Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Preliminary Site Investigation
for Contamination

Proposed Site Rehabilitation of Old Quarry
Part of 39 Dell Road, West Gosford

Prepared for
Valencia Homes Pty Ltd

Project 75853.00
September 2014

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	75853.00	Document No.	1
Document title	Report on Preliminary Site Investigation for Contamination		
Site address	39 Dell Road, West Gosford		
Report prepared for	Valencia Homes Pty Ltd		
File name	P:\75853.00 West Gosford BJK\Docs\75853.00 - PSI.doc		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
0	Brent Kerry	Tim Wright	September 2014

Distribution of copies

Revision	Electronic	Paper	Issued to
0	1	0	Matthew Wales (Wales & Associates Pty Ltd)

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		
Reviewer		

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Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
Unit 5, 3 Teamster Close
Tuggerah NSW 2259
Phone (02) 4351 1422
Fax (02) 4351 1410

Executive Summary

This report details the methodology and results of a *Preliminary Site Investigation for Contamination (PSI)* undertaken by Douglas Partners Pty Ltd (DP) at part of an old quarry, located at 39 Dell Road West Gosford, NSW (the site). The work was requested by Valencia Homes Pty Ltd and carried out in consultation with Wales & Associates Pty Ltd, project managers. The investigation has been carried out with reference to DP proposal WYG140249, dated 7 August 2014.

This PSI provides a preliminary contamination investigation of the site to support an application for site rehabilitation of the old quarry to Gosford City Council (GCC) and also provides information on the likely contamination constraints associated with the proposed redevelopment of the site for a commercial/industrial land use.

On the basis of the background information gathered during the PSI, DP considered that there was a low to moderate potential for contamination within the site, due primarily to past filling activities and other activities associated with historical use (i.e. quarry and transfer yard) of the site. The PSI also included a broad systematic intrusive soil investigation programme that aimed to assess site's contamination status. The preliminary investigations comprised the assessment of soil contaminants at 11 locations.

The results of soil testing reported contaminant concentrations that were generally below the adopted site assessment criteria (SAC). However, the benzo(a)pyrene (BaP) concentration in the surface filling at Pit 1 exceeded the ecological-based SAC. The elevated BaP concentration was likely to be the result of incomplete combustion of organic materials (i.e. past bonfires in the locality of Pit 1) in the south-east portion of the site. The placement at least 2 m filling in this area would result in the exceedance being at a depth greater than 2 m below the final site levels and would negate the need for additional investigation and/or remediation as part of the proposed Site Rehabilitation Plan approvals process.

In summary, the PSI indicates that the site can be made compatible with the proposed commercial/industrial land use development from a contamination standpoint, subject to the following conditions being incorporated into the Site Rehabilitation Plan:

- Placement at least 2 m filling in the south-east portion of the site (specifically in the locality of Pit 1).
- An *Unexpected Find Protocol* to manage any asbestos fragments, or other unexpected contamination, encountered at the ground surface or within soils during the rehabilitation works at the site. It is noted that the PSI did not identify the presence of any asbestos containing materials (ACM), however, the presence of minor building waste materials within the filling indicates that their presence cannot be ruled out.

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1. Introduction

This report details the methodology and results of a *Preliminary Site Investigation for Contamination (PSI)* undertaken by Douglas Partners Pty Ltd (DP) at part of an old quarry, located at 39 Dell Road West Gosford, NSW (the site). The work was requested by Valencia Homes Pty Ltd and carried out in consultation with Wales & Associates Pty Ltd, project managers. The investigation has been carried out with reference to DP proposal WYG140249, dated 7 August 2014.

This PSI provides a preliminary contamination investigation of the site to support an application for site rehabilitation of the old quarry to Gosford City Council (GCC) and also provides information on the likely contamination constraints associated with the proposed redevelopment of the site for a commercial/industrial land use.

This report presents the results of a limited site history review, and preliminary intrusive investigations including analytical laboratory testing. The PSI was undertaken with respect to the staged investigation approach outlined in *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55 – Ref 1) and The *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM, 1999), amended 2013 (Ref 2).

1.1 Purpose of Investigation

The objectives of the PSI were to:

- Identify potential sources of contamination due to past and present activities/practices;
- Identify the likely nature and potential extent of contamination at the site through visual inspection and limited soil sampling and analysis;
- Assess the compatibility of the site with the proposed commercial/industrial use with respect to contamination issues; and
- Provide advice on further investigations or remedial works (if required).

1.2 Site Identification

The site has a street address of 39 Dell Road, West Gosford and is identified as part of Lot 6 in Deposited Plan 3944. The site is an irregular shaped parcel of land, with an area of approximately 0.9 ha, within the rectangular shaped Lot 6 (approximately 9.7 ha). At the time of the investigation the site comprised a relatively flat cleared area with grass surface cover.

Figures 1 and 2 identify the location of the site in relation to various local features and the Lot 6 boundary.

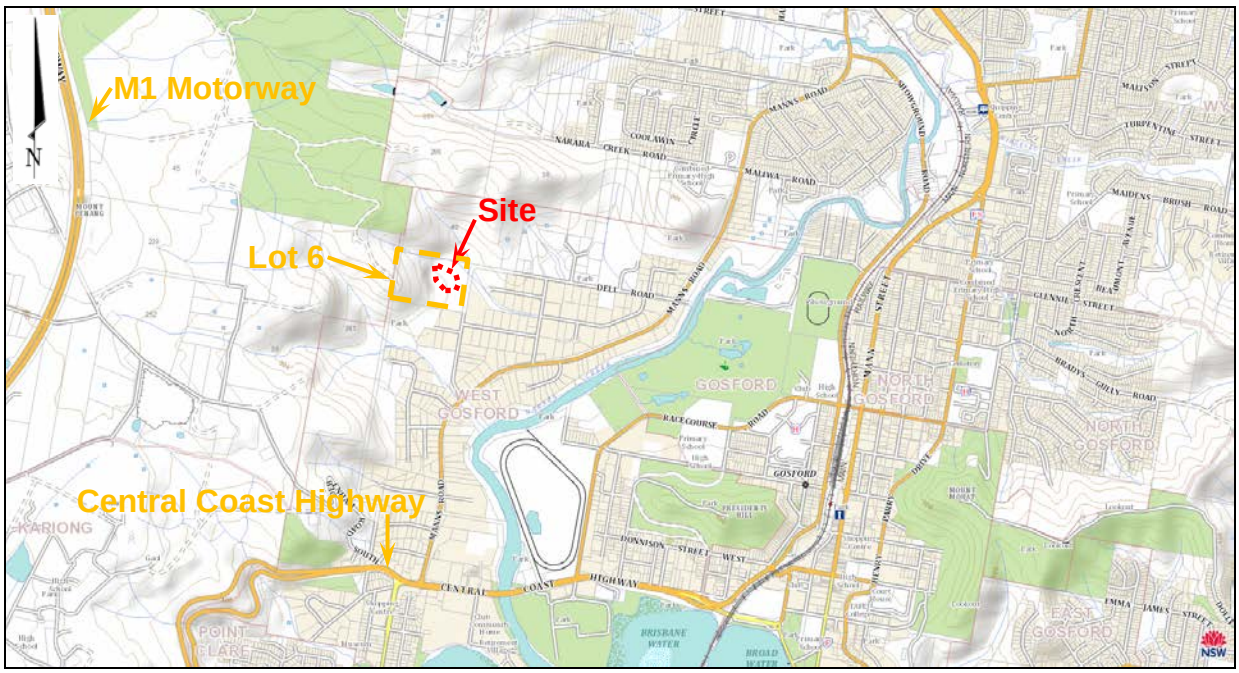


Figure 1: Location of Site (image sourced from Land and Property Information)

Figure 2: Location of Site (image sourced from Land and Property Information)

The site is located within the parish of Gosford, County of Northumberland and in the GCC local government area. Under the Gosford Local Environmental Plan 2014 is understood that the land use zoning is identified as a deferred matter (or deferred lands), however, is identified to have a 7a conservation zone under the pre-LEP 2014 zones.

Drawing 1, which is included in Appendix B, shows the existing layout of the site.

2. Scope of Work

The scope of work comprised:

- Collation and interpretation of data from the following sources to update the site historical information:-
  - Published data, including topographical, geological and hydrogeological maps;
  - Registered groundwater bore licence search;
  - GCC Property Enquiry Information;
  - NSW EPA Contaminated Land and Protection of Environment Operations databases;
  - Historical aerial photographs;
  - Site plans, archives and anecdotal information (where available)
- Site walkover to update the status of the site;
- Investigations comprising the assessment of soil conditions at the site. The soil investigations comprised the excavation of 11 test pits (Pits 1 to 11) and included screening and selective testing of soil samples for the contaminants of concern identified by the site historical review and walkover.
- Preparation of this report outlining the works undertaken and the findings of the PSI.

Specifics of the work completed are further detailed in the Sections 8 and 9 of the report.

3. Physical Setting

3.1 Topography and Hydrology

According to local topographic mapping the site is located near the toe of the eastern face of a hill. Site elevations range between approximately 5 m and 10 m relative to Australian height datum (AHD). The site locality generally slopes down to the north-east; however, site gradients are relatively flat within the site. It is expected that surface levels within the site have been somewhat re-graded since development of the surface elevation contours. Steeper areas were identified in areas adjacent to the western boundary. The mapping indicated that an intermittent tributary of Narara Creek is located adjacent to the northern boundary of Lot 6. Site observations generally indicated that any surface water runoff would enter the intermittent tributary via overland flow and then discharge into Brisbane Water via Narara Creek.

Figure 3 shows surface elevation contours at 2m intervals and local water bodies in the vicinity of the site.

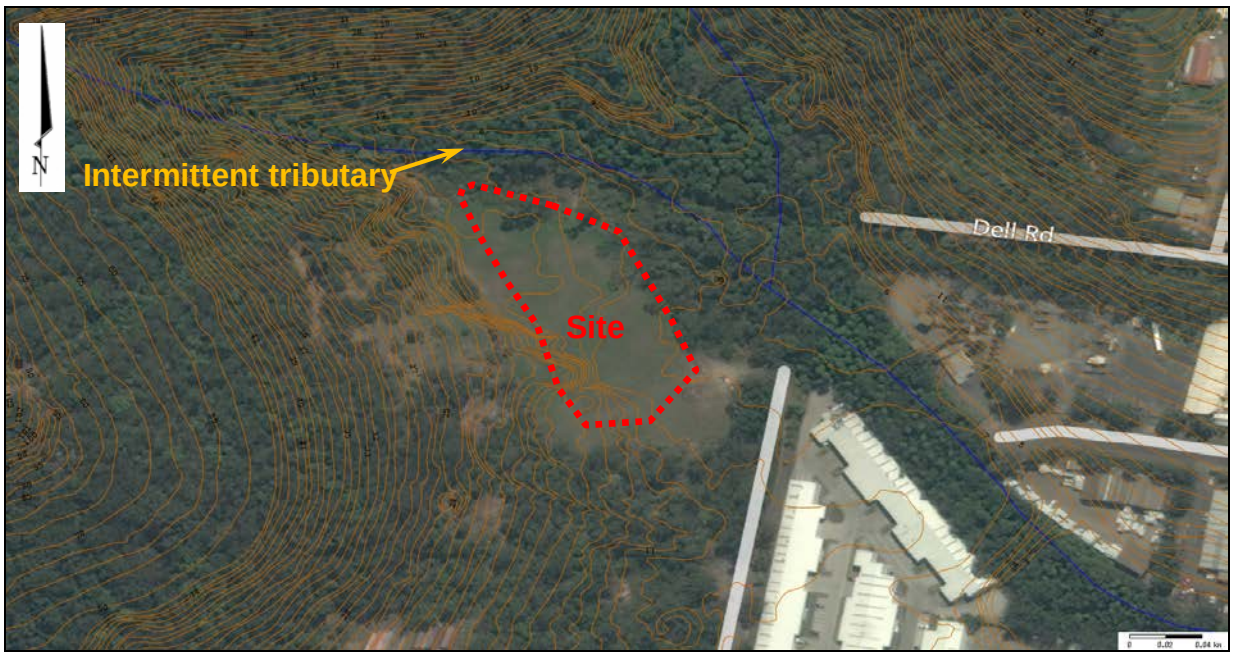


Figure 3: Site Topography

(Image sourced from Microsoft Virtual Earth with 2 m elevation contour and watercourse overlays)

Some modification to the natural site surface levels has been undertaken in the past primarily through the past quarrying activities and then site regrading (i.e. placement of topsoil) as part of past rehabilitation activities.

3.2 Adjacent Site Uses

Surrounding land uses comprise the following:

- North (down slope) – Remaining portions of Lot 6 and then undeveloped bushland.
- West (up slope) – Remaining portions of Lot 6 with bushland regrowth and then undeveloped bushland.
- East (down slope) – Remaining portions of Lot 6, which comprised a mix of grassed areas and bushland regrowth. Several stockpiles of filling materials and green waste (cleared weed regrowth and trees/stumps) were identified in this portion of Lot 6. Beyond Lot 6 is a mix of bushland, Nells Road and industrial properties.
- South (across slope) – Remaining portions of Lot 6, which comprised a mix of grassed areas and bushland regrowth. Several stockpiles of filling materials and green waste (cleared weed regrowth and trees/stumps) were identified in this portion of Lot 6. Beyond Lot 6 are industrial properties.

The potential for contamination from the existing surrounding land uses to have impacted the subject site is considered to be generally low. No specific walkover inspections of the adjacent sites were, however, undertaken as part of this PSI.

3.3 Geology and Soil Landscape

Reference to the local geological mapping indicates that the majority of the site is underlain by the Terrigal Formation (identified as Rnt in Figure 4). An area mapped as Quaternary alluvium (identified as Qa in Figure 4) boarders the eastern boundary of the site. An extract of the geological mapping is presented as Figure 4, which shows the mapped geology in the locality of the site.

