the following table:

Table 6-2: Soil SAC

Analyte	Column A[1] (mg/kg)	PPILs[2] (mg/kg)
Metals		
Arsenic (total)	100	20
Cadmium	20	3
Chromium (III)	12%	400
Copper	1000	100
Lead	300	600
Mercury (inorganic)	15	1
Nickel	600	60
Zinc	7000	200
Petroleum Hydrocarbons		
TPH (C_6-C_9)	65 [a]	Na
TPH (C_{10}-C_{36})	1000 [a]	Na

[20] *Work Health and Safety Regulation*, NSW Government 2011

[21] *National Code of Practice How to Safely Remove Asbestos*, Safe Work Australia 2011

[22] *Guide for Applicants for Asbestos Removal and Asbestos Assessor Licences and Notifications*, Safe Work Australia 2012

Analyte	Column A[1] (mg/kg)	PPILs[2] (mg/kg)
Benzene	1 [a]	Na
Toluene	1.4 [a]	Na
Ethylbenzene	3.1 [a]	Na
Total Xylenes	14 [a]	Na
PAHs		
Total PAHs	20	Na
Benzo(a)pyrene	1	Na
Pesticides		
Aldrin + Dieldrin	10	Na
Chlordane	50	Na
DDT+ DDD + DDE	200	Na
Heptachlor	10	Na
Total OPPs	0.1 [b]	Na
Others		
PCBs (Total)	10	Na
Asbestos	Not Detected [c]	Na

Note:
1 – HILs outlined in NEPM 1999
2 – PPILs outlined in the Site Auditor Guidelines 2006
a - Service Station Guidelines 1994
b- Due to the absence of locally endorsed guideline criteria, the laboratory PQL has been adopted
c - Not Detected (at the Limit of Reporting)
Na – Not Applicable

6.1.6 Waste Classification Criteria for Off-Site Disposal

Any material excavated for the proposed development will require a waste classification for off-site disposal in accordance with the Waste Classification Guidelines 2009.

Soils are classed into the following categories based on the chemical contaminant criteria outlined in the guidelines (refer to Table A):

Table 6-3: Waste Categories

Category	Description
General Solid Waste (non-putrescible) (GSW)	• If SCC ≤ CT1 then TCLP not need to classify the soil as GSW • If TCLP ≤ TCLP1 and SCC ≤ SCC1 then treat as GSW
Restricted Solid Waste (non-putrescible) (RSW)	• If SCC ≤ CT2 then TCLP not need to classify the soil as RSW • If TCLP ≤ TCLP2 and SCC ≤ SCC2 then treat as RSW
Hazardous Waste (HW)	• If SCC > CT2 then TCLP not need to classify the soil as HW • If TCLP > TCLP2 and/or SCC > SCC2 then treat as HW
Virgin Excavated Natural Material (VENM)	Natural material (such as clay, gravel, sand, soil or rock fines) that meet the following: • that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial mining or agricultural activities; • that does not contain sulfidic ores or other waste; and • includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice published in the NSW Government Gazette.

Note:
SCC – Specific Contaminant Concentration
CT – Contaminant Threshold
TCLP – Toxicity Characteristics Leaching Procedure

7 INVESTIGATION PROCEDURE

7.1 Soil Sampling Rationale

The NSW EPA Sampling Design Guidelines 1995 recommend a sampling density for contamination assessments, based on a systematic sampling pattern. A minimum number of sampling points are recommended for the investigation based on the size of the site (i.e. the size of the investigation area).

For a site of this size (approximately 3,000m^2), the guidelines recommend sampling from a minimum of nine evenly spaced sampling points. Samples were obtained from three locations for this preliminary investigation as shown on the attached Figure 2. This density is approximately 35% of the minimum sampling density.

The sampling rationale is outlined in the following table:

Table 7-1: Soil Sampling Rationale

Location Reference	Sampling Plan & Spacing	Rationale
BH101 to BH103 (inclusive)	Systematic plan with a maximum spacing of approximately 60m between sampling points	The majority of the site is occupied by the existing swimming pools and is inaccessible. The CSM identified fill material as the primary potential contamination source at the site and the distribution of contamination in fill is considered to be random.

7.1.1 Soil Sampling Methods

The sampling locations were set out using a measuring wheel and marking paint. Each location was cleared for underground services prior to augering. Due to access restrictions, sampling was completed using hand equipment (hand auger).

Soil samples were collected from the fill and natural profiles encountered during the investigation. Samples were also obtained when there was a distinct change in lithology or based on the observations made during the investigation. All samples were recorded on the borehole logs attached in Appendix A.

During sampling, soil at selected depths was split into initial and duplicate samples for field QA/QC analysis.

Samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. Sampling personnel used disposable nitrile gloves during sampling activities. The samples were labelled with the job number, sampling location, sampling depth and date.

7.1.2 VOC Screening

A portable Photoionisation Detector (PID) was used to screen the samples for the presence of VOCs and to assist with selection of samples for BTEX analysis.

The sensitivity of the PID is dependent on the organic compound and varies for different mixtures of hydrocarbons. Some compounds give relatively high readings and some can be undetectable even though present in identical concentrations. The portable PID is best used semi-quantitatively to compare samples contaminated by the same hydrocarbon source.

The PID is calibrated before use by measurement of an isobutylene standard gas. All the PID measurements are quoted as parts per million (ppm) isobutylene equivalents.

PID screening for VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. The PID headspace data is presented on the COC documents in Appendix B. PID calibration records are retained on file by EIS.

7.1.3 Decontamination and Sample Preservation

Details of the decontamination procedure adopted during sampling are presented in Appendix C. Where applicable, the sampling equipment was decontaminated using a scrubbing brush and potable water and Decon 90 solution (phosphate free detergent) followed by rinsing with potable water. A rinsate sample was obtained during the decontamination process as part of the field QA/QC.

Soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with AS4482.1-2005 and AS4482.2-1999[23] as summarised in the following table:

[23] *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part2: Volatile Substances,* Standards Australia, 1999 (AS 1999)

Table 7-2: Soil sample preservation and storage

Analyte	Preservation	Storage
Heavy metals	Unpreserved glass jar with Teflon lined lid	Store at <4°, analysis within 28 days (mercury and Cr[VI]) and 180 days (other metals).
VOCs (TPH/BTEX)	As above	Store at <4°, analysis within 14 days
PAHs, OCP, OPP & PCBs	As above	Store at <4°, analysis within 14 days
Asbestos	Sealed plastic bag	None

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures. Field sampling protocols adopted for this assessment are summarised in Appendix C.

7.2 Laboratory Analysis

The soil and groundwater samples were analysed by the following laboratories:

Table 7-3: Laboratory Details

Samples	Laboratory	Report Reference
All primary soil samples, intra-laboratory duplicates, trip blanks, trip spikes and field rinsate samples	Envirolab Services Pty Ltd, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)	80344

Samples were analysed by the laboratory using the analytical methods detailed in Schedule B(3) of NEPM (1999[24]). Reference should be made to the laboratory reports attached in Appendix B for further details.

[24] *Guideline on Laboratory Analysis of Potentially Contaminated Soils*, Schedule B(3), NEPM, 1999 (Schedule B(3))

7.3 Soil Analytical Schedule

The soil analytical schedule is outlined in the following table:

Table 7-4: Laboratory Analytical Schedule

PCC	No. of Fill Soil Samples	No. of Natural Soil Samples
Heavy Metals	3	2
TPH/BTEX	3	2
PAHs	3	2
OCPs/OPPs	3	0
PCBs	3	0
Asbestos	3	0

8 INVESTIGATION RESULTS

8.1 Subsurface Soil Conditions

In summary, the boreholes generally encountered fill material underlain by natural silty clay soil. The fill soil included brown silty sand, sandy silt and gravelly silt with inclusions of ironstone and sandstone gravels, slag and root fibres.

BH102 refused in the fill material at a depth of approximately 0.15m. The fill material in BH101 and BH103 extended to depths of 0.15m and 0.2m respectively.

Groundwater seepage was not encountered during augering and all three boreholes were 'dry' on completion.

Reference should be made to the borehole logs attached in Appendix A for further details.

8.1.1 VOC Screening

PID soil sample headspace readings are presented in Table B and on the COC documents attached in Appendix A. The results ranged from 0ppm to 4.7ppm equivalent isobutylene. This indicates that significant quantities of PID detectable VOCs were not present in the samples.

8.2 Soil Laboratory Results

The soil laboratory results are presented in Table B attached to the report. The laboratory reports are presented in Appendix B. A summary of the results assessed against the SAC is presented below.

Table 8-1: Summary of soil laboratory results

Analyte	Number of Samples Analysed	Results Compared to SAC and Waste Classification Guidelines
Heavy Metals	Three fill and two natural samples	All results were below the SAC. With the exception of the zinc concentration in one fill sample obtained from BH103 (0-0.1m), all of the results were below the PPILs. **WC:** All results were less than the CT1 criteria.

Analyte	Number of Samples Analysed	Results Compared to SAC and Waste Classification Guidelines
TPH & BTEX	Three fill and two natural samples	All results were below the SAC. Quantifiable concentrations of toluene and TPH (C_{10}-C_{36}) were encountered in the fill samples obtained from BH102 (0-0.1m) and BH103 (0-0.1m) respectively. These results were below the SAC. **WC:** All results were less than the relevant CT1 and SCC1 criteria.
PAHs	Three fill and two natural samples	All results were below the SAC. Quantifiable concentrations of PAHs were encountered in the fill sample obtained from BH101 (0-0.1m). These results were below the SAC. **WC:** All results were less than the relevant CT1 and SCC1 criteria.
OCPs & OPPs	Three fill samples	All results were below the laboratory PQLs and were less than the SAC. **WC:** All results were less than the relevant CT1 and SCC1 criteria.
PCBs	Three fill samples	All results were below the laboratory PQLs and were less than the SAC. **WC:** All results were less than the SCC1 criterion.
Asbestos	Three fill samples	Asbestos was not detected in the samples analysed (above the reporting limit).

Note:
HILs – Health Investigation Levels
PPILs – Provision Phyto-toxicity Investigation Levels
SAC – Site Assessment Criteria
PQLs – Practical Quantitiation Limits
WC – Waste Classification Guidelines 2009

9 QA/QC ASSESSMENT

The QA/QC assessment includes a review of the DQIs established for the investigation (see **Section 3.2**). A summary of the field QA/QC samples are outlined below:

Table 9-1: Field QA/QC Samples

Field QA/QC	Sample Details
Intra-laboratory duplicate	Dup 1 is a soil duplicate of sample BH101 (0-0.1m).
Trip blank (TB)	TB is a sand blank (dated 16/10/2012).
Rinsate	RINSATE is a field rinsate from the hand auger decontamination process (dated 16/10/2012).
Trip Spike (TS)	TS is a soil spike (BTEX) (dated 16/10/2012).

An assessment of the DQIs is summarised in the following table.

