



Report
Title:

Geo-Environmental Site Investigation

Project
Name:

Burndell Road, Yapton



Report Reference: **BRD2484-OR2-A**

Date: **December 2015**



REPORT CONTROL SHEET

REPORT TITLE	GEO-ENVIRONMENTAL SITE INVESTIGATION
PROJECT	BURNDELL ROAD, YAPTON
CLIENT	GLEESON DEVELOPMENTS

REPORT REFERENCE	ISSUE DETAIL	DATE	PREPARED BY	CHECKED BY
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REPORT LAYOUT

This report is divided into the following four sections: Summary Report, Technical Report, Supporting Information and Appendices.

SUMMARY REPORT

This expanded executive summary provides the main findings of the work undertaken in brief non-technical language. This section provides an overview of the key outcomes for the benefit of non-specialists and concludes with the main recommendations. This section should only be relied upon in the context of the whole report and the Technical Report should be referred to with respect to any design decisions.

TECHNICAL REPORT

The main report section is intended to provide the technical detail of the investigation and is intended to provide the level of information required by current guidance documents and practice. The Technical Report is written in a language that, in part, assumes knowledge of subject matter so that it can be written in as concise a form as possible. Its intended audience is peers, regulators and other professionals in related disciplines.

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This section of the report provides background details of a generic nature together with specific technical approaches adopted by BRD and details of the guidance documents that are commonly referenced in the report. The section also includes explanations of technical terms to assist non-specialist readers in understanding the Technical Report. It should be noted that not all the information within this section is necessarily applicable to this specific report.		

APPENDICES

The final section of the report presents the factual data collected and employed as part of the investigation.

APPENDIX 1 SITE PLANS & PHOTOGRAPHS

Site Location Plan	Ref. BRD2484-OP1-A
Revised Conceptual Site Model	Ref. BRD2484-OP6-A
Exploratory Hole Location Plan	Ref. BRD2484-OD1-A

APPENDIX 2 EXPLORATORY HOLE & MONITORING RECORDS

Logs of trial pits.	Ref. TP01-TP09
Photographic records of trial pits.	Ref. BRD2484-OP5-A
Logs of boreholes.	Ref. WS01 – WS05
BRE365 soakage test records.	2 x A4 pages
TRL Dynamic Cone Penetrometer.	Ref. TRL01 – TRL03
Groundwater monitoring records.	1 x A4 page
Gas monitoring records.	3 x A4 pages

APPENDIX 3 LABORATORY TEST RESULTS

QTS report 15-37508	13 x A4 pages
SPT report S29451	13 x A4 pages

SUMMARY REPORT - GENERAL INFORMATION

SUBJECT	COMMENTS
CURRENT USE & DESCRIPTION	The site is currently a recently cropped corn field with mixed hedgerows along the site boundaries. Vehicular access into the site is from a track off Burndell Road.
PROPOSED USE	It is proposed that the site will be developed as a residential housing estate with associated private garden areas and new access roads. At the time of writing, no proposed layout was available.
HISTORICAL SUMMARY	The site has remained undeveloped throughout its history. From the earliest available map of 1876 up until 1975, the site was part of a large agricultural field. From 1975 the larger field had been divided and the site existed as its current layout.
PUBLISHED GEOLOGY	The site is shown to be underlain by superficial deposits comprising sandy, clayey silts of the Aeolian Deposits. The shallowest bedrock unit is shown to be the Upper Chalk Formation.
RADON GAS	In an area where no radon protection measures are required in new dwellings.
ACTUAL GROUND CONDITIONS	The investigation has proved superficial Aeolian Deposits across the site to depths of between 4.05m and 4.95m below ground level. Underlying the superficial deposits was bedrock of the Upper Chalk Formation, which was proved to a maximum depth of 5.45m bgl.
HYDROGEOLOGY	The site is situated upon superficial deposits designated a Secondary A Aquifer. The underlying bedrock geology is designated a Principal Aquifer. The site is not located within a groundwater Source Protection Zone.
HYDROLOGY	The closest water feature to the site is a drainage ditch along the southern boundary. The site is not in an area indicated to be at risk of flooding.
PREVIOUS GROUND REPORTS	BRD is not aware of any previous ground investigations having been conducted at the site. However, BRD has undertaken geo-environmental desk study research and this has been reported separately.

SUMMARY REPORT - GEOTECHNICAL

SUBJECT	COMMENTS
EXCAVATIONS	It should be possible to forward excavations employing normal equipment. Groundwater control in the form of pumping from sumps may to be required at this site. It is unlikely that requirements of the Party Wall Act will apply to the development.
SLOPE STABILITY	It is considered that slope stability is unlikely to be a concern at this site.
SUB-SURFACE CONCRETE	For all on-site soils a Design Sulphate Class of DS-1 and Aggressive Chemical Environment for Concrete class of AC-1 applies.
SOAKAWAYS	The site is not particularly suitable for surface water disposal to conventional soakaways.
PAVEMENT DESIGN	A preliminary design California Bearing Ratio (CBR) of 3% has been recommended.
FOUNDATIONS	
LIKELY FOUNDATION TYPE	Given the relatively low strength of the Aeolian Deposits reinforced widened strip footings could be adopted. Alternatively, the option of employing reinforced footings upon vibro-replacement stone columns could also be considered or otherwise piles, taken through into the underlying Chalk strata. Raft foundations may be suitable for small lightly loaded structures.
VOLUME CHANGE POTENTIAL	The Aeolian Deposits should be assumed to have a Medium volume change potential.
ESTIMATED FOUNDATION DEPTHS	A minimum foundation depth of 0.90m is considered appropriate for shallow foundations within the upper units of the Aeolian Deposits, increased where necessary for tree influence. Pile lengths to be determined by specialist piling contractor.
HEAVE PROTECTION	May be required for some plots near boundary trees.

SUMMARY REPORT - CONTAMINATION ISSUES

SUBJECT	COMMENTS
SOIL RISKS TO HUMAN HEALTH	No unacceptable contamination risks to human health have been identified by this investigation.
LANDFILL GAS	The gas monitoring completed to date has shown that landfill gas protection measures are not required. A further six visits are recommended to confirm this and to comply with current guidance.
RADON GAS	The site is located in an area where no radon protection measures are required in new dwellings.
RISKS TO THE WATER ENVIRONMENT	No unacceptable contamination risks to water resources have been identified by this investigation.
RISKS TO BUILDING MATERIALS AND SERVICES	No unacceptable contamination risks to building materials and services have been identified by this investigation.
REMEDIATION	No remedial works are considered necessary at this stage.
ASBESTOS	No asbestos has been detected in the soil samples tested.
WASTE SOIL DISPOSAL	The natural sub-soils at the site should be disposed of as inert waste.

SUMMARY REPORT - KEY RECOMMENDATIONS

RECOMMENDATIONS

It is recommended that a further six gas monitoring visits are undertaken to comply with current CIRIA C665 guidance. At least one of these visits should be undertaken during a period of falling atmospheric pressure.

Once the layout for this proposed development has been finalised it is recommended that additional site investigation works are undertaken in order to confirm the deeper ground conditions for pile design. It is suggested that these works should comprise 4No. cable percussive boreholes drilled to a minimum depth of 15m. Monitoring wells should be included in the boreholes and at least one post work monitoring visit should be undertaken to record groundwater levels. In-situ Standard Penetration Tests should be conducted during forwarding of the boreholes and collected soil samples submitted for appropriate geotechnical laboratory testing.

The invasive plant Japanese Knotweed has been identified in access track way to the site. It is a criminal offence to cause the plant to grow in new areas and it spreads easily through fragments of its rhizome (root like structure) being deposited in new areas. With its location on the access track, the plant could be easily spread to new areas through vehicles or foot traffic passing through the affected area. This appears to have been occurring already. It is recommended that an inspection of the extent of the infestation is undertaken by a suitably experienced consultant, such as BRD, at the start of the growing season in April 2016. A knotweed management plan should then be developed in accordance with Environment Agency guidance.