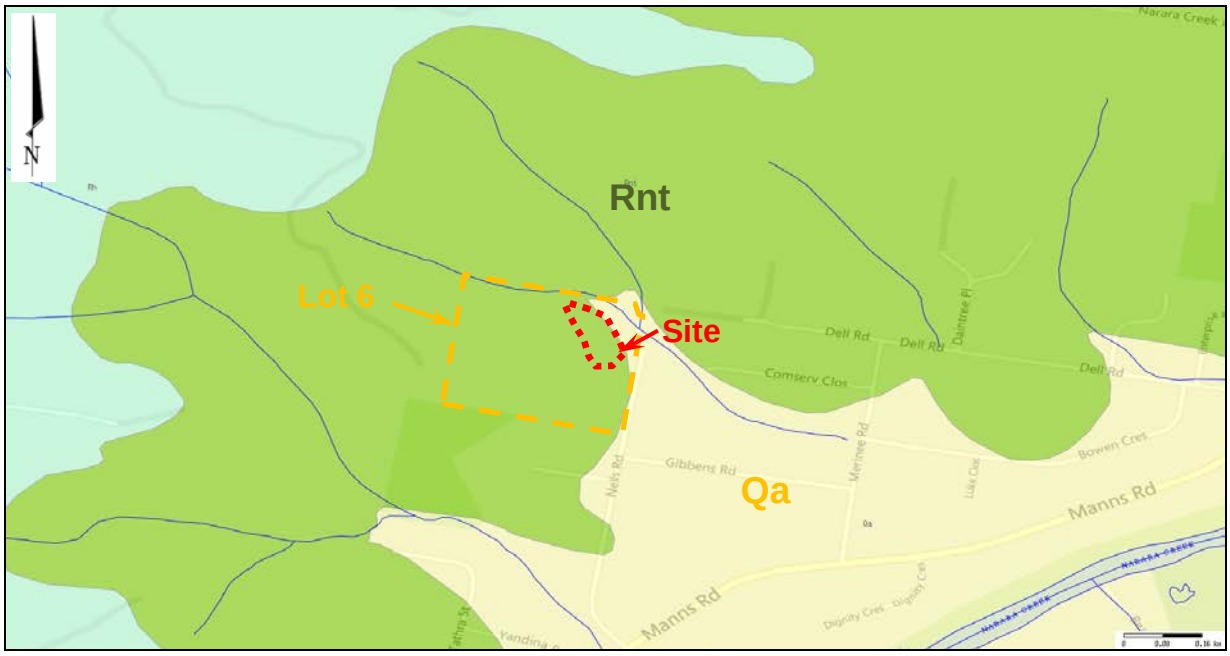


Figure 4: Local Geology

(Image sourced from Microsoft Virtual Earth with Gosford-Lake Macquarie 1:100,000 Geology Sheet overlays)

The Triassic-aged Terrigal Formation typically comprises fine-grained, lithic-quartz sandstone and siltstone with shale interbeds. The weathering products of sandstone and shale are usually clay soils, overlying highly and extremely weathered sandstone bedrock. Quaternary alluvium (Qa) is typically characterised by sand, gravel, silt and clay to considerable depth.

Reference to the local soil landscape mapping indicates that disturbed terrain (annotated as xx in Figure 5) exists at the site. An extract of the soil landscape mapping is presented as Figure 5, which shows the soil landscape conditions within the study area.

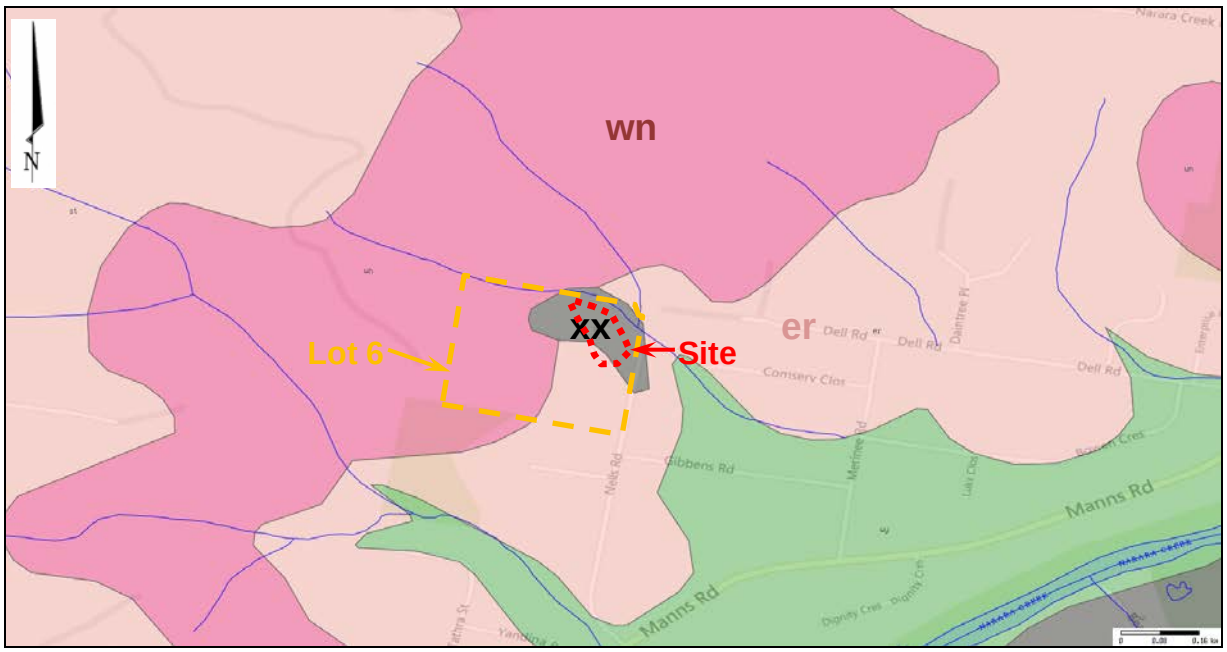


Figure 5: Local Soil Landscape

(Image sourced from Microsoft Virtual Earth with Gosford-Lake Macquarie 1:100,000 Soil Landscape Sheet overlays)

The site and surrounding areas are understood to have been historically operated as a quarry (refer soil landscape mapping – Figure 5). Uncontrolled filling is often encountered in areas of disturbed terrain.

3.4 Acid Sulfate Soils

The local acid sulfate risk mapping indicates that the site and surrounding areas are mapped as having no known occurrence of acid sulfate soils. An extract of the acid sulfate soil risk mapping is presented as Figure 6, which shows the acid sulfate soils conditions in the vicinity of the site.

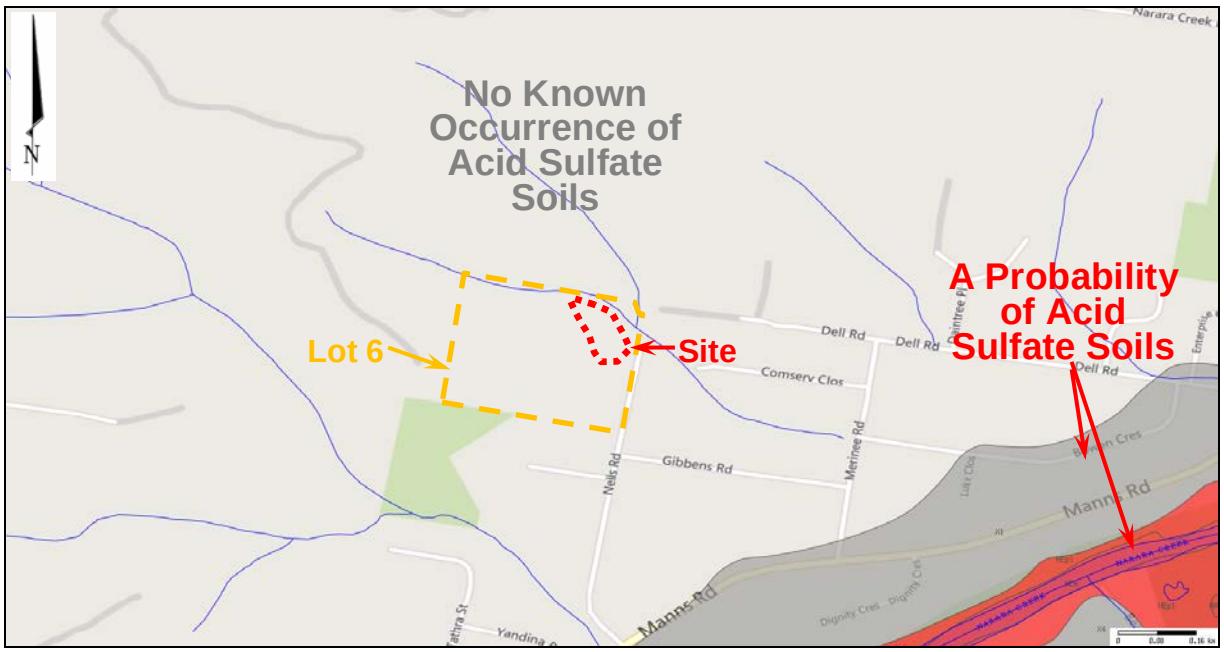


Figure 6: Local Acid Sulfate Soil Risk Mapping

(Image sourced from Microsoft Virtual Earth with Gosford-Lake Macquarie 1:100,000 Soil Landscape Sheet overlays)

The notes associated with the mapping indicate that soil investigations are generally not required to assess the presence of acid sulfate soils in the site locality. No investigation for acid sulfate soils was undertaken for this PSI.

3.5 Groundwater

Permanent groundwater is likely to be present within the Terrigal Formation rock and would be expected at a depth of between 5 m and 15 m below the ground surface. Some minor seepage layers may also be located at shallower depth possibly at the interface of localised permeability boundaries such as at the interface of filling and natural soil or at the interface of residual soils and weathered bedrock where some ironstone deposits may be encountered.

A search was conducted for registered groundwater bores in the Department of Natural Resources groundwater bore database [Note: this function has been taken up by NSW Office of Water]. Figure 7 shows registered groundwater bores in the vicinity of the site.

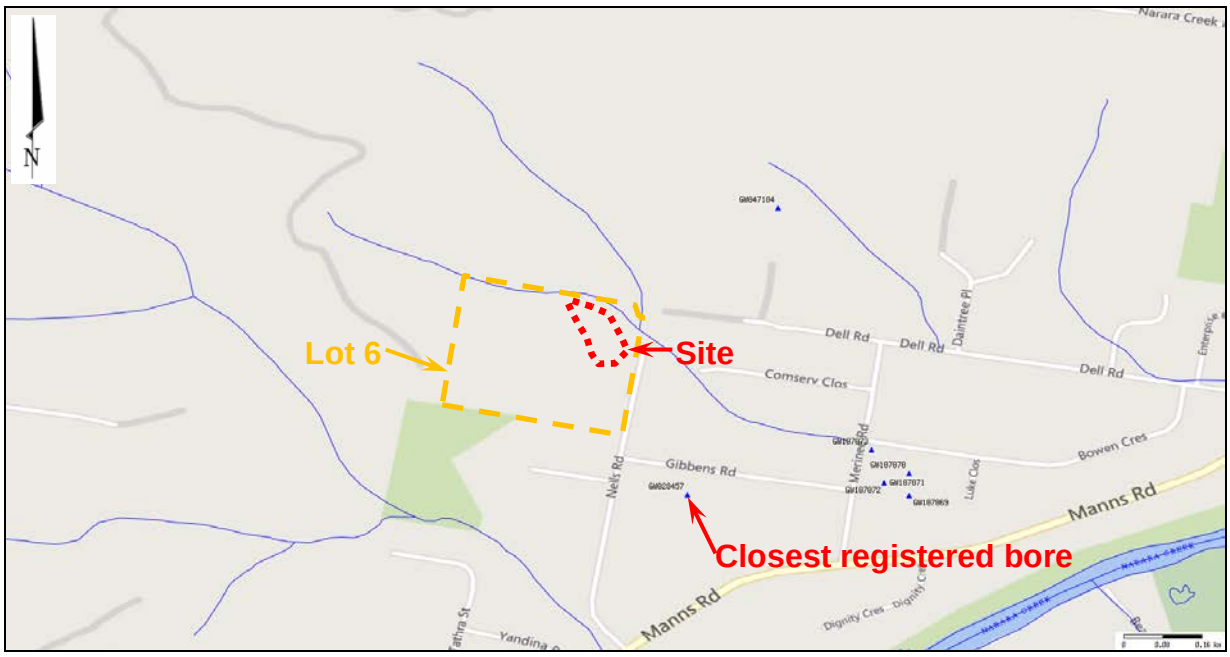


Figure 7: Local Registered Groundwater Bores

(Image sourced from Microsoft Virtual Earth with registered groundwater bore overlays)

The closest registered bore (GW028457) appeared to be located approximately 300 m south-east (across gradient) of the site with an authorised purpose of providing water for domestic horticulture purpose. The bore licence status was reported to be active and installed to a depth of 3.6 m. It is considered unlikely that any groundwater contamination originating from the site would impact any registered groundwater bores in the vicinity of the site. Based on the available information the intermittent tributary is likely to be the closest groundwater receptor to the site.

A copy of the nearest registered groundwater bore work summary sheet is included in Appendix C.

3.6 Site Features

The following is a summary of site features observed during the site walkover undertaken as part of the PSI. The walkover was undertaken on 6 August 2014, prior to completing the preliminary intrusive investigations. In summary, the site is currently a relatively flat area with a grass surface cover. Several stockpiles of filling materials and green waste (cleared weed regrowth and trees/stumps) were identified beyond the south-east site boundary (but within Lot 6). Other mounds of filling were also observed, beyond the site boundary, in areas of vegetation regrowth. Figures 8 to 15 further present some of the site features.