Table 9-2: Assessment of DQIs

Completeness

Data and documentation completeness was achieved through the following measures:

- A sampling and analysis plan was prepared for the investigation;
- Chain of custody (COC) records were prepared for samples sent to the lab (see Appendix B);
- Laboratory sample receipt information was reviewed for the batch of samples (see Appendix B);
- A NATA registered laboratory was used for all analysis;
- Visual observations and PID screening of samples was undertaken during the investigation; and
- Fill samples were analysed for the PCC identified in **Section 5.1**.

Comparability

Data comparability was achieved through the following measures:

- Similar sampling techniques were used during the investigation;
- Appropriate preservation, storage and transport methods were adopted for all samples; and
- Consistent analysis techniques and reporting standards were adopted by the laboratories.

Representativeness

Data representativeness was achieved through the following measures:

- The sampling plan was optimised to obtain a good coverage of sample locations; and
- The assessment included a representative coverage of analysis for PCC.

Precision

Intra-laboratory RPD Results:

The intra-laboratory soil RPD results are summarised in Table C. The results indicated that field precision was acceptable.

Accuracy

Accuracy was achieved through the following measures:

- Trained and qualified field staff were used for the investigation;
- Appropriate industry standard sampling equipment and decontamination procedures were adopted for the investigation as outlined in Appendix C;
- PID screening equipment is routinely factory calibrated. An in-house calibration check was undertaken prior to using onsite;
- Appropriate sample preservation, handling, holding time and COC procedures were adopted for the investigation;
- The report was prepared generally in accordance with Reporting Guidelines 1997; and
- Review of trip spike, trip blank and field rinsate results are summarised below (refer also to Table D):

Trip Spike Results:

The BTEX results for the trip spike ranged from 91% to 92% and indicated that field preservation methods were appropriate.

Field Rinsate Results:

The field rinsate results did not identify any cross-contamination artefacts associated with sampling equipment. The detection of light fraction (C_6-C_9) TPHs in the rinsate sample is considered to be associated with trihalomethanes. Trihalomethanes are commonly encountered in potable water when chlorine (added for purification) reacts with natural organic material.

Trip Blank Results:

The trip blank results were all less than the PQLs.

- Review of laboratory QA/QC data is summarised below:

Laboratory Duplicate RPD Results:

Laboratory duplicate RPD results for the soil analysis were generally within the acceptance criteria adopted by the laboratory. An elevated RPD was encountered for copper. As a result, a triplicate sample was analysed and the RPD was subsequently acceptable. As both the primary and duplicate results were below the SAC, these results are not considered to have had an adverse impact on the data set as a whole.

Matrix Spike Recovery:

Matrix spike recovery concentrations were within the acceptable limits of 60-140% for organics and 70-130% for inorganics.

Surrogate Spike Recovery:

Surrogate spike recovery concentrations were within the acceptable limits of 60-140% for organics and 10-140% for VOCs.

LCS recovery:
LCS recovery concentrations were within the acceptable limits of 60-140% for organics and 70-130% for inorganics.

EIS consider that the DQIs adopted for this ESA (see **Section 3.1**) have been addressed.

10 DISCUSSION

10.1 Soil

Elevated concentrations of contaminants, above the SAC, were not encountered in the soil samples analysed for the investigation. Based on these results, EIS are of the opinion that the potential for significant widespread soil contamination at the site is relatively low. A RAP is not considered necessary for the site.

The zinc concentration in one fill soil sample obtained from BH103 (0-0.1m) was above the PPIL. The PPIL criteria are principally concerned with phytotoxicity (i.e. adverse effects on plant growth in established and proposed areas of landscaping) and are described in NEPM 1999 as *"somewhat arbitrary"*, as the effect of these compounds on plant growth will depend on the soil and plant type.

BH103 was located within an established garden area and the surrounding trees/shrubs showed no obvious signs of stress. However, in the event that the fill material in and around BH103 is to be re-used on-site during the proposed development works, this material should either: be placed in an area where landscaping is not proposed; or further consideration of the zinc concentration would be required by the landscape consultants.

The detection of a trace of toluene (below the SAC) in BH102 (0-0.1m) is possibly the result of a minor housekeeping issue associated with cleaning/washing paint brushes under the nearby tap (toluene is the principal ingredient in paint thinners). There was nothing to suggest that this was a widespread issue. As toluene is very volatile, we would expect that this trace concentration would breakdown rapidly on exposure to air.

The detection of a trace of heavy fraction TPHs (below the SAC) in BH103 (0-0.1m) may be the result of sap from the nearby gum/eucalyptus trees. This is relatively a common occurrence in areas where large gum/eucalyptus trees are present.

10.2 Waste Classification

Based on the results of the ESA, the fill soils at the site are classified as 'General Solid Waste (non-putrescible)', in accordance with the Waste Classification Guidelines 2009.

The underlying natural material is classified as Virgin Excavated Natural Material (VENM). Material classed as VENM must not be mixed with any fill material (including building rubble) as this will invalidate the VENM classification. Where doubt exists

about the difference between fill and VENM material an environmental/geotechnical engineer should be contacted.

10.3 Groundwater

An assessment of the groundwater contamination conditions was outside the scope of this ESA. Based on the EIS 2012 desktop assessment and the preliminary Stage 2 soil analysis results, EIS are of the opinion that the potential for groundwater contamination at the site is relatively low. An assessment of the groundwater contamination conditions is not considered necessary at this stage.

11 CONCLUSION

Based on the results of the preliminary Stage 2 ESA, EIS consider the site (Stage 1 Works Area) to be suitable for the proposed development. In the event that anything unexpected is encountered during earthworks, EIS should be contacted for advice.

EIS consider that the objectives of this ESA (detailed in **Section 1.2**) and the DQOs (detailed in **Section 3**) have been met.

12 LIMITATIONS

The sampling locations for the investigation have enabled an assessment to be made of the risk of the existence of significant, large quantities of contamination. The conclusions based on this investigation are that, while major contamination of the site is not apparent, problems may be encountered with smaller scale features between sampling points.

EIS adopts no responsibility whatsoever for any problems such as underground storage tanks, buried items or contaminated material that may be encountered between sampling locations at the site. Development activities at the site should be planned on this basis, and any unexpected problems that may be encountered between sampling locations should be immediately inspected by experienced environmental personnel. This should ensure that such problems are dealt with in an appropriate manner, with minimal disruption to the project timetable and budget.

The conclusions developed in this report are based on site conditions which existed at the time of the investigation and the scope of work outlined in the report. They are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, and visual observations of the site and immediate surrounds, together with the interpretation of available historical information and documents reviewed as described in this report.

The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined previously in this report.

Where information has been provided by third parties, EIS has not undertaken any verification process, except where specifically stated in the report.

EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report.

Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes.

Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken

with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work.

EIS accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site.

EIS have not and will not make any determination regarding finances associated with the site.

Changes in the proposed or current site use may result in remediation or further investigation being required at the site.

During construction at the site, soil, fill and any unsuspected materials that are encountered should be monitored by qualified environmental and geotechnical engineers to confirm assumptions made on the basis of the limited investigation data, and possible changes in site level and other conditions since the investigation. Soil materials considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. Copyright in this report is the property of EIS. EIS has used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report.

LIST OF IN-TEXT TABLES:

IMPORTANT INFORMATION ABOUT THIS REPORT

These notes have been prepared by EIS to assist with the assessment and interpretation of this report.

The Report is Based on a Unique Set of Project Specific Factors:
This report has been prepared in response to specific project requirements as stated in the EIS proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- the proposed land use is altered;
- the defined subject site is increased or sub-divided;
- the proposed development details including size, configuration, location, orientation of the structures are modified;
- the proposed development levels are altered, eg addition of basement levels; or
- ownership of the site changes.

EIS/J&K will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by EIS to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions
Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (eg. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is Based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations

Although information provided by a site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

Misinterpretation of Site Assessments by Design Professionals
Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

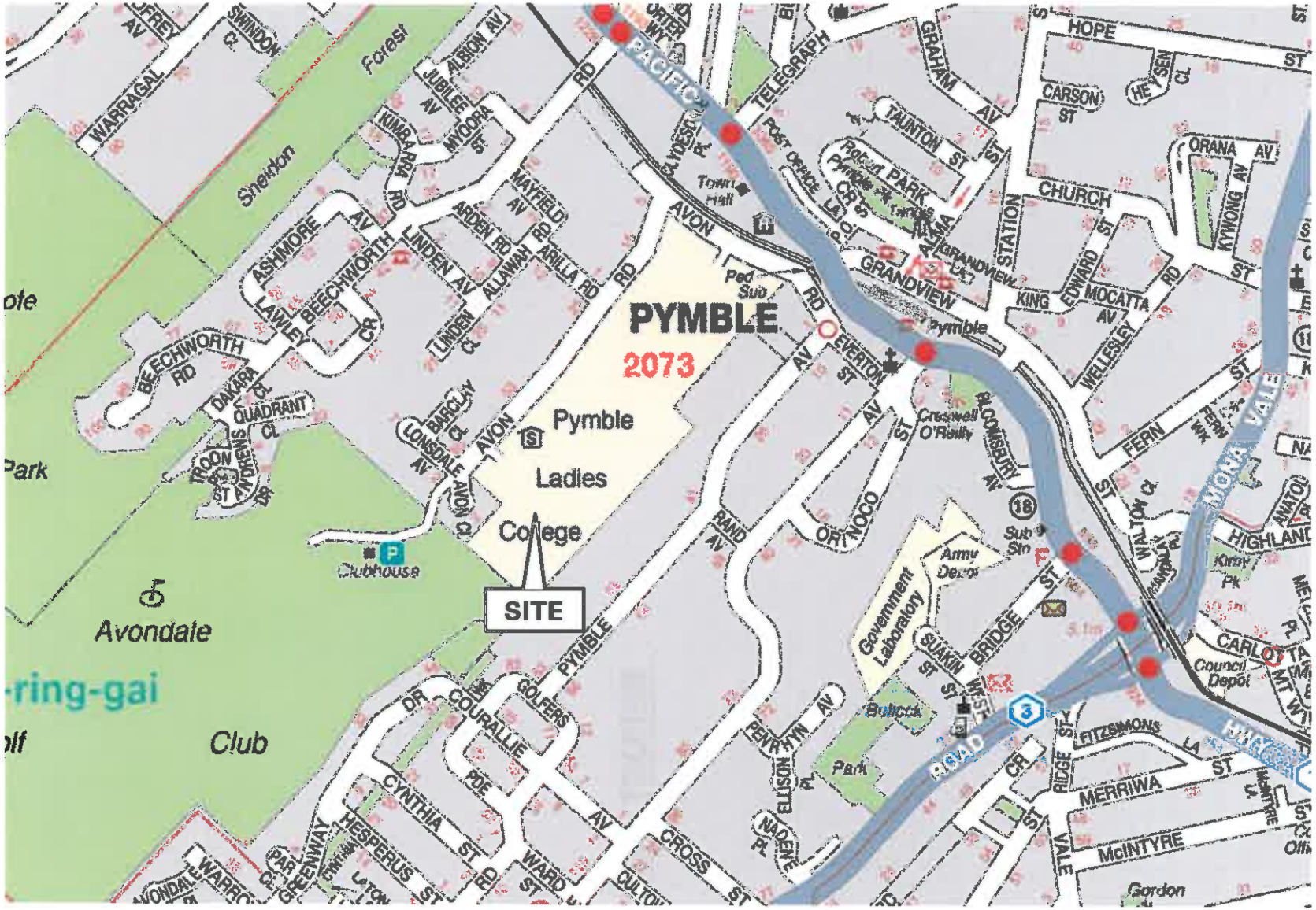
Logs Should not be Separated from the Assessment Report
Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problems, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the test of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely
Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