1. INTRODUCTION TO TECHNICAL REPORT

1.1. CONTRACT DETAILS

CLIENT	Gleeson Developments Ltd trading as Gleeson Developments.
SITE	Land situated to the south of Burndell Road in the village of Yapton, Sussex.
CLIENT'S ADVISORS	BRD Environmental Limited (BRD) has been commissioned directly by the Client.
REPORT CONTEXT	It is understood that the Client intends to purchase the site and develop it for residential housing.
REPORT TYPE	Geo-environmental site investigation (i.e. combined geotechnical ground investigation and Phase 2 contamination assessment).
REPORT OBJECTIVES	The site has been the subject of a desk study referenced as follows: • 'Phase 1 Environmental Desk Study – Burndell Road, Yapton', BRD Environmental Ltd, report ref. BRD2484-OR1-A, dated November 2015. The purpose of the report is to undertake a contamination and geotechnical assessment to support a future planning application at the site.

1.2. SCOPE OF WORKS

The agreed scope of works was:

- Mobilisation to site and production of health and safety documentation.
- One day of windowless sampling using a percussive drilling rig to provide approximately 5-6No. boreholes to a nominal depth of 3m-5m, ground conditions permitting. Undertake Standard Penetration Tests (SPT) at 1m intervals.
- Installation of a 5m depth combined gas and groundwater monitoring well (nominal 50mm diameter) into 4No. boreholes. Installations will be finished with a flush fitting metal stopcock cover.
- One day of trial pitting using a mechanical excavator to provide approximately 8-9No. trial pits to a nominal depth of 3m, ground conditions permitting.
- Undertake a soakage test in 3-4No. of the trial pits, ground conditions permitting, in general accordance with BRE Digest 365. Water will be supplied by tanker and the budget and time constraints allow for one filling of each point, although repeat tests will be undertaken if rapid infiltration is observed. A Geo-Environmental Technician will attend site in order to monitor the soakage tests.
- All exploratory points will be logged and sampled in general accordance with BS5930:1999+A2:2010 and CIRIA C574 "Engineering in Chalk" by supervising Geo-Environmental Consultant.

- In-situ geotechnical testing of any fine soils using a Hand Shear Vane and/ or Pocket Penetrometer.
- Determination of the location of exploratory points by tape measurements or the use of a handheld recreational GPS unit.
- Geo-Environmental Technician to undertake one return groundwater monitoring visit to determine resting groundwater levels.
- Geo-Environmental Technician to undertake a total of 3No. combined gas and groundwater monitoring visits. For gas, the determination of oxygen, carbon dioxide, methane, hydrogen sulphide and carbon monoxide concentrations, together with atmospheric pressure and flow rates, using portable equipment. For groundwater, the determination of groundwater levels.
- Chemical testing of soil samples with the budget based on the following testing schedule:
 - 8No. Metals Suite - As, Cd, Cr, CrVI, Hg, Pb, Se, Cu, Ni and Zn.
 - 8No. Inorganics Suite –water soluble sulphate, pH, organic matter.
 - 8No. Speciated Polycyclic Aromatic Hydrocarbons (PAH).
 - 5No. Banded aliphatic/ aromatic Total Petroleum Hydrocarbons (TPH).
 - 5No. Benzene, Toluene, Ethylbenzene, Xylene (BTEX) and Methyl Tertiary Butyl Ether (MTBE) compounds.
 - 2No. Semi-Volatile Organic Compounds (SVOC) suite.
- Geotechnical testing as appropriate to the nature of the ground conditions encountered, but the budget is based on the following testing schedule:
 - 6No. Moisture content.
 - 6No. Plasticity indices.
 - 3No. Particle size distribution by wet sieve and follow on hydrometer.
 - 8No. pH and water soluble sulphate analysis.
 - 4No. Total sulphate and sulphur analysis.
- Provision of a combined factual and interpretative investigation report. Factual findings to include all exploratory point records, monitoring and test results. Interpretative reporting to include a summary of information from desk study research, a Generic Quantitative Contamination Risk Assessment (GQRA), waste classification and a Geotechnical Assessment providing comments on pavement design, concrete classification, soakaway feasibility, foundation design recommendations. Report to be supplied in an electronic Adobe pdf format and forwarded on CD-ROM.

1.3. REPORT LIMITATIONS

Any site boundary lines depicted on plans included within this report are approximate only and do not imply legal ownership of land. Any observations of tree species, asbestos containing materials within structures or invasive weeds, such as Japanese Knotweed, does not constitute a formal survey of such features. The identification of such features is therefore tentative only. The report does not consider whether sensitive ecology or archaeology is present as these require consideration by professionals specialising in these matters. It should be recognised that the collection of desk study information may not be exhaustive and that other information pertinent to the site may be available.

The recommendations, interpretations and conclusions of this report are based solely on the ground conditions found at the exploratory holes. Due to the variability in the nature of ground, conditions between exploratory holes can only be interpreted and not defined. The description of the site and the ground conditions is accurate only for the dates of the field works. In particular, groundwater levels can vary due to seasonal and other effects.

The assessment and interpretation of contamination risks is based on the scope of works agreed with the Client together with the budgetary and programme constraints imposed. Further investigation, analysis and assessment of contamination may be required by regulators or other third parties with an interest in the site. An ecological risk assessment of contaminated soils is beyond the scope of this report. This report is concerned with assessing those contamination risks which apply to the future use of the site through the proposed development as part of the planning regime. The assessment does not consider the risk to current site users or continued future use of the site in its current state. If development of the site should occur that differs from that proposed, then the findings of the contamination assessment would need to be re-evaluated.

At the time of writing, detailed information on the proposed structure, such as detailed layout, loadings and serviceability limits, was not available. Accordingly, where geotechnical design advice is provided it is on the prescriptive basis allowed for by Eurocode 7: employing conventional and conservative design rules. The scope of this investigation excludes a formal slope stability study and any observations made regarding slopes are for information only.

2. SITE CHARACTERISTICS

2.1. SITE SETTING

SITE ADDRESS AND POST CODE	Land south of Burndell Road, Yapton, Arundel, West Sussex, BN18 0HP.
NATIONAL GRID REFERENCE	The site is approximately centred on 498310E, 102840N.

2.2. SITE SUMMARY

SUBJECT	COMMENTS
CURRENT SITE DESCRIPTION	The site is currently a recently cropped corn field with mixed hedgerows along the site boundaries. Vehicular access into the site is from a track off Burndell Road.
SURROUNDING LAND USE	The site is set in the southern fringes of a residential semi-rural area.
PROPOSED DEVELOPMENT	It is proposed that the site will be developed as a residential housing estate with associated private garden areas and new access roads. At the time of writing, no proposed layout was available.
HISTORICAL SUMMARY	The site has remained undeveloped throughout its history. From the earliest available map of 1876 up until 1975, the site was part of a large agricultural field. From 1975 the larger field had been divided and the site existed as its current layout.
PUBLISHED GEOLOGY	The site is shown to be underlain by superficial deposits comprising sandy, clayey silts of the Aeolian Deposits. The shallowest bedrock unit is shown to be the Upper Chalk Formation.
RADON	In an area where no radon protection measures are required in new dwellings.
HYDROGEOLOGY	The site is situated upon superficial deposits designated a Secondary A Aquifer. The underlying bedrock geology is designated a Principal Aquifer. The site is not located within a groundwater Source Protection Zone.
HYDROLOGY	The closest water feature to the site is a drainage ditch along the southern boundary. The site is not in an area indicated to be at risk of flooding.