Figure 8: Photograph of site taken from the northern site boundary.

Figure 9: Photograph of the southern portion of the site. Mounds of green waste (cleared weed regrowth and trees/stumps) were identified beyond the south-east site boundary.

Figure 10: Photograph along the western site boundary (facing north). The adjacent mound of filling (beyond site boundary) formed a catch drain to redirect surface water run-on from areas to the west.

4. Summary of Site History

4.1 Property Enquiry Information from Gosford City Council

A property enquiry was completed through Gosford City Council's (GCC's) customer service line. The results of the enquiry identified the current proposal under consideration by council relating to rehabilitation of the old quarry. The only other application related to a 1994 proposal for landfilling that was refused by GCC in April 1995.

Other than identifying the former quarrying use of the site, information indicating that the site may be potentially contaminated land by reason of its past/present use was not provided in the records.

4.2 Regulatory Notices Search

The NSW EPA Register of Contaminated Land was searched for any Regulatory Notices that may be current on the site issued under the *Contaminated Land Management (CLM) Act* 1997 and Section 55 of the *Protection of the Environment Operations (POEO) Act* 1997. The information obtained at the time of preparing this report indicated that no current or previous Licences, Notices or Orders were applicable for the site.

4.3 Historical Aerial Photographs

Historical aerial photographs were reviewed dating back to the earliest readily available record (1954) and approximately every 10 to 20 years thereafter to assess any major changes to the site and surrounding areas during this period. The following historical aerial photographs were reviewed:

- Photograph – Gosford Run 10G, dated 18.3.54;
- Photograph – Gosford – Lake Macquarie NSW Run 3, dated May 64;
- Photograph – Gosford NSW Run 7, dated 28.05.75;
- Photograph – Gosford NSW Run 7, dated 26.04.84;
- Photograph – Gosford NSW Run 11, dated 15.10.91;
- Photograph – Google earth image, dated 26.09.03; and
- Photograph – Nearmap.com photomap, dated 06.08.14

Table 1 summarises the observations made during the aerial photograph review.

Table 1 – Historical Aerial Photograph Review

Aerial Photograph	Observations
1954	The site appears to comprise undeveloped bushland. Nearby areas to the south and east appear to be developed for a mix of grazing and orchard uses, however, immediately adjoining areas appear to have a grazing use or be undeveloped bushland associated with intermittent watercourse. Adjacent areas to the north and west appear to be undeveloped bushland.
1964	The site appears to be cleared and the reflective surface suggests that quarrying activities may be occurring within the site and extending to the west and south. Surrounding land uses remain unchanged. (Drawing 2, Appendix B).
1975	The highly reflective surface suggests that quarrying activities are still occurring. Surrounding land uses remain unchanged.
1984	The highly reflective surface site suggests that quarrying activities are still occurring. A large stockpile of material (possibly grass covered) is visible in the eastern portion of the site.
1991	The extent of site disturbance appears to have decreased, with some vegetation regrowth evident. Surrounding areas to the east and south appear to be partly developed for commercial/industrial uses with large buildings observed. Surrounding areas to the north and west remain undeveloped.
2003	Several stockpiles of materials are visible within the site. The stockpiles possibly suggest that the site was being used as a temporary material storage/transfer facility. The local area appears to be in a similar condition to that observed in the 1991 photograph. (Drawing 2, Appendix B).
2014	Site appears to have a grass surface cover. Refer to Section 3.6.

Extracts of the 1964 and 2003 historical aerial photographs are included as Drawing 2 in Appendix B.

4.4 Other Historical Information

The site representative, Mr Kevin Rig, indicated that the site was historically used as a quarry to supply bulk filling for various local construction projects. He indicated that the site was then used as a material transfer yard (temporary storage) for construction materials. These activities were confirmed by the review of aerial photographs. The transfer yard activities ceased approximately ten years ago and as part of discontinuing the activity all materials were removed from the site and topsoil was spread across the site.

Mr Rig indicated that the topsoil placed across the site may have been the topsoil stripped as part of the original quarrying activities.

5. Summary of Potential Contaminants and Preliminary Conceptual Site Model

Based on the results of the desktop and site history review, a preliminary Conceptual Site Model (CSM) has been prepared for the site with reference to the *National Environment Protection (Assessment of Site Contamination) Measure* 2013 (Ref 2) Schedule B2. The CSM identifies potential contaminant sources and contaminants of concern, contaminant release mechanisms, exposure pathways and potential receptors. The CSM is presented in Table 2 below.

Table 2: Preliminary Conceptual Site Model

Known and Potential Primary Sources	Potential For Contamination	Primary Release Mechanism	Secondary Release Mechanism	Potential Impacted Media	Contaminants of Concern	Exposure Pathway	Potential Receptors	
							Current	Future
Areas of significant filling and areas of surface disturbance associated with the former site activities	Low to moderate	Placement of filling and construction materials	Earthworks and vehicle movements impacting near surface soils	Soil	TRH, PAH, BTEX, PCB, OCP, metals, asbestos	Dermal contact, inhalation (dust/vapour), ingestion	Site workers, trespassers	Site redevelopment workers, future tenants/occupiers
						Dermal contact, ingestion	Ecology	Ecology
Nearby historical agricultural activities	Very low	Over spray of chemicals	-	Soil	OCP, metals	Dermal contact, inhalation (dust/vapour), ingestion	Site workers, trespassers, ecology	Site redevelopment workers, future tenants/occupiers, ecology
						Dermal contact, ingestion	Ecology	Ecology

6. Data Quality Objectives

The scope of the PSI was devised with reference to the seven step data quality objective (DQO) process, as defined in NEPC (2013) (Ref 2) and Australian Standard *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1 – 2005) (Ref 3). The DQO process is outlined as follows:

Step 1: State the Problem

The site is proposed to be filled as part of the rehabilitation proposal (currently being considered by Council). It is understood that the site is proposed to be eventually redeveloped for a commercial/industrial use. The past activities within the site have the potential to contaminate primarily the soils beneath the site, therefore potentially rendering the site incompatible (as it stands) with the proposed uses.

The "problem" to be addressed is to assess the nature and possible extent of contamination at the site, and to determine if the site is suitable for commercial/industrial land uses or requires management and/or remediation to render the site compatible with the proposed uses.

It is considered likely that the site can be made compatible with the proposed commercial/industrial use provided any identified contamination issues are appropriately remediated and/or managed.

Step 2: Identify the Decision

Environmental data, primarily comprising soil characteristics, is required as part of the contamination assessment process to enable an assessment of the contamination status of the site, and the requirement for further assessment and/or remediation. The following specific decisions are required to be made:

- Do the existing fill materials and natural soils pose a potential risk to the human health of potential future users of the site, including construction workers, site workers, residents, and visitors?
- Do the existing fill materials and natural soils pose a potential risk to ecological receptors, either current receptors or potential future receptors (e.g. newly established plants / trees)?
- Do the existing fill materials and natural soils pose a potential risk to groundwater or surface water (Narara Creek and Brisbane Water)?
- Is the environmental data that was obtained sufficient to make a decision regarding the abovementioned risks, or are additional investigations required?
- Is the environmental data that was obtained sufficient to enable preparation of a Remediation Action Plan (RAP) and/or Environmental Management Plan (EMP) should the data suggest these are required?

In identifying the decisions to be made by the PSI, it is recognised that some of the data gaps may remain at the completion of the assessment. Any data gaps will be noted in the PSI and recommendations regarding action on those issues will be reported (if required).

Step 3: Identify Inputs into the Decision

Inputs into the decision are as follows:

- The preliminary site conceptual model (refer to Table 2);
- Soil data collected from the site, including analytical results for the contaminants of concern (COC) from the PSI;
- Relevant site assessment criteria (SAC) given the current and proposed uses; and
- Field and laboratory QA/QC data to assess the suitability of the data for the assessment.

Step 4: Define the Assessment Boundaries

The site is defined as part of Lot 6 in Deposited Plan 3944, as indicated on Figure 2 (Section 1.2) and extends depths of approximately 2 m into the natural soil profile. The assessment results and conclusions are to apply to the whole of the site.

Step 5: Develop a Decision Rule

The information obtained through the PSI will be used to characterise the site in terms of contamination issues and risk to human health and/or the environment. The decision rule in characterising the site will be as follows:

- Laboratory test results for systematic soil samples (i.e. non-targeted soil samples) will be analysed statistically, if considered appropriate, to ascertain the 95% upper confidence level (UCL) for each analyte or analyte group (for like materials);
- Laboratory test results for targeted locations (and identified “hot spots”) will be assessed individually;
- The site assessment criteria will be the NSW EPA produced and/or endorsed criteria. Where such criteria are not available, other recognised national or international standards will be used;
- The contaminant concentrations should meet the following criteria or further investigation, assessment or remediation / management may be required:
  - The 95% UCL of the arithmetic mean of the data set is less than the SAC;
  - The standard deviation of the data set is less than 50% of the SAC; and
  - No individual test result is greater than 250% of the SAC;

Further data analysis may be required, and/or additional sampling and testing undertaken, if significant contamination is encountered.

Laboratory test results will be considered usable for the assessment (without qualification) under the following conditions:

- All laboratories used are accredited by NATA for the analyses undertaken. DP have used Envirolab Services as the primary laboratory;
- All practical quantitation limits (PQL) set by the laboratories fall below the site assessment criteria adopted, or indicate across the board lack of detection;
- The differences between the reported concentrations of analytes in the intra-laboratory replicate samples and the corresponding original samples are within adopted acceptance limits; and
- The quality assurance / quality control (QA/QC) protocols and results reported by the laboratories comply with the requirements of the *National Environment Protection (Assessment of Site Contamination) Measure* 2013 (Ref 2) Schedule B3.

Step 6: Specify Limits on the Decision Error

In order to confirm that the results obtained are accurate and reproducible, Quality Assurance and Quality Control (QA/QC) measures and evaluations have been incorporated into the sampling and testing regime, as discussed in Sections 8 and 9, and Appendix F.

Step 7: Optimise the Design for Obtaining Data

Environmental sample collection procedures, as described in Section 8.2 were developed prior to undertaking the contamination assessment fieldwork. These procedures concur with current industry practice. DP employs NATA-registered analytical laboratories to conduct sample analysis.

Table 3 summarises Quality Assurance/Quality Control (QA/QC) indicators and the procedures designed to enable their achievement.

Table 3: Data Quality Indicators

DQO	Achievement Evaluation Procedure
Documentation completeness	Completion of field and laboratory chain of custody documentation, completion of bore logs.
Data completeness	Analysis of appropriate determinants and sampling locations based on site history and on-site observation. Use of appropriately trained field staff. Compliance with sample holding times. Use of appropriate laboratory methods and quantitation limits.
Data comparability	Use of NATA accredited laboratory, use of consistent sampling technique, trained field staff, consistent laboratory methods and quantitation limits.
Data Representativeness	Completion of logs describing conditions encountered, collection of samples representative of materials encountered at the site, appropriate sampling methodology, analysis of a range of materials encountered, appropriate collection, handling, storage and preservation.
Precision and accuracy for sampling and analysis	Analysis of field and lab replicates, spikes, blanks, rinsates etc, achievement of 50% RPD for replicate analysis, acceptable levels for laboratory QC criteria.

7. Assessment Criteria

The site is proposed to be filled as part of the rehabilitation proposal (currently being considered by Council). It is understood that the site is proposed to then be redeveloped for a commercial/industrial (subject to a planning approval).

7.1 Soil Contamination

The analytical results will be compared against a generic commercial/industrial land use scenario. It should be noted, however, that the proposed use would dependant on a separate planning proposal yet to be submitted to council. The adopted soil assessment criteria (SAC) should be reassessed if a more sensitive land use(s) is proposed for the site.

In considering the sites contamination status and the potential impacts to human health and the environment the soil chemical analyses have been assessed (as a Tier 1 assessment) against the investigation and screening levels in Schedule B1 of the NEPC, 2013 (Ref 2).

This guideline has been endorsed by the NSW EPA under the *Contaminated Land Management* (CLM) Act 1997. Schedule B1, NEPC (2013) provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination.

7.1.1 Background - Health Investigation and Screening Levels

The health investigation levels (HILs) are scientifically based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential risks to human health from chronic exposure to contaminants. They are intentionally conservative and are based on a reasonable worst-case scenario for four generic land use scenarios. Given the former and proposed land use (commercial/industrial), the HILs for commercial / industrial sites, column D of Table 1A(1) of NEPC (2013) have been adopted (HIL D). The adopted HILs are shown on Table 5 of Section 9.2.

Health screening levels (HSLs) are used to assess selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact with affected soils and groundwater. The HSLs were developed by the Co-operative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) and were derived through the consideration of health effects only, with particular emphasis on the vapour exposure pathway. Other considerations such as ecological risk, aesthetics, the presence of free phase product and explosive / fire risk are not addressed by the HSLs. As such the HSLs are used similarly to the HILs, i.e. as a screening tool.

The HSLs have been developed for a range of petroleum hydrocarbons, and for different land uses, media, pathways, soil types and depths to contamination. HSLs have also been derived by CRC CARE for direct contact with petroleum hydrocarbons for the four land use scenarios and intrusive maintenance workers.

The adopted HSLs for the site have been based on the proposed commercial / industrial land use, and a conservative soil type of sand and a contamination depth of 0 m to <1 m. They have also been developed based on the possibility of workers engaged in subsurface works. Therefore, HSLs for soil vapour intrusion for HSL D have been adopted and are provided in Table 5 in Section 9.2.