EIS

REPORT FIGURES

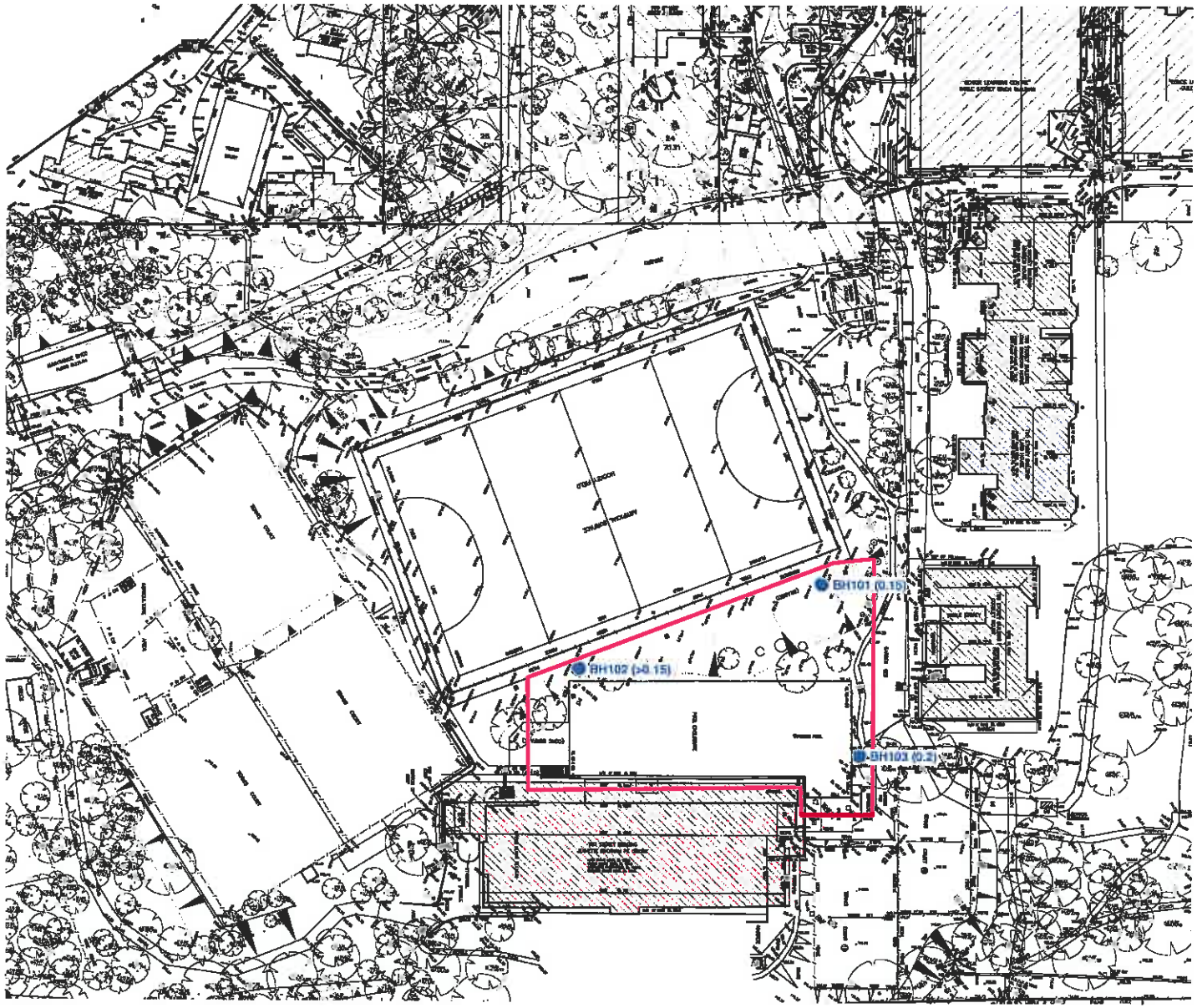


NOTES:
Figure 1 has been recreated from UBD on disc (version 5.0). Figure is not to scale.

UBD Map ref: 174 F4

Reference should be made to the report text for a full understanding of this plan.

EIS ENVIRONMENTAL INVESTIGATION SERVICES	Project Number: E25921KP rpt2	Title: SITE LOCATION PLAN
	Figure: 1	Address: 20-64 AVON ROAD, PYMBLE, NSW



LEGEND:

Approximate site boundary (Stage 1 Works)

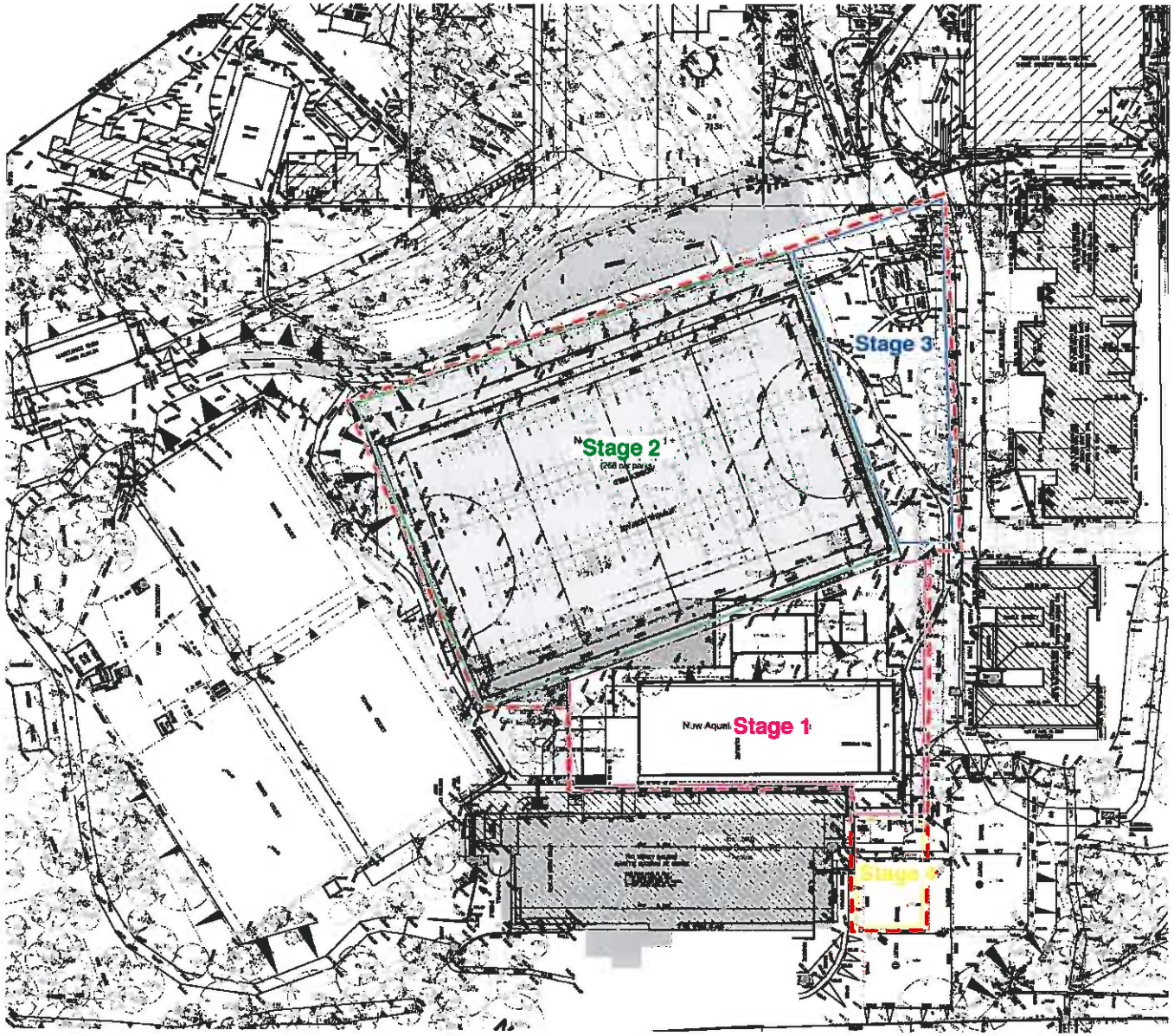
BH101 (0.3) Borehole location, number and depth of fill (m)

NOTES:
Figure 2 has been recreated from survey provided by Geoff Ninnes, Fong & Partners.

The borehole locations have been established from site measurements and should not be construed as survey points.

Reference should be made to the report text for a full understanding of this plan.

Approximate Scale (m): 0 10 20 30 40 50	ENVIRONMENTAL INVESTIGATION SERVICES	Project Number: E25921KP rpt2	Title: BOREHOLE LOCATION PLAN
		Figure: 2	Address: 20-64 AVON ROAD, PYMBLE, NSW



N

LEGEND:

Wider development site boundary

NOTES:
Figure 3 has been recreated from survey provided by Geoff Ninnes, Fong & Partners.

The development stages are indicative only.

Reference should be made to the report text for a full understanding of this plan.

Approximate Scale (m): 0 10 20 30 40 50	ENVIRONMENTAL INVESTIGATION SERVICES	Project Number: E25921KP rpt2	Title: PROPOSED DEVELOPMENT LAYOUT
		Figure: 3	Address: 20-64 AVON ROAD, PYMBLE, NSW

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REPORT TABLES

TABLE A
CHEMICAL CONTAMINANT CRITERIA FOR WASTE CLASSIFICATION
Waste Classification Guidelines Part 1: Classifying Waste DECCW NSW July 2009
All data in mg/kg unless stated otherwise

CONTAMINANT	GENERAL SOLID WASTE			RESTRICTED SOLID WASTE		
	CT1 (mg/kg)	TCLP1 (mg/L)	SCC1 (mg/kg)	CT2 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Heavy Metals						
Arsenic	100	5	500	400	20	2,000
Beryllium	20	1	100	80	4	400
Cadmium	20	1	100	80	4	400
Chromium VI	100	5	1,900	400	20	7,600
Cyanide (total)	320	16	5,900	1280	64	23,600
Cyanide (Amenable)	70	3.5	300	280	14	1,200
Fluoride	3,000	150	10,000	12,000	600	40,000
Lead	100	5	1,500	400	20	6,000
Mercury	4	0.2	50	16	0.8	200
Molybdenum	100	5	1,000	400	20	4,000
Nickel	40	2	1,050	160	8	4,200
Selenium	20	1	50	80	4	200
Silver	100	5	180	400	20	720
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)						
Benzene	10	0.5	18	40	2	72
Toluene	288	14.4	518	1,152	57.6	2,073
Ethyl benzene	600	30	1,080	2,400	120	4,320
Total xylenes	1,000	50	1,800	4,000	200	7,200
Total Petroleum Hydrocarbons (TPHs)						
Light Fraction TPH (C6-C9)	nsl	nsl	650	nsl	nsl	2,600
Mid to Heavy Fraction TPH (C10-C36)	nsl	nsl	10,000	nsl	nsl	40,000
Polycyclic Aromatic Hydrocarbons (PAHs)						
Benzo(a)pyrene	0.8	0.04	10	3.2	0.16	23
Total PAHs	nsl	nsl	200	nsl	nsl	800
Others						
Polychlorinated biphenyls	nsl	nsl	<50	nsl	nsl	<50
Phenol (non-halogenated)	288	14.4	518	1,152	57.6	2.073
Scheduled chemicals	nsl	nsl	<50	nsl	nsl	<50