2.3. PREVIOUS INVESTIGATIONS

BRD is unaware of any previous ground investigations having been conducted at the site. However, the site has been the subject of geo-environmental desk study research by BRD and this has been reported separately in "Phase 1 Geo-Environmental Desk Study – Burndell Road, Yapton", BRD Environmental Ltd, ref. BRD2484-OR1-A, dated November 2015. This current report should be read in conjunction with the previous desk study report.

2.4. PRELIMINARY ASSESSMENTS

PRELIMINARY CONTAMINATION RISK ASSESSMENT

The vast majority of the site is unlikely to be significantly contaminated, although there is the potential for pesticide residues to be present within the near surfaces soils across the site. This potential contamination may be a cause for concern to human health and the water environment.

PRELIMINARY GEOTECHNICAL ASSESSMENT

The anticipated near surface geology underlying the site of Aeolian Deposits, may potentially comprise low strength soils, thereby making the stratum unlikely to be suitable for the adoption of standard trench fill/strip footings. Wider, reinforced strip footings could be employed to spread loads over a wider area, or ground improvement may be required. Alternatively a piled foundation solution could be considered.

Depending on the composition of the superficial deposits i.e. should clayey or silty soils be encountered at a shallow depth, the trees and hedges along the site boundaries may have an impact on the soils, and foundations in close proximity to existing or proposed trees, may require deepening.

Soakaways may be viable at the site, depending on whether granular deposits are encountered within the superficial Aeolian Deposits. If the Chalk bedrock is relatively shallow and/or fractured, deeper borehole style soakaways are may be feasible.

3. GROUND INVESTIGATION

3.1. INVESTIGATION DESIGN

METHODOLOGY	A combination of trial pits and windowless sample boreholes were selected for the site. Trial pits expose more soils, which enables a more reliable record to be made of the ground conditions encountered. In addition, soakage tests were required in some of the trial pits. Windowless sample boreholes were selected as monitoring installations were required, along with in-situ density tests.	
DATES OF SITE WORKS	The main field works were undertaken on 5th and 6th November 2015. A groundwater level monitoring visit was undertaken on 12th November 2015. Gas and groundwater monitoring visits were undertaken on 27th November, 3rd December and 10th December 2015.	
CONSTRAINTS TO EXPLORATORY HOLE LAYOUT	Overhead electricity lines were located along the western boundary of the site. No trial pits or windowless sample boreholes were located within 10m of the lines.	
EXPLORATORY HOLE SPACING	Approximately 40m – 60m grid.	
LAYOUT RATIONALE	SOURCE / FEATURE	EXPLORATORY HOLE
CONTAMINATION SOURCES TARGETED	General site coverage.	TP01 – TP09 and WS01 - WS09.
GROUND FEATURES TARGETED	Access track.	TRL01 – TRL03.
	General site coverage.	TP01 – TP09 and WS01 - WS09.
CONTAMINATION SAMPLING PLAN	Based on the proposed end use, the sampling and analysis plan is more positively biased towards near surface samples as these represent the soils most likely to be available to future site users.	
ANALYSIS PLAN	Given the site's history as an agricultural field, and based on the potential contaminants identified within the Hazard Identification section of the Phase 1 contamination assessment, BRD has scheduled a suite of typically occurring contaminants.	

3.2. BRD FIELDWORK

TRIAL PITS	
REFERENCES	TP01 to TP09.
DEPTH RANGE	From 2.10m to 3.30m.
EXCAVATOR	JCB 3CX style wheeled backactor.
SOAKAGE	Soakage was undertaken in TP01 and TP02.
BACKFILL	All the trial pits were backfilled with arisings upon completion and compacted with rams of the excavator bucket.

WINDOWLESS SAMPLING BOREHOLES	
REFERENCES	WS01 to WS05.
DEPTH RANGE	From 4.45m to 5.45m.
RIG TYPE	Premier Drilling Rig.
INSTALLATION / BACKFILL	Borehole WS03 was backfilled with arisings only. Boreholes WS01, WS02, WS04 and WS05 had monitoring wells installed. These comprised 50mm nominal diameter standpipes fitted with a plain cap finished with a flush metal cover. The slotted response length of the well is shown on the individual logs. Bentonite seals are also indicated on the logs. The filter medium used was pea gravel.

TRL DYNAMIC CONE PENETROMETER	
REFERENCES	TRL01 – TRL03.
DEPTH RANGE	1.00m.
METHODOLOGY	TRL DCP.

MONITORING	
TYPE	Ground gases. Groundwater level monitoring.
DATES	12 th November (Groundwater level only), 27 th November, 3 rd December and 10 th December 2015.
GROUNDWATER SAMPLING METHOD	No groundwater samples were obtained during the monitoring visit.

3.3. LABORATORY TESTING

GEOTECHNICAL TESTING	
The soil samples for geotechnical testing were forwarded to the laboratory of Soil Property Testing Ltd with pH and sulphate analysis undertaken at the laboratory of QTS Environmental Ltd. The geotechnical testing suite is detailed below. The UKAS accreditation of the individual test methods is shown on the laboratory test report included in the Appendices.	
TEST	NUMBER OF SAMPLES TESTED
Moisture content	6
Liquid and plastic limits	6
Particle size distribution by wet sieve and hydrometer	3
pH and Water soluble Sulphate	16
Total Sulphur and Sulphate	4

SOIL CHEMICAL TESTING	
The soil samples for contamination and/or chemical geotechnical testing were forwarded to the laboratory of QTS Environmental Ltd and the testing suite is detailed below. The UKAS or MCERTS accreditation of the individual test methods is shown on the laboratory test report included in the Appendices.	
SOIL TESTS	NUMBER OF SAMPLES TESTED
Arsenic, Cadmium, Chromium, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Zinc	8
Speciated Polycyclic Aromatic Hydrocarbons (PAH)	8
Total Petroleum Hydrocarbons (TPH) with full carbon banding and aliphatic/ aromatic split	3
Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) plus Methyl Tert Butyl Ether (MTBE)	3
Organic Matter	8
Semi-Volatile Organic Compounds (SVOCs)	2
Pesticides	1

4. GROUND CONDITIONS

4.1. OVERVIEW

The ground conditions encountered were as anticipated from published geological maps and BRD's knowledge of the area, with sandy, gravelly clays of the superficial Aeolian Deposits encountered overlying the Upper Chalk Formation.

Details of the various stratigraphic units are given in the following sections.

4.2. ARTIFICIAL GROUND

SURFACE HARDSTANDING, BURIED STRUCTURES AND BURIED SERVICES	Not encountered in exploratory points.
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Made Ground was not encountered in any of the exploratory holes.

4.3. TOPSOIL AND MADE GROUND TOPSOIL

TOPSOIL AND MADE GROUND TOPSOIL			
LOCATION	Ste wide.		
DEPTH TO BASE	0.30m to 0.40m	THICKNESS	0.30m to 0.40m
DESCRIPTION	Crop stubble over: soft to firm, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded, flint and occasional clinker.		
COMMENTS	GEOTECHNICAL	Nothing significant noted.	
	CONTAMINATION	Other than the presence of occasional clinker fragments, there was no further visual or olfactory evidence of contamination.	
	GROUNDWATER	Groundwater was not observed in this stratum.	

4.4. SUPERFICIAL DEPOSITS

AEOLIAN DEPOSITS			
LOCATION		Ste wide.	
DEPTH TO BASE		Between 4.05m and 4.95m	THICKNESS Between 3.70m and 4.60m
DESCRIPTION	The superficial deposits were noted to be variable in composition across the site, with changes observed over short distances. These deposits predominantly comprised clay or silty soils with variable quantities of sand and gravel.		
COMMENTS	GEOTECHNICAL	Nothing significant noted.	
	CONTAMINATION	No visual or olfactory evidence of contamination.	
	GROUNDWATER	Groundwater was observed in this stratum in the boreholes as moist soils, and in TP07 and TP08 as seepages at the base of the pits.	