No direct assessment of vapour intrusion was undertaken as part of this investigation and therefore consideration of the soil vapour HSLs for vapour intrusion was not undertaken.

7.1.2 Background – Ecological Investigation and Screening Levels

Ecological investigation levels (EILs) have been developed and discussed in NEPC (2013 – Ref 2) for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which essentially corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant using the following formula:

EIL = ABC (Ambient Background Concentration) + ACL (Added Contaminant Limit)

The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions).

The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al. (1995) or Hamon et al. (2004).

ACLs can be based on the soil characteristics of pH, cation exchange capacity (CEC) and clay content.

At this site, given the low levels of detection of metals and organic compounds in the soil samples tested, a conservative approach has been undertaken in derivation of EILs, as follows:

1. Ignoring the contribution of ABC; and
2. Derivation of the ACL based on conservative soil conditions (i.e. silt with a pH of 4 or less and a CEC of 5 cmol/kg).

The following assumptions have also been made during the formulation of EILs for the site:

- A protection level of 60% of species (commercial and industrial land use) has been adopted;
- The EILs will apply to the top 2 m of the soil profile; and
- Given the likely source of soil contaminants the contamination is considered as “aged” (>2 years);

EILs (and ACLs where appropriate) have been derived in NEPC (Ref 2) for only a short list of contaminants including As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. A spreadsheet EIL calculator was used for calculating site-specific EILs, which has been provided in the NEPM Toolbox on line. Given that the contaminants outside the above list were not found in high concentrations, only the NEPC (Ref 3) published EILs have been used to assess ecological risk at the site.

Ecological screening levels (ESLs) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESLs apply to the top 2 m of the soil profile, which essentially corresponds to the root zone and habitation zone of many species. ESLs have been derived in NEPC (2013) for the same four petroleum fractions as the HSLs (F1 to F4) as well as BTEX and Benzo(a)pyrene. The adopted ESLs, from Table 1B(6), Schedule B1 of NEPC (Ref 3) are shown in Table 5 of Section 9.2. The following site specific data and assumptions have been used to determine the ESLs:

- The ESLs will apply to the top 2 m of the soil profile;
- The ESLs for a commercial / industrial land use; and
- The majority of soils encountered at the site contain typically a mix of sand and clay, and conservatively a “coarse” soil texture has generally been adopted except for xylene where conservatively a “fine” soil texture has been adopted.

7.1.3 Management Limits – Petroleum Hydrocarbons

In addition to appropriate consideration and application of the HSLs and ESLs, there are considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management limits have been adopted in NEPC (Ref 2) as interim Tier 1 guidance to avoid or minimise these potential effects. Management limits have been derived in NEPC (Ref 2) for the same four petroleum fractions as the HSLs (F1 to F4). The adopted management limits, from Table 1B(7), Schedule B1 of NEPC (Ref 2) are shown on Table 5 of Section 9.2 and have been based on application to any depth within the soil profile, commercial / industrial land use and generally a "coarse" soil texture.

7.1.4 Asbestos in Soil

Bonded asbestos-containing material (ACM) is the most common form of asbestos contamination across Australia, generally arising from:

- Inadequate removal and disposal practices during demolition of buildings containing asbestos products;
- Widespread dumping of asbestos products and asbestos containing fill on vacant land and development sites; and
- Commonly occurring in historical fill containing unsorted demolition materials.

Mining, manufacturing or distribution of asbestos products may result in sites being contaminated by friable asbestos including free fibres. Severe weathering or damage to bonded ACM may also result in the formation of friable asbestos comprising fibrous asbestos (FA) and/or asbestos fines (AF).

Asbestos only poses a risk to human health when asbestos fibres are made airborne and inhaled. If asbestos is bound in a matrix such as cement or resin, it is not readily made airborne except through substantial physical damage. Bonded ACM in sound condition represents a low human health risk, whilst both FA and AF materials have the potential to generate, or be associated with, free asbestos fibres. Consequently, FA and AF must be carefully managed to prevent the release of asbestos fibres into the air.

A detailed asbestos assessment was not undertaken as part of these works as asbestos was not an identified as a contaminant of concern [at the time of writing the proposal]. Therefore the presence or absence of asbestos at a limit of reporting of 0.1 g/kg has been adopted for this assessment as an initial screen.

8. Fieldwork

As part of the PSI, DP conducted a field sampling programme comprising screening and testing of selected soil samples collected from the site. The field rationale, sampling methodology and field results are outlined in the following subsections.

Primarily a broad systematic sampling pattern was undertaken, with the number of sampling points undertaken for the PSI approximately 50% of the minimum number of sampling points required for site characterisation of a 0.9 Ha site as required by *Contaminated Sites: Sampling Design Guidelines* (NSW EPA 1995 – Ref 4).

8.1 Fieldwork Programme

The fieldwork for the PSI was undertaken between 6 and 8 August 2014 and comprised:

Table 4: Fieldwork Programme

Date(s)	Description of Field Work Completed	Additional Comments
6 August 2014	Initial site walk over and discussion with site representative	Discussed expected ground conditions with site representative. Completed walkover of the site area.
8 August 2014	Excavate Pits 1 to 11	Pits positioned to provide broad systematic site coverage. No investigation conducted beyond the identified site area.

A copy of the test pit logs and calibration records are provided in Appendix D.

8.2 Fieldwork Methods

The following subsections summarise the procedures and methods adopted for the PSI.

8.2.1 Soil Sampling

The subsurface investigations were completed using a five tonne excavator fitted with a 450 mm with bucket. The investigations were completed through any filling identified, to a minimum depth of approximately 1 m, into natural soils showing no visual or olfactory evidence of contamination.

The approximate test locations are shown on Drawing 1, Appendix B. All soil sampling was performed with reference to industry standard operating procedures. All sampling data was recorded on test pit log sheets. The general sampling procedure comprised the following:

- Collecting soil samples directly from the test pit wall using disposable gloves or stainless steel sampling equipment. Care was taken to remove any extraneous material deposited on the pit wall by the excavation process. Identification of the sampling method for each sample was recorded on the individual test pit logs, Appendix D;
- Changing of disposable gloves between each sampling event to prevent cross contamination;
- Decontaminating all sampling equipment using a 3% solution of phosphate free detergent (Decon 90) and tap water. Sampling equipment was given a final rinse with deionised water prior to collecting each sample;
- Transferring samples into laboratory-prepared glass jars and capping immediately;
- Collecting replicate samples in zip-lock plastic bags for screening of samples using a calibrated photoionisation detector (PID). The PID is capable of detecting a wide range of volatile hydrocarbons and solvents, and the PID reading provides an indication for the presence of these contaminants in a sample;
- Labelling sample containers with individual and unique identification, including project number, sample location and sample depth;
- Placing the glass jars into a cooled, insulated and sealed container while on site;

- Using chain of custody (COC) documentation enabling sample tracking and custody to be cross-checked at any point in the transfer of samples from the field to the laboratory; and
- Dispatching samples to a NATA accredited laboratory for analysis.

8.3 Fieldwork Results and Observations

Results of the fieldwork are summarised below and are included in the test pit logs, Appendix D. These logs should be read in conjunction with the attached notes which define the descriptive terms and classification methods used.

The pits undertaken as part of the PSI encountered generally consistent subsurface conditions across the site, which can be generalised and described below:

Shallow Filling Overlying Residual Soils

TOPSOIL / FILLING	Generally comprising brown and grey silty and clayey sand with some gravels and trace organics to depths ranging from 0.25 m to 1.1 m bgl;
FILLING (REGRADED SITE MATERIAL)	Four of the eleven pits (Pits 3, 4, 7 and 8) encountered grey mottled pink/red clayey sand with sandstone gravels to depths typically ranging between 0.4 m and 1.0 m bgl;
SANDY CLAY or CLAYEY SAND	Generally light grey mottled orange brown sandy clay / clayey sand with some iron induration extending to the termination depth of the pits ranging between 0.7 and 1.3 m bgl. In some pits the sandy clay / clayey sand graded into extremely weathered sandstone;

No free groundwater was observed in the above referenced pits. Minor seepage was however encountered in Pit 3 at 1.0 m depth (interface of filling and natural clay soils). It should be noted that groundwater levels are variable and affected by factors such as climatic conditions and soil permeability.

The filling encountered appeared to generally free of anthropogenic inclusions and based on the site representative's comments was likely to comprise site sourced soils (original topsoil stripped from the site). Notwithstanding, minor (single or a small number) anthropogenic inclusions comprising brick, concrete, timber, metal, glass, asphalt and/or plastic were noted in the filling at Pits 2, 5, 7, 9 and 10.

8.3.1 Photoionisation Detector

Replicates for all soil samples were collected in plastic bags and allowed to equilibrate under ambient temperatures before screening for Total Photoionisable Compounds (TOPIC) using a PID. The PID was calibrated each day prior to use using ambient air as the "zero" air (0.0 ppm) and isobutylene at a concentration of 100 ppm as the calibration "span" gas.

Field measurement of TOPIC indicated relatively low results ranging between 0.0 and 2.2 ppm. The recorded readings were not considered to be indicative of potentially significant volatile organic compound contamination and are considered to fall within background levels. The results of sample screening are shown on the test pit logs in Appendix D. It is noted that the PID results were consistent with general observations made during the field work.

9. Laboratory Testing

9.1 Soil Contamination Laboratory Program

Of the 32 soil samples collected and screened, 14 primary soil samples were submitted for analysis to Envirolab Services Pty Ltd (Envirolab), a NATA accredited laboratory. Analytical methods used are shown in the laboratory certificates presented in Appendix E.

Soil samples were analysed for a selected suite of potential contaminants with reference to the preliminary CSM (Table 2). The laboratory testing undertaken included a selected suite of the following potential contaminants:

- Metals: arsenic (As); cadmium (Cd); chromium (Cr); copper (Cu); lead (Pb); mercury (Hg); nickel (Ni); zinc (Zn);
- Total recoverable hydrocarbons (TRH);
- Benzene, toluene, ethylbenzene, xylene (BTEX);
- Polycyclic aromatic hydrocarbons (PAH);
- Polychlorinated biphenyls (PCB);
- Organochlorine pesticides (OCP); and
- Asbestos in soil.

In addition to the primary samples tested, soil Quality Control/Quality Assurance (QA/QC) testing comprised two soil replicate samples and one equipment rinsate blank sample. The QA/QC procedures and results are discussed in Appendix F.

9.2 Soil Contamination Laboratory Results

The soil laboratory test results are summarised below in Table 5.

Table 5: Results of Soil Analysis (All results in mg/kg unless otherwise stated)

Sample ID	Depth	PID	Heavy Metals								PAH				TRH				Benzene	Toluene	Ethylbenzene	Total Xylene	PCB[2]	OCP[2]	Asbestos
			As	Cd	Cr[1]	Cu	Pb	Hg	Ni	Zn	B(a)P	B(a)P TEQ	Naphthalene	total[2]	F1 (C_6-C_{10})	F2 (>C_{10}-C_{16})	F3 (>C_{16}-C_{34})	F4 (>C_{34}-C_{40})							
1/0.1	0.1	0.9	ND	ND	10	6	12	ND	5	21	**4**	6	ND	45	ND	ND	140	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
2/0.1	0.1	1.8	5	ND	13	5	11	ND	5	18	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-
QA1	2/0.1	1.8	5	ND	15	6	11	ND	8	17	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-
2/1.0	1	1.6	20	ND	32	5	28	ND	3	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
3/0.1	0.1	2.2	ND	ND	9	10	12	ND	5	28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
4/0.4	0.4	1.7	6	ND	13	2	13	ND	2	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
5/0.1	0.1	0.7	4	0.5	14	20	33	ND	13	50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
5/0.6	0.6	1.7	ND	ND	11	2	11	ND	1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-
6/0.1	0.1	1.7	4	ND	12	5	18	ND	5	17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
7/0.1	0.1	2.0	6	ND	12	19	19	ND	8	34	0.14	ND	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
7/0.7	0.7	1.9	ND	ND	3	ND	6	ND	ND	2	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-
8/0.1	0.1	2.0	6	ND	14	28	22	ND	11	48	0.09	ND	ND	0.39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
9/0.4	0.4	1.5	4	ND	13	14	14	ND	15	32	0.07	ND	ND	0.32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
10/0.1	0.1	1.5	ND	ND	12	18	14	ND	7	29	0.26	ND	ND	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
QA2	10/0.1	1.5	ND	ND	14	17	14	ND	9	33	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-
11/0.1	0.1	1.1	ND	ND	19	13	15	ND	6	28	0.1	ND	ND	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No asbestos detected
PQL			4	0.4	1	1	1	0.1	1	1	0.05	0.5	0.1	0.1	25	50	100	100	0.5	0.5	1	2	0.1	0.1 (individual)	0.1g/kg
Site Assessment Criteria (SAC)																									
HIL/HSL [3]			3,000	900	3600	240,000	1,500	730	6,000	400,000	NC	40	NL	4,000	260	1000	3500	10000	3	NL	NL	230	7	45/530/3600/50 [5]	No visible asbestos for surface soil and 50 g/kg for bonded ACM
EIL/ESL [4]			160	NC	670	85	1800	NC	60	440	1.4	NC	370	NC	215	170	1700	3300	75	135	165	85	NC	640 [6]	NC

Notes:

1 All Chromium are assumed to exist in the Cr(III), however the HIL SAC adopted has been conservatively assumed to be that for Cr(IV)
2 where analytical results below laboratory practical quantitation limit (PQL) for all compounds, results quoted as ND
3 Health based investigation/screening or management levels for commercial/industrial land use
4 Ecological based investigation/screening or management levels for commercial/industrial land use
5 OCP thresholds given in order Aldrin+Dieldrin/Chlordane/ DDD+DDE+DDT/Heptachlor
6 OCP threshold based on DDT concentration only
ND Not detected at reporting limit
NL Not limiting
- not analysed / not applicable
PQL Laboratory practical quantative limit
Bold Exceedes Guidelines

10. Discussion of Results

A discussion of the soil laboratory results (summarised in Sections 9) are provided below. The adopted SAC are based on a commercial/industrial land use. The SAC and discussion provided below should be re-evaluated if a commercial/industrial land use is not appropriate for the site.