Explanation:

1). General Solid Waste (GSW):

- If SCC ≤ CT1 then TCLP not needed to classify the material as GSW
- If TCLP ≤ TCLP1 and SCC ≤ SCC1 then treat as GSW

2). Restricted Solid Waste (RSW):

- If SCC ≤ CT2 then TCLP not needed to classify the material as RSW
- If TCLP ≤ TCLP2 and SCC ≤ SCC2 then treat as RSW

3). Hazardous Waste (HW):

- If SCC > CT2 then TCLP not needed to classify the material as HW
- If TCLP > TCLP2 and/or SCC > SCC2 then treat as HW

Abbreviations:

SCC – Specific Contaminant Concentration
CT – Contaminant Threshold
TCLP – Toxicity Characteristics Leaching Procedure
nsl - No Set Limit
DECCW - NSW Department of Environment, Climate Change and Water (now EPA)

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TABLE B
SUMMARY OF SOIL LABORATORY RESULTS
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OCPs				TOTAL OPPs	Total PCBs	TPH					BTEX COMPOUNDS				FIELD PID VALUES	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor			C_6-C_9	C_{10}-C_{14}	C_{15}-C_{25}	C_{26}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes		
PQL - Envirolab Services			4	0.5	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	0.1	25	50	100	100	250	0.5	0.5	1	3		100
Site Assessment Criteria (SAC) [1]			100	20	12%	1000	300	15	600	7000	20	1	10	50	200	10	0.1[a]	10	65[b]	nsl	nsl	nsl	1000[b]	1[b]	1.4[b]	3.1[b]	14[b]		100[a]
PRILs [2]			20	3	400	100	600	1	60	200	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl		nsl
General Solid Waste CT1 [3]			100	20	100	nsl	100	4	40	nsl	nsl	0.8	nsl	nsl	nsl	nsl	detect[4]	nsl	nsl		nsl		nsl	10	288	600	1000	-	-
General Solid Waste SCC1 [3]			500	100	1900	nsl	1500	50	1050	nsl	200	10	Scheduled Chemicals <50					50	650		nsl		10000	18	518	1080	1800	-	-
Restricted Solid Waste CT2 [3]			400	80	400	nsl	400	16	160	nsl	nsl	3.2	nsl	nsl	nsl	nsl	detect[4]	nsl	nsl		nsl		nsl	40	1152	2400	4000	-	-
Restricted Solid Waste SCC2 [3]			2000	400	7600	nsl	5000	200	4200	nsl	800	23	Scheduled Chemicals <50					50	2600		nsl		40000	72	2073	4320	7200	-	-
Sample Reference	**Sample Depth**	**Sample Description**																											
BH101	0-0.1	Fill: silty sand	4	LPQL	14	13	16	LPQL	7	35	0.25	0.05	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH101	0.15-0.25	Silty clay	10	LPQL	17	24	22	LPQL	6	30	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH102	0-0.1	Fill: gravelly silt	7	LPQL	13	44	14	0.2	8	32	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.6	LPQL	LPQL	4.7	Not Detected
BH103	0-0.1	Fill: sandy silt	LPQL	LPQL	17	77	63	0.1	10	500	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	140	140	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH103	0.3-0.4	Silty clay	12	LPQL	18	23	16	LPQL	4	16	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
Total Number of samples			5	5	5	5	5	5	5	5	5	5	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5	3
Maximum Value			12	LPQL	18	77	63	0.2	10	500	0.25	0.05	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	140	140	LPQL	0.6	LPQL	LPQL	4.7	Not Detected

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 1999 (NEPC Guidelines) HILs - Column A 'Residential with garden accessible soils'
2 - Provisional Phyto-toxicity Investigation Levels (PRILs)
3 - NSW DECCW Waste Classification Guidelines (2009)
4 - Some individual OPPs have CT1 & CT2 values. Reference should be made to the Waste Classification Guidelines in the event of any detections
a - In the absence of Australian guidelines, the laboratory PQL has been adopted as the SAC
b - NSW DECC Guidelines for Assessing Service Station Sites (1994)
c - The PQL has been adopted as the SAC

Concentration above the SAC — VALUE
Concentration above PRILs — *VALUE*

Abbreviations:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
CPP: Organophosphorus Pesticides
PID: Photoionisation Detector
PCBs: Polychlorinated Biphenyls
UCL: Upper Level Confidence Limit on Mean Value
ALPQL: All values less than PQL
na: Not Analysed
nc: Not Calculated
nsl: No Set Limit
SAC: Site Assessment Criteria
TPH: Total Petroleum Hydrocarbons
BTEX: Monocyclic Aromatic Hydrocarbons
OCP: Organochlorine Pesticides
CT: Contaminant Threshold
SCC: Specific Contaminant Concentration
HILs: Health Investigation Levels
NEPM: National Environmental Protection Measure

TABLE C
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
BH101 (0-0.1m)	Arsenic	4	4	4	4	0.0
Dup 1	Cadmium	0.5	LPQL	LPQL	nc	nc
	Chromium	1	14	10	12	33.3
	Copper	1	15	13	14	14.3
	Lead	1	16	16	16	0.0
	Mercury	0.1	LPQL	LPQL	nc	nc
	Nickel	1	7	4	5.5	54.5
	Zinc	1	35	33	34	5.9
	Naphthalene	0.1	LPQL	LPQL	nc	nc
	Acenaphthylene	0.1	LPQL	LPQL	nc	nc
	Acenaphthene	0.1	LPQL	LPQL	nc	nc
	Fluorene	0.1	LPQL	LPQL	nc	nc
	Phenanthrene	0.1	LPQL	LPQL	nc	nc
	Anthracene	0.1	LPQL	LPQL	nc	nc
	Fluoranthene	0.1	0.1	<0.1	0.075	66.7
	Pyrene	0.1	0.1	<0.1	0.075	66.7
	Benzo(a)anthracene	0.1	LPQL	LPQL	nc	nc
	Chrysene	0.1	LPQL	LPQL	nc	nc
	Benzo(b)&(k)fluorant	0.2	LPQL	LPQL	nc	nc
	Benzo(a)pyrene	0.05	0.05	<0.05	0.0375	66.7
	Indeno(123-cd)pyrene	0.1	LPQL	LPQL	nc	nc
	Dibenzo(ah)anthracene	0.1	LPQL	LPQL	nc	nc
	Benzo(ghi)perylene	0.1	LPQL	LPQL	nc	nc
	C_6-C_9 TPH	25	LPQL	LPQL	nc	nc
	C_{10}-C_{14} TPH	50	LPQL	LPQL	nc	nc
	C_{15}-C_{28} TPH	100	LPQL	LPQL	nc	nc
	C_{29}-C_{36} TPH	100	LPQL	LPQL	nc	nc
	Benzene	0.5	LPQL	LPQL	nc	nc
	Toluene	0.5	LPQL	LPQL	nc	nc
	Ethylbenzene	1	LPQL	LPQL	nc	nc
	m+p-xylene	2	LPQL	LPQL	nc	nc
	o-xylene	1	LPQL	LPQL	nc	nc

EXPLANATION:
The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:
Results > 10 times PQL = RPD value < = 50% are acceptable
Results between 5 & 10 times PQL = RPD value < = 75% are acceptable
Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:
PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

TABLE D
SUMMARY OF QA/QC - TRIP SPIKE, TRIP BLANK AND RINSATE RESULTS

ANALYSIS	Envirolab PQL		TB^S	$RINSATE^W$	TS^S
	mg/kg	µg/L	mg/kg	mg/kg	% Recovery
C_6-C_9 TPH	10	10	na	120	na
C_{10}-C_{14} TPH	50	50	na	LPQL	na
C_{15}-C_{28} TPH	100	100	na	LPQL	na
C_{29}-C_{36} TPH	100	100	na	LPQL	na
Benzene	1	1	LPQL	LPQL	92
Toluene	1	1	LPQL	LPQL	92
Ethylbenzene	1	1	LPQL	LPQL	91
m + p-xylene	2	2	LPQL	LPQL	91
o-xylene	1	1	LPQL	LPQL	91

EXPLANATION:
[W] Sample type (water)
[S] Sample type (sand)
BTEX concentrations in trip spikes are presented as % recovery

Values above PQLs/Acceptance criteria VALUE

ABBREVIATIONS:
PQL: Practical Quantitation Limit
LPQL: Less than PQL
(-) : Not Applicable / Not Analysed
TB: Trip Blank
TS: Trip Spike
na: Not Analysed
nc: Not Calculated
TPH: Total Petroleum Hydrocarbons

APPENDIX A

Borehole Logs and Explanatory Notes

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 101 1/1

Environmental logs are not to be used for geotechnical purposes

Client: PYMBLE LADIES COLLEGE

Project: PROPOSED DEVELOPMENT (STAGE 1)

Location: 20-64 AVON ROAD, PYMBLE, NSW

Job No. E25921KP **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 16-10-12 **Datum:**

Logged/Checked by: R.V.C./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■			■		0			FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained ironstone and sandstone gravel, slag, root fibres and clay fines.	D			GRASS COVER
								CL-CH	SILTY CLAY: medium to high plasticity, orange brown, trace of root fibres.	MC<PL	(H)		RESIDUAL
						0.5			END OF BOREHOLE AT 0.25m				HAND AUGER REFUSAL
						1							
						1.5							
						2							
						2.5							
						3							
						3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

ENVIRONMENTAL LOG

Borehole No. 102

1/1

Environmental logs are not to be used for geotechnical purposes

Client: PYMBLE LADIES COLLEGE

Project: PROPOSED DEVELOPMENT (STAGE 1)

Location: 20-64 AVON ROAD, PYMBLE, NSW

Job No. E25921KP **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 16-10-12 **Datum:**

Logged/Checked by: R.V.C./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■					0			FILL: Gravelly silt, low plasticity, light brown, fine to coarse grained igneous and slag gravel, trace of root fibres, fine to medium grained sand and clay	D (MC<PL)			GRASS COVER APPEARS WELL COMPACTED
									END OF BOREHOLE AT 0.15m				HAND AUGER REFUSAL
						0.5							
						1							
						1.5							
						2							
						2.5							
						3							
						3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

ENVIRONMENTAL LOG

Borehole No. 103

1/1

Environmental logs are not to be used for geotechnical purposes

Client: PYMBLE LADIES COLLEGE

Project: PROPOSED DEVELOPMENT (STAGE 1)

Location: 20-64 AVON ROAD, PYMBLE, NSW

Job No. E25921KP **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 16-10-12 **Datum:**

Logged/Checked by: R.V.C./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			FILL: Sandy silt, low plasticity, dark brown, trace of fine to medium grained igneous gravel, wood chips and root fibres.	M			APPEARS POORLY COMPACTED
								CL-CH	SILTY CLAY: medium to high plasticity, orange brown, trace of fine grained ironstone gravel.	MC>PL			RESIDUAL
						0.5							
									END OF BOREHOLE AT 0.75m				
						1							
						1.5							
						2							
						2.5							
						3							
						3.5							

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (eg sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'Shale' is used to describe thinly bedded to laminated siltstone.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

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

  N = 13
  4, 6, 7

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

  N>30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N_c" on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as **exact**.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

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

ENGINEERING REPORTS

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

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed that at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document *'Guidelines for the Provision of Geotechnical Information in Tender Documents'*, published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or

iii) full time engineering presence on site.