4.5. BEDROCK

UPPER CHALK FORMATION (UNDIFFERENTIATED)			
LOCATION		Ste wide (only encountered in WS01, WS02, WS04 and WS05)	
DEPTH TO BASE		>5.45m	THICKNESS >1.35m
DESCRIPTION	The top of the Upper Chalk Formation was only encountered within the windowless sample boreholes. Due to the drilling process, the chalk was described as 'firm, becoming stiff, moist, gravelly clay. Gravel of fine to coarse, angular to rounded flint and chalk'.		
COMMENTS	GEOTECHNICAL	Nothing significant noted.	
	CONTAMINATION	No visual or olfactory evidence of contamination.	
	GROUNDWATER	Groundwater strikes were not observed in this stratum, although the soils were noted to be moist.	

4.6. GROUNDWATER MONITORING

DATE	RESTING GROUNDWATER RANGE	COMMENTS
12/ 11/ 15	From 2.47m to 3.39m bgl.	The shallowest groundwater was recorded in the south western corner of the site (WS02), while the deepest groundwater was recorded in the north eastern corner (WS04).
27/ 11/ 15	From 1.64m to 2.87m bgl.	The groundwater levels within all boreholes had risen since the first groundwater visit. The levels had risen by approximately 0.50m in WS01, WS04 and WS05 and by 0.83m in WS02.
03/ 12/ 15	From 1.90m to 2.90m bgl.	The groundwater levels remained consistent in all but WS02, where the levels dropped by 0.26m.
09/ 12/ 15	From 1.84m to 2.84m bgl.	The shallowest groundwater was always recorded in WS02 and the deepest groundwater always in WS04. The groundwater levels remained fairly consistent within all boreholes since the previous visit.

5. GEOTECHNICAL PROPERTIES

5.1. DYNAMIC PROBING

Three CBR tests (CBR01 to CBR03), using TRL DCP apparatus, were undertaken, to 1.00m depth, along the existing access track to target areas of proposed roads and hardstanding. The results provide an indication of approximate CBR values for the Aeolian Deposits, which ranged between 4.5% and >25%

The locations of the CBR tests are shown on the Exploratory Hole Location Plan, which along with the results are included in the Appendices.

5.2. SOIL PARAMETERS

5.2.1. Particle Size Distribution

Three Particle Size Distribution determinations were undertaken on samples of the Aeolian Deposits between 0.80m and 2.10m depth. Within the samples the results returned indicate that this stratum generally comprises 19% to 23% Clay, 46% to 67% Silt, 10% to 30% Sand and 1% Gravel. The results show that this material can be classed as well graded clayey silt with variable quantities of sand and gravel.

5.2.2. Index Property Testing

SOIL TYPE	Aeolian Deposits
PLASTICITY INDEX (PI)	19% to 26% (four results).
MODIFIED PI	8% and 19% (two results).
NHBC CLASS	Non shrinkable soil type / Low to Medium volume change potential.

5.2.3. Undrained Shear Strength

5.2.3.1. *Hand Shear Vane*

SOIL TYPE	Aeolian Deposits
CORRECTION FACTOR μ	None.
JUSTIFICATION	By comparison with and interpretation from laboratory triaxial tests.
DISCUSSION OF CORRECTED RESULTS	Hand shear vane tests undertaken within the Aeolian Deposits at between 0.90m and 2.70m depth. The results returned ranged between 19 kN/m ² and 74 kN/m ² indicating a soft to firm fine soil consistency, which corresponds to a soil strength of low to medium. This generally agrees with what was encountered within the hand specimens.

5.2.3.2. Hand Penetrometer

SOIL TYPE	Aeolian Deposits
DISCUSSION OF CORRECTED RESULTS	The results of hand penetrometer results undertaken within these deposits, between 0.30m and 3.95m depth, returned values of 0.50 kg/ cm ² to 4.75 kg/ cm ² , indicative a soft to very stiff fine soil consistency and a soil strength of low to very high. This generally agrees with what was encountered within the hand specimens.

5.2.3.3. Standard Penetration Test Correlations

In-situ Standard Penetration Tests (SPTs) were undertaken in all the window sample boreholes, at roughly 1.00m intervals, between 1.00m and 4.00m depth. The SPTs undertaken, between 1.00m and 3.00m depth, returned a range of N values between 4 and 15, which indicates a fine soil consistency of soft to firm. Below 4.00m depth N values in excess of 50 were recorded, indicating very stiff clay soils.

All SPT N values undertaken within the Upper Chalk Formation, at 4.00m and 5.00m depth, were in excess of 50.

5.3. WATER SOLUBLE SULPHATE AND PH

	ALL ON-SITE SOILS			
	Sulphate		pH	
Characteristic Value	100 mg/ l		6.6 units	
Justification	Mean of highest 20% results rounded to nearest 100mg/ l.		Mean of lowest 20% results.	
	No. of tests	Results Range	No. of tests	Results Range
Soil	16	<10 mg/ l to 140 mg/ l	16	6.3 to 8.7 units
Groundwater	No samples tested.		No samples tested.	
Total Potential Sulphate	4	Pyrite geologically unlikely and not indicated in samples tested.		

6. GEOTECHNICAL ASSESSMENT

6.1. INTRODUCTION

The following advice and recommendations are based on the construction of two-storey houses. The proposed development layout has yet to be finalised and no layout was available at the start of this project. From assessment of the nature of the ground conditions and the type of proposed structures, it is considered that the situation falls within EC7 Geotechnical Category 1.

Should the nature of the development be changed then the results of this investigation would need to be reviewed and reassessed.

6.2. EXCAVATIONS

STABILITY	It is anticipated that all Topsoil / Made Ground Topsoil will be stripped and stockpiled prior to development commencing. It is anticipated that narrow trench excavations will remain relatively stable and open for short periods, but minor spalling of side walls could still occur. Any excavation requiring man entry should be battered back to a safe angle, supported by an appropriate proprietary trench support system or adequately shored to provide safe working conditions. Shoring to any excavation requiring man entry must be designed by a suitably qualified and experienced engineer. Any support system will require regular inspection as detailed in published guidelines to ensure the excavation support is adequate and appropriate for the ground conditions present. Two shallow groundwater seepages were encountered in trial pits during the investigation works and relatively shallow groundwater was encountered during follow-on monitoring rounds. Groundwater seepages and inclement weather can result in flooding through saturation of near surface soils leading to sidewall collapse. Consequently excavations should be suitably supported and consideration given to appropriate groundwater / surface water exclusion.
EQUIPMENT	It should be possible to progress excavations with conventional equipment.
GROUNDWATER CONTROL	Apart from two seepages, at approximately 3.00m depth, in TP07 and TP08, no groundwater was encountered during the investigation works. However, during post site works monitoring rounds groundwater was encountered, at between 1.64m and 3.39m depth, within the window sample installations. It is anticipated that groundwater control in the form of pumping from sumps formed in the base of excavations will be required. Any groundwater control system should be designed and operated to minimise the loss of fines from the soil matrix as this could adversely affect settlement.
PARTY WALL ISSUES	As there are no nearby third party structures, the Party Wall Act is unlikely to apply to the development.

6.3. SLOPE STABILITY

The site is relatively flat and no significant changes in level as part of the development are anticipated. It is therefore considered that slope stability is unlikely to be a concern at this site.