10.1 Soil Results

Soil samples tested reported contaminant concentrations below the adopted health-based and ecological-based SAC (Ref 2) for a proposed commercial/industrial end use, except for a single surface soil sample at Pit 1 (i.e. Sample 1/0.1) which exceeded the ecological-based SAC (Ref 2) only. The exceedence related to an elevated benzo(a)pyrene (BaP) concentration of 4.0 mg/kg compared to an SAC of 1.4 mg/kg.

Common sources of PAH (specifically BaP) that may relate to this site include asphalt/bitumen seal materials and the incomplete combustion of organic matter (such as bushfires). Close inspection of Sample 1/0.1 did not identify the presence of asphalt, bitumen or charcoal. However, review of recent aerial photographs, via Nearmap.com website, identified evidence of recent fires (scorched area in 2012) in the locality of Pit 1. It therefore considered that likely that the elevated BaP concentration is the result of the localised fire and not is representative of the filling spread across the site.

Ecological Screening Levels (ESLs) have been developed and discussed in NEPM (Ref 2) for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems. ESLs depend on the soil grain size and land use scenarios and generally apply to the top 2 m of soil, which essentially corresponds to the root zone and habitation zone of many species. Based on discussions with Wales & Associates (Project Managers) and Conacher Consulting Pty Ltd (consultant responsible for preparing Site Rehabilitation Plan) the south-east portion (i.e. locality of Pit 1) of the site will include the placement of at least 2 m of filling as part of the proposed Site Rehabilitation Plan. The placement at least 2 m filling in this area would result in the exceedance being at a depth greater than 2 m below the final site levels and would negate the need for additional investigation and/or remediation as part of the proposed Site Rehabilitation Plan approvals process.

Eleven soil samples (near surface filling) were analysed for asbestos fibres. All soil samples reported no detectable asbestos at the limit of reporting (0.01% w/w) and no respirable fibres detected in accordance with Australian Standard 4964-2004 (Ref 5). .

11. Conclusions and Recommendations

DP has undertaken a PSI at part of an old quarry, located at 39 Dell Road West Gosford, NSW. The extent of the site (assessment area) is identified in Figure 2 (Section 1.2) This PSI is to support an application for site rehabilitation of the old quarry to Gosford City Council (GCC) and also provides information on the likely contamination constraints associated with the proposed redevelopment of the site for a commercial/industrial land use.

On the basis of the background information gathered during the PSI, DP considered that there was a low to moderate potential for contamination within the site, due primarily to past filling activities and other activities associated with historical use (i.e. quarry and transfer yard) of the site. The PSI also included a broad systematic intrusive soil investigation programme that aimed to assess site's contamination status. The preliminary investigations comprised the assessment of soil contaminants at 11 locations.

The results of soil testing reported contaminant concentrations were generally below the adopted SAC. However, the BaP concentration in the surface filling at Pit 1 exceeded the ecological-based SAC. The elevated BaP concentration was likely to be the result of incomplete combustion of organic materials (i.e. past bonfires in the locality of Pit 1) in the south-east portion of the site. The placement at least 2 m filling in this area would result in the exceedance being at a depth greater than 2 m below the final site levels and would negate the need for additional investigation and/or remediation as part of the proposed Site Rehabilitation Plan approvals process.

In summary, the PSI indicates that the site can be made compatible with the proposed commercial/industrial land use development from a contamination standpoint, subject to the following conditions being incorporated into the Site Rehabilitation Plan:

- Placement at least 2 m filling in the south-east portion of the site (specifically in the locality of Pit 1).
- An *Unexpected Find Protocol* to manage any asbestos fragments, or other unexpected contamination, encountered at the ground surface or within soils during the rehabilitation works at the site. It is noted that the PSI did not identify the presence of any asbestos containing materials (ACM), however, the presence of minor building waste materials within the filling indicates that their presence cannot be ruled out.

12. Limitations

Douglas Partners (DP) has prepared this report for the proposed rehabilitation of part of 39 Dell Road West Gosford, NSW with reference to DP's proposal (WYG140249) dated 7 August 2014. The work was carried out under DP's Conditions of Engagement. The report is provided for the exclusive use of Valencia Homes Pty Ltd for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints (as discussed above), or to parts of the site being inaccessible and not available for inspection/sampling, or to vegetation preventing visual inspection and reasonable access. It is therefore considered possible that hazardous building materials, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

13. References

1. Minister for Urban Affairs and Planning, Managing Land Contamination, *Planning Guidelines SEPP 55 – Remediation of Land*, 1998.
2. National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999* (amended 2013) (NEPC, 2013).
3. Australian Standard: *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 1: Non-Volatile and Semi-Volatile Compounds* (AS 4482.1) - 2005.
4. NSW EPA, *Contaminated Sites: Sampling Design Guidelines, September* 1995.
5. Australian Standard: Method for the Qualitative Identification of Asbestos in Bulk Samples (AS 4964) – 2004.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

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

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

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

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole 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. They may not be the same at the time of construction as are indicated in the report; and
- 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 first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or 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 a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP 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 and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

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

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

About this Report

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, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

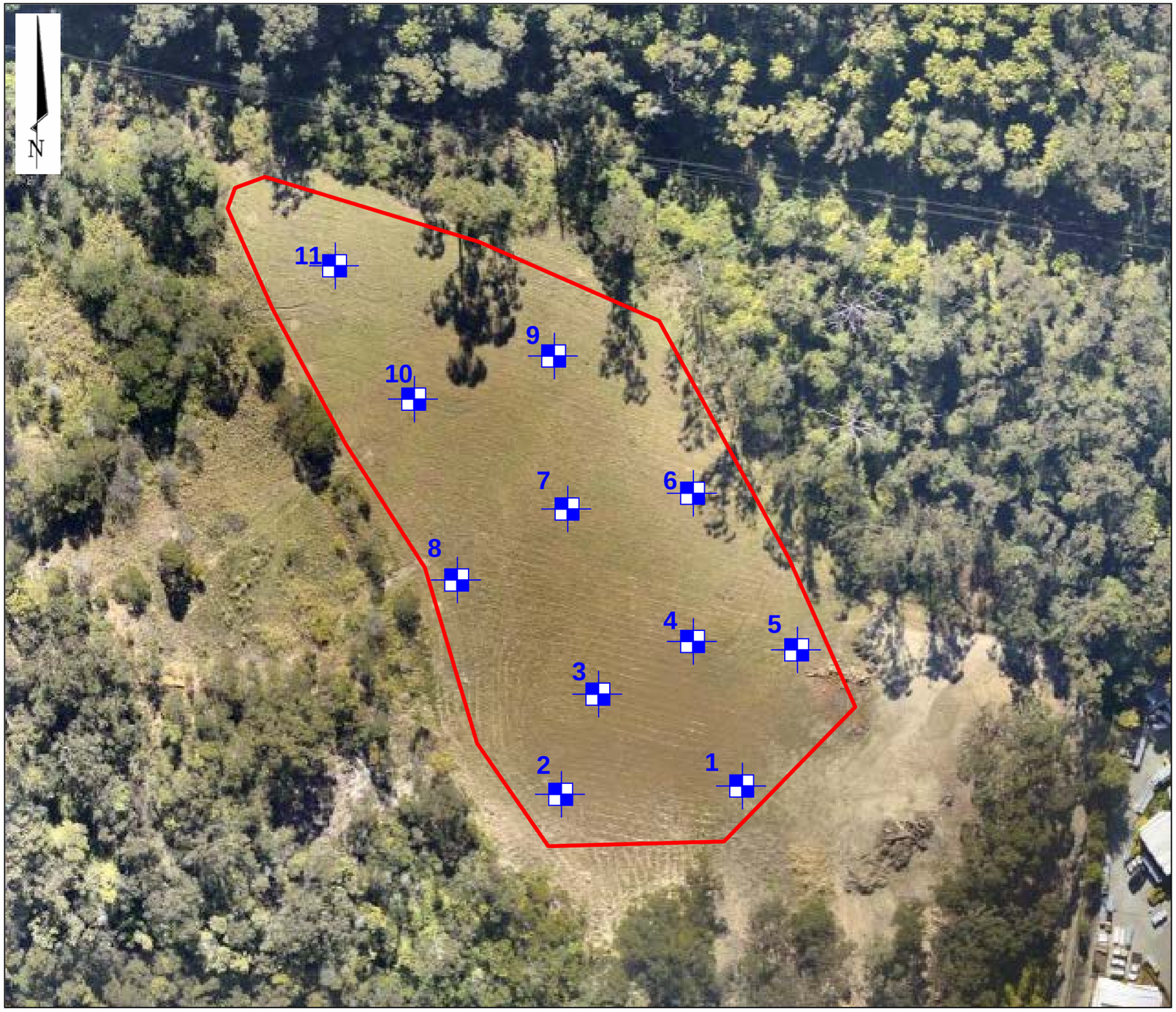
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

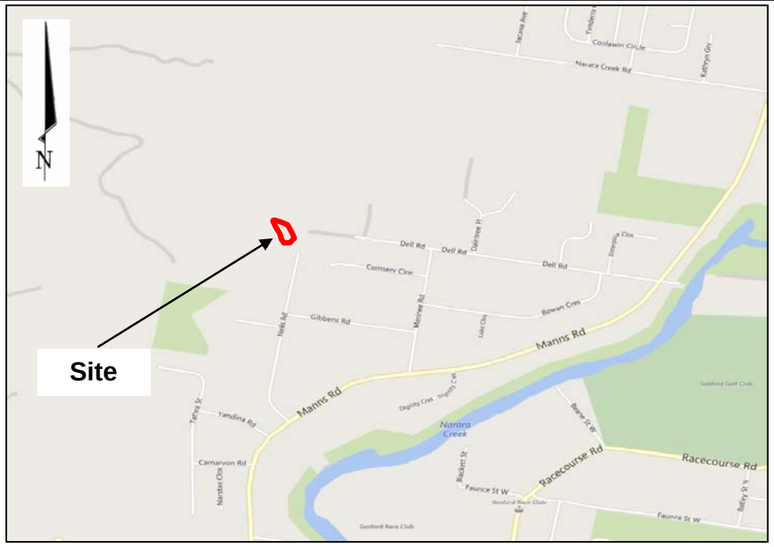
Site Inspection

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

Appendix B

Drawings





LOCALITY

Notes:

1. Drawing adapted from survey plan provided by Nearmap.com

Approximate test pit location

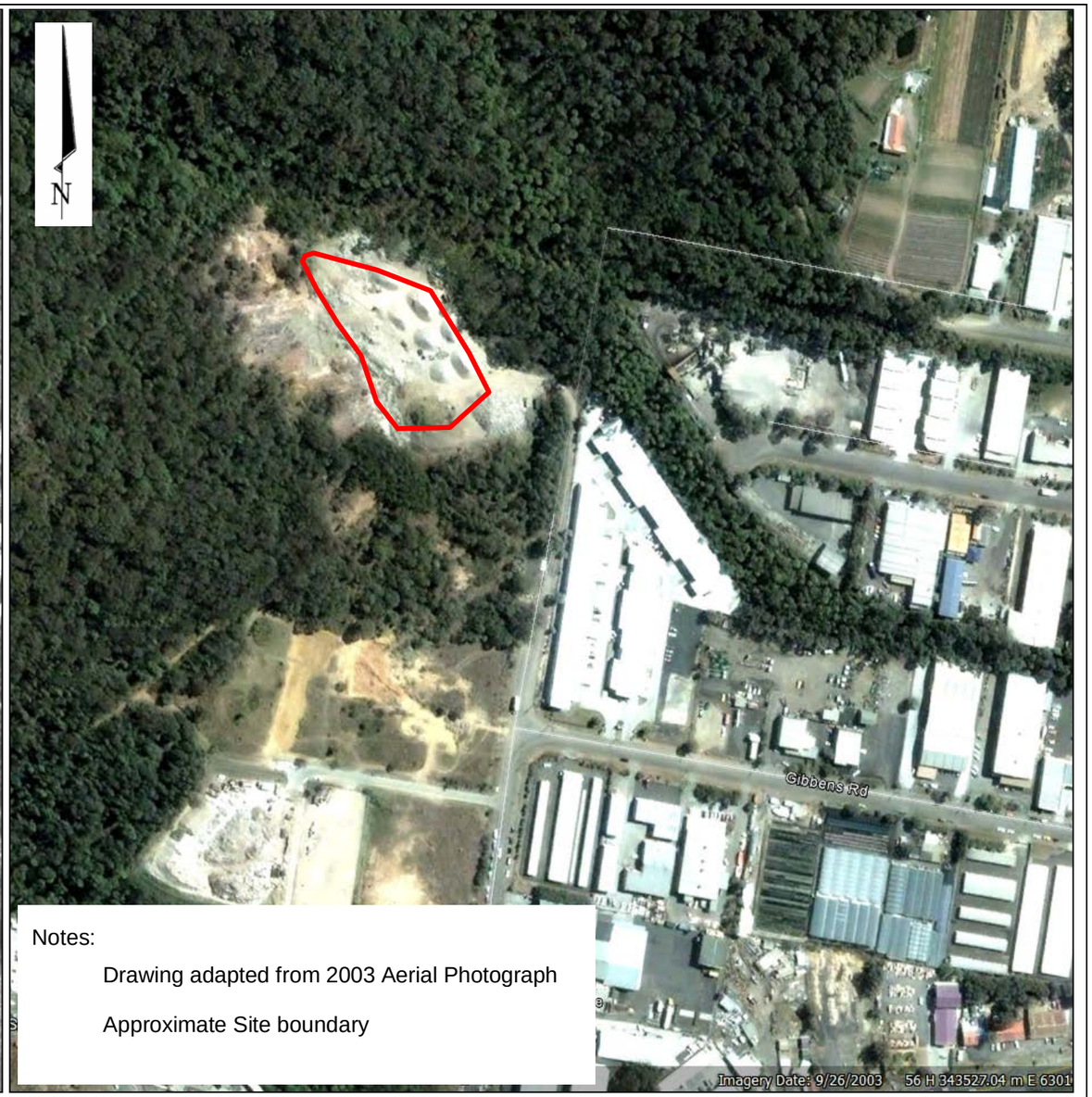
Site boundary

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Valencia Homes Pty Ltd		TITLE: **Preliminary Site Investigation for Contamination**	PROJECT No:	75853.00
	OFFICE: Wyong	DRAWN BY: BJK	**Proposed Rehabilitation of Old Quarry**	DRAWING No:	1
	SCALE: As shown	DATE: Aug 2014	**Part of Lot 6 in DP 3944 – 39 Dell Road, West Gosford**	REVISION:	A