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL


FILL


TOPSOIL


CLAY (CL, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CH)


SILTY CLAY (CL, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML)


PEAT AND ORGANIC SOILS

ROCK


CONGLOMERATE


SANDSTONE


SHALE


SILTSTONE, MUDSTONE, CLAYSTONE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

DEFECTS AND INCLUSIONS


CLAY SEAM


SHEARED OR CRUSHED SEAM


BRECCIATED OR SHATTERED SEAM/ZONE


IRONSTONE GRAVEL


ORGANIC MATERIAL

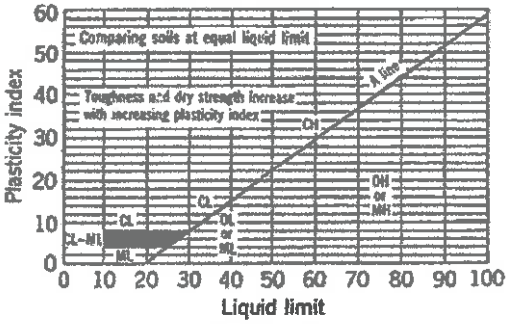
OTHER MATERIALS


CONCRETE


BITUMINOUS CONCRETE, COAL


COLLUVIUM

Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)						Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils More than half of material is *larger* than 75 μm sieve size[b] (The 75 μm sieve size is about the smallest particle visible to naked eye)	**Gravels** More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes			*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name: indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	Use grain size curve in identifying the fractions as given under field identification Determine percentages of gravel and sand from grain size curve Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP* More than 12% *GM, GC, SM, SC* 5% to 12% *Borderline* cases requiring use of dual symbols $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *GW* Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols Atterberg limits above "A" line, with *PI* greater than 7 $C_U = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *SW* Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols Atterberg limits below "A" line with *PI* greater than 7
		Gravels with fines (appreciable amount of fines)	Predominantly one size or a range of sizes with some intermediate sizes missing			*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		
			Nonplastic fines (for identification procedures see *ML* below)			*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)			*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes			*SW*	Well graded sands, gravelly sands, little or no fines		
			Predominantly one size or a range of sizes with some intermediate sizes missing			*SP*	Poorly graded sands, gravelly sands, little or no fines		
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)			*SM*	Silty sands, poorly graded sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)			*SC*	Clayey sands, poorly graded sand-clay mixtures		
Fine-grained soils More than half of material is *smaller* than 75 μm sieve size	**Identification Procedures on Fraction Smaller than 380 μm Sieve Size**		**Dry Strength (crushing characteristics)**	**Dilatancy (reaction to shaking)**	**Toughness (consistency near plastic limit)**			Give typical name: indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)	
	Silts and clays liquid limit less than 50		None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity		
			Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity		
	Silts and clays liquid limit greater than 50		Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays		
			Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity		
Highly Organic Soils			Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils		



Plasticity chart
for laboratory classification of fine grained soils

Note: 1 Soils possessing characteristics of two groups are designated by combinations of group symbols (eg. GW-GC, well graded gravel-sand mixture with clay fines).
2 Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record	▼	Standing water level. Time delay following completion of drilling may be shown.
	C	Extent of borehole collapse shortly after drilling.
	▶	Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos screening.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY – Runs freely through fingers.
	M	MOIST – Does not run freely but no free water visible on soil surface.
	W	WET – Free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – Unconfined compressive strength less than 25kPa
	S	SOFT – Unconfined compressive strength 25-50kPa
	F	FIRM – Unconfined compressive strength 50-100kPa
	St	STIFF – Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF – Unconfined compressive strength 200-400kPa
	H	HARD – Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose <15 0-4
	L	Loose 15-35 4-10
	MD	Medium Dense 35-65 10-30
	D	Dense 65-85 30-50
	VD	Very Dense >85 >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

LOG SYMBOLS continued

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
		0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
		0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
		0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
		1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
		3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
		10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

APPENDIX B

Laboratory Reports and Chain of Custody Documents

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 80344

Client:
Environmental Investigation Services
PO Box 976
North Ryde BC
NSW 1670

Attention: Brendan Page

Sample log in details:

Your Reference:	**E25921KP, Pymble**
No. of samples:	8 soils, 1 water
Date samples received / completed instructions received	17/10/12 / 17/10/12

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	24/10/12 / 24/10/12
Date of Preliminary Report:	Not issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Nancy Zhang
Chemist

Rhian Morgan
Reporting Supervisor

Hinoko Miyazaki
Chemist

Lulu Guo
Approved Signatory

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

vTRH & BTEX in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-1 BH101 0-0.1 16/10/2012 Soil	80344-2 BH101 0.15-0.25 16/10/2012 Soil	80344-3 BH102 0-0.1 16/10/2012 Soil	80344-4 BH103 0-0.1 16/10/2012 Soil	80344-5 BH103 0.3-0.4 16/10/2012 Soil
Date extracted	-	22/10/2012	22/10/2012	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	22/10/2012	22/10/2012	22/10/2012	22/10/2012	22/10/2012
vTRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	0.6	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	107	108	104	98	101

vTRH & BTEX in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-6 DUP1 - 16/10/2012 Soil	80344-8 TS - 16/10/2012 Soil	80344-9 TB - 16/10/2012 Soil
Date extracted	-	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	22/10/2012	22/10/2012	22/10/2012
vTRH C_6 - C_9	mg/kg	<25	[NA]	[NA]
Benzene	mg/kg	<0.2	92%	<0.2
Toluene	mg/kg	<0.5	92%	<0.5
Ethylbenzene	mg/kg	<1	91%	<1
m+p-xylene	mg/kg	<2	91%	<2
o-Xylene	mg/kg	<1	91%	<1
Surrogate aaa-Trifluorotoluene	%	106	92	113

sTRH in Soil (C10-C36)						
Our Reference:	UNITS	80344-1	80344-2	80344-3	80344-4	80344-5
Your Reference	----------	BH101	BH101	BH102	BH103	BH103
Depth	----------	0-0.1	0.15-0.25	0-0.1	0-0.1	0.3-0.4
Date Sampled		16/10/2012	16/10/2012	16/10/2012	16/10/2012	16/10/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/10/2012	22/10/2012	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	23/10/2012	23/10/2012	23/10/2012	23/10/2012	23/10/2012
$TRHC_{10} - C_{14}$	mg/kg	<50	<50	<50	<50	<50
$TRHC_{15} - C_{28}$	mg/kg	<100	<100	<100	<100	<100
$TRHC_{29} - C_{36}$	mg/kg	<100	<100	<100	140	<100
Surrogate o-Terphenyl	%	90	87	88	91	87

sTRH in Soil (C10-C36)		
Our Reference:	UNITS	80344-6
Your Reference	----------	DUP1
Depth	----------	-
Date Sampled		16/10/2012
Type of sample		Soil
Date extracted	-	22/10/2012
Date analysed	-	23/10/2012
$TRHC_{10} - C_{14}$	mg/kg	<50
$TRHC_{15} - C_{28}$	mg/kg	<100
$TRHC_{29} - C_{36}$	mg/kg	<100
Surrogate o-Terphenyl	%	90

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-1 BH101 0-0.1 16/10/2012 Soil	80344-2 BH101 0.15-0.25 16/10/2012 Soil	80344-3 BH102 0-0.1 16/10/2012 Soil	80344-4 BH103 0-0.1 16/10/2012 Soil	80344-5 BH103 0.3-0.4 16/10/2012 Soil
Date extracted	-	22/10/2012	22/10/2012	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	22/10/2012	22/10/2012	22/10/2012	22/10/2012	22/10/2012
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	90	92	94	94	93

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-6 DUP1 - 16/10/2012 Soil
Date extracted	-	22/10/2012
Date analysed	-	22/10/2012
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	<0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	<0.1
Pyrene	mg/kg	<0.1
Benzo(a)anthracene	mg/kg	<0.1
Chrysene	mg/kg	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2
Benzo(a)pyrene	mg/kg	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1
Surrogate p-Terphenyl-d14	%	97

Organochlorine Pesticides in soil				
Our Reference:	UNITS	80344-1	80344-3	80344-4
Your Reference	----------	BH101	BH102	BH103
Depth	----------	0-0.1	0-0.1	0-0.1
Date Sampled		16/10/2012	16/10/2012	16/10/2012
Type of sample		Soil	Soil	Soil
Date extracted	-	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	24/10/2012	24/10/2012	24/10/2012
HCB	mg/kg	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1
Surrogate TCMX	%	83	83	84

Organophosphorus Pesticides Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-1 BH101 0-0.1 16/10/2012 Soil	80344-3 BH102 0-0.1 16/10/2012 Soil	80344-4 BH103 0-0.1 16/10/2012 Soil
Date extracted	-	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	24/10/2012	24/10/2012	24/10/2012
Diazinon	mg/kg	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1
Surrogate TCMX	%	83	83	84

PCBs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ---------- 	80344-1 BH101 0-0.1 16/10/2012 Soil	80344-3 BH102 0-0.1 16/10/2012 Soil	80344-4 BH103 0-0.1 16/10/2012 Soil
Date extracted	-	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	24/10/2012	24/10/2012	24/10/2012
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1
Surrogate TCLMX	%	83	83	84

Acid Extractable metals in soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-1 BH101 0-0.1 16/10/2012 Soil	80344-2 BH101 0.15-0.25 16/10/2012 Soil	80344-3 BH102 0-0.1 16/10/2012 Soil	80344-4 BH103 0-0.1 16/10/2012 Soil	80344-5 BH103 0.3-0.4 16/10/2012 Soil
Date digested	-	22/10/2012	22/10/2012	22/10/2012	22/10/2012	22/10/2012
Date analysed	-	22/10/2012	22/10/2012	22/10/2012	22/10/2012	22/10/2012
Arsenic	mg/kg	4	10	7	<4	12
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	14	17	13	17	18
Copper	mg/kg	15	24	44	77	23
Lead	mg/kg	16	22	14	63	16
Mercury	mg/kg	<0.1	<0.1	0.2	0.1	<0.1
Nickel	mg/kg	7	6	8	10	4
Zinc	mg/kg	35	30	32	500	16