6.4. SUBSURFACE CONCRETE

ALL ON-SITE SOILS	
SITE / SOIL CATEGORY	Natural ground.
DESIGN SULPHATE CLASS	DS-1
GROUNDWATER REGIME	Mobile.
AGGRESSIVE CHEMICAL ENVIRONMENT FOR CONCRETE (ACEC) CLASS	AC-1
COMMENTS	

6.5. SOAKAWAYS

6.5.1. Soil Infiltration Rate

The records of the soakage tests are presented in the Appendices that includes the calculation of the soil infiltration rate. A summary of results are presented in the table below:

TRIAL PIT	SOIL INFILTRATION RATE		STRATUM TESTED
TP01	Test 1	Permeability too low to calculate soil infiltration rate.	Aeolian Deposits.
TP02	Test 1	2.54 x 10 ⁻⁶ m/s Result extrapolated and so guide only.	Aeolian Deposits.

6.5.2. Soakaway Design Advice

The drainage requirements for the proposed development have not been provided. The results of soakage tests undertaken within the Aeolian Deposits show that this stratum has low permeability and therefore poor infiltration, which would be expected given its cohesive nature.

The deeper Upper Chalk bedrock would offer greater permeability. However, groundwater is associated with this stratum and therefore deep soakaways will not be permitted by the Environment Agency as direct discharge to groundwater is not allowed.

Consequently the disposal of collected surface water to conventional soakaways are not considered particularly feasible at this site. It is anticipated that any drainage associated with the proposed development will need to feed into the existing local drainage network situated beneath Burndell Road.

6.6. PAVEMENT CONSTRUCTION

Given the ground conditions encountered it is anticipated that pavement construction will sit on the fine soils of the Aeolian Deposits. Given the plasticity of these deposits, between 19% and 26% a preliminary design California Bearing Ratio (CBR) of 3% is recommended. These deposits will be prone to rapid degradation during wet weather working and this should be avoided where possible.

All unsuitable soils, such as topsoil or desiccated soils, should be removed from beneath proposed paved areas. The exposed sub-grade formation should then be proof rolled to reveal any excessively soft or compressible zones and any such features identified also removed by excavation. Where unsuitable materials are removed, the resultant voids should be filled in layers with appropriately compacted suitable granular fill. To reduce the loss of granular construction materials into the sub-grade, consideration should be given to utilising a geotextile starter layer across the formation level.

6.7. PRELIMINARY FOUNDATION RECOMMENDATIONS

6.7.1. Introduction

The details for the proposed development are yet to be decided.

The ground conditions encountered during the investigation works included a thin covering of Topsoil / Made Ground Topsoil overlying predominantly clay and silt rich soils interpreted as Aeolian Deposits, to between 4.05m and 4.95m depth. Upper Chalk Formation (undifferentiated) was encountered underlying the Aeolian Deposits to the maximum depth of the investigation works at 5.45m.

Similar ground conditions have been encountered during previous investigation works undertaken within the local area. The low strength of the Aeolian Deposits encountered will limit the allowable bearing capacity available. This can be overcome through the adoption of either widened reinforced strip footings or, for small isolated and lightly loaded structures, raft foundations. Alternatively a deeper foundation solution such as ground improvement or piles could be adopted.

6.7.2. Floor Slabs

Given the presence of predominantly clay rich soils beneath the site it is recommended that fully suspended floor slabs designed and constructed in accordance with NHBC Standards are adopted at this development.

With reference to Sections 2.2 and 8.0, the floor construction will not have to incorporate radon protection measures and is unlikely to have to incorporate gas protection measures.

6.7.3. Spread Footings

Given the soft to firm nature of near surface Aeolian Deposits the site is considered suitable for the adoption of reinforced widened strip footings within these deposits. A presumed bearing value of 80 kN/m² is considered appropriate for foundations up to 1m wide and immediate and long term settlement should be within tolerable limits and take place over several years.

The clay rich soils of the Aeolian Deposits has been shown to have a varied volume change potential when assessed against NHBC standards. A worst case medium volume change potential should be assumed and a minimum foundation depth of 0.90m is required, deepened to 1.25m to allow for restricted new tree planting. Under the NHBC Standards, foundation depths have to be increased if they are within the influence zone of felled trees, existing trees or proposed tree planting. It should be noted that where trees are in groups the resulting competition for resources can lead to deeper root systems than allowed for in the NHBC Standards. In any event, foundations should be taken below any roots encountered in foundation trench excavation. Where the required foundation depth varies around a structure, this can be accommodated by forming steps in the foundation as per NHBC Standards.

Trees and hedgerows are present around the site perimeter, but not on the site itself. It will be necessary to remove all unwanted trees, stumps and root structures prior to commencing with the development. Any resultant void should be backfilled accordingly with respect to the preferred foundation design.

During construction, any soft spots found at foundation formation level should be excavated and replaced with lean mix concrete. Foundation excavations should be kept dry and left open for the minimum amount of time possible. Where foundations cannot be completed immediately, a blinding layer of concrete should be placed.

6.7.4. Raft Foundations

For small isolated lightly loaded structures, such as detached domestic garages, consideration could be given to employing reinforced raft foundations bearing on the Aeolian Deposits.

6.7.5. Ground Improvement

It may be possible for the ground to be improved by the use of vibro-replacement stone or concrete columns. After ground improvement by such techniques, shallow reinforced strip footings could then be employed. Discussions with specialist contractors should be held to confirm that this technique is suitable for the ground conditions at the site.

Ground improvement techniques such as dynamic compaction, excavation and replacement with suitable engineered fill, and surcharging for to allow the use of shallow spread foundations are not generally accepted by construction warranty providers, e.g. NHBC, and are therefore not discussed.

6.7.6. Piling

The Aeolian Deposits were found to be of relatively low strength to around 3.00m depth. A pile solution would allow loads, from the proposed dwellings, to be transmitted to deeper more competent strata, i.e. the Upper Chalk Formation.

Due to the partially granular nature of the Aeolian Deposits, traditional bored piles may be difficult to construct unless they are cased through to the underlying Upper Chalk Formation. The need for casing could be avoided through the use of Continuous Flight Auger (CFA) piling techniques and this may be the best method to construct cast insitu piles. Alternatively driven pre-cast concrete piles would be a viable option.

For the purposes of pile design it is recommended that skin friction from the Aeolian Deposits is treated conservatively, and that the working load is primarily calculated from a combination of skin friction and end bearing within the underlying Upper Chalk Formation.

The existing trees around the site perimeter may cause soil heave. In the influence zone of trees, pile caps and ground beams will have to be separated from the soil by a suitable void former on the sides and in the case of ground beams, underneath. Piles will have to be designed to withstand the seasonal movements exerted by the remaining and proposed vegetation either by the use of suitable reinforcement or by the provision of sleeving through the swelling zone. Such precautions against heave should be designed and constructed in accordance with NHBC Standards.

It is recommended that consultation with a specialist piling contractor is undertaken in order to evaluate likely pile loads, diameter and depths based upon the ground conditions revealed within the context of the specified technical requirements of the chosen piling method. In any event, positive contractual assurances should be sought from the piling contractor in respect of the performance of their proprietary system.

6.8. RECOMMENDATIONS FOR FURTHER GEOTECHNICAL WORK

Once the layout for this proposed development has been finalised it is recommended that additional site investigation works are undertaken in order to confirm the deeper ground conditions for pile design. It is suggested that these works should comprise 4No. cable percussive boreholes drilled to a minimum depth of 15m. Monitoring wells should be included in the boreholes and at least one post work monitoring visit should be undertaken to record groundwater levels. In-situ Standard Penetration Tests should be conducted during forwarding of the boreholes and collected soil samples submitted for appropriate geotechnical laboratory testing.

7. RISK ESTIMATION - SOILS

7.1. HUMAN HEALTH

The Generic Assessment Criteria (GAC) employed below are for residential land use as this is appropriate to the proposed form of development.