Notes:

Drawing adapted from 1964 Aerial Photograph

Approximate Site boundary



Notes:

Drawing adapted from 2003 Aerial Photograph

Approximate Site boundary

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Valencia Homes Pty Ltd			TITLE:	**Preliminary Site Investigation for Contamination**	PROJECT No: 75853.00
OFFICE: Wyong	DRAWN BY: BJK			**Proposed Rehabilitation of Old Quarry**	DRAWING No: 2
SCALE: As shown	DATE: Aug 2014			**Part of Lot 6 in DP 3944 – 39 Dell Road, West Gosford**	REVISION: A

Appendix C

Desktop Information

NSW OFFICE OF WATER
Work Summary

GW028457

Converted From HYDSYS

Licence : 20BL020660

Licence Status Active

Work Type : Well
Work Status : (Unknown)
Construct. Method : (Unknown)
Owner Type : Private

Authorised Purpose(s)
DOMESTIC
HORTICULTURE

Intended Purpose(s)
GENERAL USE

Commenced Date :
Completion Date :

Final Depth : 3.60 m
Drilled Depth : 3.70 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 0-500 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	NORTHUMBERLAND	GOSFORD	208
Licensed :	NORTHUMBERLAND	GOSFORD	PT 208

Region : 10 - SYDNEY SOUTH COAST
River Basin : 212 - HAWKESBURY RIVER
Area / District :

CMA Map : 9131-2S GOSFORD
Grid Zone : 56/1 **Scale :** 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6301375 **Latitude (S) :** 33° 24' 56"
Easting : 343977 **Longitude (E) :** 151° 19' 19"

GS Map : 0055B2 **MGA Zone :** 56 **Coordinate Source :** GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Brick	-0.40	-0.40	1524			(Unknown)
1	1	Casing	Timber	0.00	0.00	1524			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.82	1.82	Loam Black Sandy	Loam	
1.82	2.74	0.92	Sand White	Sand	
2.74	3.65	0.91	Sand Clay Interlayere	Sand	
2.74	3.65	0.91	Gravel Bands	Gravel	

Remarks

***** End of GW028457 *****

Appendix D

Test Pit Logs

Sampling

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

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

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud 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 the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils 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 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm 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 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

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

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This 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.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

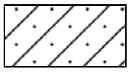
Soils


Topsoil

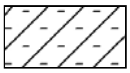

Peat


Clay

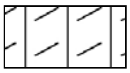

Silty clay

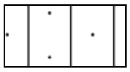

Sandy clay

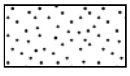

Gravelly clay

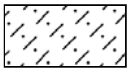

Shaly clay

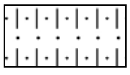

Silt


Clayey silt


Sandy silt

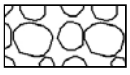

Sand

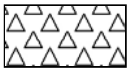

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

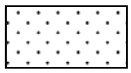

Talus

Sedimentary Rocks

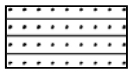

Boulder conglomerate

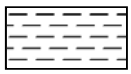

Conglomerate


Conglomeratic sandstone

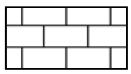

Sandstone


Siltstone


Laminite

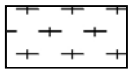

Mudstone, claystone, shale

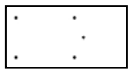

Coal


Limestone

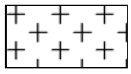
Metamorphic Rocks

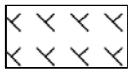

Slate, phyllite, schist

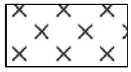

Gneiss

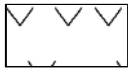

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343841
NORTHING: 6301650

PIT No: 1
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Brown silty clayey sand with some gravels and a trace of organics, moist		E	0.1		PID = 0.9 ppm		
	0.4	CLAYEY SAND: Light grey mottled orange brown clayey sand with some silt, moist		E	0.5		PID = 1.3 ppm		
	1 1.0	Pit discontinued at 1.0m - Limit of investigation		E	1.0		PID = 1.1 ppm		
	2								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343807
NORTHING: 6301634

PIT No: 2
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Brown and red brown grey silty and sandy clay filling with a trace of gravels, cobbles and organics, M>Wp		E	0.1		PID = 1.8 ppm		
				E	0.5		PID = 0.9 ppm		
		- minor anthropogenic inclusions (3 bricks, 1 fragment of concrete, 1 piece of timber)							
	1			E	1.0		PID = 1.6 ppm		1
	1.1	SILTY CLAY: Light grey mottled red brown medium plasticity, silty clay, M>Wp							
		- grading into extremely weathered, fine grained sandstone at 1.2m		E	1.2		PID = 1.1 ppm		
	1.3	Pit discontinued at 1.3m - Refusal							
	2								2

RIG: 5 tonne Excavator
LOGGED: B Kerry
SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343806
NORTHING: 6301668

PIT No: 3
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Grey brown silty sand with a trace of rootlets, moist/wet		E	0.1		PID = 2.2 ppm		
	0.5	FILLING: Grey mottled pink clayey sand with sandstone gravels/cobbles, wet		E	0.6		PID = 1.2 ppm		
1	1.0	SANDY CLAY: Light grey mottled orange red brown sandy clay with some silt and iron induration, M~Wp		E	1.1		PID = 2.0 ppm	▽	1
	1.2	Pit discontinued at 1.2m - Limit of investigation							
2									2

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: Minor Seepage at 1.0m

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343821
NORTHING: 6301678

PIT No: 4
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Brown, fine grained, silty sand with a trace of rootlets and gravels		E	0.1		PID = 1.1 ppm		
	0.3	FILLING: Grey mottled pink clayey sand with sandstone gravels and cobbles, moist		E	0.4		PID = 1.7 ppm		
	0.55	CLAYEY SAND: Light grey mottled orange brown, fine grained clayey sand, moist (extremely weathered sandstone)		E	0.6		PID = 1.5 ppm		
	0.8	Pit discontinued at 0.8m - Limit of investigation							
	1								1
	2								2

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343840
NORTHING: 6301683

PIT No: 5
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Grey brown clayey sand with some gravels and cobbles and trace anthrogenic inclusions (single pieces of brick, metal, glass, asphalt and concrete)		E	0.1		PID = 0.7 ppm		
	0.5	CLAYEY SAND: Light grey mottled orange brown, fine to medium grained, clayey sand with some iron induration		E	0.6		PID = 1.7 ppm		
	0.8	Pit discontinued at 0.8m - Limit of investigation							
	1								1
	2								2

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343821
NORTHING: 6301708

PIT No: 6
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Brown grey silty sand with a trace of gravels and rootlets, moist		E	0.1		PID = 1.7 ppm		
	0.25	SAND: Light grey mottled orange brown, fine to medium grained sand with some clay, moist		E	0.3		PID = 0.89 ppm		
	1			E	1.0		PID = 0.0 ppm		1
	1.1	Pit discontinued at 1.1m - Limit of investigation							
	2								2

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343794
NORTHING: 6301701

PIT No: 7
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Brown silty clayey sand with some gravels and cobbles and trace of anthropogenic inclusions (single piece of metal and timber and 4 bricks in pit) & rootlets, moist		E	0.1		PID = 2.0 ppm		
	0.4	FILLING: Grey mottled pink clayey sand with sandstone gravels and cobbles, moist		E	0.5		PID = 1.6 ppm		
	0.6	CLAYEY SAND: Grey mottled orange brown, fine to medium grained clayey sand with some iron induration		E	0.7		PID = 1.9 ppm		
	0.9	Pit discontinued at 0.9m - Limit of investigation							
	1								1
	2								2

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343725
NORTHING: 6301681

PIT No: 8
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Brown grey clay sand with a trace of gravels and rootlets, moist		E	0.1		PID = 2.0 ppm		
	0.25	FILLING: Grey mottled pink/red clay sand with sandstone gravels and cobbles, moist		E	0.3		PID = 1.5 ppm		
	0.4	CLAYEY SAND: Grey mottled red brown, fine to medium grained clayey sand with iron induration, moist		E	0.5		PID = 1.5 ppm		
	0.9	Pit discontinued at 0.9m - Limit of investigation							
	1								1
	2								2

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343774
NORTHING: 6301716

PIT No: 9
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Brown, fine to medium grained silty sand with a trace of rootlets and gravels, moist		E	0.1		PID = 2.2 ppm		
	0.3	FILLING: Brown and grey brown clayey sand with gravels and cobbles and trace anthropogenic inclusions (single pieces of concrete and metal)		E	0.4		PID = 1.5 ppm		
	0.95	SANDY CLAY: Grey mottled red brown, medium plasticity sandy clay with iron induration		E	1.0		PID = 1.6 ppm		
	1.2	Pit discontinued at 1.2m - Limit of investigation							

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343795
NORTHING: 6301725

PIT No: 10
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Brown, fine to medium grained silty sand with a trace of clay, rootlets and gravels. Single piece of plastic		E	0.1		PID = 1.5 ppm		
	0.6	CLAYEY SAND: Grey mottled red brown clayey sand with iron induration, moist		E	0.7		PID = 1.8 ppm		
	1			E	1.0		PID = 2.0 ppm		1
	1.1	Pit discontinued at 1.1m - Limit of investigation							
	2								2

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Valencia Homes Pty Ltd
PROJECT: Preliminary Site Investigation for Contamination
LOCATION: 39 Dell Road, West Gosford

SURFACE LEVEL: --
EASTING: 343757
NORTHING: 6301740

PIT No: 11
PROJECT No: 75853.00
DATE: 8/8/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Brown grey silty sand with organics and a trace of clay, moist		E	0.1		PID = 1.1 ppm		
	0.35	CLAYEY SAND: Grey mottled red brown, fine to medium grained clayey sand with iron induration, moist		E	0.5		PID = 0.0 ppm		
	0.7	Pit discontinued at 0.7m - Limit of investigation							
	1								
	2								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 5 tonne Excavator

LOGGED: B Kerry

SURVEY DATUM:

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix E

Laboratory Certificates

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 114446

Client:

Douglas Partners Tuggerah
Unit 5, 3 Teamster Close
Tuggerah
NSW 2259

Attention: Brent Kerry

Sample log in details:

Your Reference:	**75853.00, West Gosford - PSI**
No. of samples:	16 Soils, 1 water
Date samples received / completed instructions received	12/08/2014 / 12/08/2014

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:	19/08/14 / 19/08/14
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:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	114446-1	114446-3	114446-4	114446-5	114446-6
Your Reference	----------	1/0.1	2/1.0	3/0.1	4/0.4	5/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	16/08/2014	16/08/2014	16/08/2014	16/08/2014	16/08/2014
TRHC$_6$ - C$_9$	mg/kg	<25	<25	<25	<25	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25	<25	<25	<25	<25
vTPHC$_6$ - C$_{10}$ less BTEX (F1)	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	<0.5	<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
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	119	119	115	115	118

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	114446-8	114446-9	114446-11	114446-12	114446-13
Your Reference	----------	6/0.1	7/0.1	8/0.1	9/0.4	10/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	18/08/2014
Date analysed	-	16/08/2014	16/08/2014	16/08/2014	16/08/2014	18/08/2014
TRHC$_6$ - C$_9$	mg/kg	<25	<25	<25	<25	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25	<25	<25	<25	<25
vTPHC$_6$ - C$_{10}$ less BTEX (F1)	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	<0.5	<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
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	121	121	118	115	125

vTRH(C6-C10)/BTEXN in Soil		
Our Reference:	UNITS	114446-14
Your Reference	----------	11/0.1
Date Sampled	----------	08/08/2014
Type of sample		Soil
Date extracted	-	13/08/2014
Date analysed	-	16/08/2014
TRHC$_6$ - C$_9$	mg/kg	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25
vTPHC$_6$ - C$_{10}$ less BTEX (F1)	mg/kg	<25
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
naphthalene	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	117

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	114446-1	114446-3	114446-4	114446-5	114446-6
Your Reference	----------	1/0.1	2/1.0	3/0.1	4/0.4	5/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
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	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	140	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	88	80	91	84	87

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	114446-8	114446-9	114446-11	114446-12	114446-13
Your Reference	----------	6/0.1	7/0.1	8/0.1	9/0.4	10/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
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	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	86	88	85	94	88

svTRH (C10-C40) in Soil		
Our Reference:	UNITS	114446-14
Your Reference	----------	11/0.1
Date Sampled	----------	08/08/2014
Type of sample		Soil
Date extracted	-	13/08/2014
Date analysed	-	14/08/2014
TRHC$_{10}$ - C$_{14}$	mg/kg	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100
Surrogate o-Terphenyl	%	86