Acid Extractable metals in soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-6 DUP1 - 16/10/2012 Soil	80344-10 BH101 - TRIPLICATE 0-0.1 16/10/2012 Soil
Date digested	-	22/10/2012	22/10/2012
Date analysed	-	22/10/2012	22/10/2012
Arsenic	mg/kg	4	5
Cadmium	mg/kg	<0.5	<0.5
Chromium	mg/kg	10	15
Copper	mg/kg	13	16
Lead	mg/kg	16	17
Mercury	mg/kg	<0.1	<0.1
Nickel	mg/kg	4	7
Zinc	mg/kg	33	36

Moisture						
Our Reference:	UNITS	80344-1	80344-2	80344-3	80344-4	80344-5
Your Reference	----------	BH101	BH101	BH102	BH103	BH103
Depth	----------	0-0.1	0.15-0.25	0-0.1	0-0.1	0.3-0.4
Date Sampled		16/10/2012	16/10/2012	16/10/2012	16/10/2012	16/10/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/10/12	22/10/12	22/10/12	22/10/12	22/10/12
Date analysed	-	23/10/12	23/10/12	23/10/12	23/10/12	23/10/12
Moisture	%	14	13	6.4	19	20

Moisture		
Our Reference:	UNITS	80344-6
Your Reference	----------	DUP1
Depth	----------	-
Date Sampled		16/10/2012
Type of sample		Soil
Date prepared	-	22/10/12
Date analysed	-	23/10/12
Moisture	%	15

Asbestos ID - soils Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	80344-1 BH101 0-0.1 16/10/2012 Soil	80344-3 BH102 0-0.1 16/10/2012 Soil	80344-4 BH103 0-0.1 16/10/2012 Soil
Date analysed	-	23/10/2012	23/10/2012	23/10/2012
Sample mass tested	g	Approx 25g	Approx 40g	Approx 25g
Sample Description	-	Brown fine-grained soil & rocks	Brown fine-grained soil, clay & rocks	Dark grey sandy soil & organic debris
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg
Trace Analysis	-	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected

vTRH & BTEX in Water		
Our Reference:	UNITS	80344-7
Your Reference	----------	RINSATE
Depth	----------	-
Date Sampled		16/10/2012
Type of sample		Soil
Date extracted	-	17/10/2012
Date analysed	-	17/10/2012
TRHC6 - C9	µg/L	120
Benzene	µg/L	<1
Toluene	µg/L	<1
Ethylbenzene	µg/L	<1
m+p-xylene	µg/L	<2
o-xylene	µg/L	<1
Surrogate Dibromofluoromethane	%	99
Surrogate toluene-d8	%	98
Surrogate 4-BFB	%	95

sTRH in Water (C10-C36)		
Our Reference:	UNITS	80344-7
Your Reference	----------	RINSATE
Depth	----------	-
Date Sampled		16/10/2012
Type of sample		Soil
Date extracted	-	19/10/2012
Date analysed	-	19/10/2012
$TRHC_{10}$ - C_{14}	µg/L	<50
$TRHC_{15}$ - C_{28}	µg/L	<100
$TRHC_{29}$ - C_{36}	µg/L	<100
Surrogate o-Terphenyl	%	96

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-008	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/10/2012	80344-1	22/10/2012 || 22/10/2012	LCS-1	22/10/2012
Date analysed	-			22/10/2012	80344-1	22/10/2012 || 22/10/2012	LCS-1	22/10/2012
vTRH C_6 - C_9	mg/kg	25	Org-016	<25	80344-1	<25 || <25	LCS-1	113%
Benzene	mg/kg	0.2	Org-016	<0.2	80344-1	<0.2 || <0.2	LCS-1	106%
Toluene	mg/kg	0.5	Org-016	<0.5	80344-1	<0.5 || <0.5	LCS-1	111%
Ethylbenzene	mg/kg	1	Org-016	<1	80344-1	<1 || <1	LCS-1	115%
m+p-xylene	mg/kg	2	Org-016	<2	80344-1	<2 || <2	LCS-1	116%
o-Xylene	mg/kg	1	Org-016	<1	80344-1	<1 || <1	LCS-1	107%
Surrogate aaa-Trifluorotoluene	%		Org-016	111	80344-1	107 || 105 || RPD: 2	LCS-1	110%
QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/10/2012	80344-1	22/10/2012 || 22/10/2012	LCS-1	22/10/2012
Date analysed	-			23/10/2012	80344-1	23/10/2012 || 23/10/2012	LCS-1	23/10/2012
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	80344-1	<50 || <50	LCS-1	105%
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	80344-1	<100 || <100	LCS-1	107%
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	80344-1	<100 || <100	LCS-1	84%
Surrogate o-Terphenyl	%		Org-003	89	80344-1	90 || 87 || RPD: 3	LCS-1	108%
QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/10/2012	80344-1	22/10/2012 || 22/10/2012	LCS-1	22/10/2012
Date analysed	-			22/10/2012	80344-1	22/10/2012 || 22/10/2012	LCS-1	22/10/2012
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	LCS-1	110%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	LCS-1	117%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	LCS-1	104%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	0.1 || 0.1 || RPD: 0	LCS-1	100%
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	0.1 || <0.1	LCS-1	113%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	LCS-1	108%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(b+k)fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	80344-1	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	80344-1	0.05 || 0.05 || RPD: 0	LCS-1	124%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		Org-012 subset	101	80344-1	90 || 92 || RPD: 2	LCS-1	100%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/10/2012	80344-1	22/10/2012 || 22/10/2012	LCS-1	22/10/2012
Date analysed	-			24/10/2012	80344-1	24/10/2012 || 24/10/2012	LCS-1	24/10/2012
HCB	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	90%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	104%
Heptachlor	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	93%
delta-BHC	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	95%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	98%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	111%
Dieldrin	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	101%
Endrin	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	100%
pp-DDD	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	118%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	LCS-1	95%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	80344-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	91	80344-1	83 || 82 || RPD: 1	LCS-1	89%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/10/2012	80344-1	22/10/2012 II 22/10/2012	LCS-1	22/10/2012
Date analysed	-			24/10/2012	80344-1	24/10/2012 II 24/10/2012	LCS-1	24/10/2012
Diazinon	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Dimethoate	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Ronnel	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	LCS-1	97%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	LCS-1	98%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	80344-1	<0.1 II <0.1	LCS-1	104%
Surrogate TCMX	%		Org-008	91	80344-1	83 II 82 II RPD: 1	LCS-1	93%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/10/2012	80344-1	22/10/2012 II 22/10/2012	LCS-1	22/10/2012
Date analysed	-			24/10/2012	80344-1	24/10/2012 II 24/10/2012	LCS-1	24/10/2012
Arochlor 1016	mg/kg	0.1	Org-006	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Arochlor 1221	mg/kg	0.1	Org-006	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	Org-006	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	Org-006	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	Org-006	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	Org-006	<0.1	80344-1	<0.1 II <0.1	LCS-1	101%
Arochlor 1260	mg/kg	0.1	Org-006	<0.1	80344-1	<0.1 II <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	91	80344-1	83 II 82 II RPD: 1	LCS-1	85%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			22/10/2012	80344-1	22/10/2012 II 22/10/2012	LCS-1	22/10/2012
Date analysed	-			22/10/2012	80344-1	22/10/2012 II 22/10/2012	LCS-1	22/10/2012
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	80344-1	4 II 5 II RPD: 22	LCS-1	99%
Cadmium	mg/kg	0.5	Metals-020 ICP-AES	<0.5	80344-1	<0.5 II <0.5	LCS-1	95%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	80344-1	14 II 14 II RPD: 0	LCS-1	99%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	80344-1	15 II 26 II RPD: 54	LCS-1	99%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	80344-1	16 II 17 II RPD: 6	LCS-1	95%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	80344-1	<0.1 II <0.1	LCS-1	117%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	80344-1	7 || 7 || RPD: 0	LCS-1	98%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	80344-1	35 || 39 || RPD: 11	LCS-1	99%

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			[NT]
Date analysed	-			[NT]
Moisture	%	0.1	Inorg-008	[NT]

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

QUALITY CONTROL vTRH & BTEX in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			17/10/2012	[NT]	[NT]	LCS-W1	17/10/2012
Date analysed	-			17/10/2012	[NT]	[NT]	LCS-W1	17/10/2012
TRHC6 - C9	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	90%
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	88%
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	88%
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	91%
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	LCS-W1	91%
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	89%
Surrogate Dibromofluoromethane	%		Org-016	109	[NT]	[NT]	LCS-W1	93%
Surrogate toluene-d8	%		Org-016	100	[NT]	[NT]	LCS-W1	98%
Surrogate 4-BFB	%		Org-016	106	[NT]	[NT]	LCS-W1	98%

QUALITY CONTROL sTRH in Water (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/10/2012	[NT]	[NT]	LCS-W1	19/10/2012
Date analysed	-			19/10/2012	[NT]	[NT]	LCS-W1	19/10/2012
TRHC10 - C14	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	103%
TRHC15 - C28	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	118%
TRHC29 - C36	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	110%
Surrogate o-Terphenyl	%		Org-003	101	[NT]	[NT]	LCS-W1	76%

Client Reference: E25921KP, Pymble

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	80344-3	22/10/2012 || 22/10/2012	80344-3	22/10/2012
Date analysed	-	80344-3	22/10/2012 || 22/10/2012	80344-3	22/10/2012
vTRH C_6 - C_9	mg/kg	80344-3	<25 || <25	80344-3	107%
Benzene	mg/kg	80344-3	<0.2 || <0.2	80344-3	95%
Toluene	mg/kg	80344-3	0.6 || 0.6 || RPD: 0	80344-3	120%
Ethylbenzene	mg/kg	80344-3	<1 || <1	80344-3	106%
m+p-xylene	mg/kg	80344-3	<2 || <2	80344-3	107%
o-Xylene	mg/kg	80344-3	<1 || <1	80344-3	100%
Surrogate aaa-Trifluorotoluene	%	80344-3	104 || 131 || RPD: 23	80344-3	108%
QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	80344-3	22/10/2012
Date analysed	-	[NT]	[NT]	80344-3	23/10/2012
TRH C_{10} - C_{14}	mg/kg	[NT]	[NT]	80344-3	96%
TRH C_{15} - C_{28}	mg/kg	[NT]	[NT]	80344-3	104%
TRH C_{29} - C_{36}	mg/kg	[NT]	[NT]	80344-3	92%
Surrogate o-Terphenyl	%	[NT]	[NT]	80344-3	106%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	80344-3	22/10/2012
Date analysed	-	[NT]	[NT]	80344-3	22/10/2012
Naphthalene	mg/kg	[NT]	[NT]	80344-3	104%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	80344-3	109%
Phenanthrene	mg/kg	[NT]	[NT]	80344-3	98%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	80344-3	84%
Pyrene	mg/kg	[NT]	[NT]	80344-3	106%
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	80344-3	101%
Benzo(b+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	80344-3	115%
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	[NT]	[NT]	80344-3	91%