CONTAMINANT	UNITS	NUMBER OF TESTS	MAXIMUM CONCENTRATION	GAC	NUMBER EXCEEDING GAC
Arsenic	mg/ kg	8	11	37	0
Cadmium	mg/ kg	8	< 0.2	22	0
Chromium (hexavalent)	mg/ kg	8	< 2	21	0
Chromium (total)	mg/ kg	8	30	910	0
Copper	mg/ kg	8	12	2,400	0
Lead	mg/ kg	8	18	200	0
Mercury	mg/ kg	8	< 1	11	0
Nickel	mg/ kg	8	20	180	0
Selenium	mg/ kg	8	< 3	250	0
Zinc	mg/ kg	8	52	3,700	0
pH	Units	16	6.3 – 8.7	<5-10>	0
Naphthalene	mg/ kg	8	< 0.1	2.3	0
Acenaphthylene	mg/ kg	8	< 0.1	170	0
Acenaphthene	mg/ kg	8	< 0.1	210	0
Fluorene	mg/ kg	8	< 0.1	170	0
Phenanthrene	mg/ kg	8	< 0.1	95	0
Anthracene	mg/ kg	8	< 0.1	2,400	0
Fluoranthene	mg/ kg	8	< 0.1	280	0
Pyrene	mg/ kg	8	< 0.1	620	0
Benzo(a)anthracene	mg/ kg	8	< 0.1	7.2	0
Chrysene	mg/ kg	8	< 0.1	15	0
Benzo(b)fluoranthene	mg/ kg	8	< 0.1	2.6	0
Benzo(k)fluoranthene	mg/ kg	8	< 0.1	77	0
Benzo(a)pyrene	mg/ kg	8	< 0.1	2.2	0
Indeno(1,2,3-cd)pyrene	mg/ kg	8	< 0.1	27	0
Dibenzo(a,h)anthracene	mg/ kg	8	< 0.1	0.24	0
Benzo(ghi)perylene	mg/ kg	8	< 0.1	320	0
TPH Aliphatic C5-C6	mg/ kg	3	< 0.01	42	0
TPH Aliphatic C6-C8	mg/ kg	3	< 0.05	100	0
TPH Aliphatic C8-C10	mg/ kg	3	< 2	27	0
TPH Aliphatic C10-C12	mg/ kg	3	< 2	130	0
TPH Aliphatic C12-C16	mg/ kg	3	< 3	1,100	0
TPH Aliphatic C16-C35	mg/ kg	3	< 10	65,000	0
TPH Aliphatic C35-C44	mg/ kg	3	< 10	65,000	0

CONTAMINANT	UNITS	NUMBER OF TESTS	MAXIMUM CONCENTRATION	GAC	NUMBER EXCEEDING GAC
TPH Aromatic C5-C7	mg/ kg	3	< 0.01	70	0
TPH Aromatic C7-C8	mg/ kg	3	< 0.05	130	0
TPH Aromatic C8-C10	mg/ kg	3	< 2	34	0
TPH Aromatic C10-C12	mg/ kg	3	< 2	74	0
TPH Aromatic C12-C16	mg/ kg	3	< 2	140	0
TPH Aromatic C16-C21	mg/ kg	3	< 3	260	0
TPH Aromatic C21-C35	mg/ kg	3	< 10	1,100	0
TPH Aromatic C35-C44	mg/ kg	3	< 10	1,100	0
Benzene	mg/ kg	3	< 0.002	0.87	0
Toluene	mg/ kg	3	< 0.005	130	0
Ethylbenzene	mg/ kg	3	< 0.002	47	0
Xylene (total of all types)	mg/ kg	3	< 0.002	56	0
Methyl Tert Butyl Ether (MTBE)	mg/ kg	3	< 0.005	49	0
Semi-Volatile Organic Compounds (SVOCs)	mg/ kg	2	< LOD	LOD*	0
Pesticides	mg/ kg	1	< LOD	LOD*	0

Notes: *Limit of detection: Given the large amount of compounds in this group, coupled with the lack of GAC for certain compounds, any concentrations above the limit of detection will be highlighted in the first instance.

RESULTS EXCEEDING HUMAN HEALTH ASSESSMENT CRITERIA

None of the samples record any contaminants at concentrations exceeding their respective assessment criteria.

7.2. WATER ENVIRONMENT

It is not appropriate to consider human health assessment criteria for human health in relation to the risk to the water environment, but currently there are no generic soil assessment criteria in respect of the water environment. In the absence of any groundwater sampling data, the soil results are assessed on the basis of professional judgement.

The contaminant concentrations recorded in the soils at the site are not considered to be at such levels that they would present any significant risk to the underlying water environment.

7.3. BUILDING MATERIALS

Contaminant	Units	Number of tests	Maximum Concentration	GAC	Number exceeding GAC
pH	units	16	6.3 – 8.7	<5.5	0
Sulphate (w/ s)	mg/ l	16	140	500	0
Sum of SVOC + Aliphatic TPH >C5-C10 + Aromatic TPH >C5-C10 above detection limits	mg/ kg	2	< LOD	2	0
Sum of Aliphatic TPH >C10-C21 + Aromatic TPH >C10-C21 above detection limits	mg/ kg	2	< LOD	10	0
Sum of Aliphatic TPH >C21-C34 + Aromatic TPH >C10-C35 above detection limits	mg/ kg	2	< LOD	500	0
Sum of BTEX + MTBE above detection limits	mg/ kg	2	< LOD	0.1	0
Phenols	mg/ kg	2	< 0.1	2	0
Cresols and chlorinated phenols	mg/ kg	2	< 0.1	2	0
Naphthalene	mg/ kg	8	< 0.1	0.5	0
Benzo(a)pyrene	mg/ kg	8	< 0.1	0.5	0

RESULTS EXCEEDING BUILDING MATERIALS ASSESSMENT CRITERIA

None of the samples record any contaminants at concentrations exceeding their respective assessment criteria.

8. RISK ESTIMATION – GROUND GAS

RESULTS SUMMARY			
Parameter	Minimum	Maximum	Comments
Methane	0.0%	0.1%	No significant concentrations recorded. The maximum concentration of methane recorded is within the tolerance limit of the gas detector employed.
Carbon Dioxide	0.0%	3.9%	The concentrations recorded may be as a result of the natural carbonate rich soils located at depth across the site.
Oxygen	9.1%	18.0%	The oxygen levels were typically depleted as carbon dioxide concentrations increased.
Hydrogen Sulphide	0 ppm	0 ppm	No concentrations recorded.
Carbon Monoxide	0 ppm	2 ppm	Background concentrations recorded.
Atmospheric pressure	1010mB	1028mB	All monitoring visits were undertaken when the atmospheric pressure was above 1000mB. The third visit followed a falling atmospheric pressure trend.
Groundwater levels	1.64m	3.39m	The shallowest groundwater levels were always recorded in the south western corner of the site (WS02) and the deepest groundwater levels were always recorded in the north eastern corner (WS04).
Flow rate	0.0 l/ hr	0.1l/ hr	No significant flow rates detected.

GAS GENERATION POTENTIAL OF SOURCE		
GAS SOURCE	GENERATION POTENTIAL	COMMENTS
Infilled brick pit to north.	Low	The brick pit is likely to have been infilled with unknown materials during the late 1930's to enable development of residential housing. Given the time elapsed since the anticipated filling of the pit, any decomposable matter is highly unlikely to still be decomposing and producing landfill gases. In addition, the brick pit is located some 150m from the developable area of the site. It is considered that the generation potential is low.
Carbonate Deposits (e.g. Chalk, Limestone)	Low	CIRIA 152 provides a risk ranking of gas sources with natural soils with a low organic content deemed to pose the lowest risk in terms of gas generation. CIRIA 152 placed the presence of carbonate deposits (e.g Chalk) relatively high in terms of gas generation risk order. However, Wilson and Card argued that such soils should be reclassified as low gas generation potential on the basis that thousands of homes have been built on such soils without any protection measures and without any recorded build up of Carbon Dioxide within these homes. This reclassification has been accepted by other authors.