PAHs in Soil						
Our Reference:	UNITS	114446-1	114446-3	114446-4	114446-5	114446-6
Your Reference	----------	1/0.1	2/1.0	3/0.1	4/0.4	5/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.2	<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	2.5	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.7	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	10	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	8.5	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	4.0	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	3.8	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	6.4	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	4.0	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	2.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	2.0	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ NEPM B1	mg/kg	6.0	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	45	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	88	83	87	86	86

PAHs in Soil						
Our Reference:	UNITS	114446-8	114446-9	114446-11	114446-12	114446-13
Your Reference	----------	6/0.1	7/0.1	8/0.1	9/0.4	10/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
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	0.2	0.1	0.1	0.3
Pyrene	mg/kg	<0.1	0.2	0.1	0.1	0.3
Benzo(a)anthracene	mg/kg	<0.1	0.1	<0.1	<0.1	0.2
Chrysene	mg/kg	<0.1	0.1	<0.1	<0.1	0.2
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	0.2	<0.2	<0.2	0.4
Benzo(a)pyrene	mg/kg	<0.05	0.14	0.09	0.07	0.26
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.1	<0.1	<0.1	0.2
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	0.2
Benzo(a)pyrene TEQ NEPM B1	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	NIL (+)VE	1.2	0.39	0.32	1.9
Surrogate p-Terphenyl-d14	%	83	86	84	89	87

PAHs in Soil		
Our Reference:	UNITS	114446-14
Your Reference	----------	11/0.1
Date Sampled	----------	08/08/2014
Type of sample		Soil
Date extracted	-	13/08/2014
Date analysed	-	14/08/2014
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	<0.1
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,j+k)fluoranthene	mg/kg	<0.2
Benzo(a)pyrene	mg/kg	0.1
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
Benzo(a)pyrene TEQ NEPM B1	mg/kg	<0.5
Total Positive PAHs	mg/kg	0.40
Surrogate p-Terphenyl-d14	%	83

Organochlorine Pesticides in soil						
Our Reference:	UNITS	114446-1	114446-2	114446-3	114446-4	114446-5
Your Reference	----------	1/0.1	2/0.1	2/1.0	3/0.1	4/0.4
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	80	78	77	81	77

Organochlorine Pesticides in soil						
Our Reference:	UNITS	114446-6	114446-7	114446-8	114446-9	114446-10
Your Reference	----------	5/0.1	5/0.6	6/0.1	7/0.1	7/0.7
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	82	99	90	88	94

Organochlorine Pesticides in soil						
Our Reference:	UNITS	114446-11	114446-12	114446-13	114446-14	114446-15
Your Reference	----------	8/0.1	9/0.4	10/0.1	11/0.1	QA1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	86	93	92	88	89

Organochlorine Pesticides in soil		
Our Reference:	UNITS	114446-16
Your Reference	----------	QA2
Date Sampled	----------	08/08/2014
Type of sample		Soil
Date extracted	-	13/08/2014
Date analysed	-	14/08/2014
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Surrogate TCMX	%	94

PCBs in Soil						
Our Reference:	UNITS	114446-1	114446-3	114446-4	114446-5	114446-6
Your Reference	----------	1/0.1	2/1.0	3/0.1	4/0.4	5/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	80	77	81	77	82

PCBs in Soil						
Our Reference:	UNITS	114446-8	114446-9	114446-11	114446-12	114446-13
Your Reference	----------	6/0.1	7/0.1	8/0.1	9/0.4	10/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	99	88	86	93	92

PCBs in Soil		
Our Reference:	UNITS	114446-14
Your Reference	----------	11/0.1
Date Sampled	----------	08/08/2014
Type of sample		Soil
Date extracted	-	13/08/2014
Date analysed	-	14/08/2014
Arochlor 1016	mg/kg	<0.1
Arochlor 1221	mg/kg	<0.1
Arochlor 1232	mg/kg	<0.1
Arochlor 1242	mg/kg	<0.1
Arochlor 1248	mg/kg	<0.1
Arochlor 1254	mg/kg	<0.1
Arochlor 1260	mg/kg	<0.1
Surrogate TCLMX	%	88

Acid Extractable metals in soil						
Our Reference:	UNITS	114446-1	114446-2	114446-3	114446-4	114446-5
Your Reference	----------	1/0.1	2/0.1	2/1.0	3/0.1	4/0.4
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Arsenic	mg/kg	<4	5	20	<4	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	10	13	32	9	13
Copper	mg/kg	6	5	5	10	2
Lead	mg/kg	12	11	28	12	13
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	5	5	3	5	2
Zinc	mg/kg	21	18	20	28	5

Acid Extractable metals in soil						
Our Reference:	UNITS	114446-6	114446-7	114446-8	114446-9	114446-10
Your Reference	----------	5/0.1	5/0.6	6/0.1	7/0.1	7/0.7
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Arsenic	mg/kg	4	<4	4	6	<4
Cadmium	mg/kg	0.5	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	14	11	12	12	3
Copper	mg/kg	20	2	5	19	<1
Lead	mg/kg	33	11	18	19	6
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	13	1	5	8	<1
Zinc	mg/kg	50	5	17	34	2

Acid Extractable metals in soil						
Our Reference:	UNITS	114446-11	114446-12	114446-13	114446-14	114446-15
Your Reference	----------	8/0.1	9/0.4	10/0.1	11/0.1	QA1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Arsenic	mg/kg	6	4	<4	<4	5
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	14	13	12	19	15
Copper	mg/kg	28	14	18	13	6
Lead	mg/kg	22	14	14	15	11
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	11	15	7	6	8
Zinc	mg/kg	48	32	29	28	17

Acid Extractable metals in soil			
Our Reference:	UNITS	114446-16	114446-18
Your Reference	----------	QA2	QA2 - TRIPLICATE
Date Sampled	----------	08/08/2014	08/08/2014
Type of sample		Soil	Soil
Date digested	-	14/08/2014	14/08/2014
Date analysed	-	14/08/2014	14/08/2014
Arsenic	mg/kg	<4	<4
Cadmium	mg/kg	<0.4	<0.4
Chromium	mg/kg	14	10
Copper	mg/kg	17	17
Lead	mg/kg	14	14
Mercury	mg/kg	<0.1	<0.1
Nickel	mg/kg	9	5
Zinc	mg/kg	33	33

Moisture						
Our Reference:	UNITS	114446-1	114446-2	114446-3	114446-4	114446-5
Your Reference	----------	1/0.1	2/0.1	2/1.0	3/0.1	4/0.4
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Moisture	%	10	15	16	16	15

Moisture						
Our Reference:	UNITS	114446-6	114446-7	114446-8	114446-9	114446-10
Your Reference	----------	5/0.1	5/0.6	6/0.1	7/0.1	7/0.7
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Moisture	%	14	11	14	11	9.6

Moisture						
Our Reference:	UNITS	114446-11	114446-12	114446-13	114446-14	114446-15
Your Reference	----------	8/0.1	9/0.4	10/0.1	11/0.1	QA1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	13/08/2014	13/08/2014	13/08/2014	13/08/2014	13/08/2014
Date analysed	-	14/08/2014	14/08/2014	14/08/2014	14/08/2014	14/08/2014
Moisture	%	102	10	14	15	[NT]

Moisture		
Our Reference:	UNITS	114446-16
Your Reference	----------	QA2
Date Sampled	----------	08/08/2014
Type of sample		Soil
Date prepared	-	13/08/2014
Date analysed	-	14/08/2014
Moisture	%	14

Asbestos ID - soils						
Our Reference:	UNITS	114446-1	114446-3	114446-4	114446-5	114446-6
Your Reference	----------	1/0.1	2/1.0	3/0.1	4/0.4	5/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	18/08/2014	18/08/2014	18/08/2014	18/08/2014	18/08/2014
Sample mass tested	g	Approx 60g	Approx 60g	Approx 60g	Approx 60g	Approx 60g
Sample Description	-	Brown coarse-grained soil & rocks	Brown fine-grained soil	Brown coarse-grained soil	Pinkish fine-grained soil	Brown coarse-grained soil
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	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	No respirable fibres detected	No respirable fibres detected

Asbestos ID - soils						
Our Reference:	UNITS	114446-8	114446-9	114446-11	114446-12	114446-13
Your Reference	----------	6/0.1	7/0.1	8/0.1	9/0.4	10/0.1
Date Sampled	----------	08/08/2014	08/08/2014	08/08/2014	08/08/2014	08/08/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	18/08/2014	18/08/2014	18/08/2014	18/08/2014	18/08/2014
Sample mass tested	g	Approx 60g	Approx 60g	Approx 60g	Approx 60g	Approx 60g
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil	Brown coarse-grained soil	Brown coarse-grained soil	Brown fine-grained soil
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	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	No respirable fibres detected	No respirable fibres detected

Asbestos ID - soils		
Our Reference:	UNITS	114446-14
Your Reference	----------	11/0.1
Date Sampled	----------	08/08/2014
Type of sample		Soil
Date analysed	-	18/08/2014
Sample mass tested	g	Approx 60g
Sample Description	-	Brown fine-grained soil
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg
Trace Analysis	-	No respirable fibres detected

Metals in Water - Dissolved		
Our Reference:	UNITS	114446-17
Your Reference	----------	RB1
Date Sampled	----------	08/08/2014
Type of sample		Water
Date digested	-	13/08/2014
Date analysed	-	13/08/2014
Arsenic - Dissolved	mg/L	<0.05
Cadmium - Dissolved	mg/L	<0.01
Chromium - Dissolved	mg/L	<0.01
Copper - Dissolved	mg/L	<0.01
Lead - Dissolved	mg/L	<0.03
Mercury - Dissolved	mg/L	<0.0005
Nickel - Dissolved	mg/L	<0.02
Zinc - Dissolved	mg/L	<0.02

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
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+/-5 deg C for a minimum of 12 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(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			13/08/2014	114446-6	13/08/2014 || 13/08/2014	LCS-12	13/08/2014
Date analysed	-			16/08/2014	114446-6	16/08/2014 || 16/08/2014	LCS-12	16/08/2014
TRHC$_6$ - C$_9$	mg/kg	25	Org-016	<25	114446-6	<25 || <25	LCS-12	96%
TRHC$_6$ - C$_{10}$	mg/kg	25	Org-016	<25	114446-6	<25 || <25	LCS-12	96%
Benzene	mg/kg	0.2	Org-016	<0.2	114446-6	<0.2 || <0.2	LCS-12	103%
Toluene	mg/kg	0.5	Org-016	<0.5	114446-6	<0.5 || <0.5	LCS-12	96%
Ethylbenzene	mg/kg	1	Org-016	<1	114446-6	<1 || <1	LCS-12	86%
m+p-xylene	mg/kg	2	Org-016	<2	114446-6	<2 || <2	LCS-12	94%
o-Xylene	mg/kg	1	Org-016	<1	114446-6	<1 || <1	LCS-12	101%
naphthalene	mg/kg	1	Org-014	<1	114446-6	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	139	114446-6	118 || 117 || RPD: 1	LCS-12	128%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			13/08/2014	114446-6	13/08/2014 || 13/08/2014	LCS-12	13/08/2014
Date analysed	-			14/08/2014	114446-6	14/08/2014 || 14/08/2014	LCS-12	14/08/2014
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	114446-6	<50 || <50	LCS-12	113%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	114446-6	<100 || <100	LCS-12	125%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	114446-6	<100 || <100	LCS-12	104%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	114446-6	<50 || <50	LCS-12	113%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	114446-6	<100 || <100	LCS-12	125%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	114446-6	<100 || <100	LCS-12	104%
Surrogate o-Terphenyl	%		Org-003	91	114446-6	87 || 82 || RPD: 6	LCS-12	101%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			13/08/2014	114446-6	13/08/2014 || 13/08/2014	LCS-11	13/08/2014
Date analysed	-			13/08/2014	114446-6	14/08/2014 || 14/08/2014	LCS-11	13/08/2014
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	LCS-11	101%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	LCS-11	98%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	LCS-11	98%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	LCS-11	98%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	LCS-11	99%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	LCS-11	95%
Benzo(b,j+k) fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	114446-6	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	114446-6	<0.05 || <0.05	LCS-11	103%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	92	114446-6	86 || 81 || RPD: 6	LCS-11	89%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			13/08/2014	114446-6	13/08/2014 || 13/08/2014	LCS-10	13/08/2014
Date analysed	-			14/08/2014	114446-6	14/08/2014 || 14/08/2014	LCS-10	14/08/2014
HCB	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	99%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	98%
Heptachlor	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	96%
delta-BHC	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	100%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	99%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	101%
Dieldrin	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	101%
Endrin	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	99%
pp-DDD	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	107%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	LCS-10	107%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	83	114446-6	82 || 78 || RPD: 5	LCS-10	76%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			13/08/2014	114446-6	13/08/2014 || 13/08/2014	LCS-10	13/08/2014
Date analysed	-			14/08/2014	114446-6	14/08/2014 || 14/08/2014	LCS-10	14/08/2014
Arochlor 1016	mg/kg	0.1	Org-006	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221	mg/kg	0.1	Org-006	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	Org-006	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	Org-006	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	Org-006	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	Org-006	<0.1	114446-6	<0.1 || <0.1	LCS-10	101%
Arochlor 1260	mg/kg	0.1	Org-006	<0.1	114446-6	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	83	114446-6	82 || 78 || RPD: 5	LCS-10	78%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date digested	-			14/08/2014	114446-6	14/08/2014 || 14/08/2014	LCS-4	14/08/2014
Date analysed	-			14/08/2014	114446-6	14/08/2014 || 14/08/2014	LCS-4	14/08/2014
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	114446-6	4 || <4	LCS-4	96%
Cadmium	mg/kg	0.4	Metals-020 ICP-AES	<0.4	114446-6	0.5 || <0.4	LCS-4	101%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	114446-6	14 || 13 || RPD: 7	LCS-4	98%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	114446-6	20 || 15 || RPD: 29	LCS-4	96%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	114446-6	33 || 28 || RPD: 16	LCS-4	96%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	114446-6	<0.1 || <0.1	LCS-4	90%
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	114446-6	13 || 13 || RPD: 0	LCS-4	99%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	114446-6	50 || 59 || RPD: 17	LCS-4	97%