Client Reference: E25921KP, Pymble

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	80344-3	22/10/2012
Date analysed	-	[NT]	[NT]	80344-3	24/10/2012
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	80344-3	78%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	80344-3	96%
Heptachlor	mg/kg	[NT]	[NT]	80344-3	76%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	80344-3	81%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	80344-3	83%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	80344-3	88%
Dieldrin	mg/kg	[NT]	[NT]	80344-3	86%
Endrin	mg/kg	[NT]	[NT]	80344-3	84%
pp-DDD	mg/kg	[NT]	[NT]	80344-3	84%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	80344-3	83%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%	[NT]	[NT]	80344-3	82%

Client Reference: E25921KP, Pymble

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	80344-3	22/10/2012
Date analysed	-	[NT]	[NT]	80344-3	24/10/2012
Diazinon	mg/kg	[NT]	[NT]	[NR]	[NR]
Dimethoate	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Ronnel	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	[NT]	[NT]	80344-3	98%
Fenitrothion	mg/kg	[NT]	[NT]	80344-3	90%
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	[NT]	[NT]	80344-3	94%
Surrogate TCMX	%	[NT]	[NT]	80344-3	82%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	80344-3	22/10/2012
Date analysed	-	[NT]	[NT]	80344-3	24/10/2012
Arochlor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1254	mg/kg	[NT]	[NT]	80344-3	97%
Arochlor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	80344-3	85%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	[NT]	[NT]	80344-3	22/10/2012
Date analysed	-	[NT]	[NT]	80344-3	22/10/2012
Arsenic	mg/kg	[NT]	[NT]	80344-3	94%
Cadmium	mg/kg	[NT]	[NT]	80344-3	96%
Chromium	mg/kg	[NT]	[NT]	80344-3	91%
Copper	mg/kg	[NT]	[NT]	80344-3	106%
Lead	mg/kg	[NT]	[NT]	80344-3	94%
Mercury	mg/kg	[NT]	[NT]	80344-3	97%
Nickel	mg/kg	[NT]	[NT]	80344-3	87%
Zinc	mg/kg	[NT]	[NT]	80344-3	92%

Report Comments:

Asbestos testing:

All samples analysed as received. However, sample 80344-1 & 3, are below the recommended volume of 40-50g (50mL) as per AS4964-2004. This insufficient sample size may lead to inaccurate interpretation of the result as it may not be representative of the sampled area.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteriae has been exceeded for 80344-1 for Cu. Therefore a triplicate result has been issued as laboratory sample number 80344-10.

Asbestos ID was analysed by Approved Identifier: Lulu Guo
Asbestos ID was authorised by Approved Signatory: Lulu Guo

INS: Insufficient sample for this test
NA: Test not required
<: Less than

PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than

NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batched of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

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

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client:

Environmental Investigation Services
PO Box 976
North Ryde BC NSW 1670

ph: 02 9888 5000
Fax: 02 9888 5001

Attention: Brendan Page

Sample log in details:

Your reference:	**E25921KP, Pymble**
Envirolab Reference:	**80344**
Date received:	17/10/12
Date results expected to be reported:	**24/10/12**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	8 soils, 1 water
Turnaround time requested:	Standard
Temperature on receipt	Cool
Cooling Method:	Ice
Sampling Date Provided:	YES

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples.

Contact details:

Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

SAMPLE AND CHAIN OF CUSTODY FORM

TO: **Envirolab Services Pty Ltd** **12 Ashley Street** **Chatswood NSW 2067** **Phone: (02) 99106200** **Fax: (02) 99106201** **Attention: Aileen**	**EIS Job Number: E25921KP** **Date Results Required:** Standard TAT **Sheet** 1 / 1	**FROM:** **Environmental Investigation Services** **Rear 115 Wicks Road** **Macquarie Park NSW 2113** **Phone: (02) 9888 5000** **Fax: (02) 9888 5004** **Contact:** Brendan Page

Project: Proposed Development (Stage 1)
Location: Pymble
Sampler: RVC

Sample Preservation: In esky on ice

Tests Required

Date Sampled	Lab Ref:	Borehole/ Sample Number	Depth (m)	Sample Container	PID	Sample Description	Combo 3	Combo 6a	Combo 3a	8 Metals	TPH	BTEX	PAHs	OCP/OPP/ PCBs	Asbestos	TCLP 6 Metals	TCLP PAHs	
16.10.12	1	BH101	0-0.1	Glass jar + Asb Bag	0	Fill (soil)		X										
↓	2	↓	0.15-0.25	Glass jar + Asb Bag	0	Natural (soil)	X											
	3	BH102	0-0.1	Glass jar + Asb Bag	4.7	Fill		X										
	4	BH103	0-0.1	Glass jar + Asb Bag	0	Fill		X										
	5	↓	0.3-0.4	Glass jar + Asb Bag	0	Natural	X											
not received ←		↓	0.6-0.7	Glass jar + Asb Bag	0	Natural												
	6	DUP1	–	Glass jar + ~~Asb Bag~~	–	Soil Dup	X											
not received ←		DUP 2	–	Glass jar + ~~Asb Bag~~	–	Soil Dup												
	7	Rinsate	–	1 amber 1 vial	–	Water					X	X						
	8	TS		Glass jar + ~~Asb Bag~~	–							X						
↓	9	TB	–	Glass jar + ~~Asb Bag~~								X						
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
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				Glass jar + Asb Bag														

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 80344
Date Received: 17.10.12
Time Received: 13:15
Received by: [illegible]
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Remarks (comments/detection limits required):

Relinquished By:	**Date:**	**Time:**	**Received By:**	
BP	17/10/12	12:05pm.	[illegible]	17.10.12

APPENDIX C

Abbreviations, Sampling Protocols and QA/QC Definitions

ABBREVIATIONS

AGST	Above Ground Storage Tank
AHD	Australian Height Datum
ALTPQL	All Less than PQL
ANZECC	Australian and New Zealand Environment Conservation Council
ASS	Acid Sulfate Soil
BA/DA	Building Approval and Development Application
B(a)P	Benzo(a)pyrene
BGL	Below Ground Level
BH	Borehole
BOM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
COC	Chain of Custody documentation
CLM	Contaminated Land Management
CMP	Construction Management Plan
CSM	Conceptual Site Model
CT	Contamination Threshold
DBYD	Dial Before You Dig
DEC	Department of Environment and Conservation (now part of OEH)
DECC	Department of Environment and Climate Change (now part of OEH)
DECCW	Department of Environment, Climate Change and Water (now part of OEH)
DWE	NSW Department of Water and Energy
DO	Dissolved Oxygen
DP	Deposited Plan
DQIs	Data Quality Indicators
DQOs	Data Quality Objective
EC	Electrical Conductivity
Eh	Redox Potential
EILs	Ecological Investigation Levels
ENM	Excavated Natural Material
EMP	Environmental Management Plan
ESA	Environmental Site Assessment
FR	Field Rinsate
GAI	General Approvals of Immobilisation
GILs	Groundwater Investigation Levels
GPS	Global Positioning System
Hazmat	Hazardous Materials Assessment
HILs	Health Based Investigation Level
HM	Heavy Metals
HMTVs	Hardness Modified Trigger Values
LNAPLs	Light Non-Aqueous Phase Liquids
NATA	National Association of Testing Authorities
NDLR	Not Detected at Limit of Reporting
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
NSW EPA	Environmental Protection Authority of NSW
MGA	Map Grid of Australia
OCPs	Organochlorine Pesticides
OEH	NSW Office of Environment and Heritage
OPPs	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential ASS

ABBREVIATIONS

PCC	Potential Contaminants of Concern
PCBs	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
POEO	Protection of Environmental Operations
PPIL	Provisional Phyto-toxicity Investigation Levels
PQL	Practical Quantitation Limit
RAP	Remediation Action Plan
RL	Reduced Level
QA/QC	Quality Assurance and Quality Control
RPD	Relative Percentage Difference
SAC	Site Assessment Criteria
SAQP	Sampling, Analysis and Quality Plan
SAS	Site Audit Statement
SCC	Specific Contamination Concentration
SD	Standard Deviation
SEPP	State Environmental Planning Policy
sPOCAS	suspension Peroxide Oxidation Combined Acidity and Sulfate
SPT	Standard Penetration Test
SVOCs	Semi-Volatile Organic Compounds
SWL	Standing Water Level
TB	Trip Blank
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
TS	Trip Spike
USEPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
UPSS	Underground Petroleum Storage Systems
UST	Underground Storage Tank
VENM	Virgin Excavated Natural Material
VOCs	Volatile Organic Compounds
WC	Waste Classification
WHS	Workplace, Health and Safety

SOIL AND GROUNDWATER SAMPLING PROTOCOLS

These protocols specify the basic procedures to be used when sampling soils or groundwater for environmental site assessments undertaken by EIS. The purpose of these protocols is to provide standard methods for: sampling, decontamination procedures for sampling equipment, sample preservation, sample storage and sample handling. Deviations from these procedures must be recorded.

Soil Sampling

a) Prepare a test pit/borehole log.
b) Layout sampling equipment on clean plastic sheeting to prevent direct contact with ground surface. The work area should be at a distance from the drill/rig excavator such that the drill rig/excavator can operate in a safe manner.
c) Ensure all sampling equipment has been decontaminated prior to use.
d) Remove any surface debris from the immediate area of the sampling location.
e) Collect samples and place in glass jar with a Teflon seal. This should be undertaken as quickly as possibly to prevent the loss of volatiles. If possible, fill the glass jars completely.
f) Collect samples for asbestos analysis and place in a zip-lock plastic bag.
g) Label the jar and/or bag with the EIS job number, sample location (eg. BH1), sampling depth interval and date. If more than one sample container is used, this should also be indicated (eg. 2 = Sample jar 1 of 2 jars).
h) Photoionisation detector (PID) screening of volatile organic compounds (VOCs) should be undertaken on samples using the soil sample headspace method. Headspace measurements are taken following equilibration of the headspace gasses in partly filled zip-lock plastic bags. PID headspace data is recorded on the borehole/test pit log and the chain of custody forms.
i) Record the lithology of the sample and sample depth on the borehole/test pit log in accordance with AS1726-1993[25].
j) Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab. All samples are preserved in accordance with AS 4482.1:2005, AS 4482.2:1999 and AS/NZS 5667.1:1998.
k) Check for the presence of groundwater after completion of each borehole using an electronic dip metre or water whistle. Boreholes should be left open until the end of fieldwork. All groundwater levels in the boreholes should be rechecked on the completion of the fieldwork.
l) Backfill the boreholes/test pits with the excavation cuttings or clean sand prior to leaving the site.

Decontamination Procedures for Soil Sampling Equipment

a) All of the equipment associated with the soil sampling procedure should be decontaminated between every sampling location.
b) The following equipment and materials are required for the decontamination procedure:
   - Phosphate free detergent (Decon 90)
   - Potable water
   - Stiff brushes
   - Plastic sheets
c) Ensure the decontamination materials are clean prior to proceeding with the decontamination.
d) Fill both buckets with clean potable water and add phosphate free detergent to one bucket.
e) In the bucket containing the detergent scrub the sampling equipment until all the material attached to the equipment has been removed.
f) Rinse sampling equipment in the bucket containing potable water.

---

[25] *Geotechnical Site Investigations*, Standards Australia 1993 (AS1726-1993)

g) Place cleaned equipment on clean plastic sheets.