Sensitivity of development	High (Residential with gardens)	
	Idealised	Actual
Monitoring period	6 months	2 months
Total number of visits	9 visits	3 visits
Number of visits during falling pressure trends	At least two visits	One visit
Comment	Three gas visits have been completed which is sufficient for a preliminary characterisation of the gas regime at the site. A further 6No. monitoring visits are recommended to comply with CIRIA C665. As only one of the monitoring visits was undertaken during a period of falling atmospheric pressure then at least one of the further monitoring visits is recommended during such times to increase confidence in the results obtained to date.	

GAS REGIME CHARACTERISATION			
Radon protection measures required?	No.	Vapour protection measures required?	No.
	Characteristic Gas Concentration (fraction)	Characteristic Gas Flow Rate (l/ hr)	Gas Screening Value (l/ hr)
Methane	0.001	0.1	0.0001
Carbon Dioxide	0.039	0.1	0.0039
Methodology	Situation A – All development types except low rise housing with gardens.		Situation B – Low rise housing with gardens – NHBC ‘Traffic Lights’.
Gas Regime	Characteristic situation 1 – Very low risk.		Green.
Gas Protection Measures	Subject to the results of recommended further monitoring: Negligible gas regime identified and no special precautions required.		Subject to the results of recommended further monitoring: Negligible gas regime identified and gas protection measures are not considered necessary.

9. RISK EVALUATION

9.1. REVISED CONCEPTUAL MODEL

The revised conceptual site model plan is presented in the Appendices.

ADDITIONAL POLLUTANT LINKAGES	During the ground investigation, no additional sources of contamination were identified.
INVALID POLLUTANT LINKAGES	No pesticide residues were recorded within the near surface soils across the site, therefore there are considered to be negligible risks to future residents or the groundwater environment from pesticides. No landfill gases were recorded at concentrations such that they would pose a risk to human health, as such the off-site brick pit is not considered a valid pollutant linkage.
LIMITATIONS AND UNCERTAINTIES	Due to the overhead electricity cables along the western boundary of the site, and the presence of Japanese Knotweed along the access track, no trial pits or boreholes were located along the access track. However, all of the potential contamination sources have been targeted by the exploratory holes and therefore it is considered that a sufficient number of exploratory points have been completed for contamination assessment purposes. The current level of gas monitoring is sufficient to make a preliminary assessment of the risk, but further monitoring is required.

9.2. UPDATED CONTAMINATION RISK ASSESSMENT

The pollutant linkages identified in the revised conceptual site model will now be evaluated as to their severity.

SOURCES AND CONTAMINANTS	PATHWAYS (REFERENCE FROM MODEL)	RECEPTORS	POTENTIAL RISK
Agricultural field -Pesticide residues	Direct contact Ingestion Consumption of home grown produce	Residents	Negligible risk
	Horizontal & vertical migration	Groundwater	Negligible risk
Off-site infilled brick pit – unknown infill materials some 50m north of the site. -Landfill gases (mainly carbon dioxide and methane).	Inhalation of landfill gases	Residents	Negligible risk

The contamination risks that are presented to the various receptor groups are discussed further in the following sections:

RISK TO HUMAN HEALTH

No significant contamination risks to human health have been identified.

RISK TO WATER ENVIRONMENT

No significant contamination risks have been identified to the water environment.

RISK TO BUILDING MATERIALS AND SERVICES

No significant contamination risks have been identified to building materials and services.

9.3. RISK MANAGEMENT

GENERAL	Following the site investigation and subsequent chemical testing, the site has been shown to be uncontaminated. No contamination risks to human health, the water environment or building materials and services have been identified. It is recommended that this report is submitted to the planning department of the Local Authority and the organisation undertaking the Building Control function, to confirm that the investigation completed to date is satisfactory.
FURTHER INVESTIGATION	It is recommended that a further six gas monitoring visits are undertaken to comply with current CIRIA C665 guidance. At least one of these visits should be undertaken during a period of falling atmospheric pressure.
OUTLINE REMEDIATION SOLUTION	Due to the absence of contamination risks, no remediation is considered necessary.
CONSTRUCTION CONSIDERATIONS	Although no contamination has been identified, as with any construction site, if any anomalous material is encountered during the redevelopment then expert environmental advice should be sought. The invasive plant Japanese Knotweed has been identified in access track way to the site. It is a criminal offence to cause the plant to grow in new areas and it spreads easily through fragments of its rhizome (root like structure) being deposited in new areas. With its location on the access track, the plant could be easily spread to new areas through vehicles or foot traffic passing through the affected area. This appears to have been occurring already. It is recommended that an inspection of the extent of the infestation is undertaken by a suitably experienced consultant, such as BRD, at the start of the growing season in April 2016. A knotweed management plan should then be developed in accordance with Environment Agency guidance.

**WASTE SOILS
CLASSIFICATION**

Topsoil should be viewed as a resource rather than a waste and as it is suitable for residential garden use, the topsoil at the site should be stripped and the surplus reused on other developments. It should be noted that topsoil, even if uncontaminated, is unlikely to constitute 'inert waste' due to its high organic matter content.

It is considered that the natural sub-soils disposed of from the site would be classified as 'inert waste'. However, the chemical results should be forwarded to the proposed landfill site and the waste classification confirmed prior to disposing of any surplus soils. Waste Acceptance Criteria (WAC) testing of the soils will also be required where the soil is to be disposed of at an landfill permitted to accept inert waste. The waste code from the European Waste Catalogue (EWC) 2002 for the soils would be 17 05 04 'Soil and Stones, not containing dangerous substances'.

REPORT SPECIFIC REFERENCES

- British Geological Survey sheet 317/ 332 “Chichester and Bognor” Solid and Drift edition (1:50,000) published 1996.
- ‘Phase 1 Environmental Desk Study – Burndell Road, Yapton’, BRD Environmental Ltd, report ref. BRD2484-OR1-A, dated November 2015.

SUPPORTING INFORMATION

GROUND INVESTIGATION

Exploratory holes are logged by an experienced Geo-Environmental Consultant in general accordance with 'Code of practice for site investigations' BS5930:1999 +A2:2010, BSi, August 2010. Soil samples for chemical and geotechnical analysis are taken from the exploratory holes at intervals dictated by the nature of the soils and the objectives of the investigation.

Where stated on the logs of inspection pits, trial pits or boreholes (where insitu testing has not been undertaken), the relative density of coarse (sand and gravel) soils is tentative only. Such assessments of density are on the basis of visual inspection only taking into consideration such factors as drilling rates, stability of pit side walls, appearance and behaviour under excavation.

Where Chalk strata is encountered it is logged and graded in general accordance with CIRIA guidance 'C574 - Engineering in Chalk'. It should be recognised that where percussive drilling methods are employed, the structure of the Chalk is destroyed and therefore the grading stated on such logs is either tentative or absent where it is not possible to assess the grade.

Hand Dug Inspection Pits

Hand tools are used to forward shallow inspection pits as a cost effective method of describing and sampling near surface soils. The technique is also used where exposure of existing footings is required. The depth reached by such techniques is a function of the nature of the ground and generally does not exceed 1.5m

Trial Pits

Mechanically excavated trial pits allow detailed inspection of near surface ground due to the large volume of soil exposed. A wheeled backhoe loader is the usual machine for digging trial pits that are typically 3 to 4.5m deep, 0.5m wide and 3m long.

Windowless Sampling Boreholes

This type of borehole is formed by a small tracked dynamic percussion drilling rig with samples retrieved in thin plastic liners within the narrow diameter steel sampling tubes. Borehole depths of up to 5m are typical, but in exceptional circumstances up to 15m depth can be achieved. This is the smallest type of rig that is capable of undertaking Standard Penetration Tests (SPTs).