QUALITY CONTROL Metals in Water - Dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			13/08/2014	[NT]	[NT]	LCS-W1	13/08/2014
Date analysed	-			13/08/2014	[NT]	[NT]	LCS-W1	13/08/2014
Arsenic - Dissolved	mg/L	0.05	Metals-020 ICP-AES	<0.05	[NT]	[NT]	LCS-W1	91%
Cadmium - Dissolved	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	96%
Chromium - Dissolved	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	93%
Copper - Dissolved	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	92%
Lead - Dissolved	mg/L	0.03	Metals-020 ICP-AES	<0.03	[NT]	[NT]	LCS-W1	92%
Mercury - Dissolved	mg/L	0.0005	Metals-021 CV-AAS	<0.0005	[NT]	[NT]	LCS-W1	104%
Nickel - Dissolved	mg/L	0.02	Metals-020 ICP-AES	<0.02	[NT]	[NT]	LCS-W1	94%
Zinc - Dissolved	mg/L	0.02	Metals-020 ICP-AES	<0.02	[NT]	[NT]	LCS-W1	93%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	114446-16	13/08/2014 || 13/08/2014	114446-8	13/08/2014
Date analysed	-	114446-16	14/08/2014 || 14/08/2014	114446-8	14/08/2014
HCB	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	114446-16	<0.1 || <0.1	114446-8	86%
gamma-BHC	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	114446-16	<0.1 || <0.1	114446-8	102%
Heptachlor	mg/kg	114446-16	<0.1 || <0.1	114446-8	75%
delta-BHC	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	114446-16	<0.1 || <0.1	114446-8	87%
Heptachlor Epoxide	mg/kg	114446-16	<0.1 || <0.1	114446-8	83%
gamma-Chlordane	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	114446-16	<0.1 || <0.1	114446-8	113%
Dieldrin	mg/kg	114446-16	<0.1 || <0.1	114446-8	83%
Endrin	mg/kg	114446-16	<0.1 || <0.1	114446-8	64%
pp-DDD	mg/kg	114446-16	<0.1 || <0.1	114446-8	109%
Endosulfan II	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	114446-16	<0.1 || <0.1	114446-8	80%
Methoxychlor	mg/kg	114446-16	<0.1 || <0.1	[NR]	[NR]

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Surrogate TCMX	%	114446-16	94 || 85 || RPD: 10	114446-8	90%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	114446-8	13/08/2014
Date analysed	-	[NT]	[NT]	114446-8	14/08/2014
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]	114446-8	114%
Arochlor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	114446-8	97%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD		
Date digested	-	114446-16	14/08/2014 || 14/08/2014		
Date analysed	-	114446-16	14/08/2014 || 14/08/2014		
Arsenic	mg/kg	114446-16	<4 || <4		
Cadmium	mg/kg	114446-16	<0.4 || <0.4		
Chromium	mg/kg	114446-16	14 || 10 || RPD: 33		
Copper	mg/kg	114446-16	17 || 17 || RPD: 0		
Lead	mg/kg	114446-16	14 || 14 || RPD: 0		
Mercury	mg/kg	114446-16	<0.1 || <0.1		
Nickel	mg/kg	114446-16	9 || 4 || RPD: 77		
Zinc	mg/kg	114446-16	33 || 27 || RPD: 20		

Report Comments:

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteriae has been exceeded for 114446-16 for Ni. Therefore a triplicate result has been issued as laboratory sample number 114446-18.

Asbestos: A portion of the supplied sample was sub-sampled for asbestos analysis according to Envirolab procedures. We cannot guarantee that this sub-sample is indicative of the entire sample. Envirolab recommends supplying 40-50g of sample in its own container.

Asbestos ID was analysed by Approved Identifier:	Paul Ching
Asbestos ID was authorised by Approved Signatory:	Paul Ching

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

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

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

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

CHAIN OF CUSTODY DESPATCH SHEET (2)

Douglas Partners
Geotechnics · Environment · Groundwater

Project Name: West Gosford - PSI
Project No: 75853.00
DP Contact Person: Brent Kerry
Prior Storage: (esky)/(fridge)/ shelved (circle)

To: Envirolab Services
12 Ashley Street
Chatswood NSW
Ph: 9910 6200
Attn: Sample Reciept

	Sample ID	Sample Type S-soil W-water	Lab ID	Analytes: Combination 5A	HM	OCP										Notes
1	1/0.1	S		X												Samples collected by BJC 8/8/14
2	2/0.8				X	X										
3	2/1.0			X												
NR	2/1.2				X	X										
4	3/0.1			X												
5	4/0.4			X												
6	5/0.1			X												
7	5/0.6				X	X										
8	6/0.1			X												
9	7/0.1			X												
10	7/0.7				X	X										
	PQL (S)	mg/kg														
	PQL (W)	mg/L														

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 114446
Date Received: 12/8/14
Time Received: 10:00
Received by: lam
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

PQL = practical quantitation limit, *As per Laboratory Method Detection Limit

Date relinquished: 11/8/14
Total number of samples in container: 1
Results required by: Normal Turnaround
B Kerry

SAMPLES RECEIVED
Please sign and date to acknowledge receipt of samples and return by fax
Signature: Kenith Wong
Date: 12/8/14 Lab Ref: 114446

Send results to: Brent Kerry
Douglas Partners Pty Ltd
Address:
Unit 5, 3 Teamster Close
Tuggerah NSW 2259
Email: brent.kerry@douglaspartners.com.au

HM = Standard 8 metals.

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CHAIN OF CUSTODY DESPATCH SHEET (2)

Project Name: West Gosford - PSI
Project No: 75853.00
DP Contact Person: Brent Kerry
Prior Storage: esky / fridge / shelved (circle)

To: Envirolab Services
12 Ashley Street
Chatswood NSW
Ph: 9910 6200
Attn: Sample Reciept

	Sample ID	Sample Type S-soil W-water	Lab ID	Analytes: Combination 5A	HM	OCP									Notes
11	8/0.1	S		X											Samples collected by BDL 8/8/14
12	9/0.4	↓		X											
13	10/0.1	↓		X											
14	11/0.1	↓		X											
15	QA1	↓			X	X									
16	QA2	↓			X	X									
17	RB1	W			X										
	PQL (S)	mg/kg													
	PQL (W)	mg/L													

PQL = practical quantitation limit, *As per Laboratory Method Detection Limit

Date relinquished: 11/8/14
Total number of samples in container: 18
Results required by: Normal Turnaround
B Kerry

SAMPLES RECEIVED
Please sign and date to acknowledge receipt of samples and return by fax

Signature: K.W
Date: 12/8/14 Lab Ref: 114446

Send results to: Brent Kerry
Douglas Partners Pty Ltd
Address:
Unit 5, 3 Teamster Close
Tuggerah NSW 2259
Email: brent.kerry@douglaspartners.com.au

Appendix F

QA/QC Procedures and Discussion

APPENDIX F

QUALITY ASSURANCE/QUALITY CONTROL FOR SOIL AND WATER SAMPLING

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Quality Assurance (QA) was maintained by:

- compliance with a Project Quality Plan written for the objectives of the study;
- using experienced staff to undertake the field supervision and sampling;
- following the DP operating procedures for sampling, field testing and decontamination as presented in Table F1;
- using NATA registered laboratories for sample testing, that generally utilise standard laboratory methods of the US EPA, the APHA and NSW EPA.

Table F1: Field Procedures

Abbreviation	Procedure Name
FPM LOG	Logging
FPM DECONT	Decontamination of Personnel and Equipment
FPM ENVID	Sample Identification, Handling, Transport and Storage of Contaminated Samples
FPM PIDETC	Operation of Field Analysers
FPM ENVSAMP	Sampling of Contaminated Soils

(from Douglas Partners Field Procedures Manual)

Quality Control (QC) of the laboratory programme was achieved by the following means:

- check replicate - a specific sample was split in the field, placed in separate containers and labelled with different sample numbers, and sent to the laboratory for analysis;
- field equipment rinsate – a specific rinsate water sample was taken in the field during field investigations and sent to the laboratory at the completion of sampling to ensure decontamination of sampling equipment was adequate.
- method blanks - the laboratory ran reagent blanks to confirm the equipment and standards used were uncontaminated;
- laboratory duplicates - the laboratory split samples internally and conducted tests on separate extracts;
- laboratory spikes - samples were spiked by the laboratory with a known concentration of contaminants and subsequently tested for percent recovery.

Discussion

A. Check Replicate

The Relative Percent Difference (RPD) between duplicate results is used as a measure of laboratory reproducibility and is given by the following:-

$$\text{RPD} = \frac{\text{ABS}(\text{Duplicate result 1} - \text{Duplicate result 2})}{(\text{Duplicate result 1} + \text{Duplicate result 2})/2} \text{ x } 100$$

The RPD can have a value between 0% and 200%. An RPD data quality objective of up to 50% is generally considered to be acceptable for organic analysis, and 35% for inorganics (i.e. metals).

A summary of the results of the field soil replicate QA/QC testing is provided in Table F2.

Table F2: Results of Soil Replicate Analysis

Sample ID	Depth	PID	Heavy Metals								OCP[2]
			As	Cd	Cr[1]	Cu	Pb	Hg	Ni	Zn	
2/0.1	0.1	1.8	5	ND	13	5	11	ND	5	18	ND
QA1	2/0.1	1.8	5	ND	15	6	11	ND	8	17	ND
RPD (%)			0	0	14	18	0	0	46	6	0
10/0.1	0.1	1.5	ND	ND	12	18	14	ND	7	29	ND
QA2	10/0.1	1.5	ND	ND	14	17	14	ND	9	33	ND
RPD (%)			0	0	15	6	0	0	25	13	0

RPDs for the soil field replicate samples were generally within the acceptable limits. The nickel result reported marginally elevated RPDs that can generally be attributed to relatively low contaminant concentrations in soil for some analytes (ie. small differences in concentrations) resulting in a high RPD. It is noted that the laboratories consider that any RPD is acceptable for laboratory duplicate results less than five times the PQL. The results are therefore considered to be acceptable.

B. Field Rinsate Blank

A field equipment rinsate sample was tested as part of field investigations to check the adequacy of field decontamination procedures. In cases were sampling equipment was used, such as a trowel; the equipment was decontaminated in accordance with filed procedure “FPM DECONT”.

The soil sampling field rinsate samples were tested for a suite of metals (As, Cd, Cr, Cu, Hg, Pb, Ni and Zn). Based on the decontamination procedure undertaken and the non-detect results reported it is considered unlikely that any significant cross-contamination occurred during the sampling. As such results were generally acceptable.

C. Sample Handling and Holding Times

A review of the laboratory reports and chain of custody forms associated with the soil investigation indicates the following:

- Samples were received chilled and in good order;
- Samples received were appropriately preserved for all tests;
- VOC/SVOC samples were received in Teflon sealed containers;
- Volatile samples were received with zero headspace; and
- Samples were received within recommended holding times.

D. Laboratory Method Blanks

A reagent blank is prepared and analysed at the beginning of every analytical run, following calibration of the analytical apparatus. Results for reagent blanks for groundwater analyses showed concentrations of all analytes to be below laboratory PQL limits. Results are included in the laboratory reports attached in Appendix E.

E. Laboratory Duplicates

The average RPD for individual contaminants ranged from 0% to 77%, with results generally within the acceptable limits. Except for the single RPD result all other results were less than 33% and were considered acceptable. The QA2 duplicate pair reported an RPD of 77% and was re-run in triplicate and an acceptable RPD was reported. The higher of the concentration result was conservatively adopted for reporting and assessment purposes. The results were significantly below the adopted SAC. The results are therefore considered to be acceptable.

F. Laboratory Spikes

Recoveries in the order of 60% to 140% are generally considered to be acceptable. The average percent recovery for individual contaminants ranged from 75% to 128% which is within the quality control objectives and as such are considered acceptable.

G. Laboratory Surrogate Recovery

This sample is prepared by adding a known amount of surrogate, which behaves similarly to the analyte, prior to analysis of each sample. The recovery result indicates the proportion of the known concentration of the surrogate detected during analysis. Surrogate recoveries were found to be generally within the Envirolab acceptance limits, indicating that the extraction was effectively and appropriately completed.

CONCLUSIONS

In summary, no significant exceedances were found for any quality control testing and therefore the overall quality control results are considered acceptable.

The accuracy and precision of the groundwater testing procedures, as inferred by the QA/QC data is generally considered to be of sufficient standard to allow the data reported to be used to interpret site contamination conditions.

Table F4 summarises data quality indicators (DQIs).

Table D4 - Data Quality Indicators

DQO	Achievement Evaluation Procedure
Documentation completeness	Completion of field and laboratory chain of custody documentation, completion of test pit logs.
Data completeness	Sampling strategy and analysis of appropriate determinants based on site history and on-site observations.
Data comparability	Use of NATA certified laboratory, use of consistent sampling technique.
Precision and accuracy for sampling and analysis	Achievement of 30-50% RPD for replicate analysis, acceptable levels for laboratory QC criteria.