If all materials are not removed by this procedure, high-pressure water cleaning is recommended. If any equipment is not completely decontaminated by both these processes that equipment should not be used until it has been thoroughly cleaned.

Groundwater Sampling

Groundwater samples are more sensitive to contamination than soil samples and therefore adhesion to this protocol is particularly important to obtain reliable, reproducible results. The recommendations detailed in AS/NZS 5667.1:1998 are considered to form a minimum standard.

The basis of this protocol is to maintain the security of the borehole and obtain accurate and representative groundwater samples. The following procedure should be used for collection of groundwater samples from previously installed groundwater monitoring wells.

a) After monitoring well installation, at least three bore volumes should be pumped from the monitoring wells (well development) to remove any water introduced during the drilling process and/or the water that is disturbed during installation of the monitoring well. This should be completed prior to purging and sampling.

b) Groundwater monitoring wells should then be left to recharge for at least three days before purging and sampling. Prior to purging or sampling the condition of each well should observed and any anomalies recorded on the field data sheets. The following information should be noted: the condition of the well, noting any signs of damage, tampering or complete destruction; the condition and operation of the well lock; the condition of the protective casing and the cement footing (raised or cracked); and, the presence of water between protective casing and well.

c) Take the groundwater level from the collar of the piezometer/monitoring well using an electronic dip meter. The collar level should be taken (if required) during the site visit using a dumpy level and staff.

d) Purging and sampling of piezometers/monitoring wells is done on the same site visit when using micro-purge (or low flow) techniques. Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:
   - Micropore filtration system or Stericup single-use filters (for heavy metals samples).
   - Filter paper for Micropore filtration system.
   - Bucket with volume increments.
   - Sample containers: teflon bottles with 1 ml nitric acid, 75mL glass vials with 1 mL hydrochloric acid, 1 L amber glass bottles.
   - Bucket with volume increments.
   - Flow cell.
   - pH/EC/Eh/T meters.
   - Plastic drums used for transportation of purged water.
   - Esky and ice.
   - Nitrile gloves.
   - Distilled water (for cleaning).
   - Electronic dip meter.
   - Micro-purge pump pack and pump head.
   - Air and water tubing for Micro-purge.
   - Groundwater sampling forms.

e) If single-use stericup filtration is not being used, clean the Micropore filtration system thoroughly with distilled water prior to use and between each sample. Filter paper should be changed between samples. 0.45um filter paper should be placed below the glass fibre filter paper in the filtration system.

f) Ensure all non-disposable sampling equipment is decontaminated or that new disposable equipment is available prior to any work commencing at a new location. The procedure for decontamination of groundwater equipment is outlined at the end of this section.

g) Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.

h) Groundwater samples are obtained from the monitoring wells using low flow/micro-purge sampling equipment to reduce the disturbance of the water column and loss of volatiles.

i) During pumping to purge the well, the pH, temperature, conductivity, dissolved oxygen, redox potential and groundwater levels are monitored (where possible) using calibrated field instruments to assess the development of steady state conditions. Steady state conditions are generally considered to have been achieved when the difference in the pH measurements was less than 0.2 units and the difference in conductivity was less than 10%.

j) All measurements are recorded on specific data sheets.

k) Once steady state conditions are considered to have been achieved, groundwater samples are obtained directly from the pump tubing and placed in appropriate glass bottles, BTEX vials or plastic bottles.

l) All samples are preserved in accordance with water sampling requirements detailed in the NEPM 1999 and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice in accordance with AS/NZS 5667.1:1998.

m) Record the sample on the appropriate log in accordance with AS1726:1993. At the end of each water sampling complete a chain of custody form.

Decontamination Procedures for Groundwater Sampling Equipment

a) All of the equipment associated with the groundwater sampling procedure (other than single-use items) should be decontaminated between every sampling location.

b) The following equipment and materials are required for the decontamination procedure:
   - Phosphate free detergent.
   - Potable water.
   - Distilled water
   - Plastic Sheets or bulk bags (plastic bags)

c) Fill one bucket with clean potable water and phosphate free detergent, and one bucket with distilled water.

d) Flush potable water and detergent through pump head. Wash sampling equipment and pump head using brushes in the bucket containing detergent until all materials attached to the equipment are removed.

e) Flush pump head with distilled water.

f) Change water and detergent solution after each sampling location.

g) Rinse sampling equipment in the bucket containing distilled water.

h) Place cleaned equipment on clean plastic sheets.

i) If all materials are not removed by this procedure that equipment should not be used until it has been thoroughly cleaned

QA/QC DEFINITIONS

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994[26]) methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (H. Keith 1991[27]).

Practical Quantitation Limit (PQL), Limit of Reporting (LOR) and Estimated Quantitation Limit (EQL)
These terms all refer to the concentration above which results can be expressed with a minimum 95% confidence level. The laboratory reporting limits are generally set at ten times the standard deviation for the Method Detection limit (MDL) for each specific analyte. For the purposes of this report the LOR, PQL, and EQL are considered to be equivalent.

When assessing laboratory data it should be borne in mind that values at or near the PQL have two important limitations. *"The uncertainty of the measurement value can approach, and even equal, the reported value. Secondly, confirmation of the analytes reported is virtually impossible unless identification uses highly selective methods. These issues diminish when reliably measurable amounts of analytes are present. Accordingly, legal and regulatory actions should be limited to data at or above the reliable detection limit"* Keith 1991.

Precision
The degree to which data generated from repeated measurements differ from one another due to random errors. Precision is measured using the standard deviation or Relative Percent Difference (RPD). Acceptable targets for precision in this report will be less than 50% RPD for concentrations greater than ten times the PQL, less than 75% RPD for concentrations between five and ten times the PQL and less than 100% RPD for concentrations that are less than five times the PQL.

Accuracy
Accuracy is a measure of the agreement between an experimental result and the true value of the parameter being measured. The assessment of accuracy for an analysis can be achieved through the analysis of known reference materials or assessed by the analysis of surrogates, field blanks, trip spikes and matrix spikes.

The proximity of an averaged result to the true value, where all random errors have been statistically removed. Accuracy is measured by percent recovery. Acceptable limits for accuracy generally lie between 70% to 130% recoveries. Certain laboratory methods may allow for values that lie outside these limits.

Representativeness
Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is primarily dependent upon the design and implementation of the sampling program. Representativeness of the data is partially ensured by the avoidance of contamination, adherence to sample handing and analysis protocols and use of proper chain-of-custody and documentation procedures.

Completeness
Completeness is a measure of the number of valid measurements in a data set compared to the total number of measurements made and overall performance against DQIs. The following information is assessed for completeness:

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[26] *SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* US EPA, 1994 (US EPA SW-846)

[27] *Environmental Sampling and Analysis, A Practical Guide*, Keith, H, 1991 (Keith 1991)

- Chain-of-custody forms;
- Sample receipt form;
- All sample results reported;
- All blank data reported;
- All laboratory duplicate and RPDs calculated;
- All surrogate spike data reported;
- All matrix spike and lab control spike (LCS) data reported and RPDs calculated;
- Spike recovery acceptable limits reported; and
- NATA stamp on reports.

Comparability

Comparability is the evaluation of the similarity of conditions (eg. sample depth, sample homogeneity) under which separate sets of data are produced. Data comparability checks include a bias assessment that may arise from the following sources:

- Collection and analysis of samples by different personnel;
- Use of different techniques;
- Collection and analysis by the same personnel using the same methods but at different times; and
- Spatial and temporal changes (due to environmental dynamics).

Blanks

The purpose of laboratory and field blanks is to check for artifacts and interferences that may arise during sampling and analysis.

Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula below. Acceptable recovery limits are 70% to 130%.

$$\frac{\text{(Spike Sample Result} - \text{Sample Result)}}{\text{Concentration of Spike Added}} \times 100$$

Surrogate Spikes

Samples are spiked with a known concentration of compounds that are chemically related to the analyte being investigated but unlikely to be detected in the environment. The purpose of the Surrogate Spikes is to check the accuracy of the analytical technique. Surrogate Spikes are reported as percent recovery.

Duplicates

Laboratory duplicates measure precision, expressed as Relative Percent Difference. Duplicates are prepared from a single field sample and analysed as two separate extraction procedures in the laboratory. The RPD is calculated using the formula where D1 is the sample concentration and D2 is the duplicate sample concentration:

$$\frac{(D1 - D2)}{\{(D1 + D2)/2\}} \times 100$$

From: John Lawrence <jl@baypartnership.com.au>
Subject: **RE: Comments on Draft.**
Date: 14 January 2013 12:50:11 PM AEDT
To: Warren Marsh <wmarsh@pmdl.com.au>
Cc: Alan Duncan <ad@baypartnership.com.au>
1 Attachment, 199 KB

Good Afternoon Warren,

As the submission of Midson's first Progress Claim was deferred from mid-December to mid-January 2013, this change relieved some timing pressure for deliverables such as the Preliminary Report for UFS & Wesley College.

In respect of the Preliminary Report contents we refer to the list of required information Bay tabled at the 11.12.12 Site Meeting and note the following items remain outstanding:

- Contract Documents:
  - Building Contract
  - Tri-Partite Agreement / Side Deed Contract
  - Contract Drawings
  - Contract Specifications
  - Other contract docs.
- PI Insurance certificates of Currency:
  - Holmes Fire & Safety
  - Koicas & Associates
  - Accessibility Solutions
  - Caldis Cook
  - Blackett Maguire
- Midson's Insurances - Certificates of Currency
- Wesley College Insurances – Certificates of Currency

In addition we need copies of the following for appending to the Preliminary Report:

- Copy of Sydney City Council's DA D/2011/436/A
- PMDL's Design Compliance Statement (Example from Kellyville Stage 1 is attached)

- Final Construction Certificate [If its issue is imminent]

We would appreciate your continued assistance by providing and obtaining the outstanding information to enable us to complete the Preliminary Report.

Thank you,

Regards,

John Lawrence

BAY PARTNERSHIP
Suite 403, 460 Pacific Highway, St. Leonards, NSW, 2065 Tel: +612 9901 4678
Fax: +612 9438 3920 Mob: 0411 600 187 Email: jl@baypartnership.com.au

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From: Warren Marsh [mailto:wmarsh@pmdl.com.au]
Sent: Thursday, 20 December 2012 4:17 PM
To: Alan Duncan; John Lawrence
Cc: Neil Westnedge
Subject: Comments on Draft.

- The building Contract is a ABIC MW-2008 Major Works Contract.
- Letter of Acceptance was issued Nov 22, 2012
- Contract docs have been issued, signed by Wesley and Builder.
- Commencement is Nov 28, 2012
- Completion is Set 24, 2013.
- note consultants listed as $262,602 in Budget schedule, bur noted as $262,622 in next clause

Regards

Warren Marsh

Senior Consultant

pmdl

Ph: +612 84585500 |**Fx**: +612 84585555

E: email | **W**: www.pmdl.com.au

Sydney | Melbourne | Hong Kong

NSW Nominated Architects: Andrew Pender 5317 | David Morris 5865 | Peter Doddrell 5134

Please consider the environment before printing this email

Example for ....pdf (199 KB)