Hand Held Window Sampling

Hand held window sampling is a useful method of drilling narrow diameter boreholes particularly where access is difficult. Hand held mechanical percussive hammers are used to drive the sampling tube into the ground. The soil samples are collected within the hollow metal sampling tubes and inspected via the open window along one side. Window sampling boreholes can be forwarded to depths of 3m to 6m depending upon ground conditions.

Cable Percussive Boreholes

This form of drilling involves repetitive dropping of a tube into the soil under its own weight from a tripod support. The sample is obtained from the clay cutter head in fine soils or a bailer for wet granular soils. As the borehole progresses SPTs can be undertaken and relatively undisturbed samples can be obtained. Typically these boreholes are 15 to 25m

deep, but depths of double that can be achieved in soils, but only thin weak rock layers can be penetrated.

Rotary Boreholes

Where competent rock is required to be drilled then rotary drilling techniques are required. The drilling rigs can vary in size from small tracked units to larger units mounted on four wheel drive trucks. Rotary open hole drilling techniques break the rock into small fragments and so recovery of any samples is limited. In contrast, rotary coring retrieves excellent samples. Some rigs also allow windowless sampling to be undertaken through soil layers. There are no practical limits to the depths that this drilling method can achieve.

Dynamic Probing

Dynamic probing comprises a sectional rod with a sacrificial cone at the base of slightly larger diameter than the rod. The rod is driven into the ground by a constant mass falling through a set distance. The number of blows required to forward the rod per 100mm is then recorded and presented in a graph of N_{10} values. The standard applicable to dynamic probing is "BS EN ISO 22476-2:2005 Incorporating corrigendum no. 1, Geotechnical investigation and testing – Field testing – Part 2: Dynamic probing" BSi, February 2007.

Dynamic Penetrometer

The Transport Research Laboratory Dynamic Cone Penetrometer (TRL DCP) uses an 8 kg hammer dropping through a height of 575mm to drive a 60° cone of 20mm maximum diameter into the ground. The depth driven either per blow or per several blows is recorded. The strength of each of the soil layer encountered is then calculated by converting the penetration rate (mm per blow) into an approximate California Bearing Ratio (CBR) value employing the correlation proposed by TRL.

Gas Monitoring

Gas monitoring is undertaken with a portable gas monitor for oxygen, Methane, Carbon Dioxide, Hydrogen Sulphide and Carbon Monoxide together with recording of atmospheric pressure and any flow rate.

Vapour Monitoring

Headspace tests and monitoring for Volatile Organic Compounds (VOC) or Semi Volatile Organic Compounds (SVOC) is undertaken using a Photo Ionisation Detector (PID). The MiniRAE models used have a 10.6 eV lamp calibrated for isobutylene. The PID is useful tool to indicate the presence of a wide range of volatile compounds, but only provides semi-quantitative data as different compounds provide a different response and thus the reading is not a true reflection of the actual concentration present.

Low PID readings can be recorded in natural uncontaminated organic soils or even as a result of atmospheric pollution. It is generally accepted by consultants and regulators that recorded values in excess 50 parts per million (ppm) represents the presence of organic compound pollutants and in excess of 100 ppm such contamination may be significant.

The headspace test procedure involves the collection of a sample of suspected contaminated soils and placing within a sample bag. A tight seal to the bag is formed with a similar volume of air trapped to that of the soil and the sample is left for fifteen minutes to allow volatilisation of any contaminants. The bag is then pierced by, and sealed around, the sample probe of the PID and a reading taken.

Borehole well monitoring is undertaken by connecting the PID directly to the gas tap on the monitoring well installation.

Groundwater Level Monitoring

Groundwater levels are recorded with an electronic dip meter that has a detector end that is lowered into the borehole well. An audible signal is made when water is reached and the depth recorded from the graduated tape used to lower the detector. Where there is potential for a separate Light Non Aqueous Phase Liquid (LNAPL) to be present floating on the groundwater an oil/water interface meter is used in preference to a conventional dip meter so that any such floating product can be detected.

Geotechnical Sampling

BRD schedule a range of geotechnical testing as appropriate to the identified ground conditions, available budget and the proposed development. Different types of soil samples are obtained as appropriate to the ground conditions and planned testing.

SAMPLE TYPE	SYMBOL USED ON LOGS	DESCRIPTION
Disturbed	D	Small disturbed soil samples of about 1 to 2 kg are collected in plastic bags.
Bulk	B	Large disturbed bulk samples up to about 30 kg are collected in plastic bags
Undisturbed	U	'Undisturbed' samples generally collected in plastic or metal tubes within cable percussive boreholes of 100mm diameter for samples of fine soils of firm to stiff consistency. Can also be representative of samples taken by cutting plastic sample liners from windowless sampling drilling methods. It is recognised that such samples do not generally meet Eurocode sample quality requirements for the tests commonly employed. However, given the wealth of experience with these sampling methods this continues to be common in United Kingdom practice particularly for less sensitive developments where more expensive sampling techniques are not economically justifiable.
Undisturbed	UT	A thin walled steel sampler developed by Archway Engineering called a UT100 in an attempt to gain better quality samples of soft to firm fine soils when using cable percussive drilling methods.

Contamination Sampling

BRD schedule contamination testing as appropriate to the ground conditions, available budget, potential contaminants and the proposed development. Samples are collected in single use laboratory supplied containers.

Soil samples are retrieved in plastic containers and/or amber glass jars with a lined plastic cap. Contamination samples are indicated by a 'J' on exploratory hole logs.

Water samples are collected in plastic bottles and/or amber glass jars with a lined plastic cap then placed in cool boxes together with freezer packs. Water samples are indicated by a 'W' on exploratory hole records, but generally such samples are not tested as testing from dedicated monitoring wells is preferred for sample quality reasons.

Samples retrieved from the exploratory holes are dispatched to the laboratory by overnight courier. Where samples cannot be transported directly from site they are temporarily stored in the BRD dedicated sample storage facility which includes refrigeration where necessary. The individual accreditation of the test methods is detailed in the laboratory test report.

GEOTECHNICAL ASSESSMENT

Under Eurocode 7 (EC7) the following risk ranking is applied to geotechnical projects:

GEOTECHNICAL CATEGORY	DESCRIPTION
1	Small and relatively simple structures for which it is possible to ensure that the fundamental requirements will be satisfied on the basis of experience and qualitative geotechnical investigations with negligible risk. For example, straightforward ground conditions, local experience, no excavation below the water table unless this will be straight forward.
2	Conventional types of structures and foundations. No difficult soil or loading conditions. Quantitative geotechnical data and laboratory testing. Routine procedures for field and laboratory testing. Conventional structures and no exceptional geotechnical risk. For example, spread, raft and piled foundations, retaining walls, bridge piers and abutments, embankments, ground anchors, tunnels and excavations.
3	Those structures not in Categories 1 and 2 such as very large or unusual structures, structures involving abnormal risks, or unusual or exceptionally difficult ground or loading conditions. Structures in highly seismic areas. Structures in areas of probable site instability or persistent ground movements that require separate investigation or special measures.

GEOTECHNICAL PARAMETERS

Soakage Tests

Soakage tests comprise the filling of a test pit with water and recording the time taken for the water to drain away. The test are undertaken in general accordance with 'BRE Digest 365: Soakaway design', Building Research Establishment, 1991. Water is generally supplied by a tanker to allow fast filling of the pits with water. Repeat tests are undertaken where possible within the time available on site with the investigation budget.

Standard Penetration Tests

The standard penetration test (SPT) determines the resistance of soils at the base of a borehole to the dynamic penetration of a split barrel sampler and the recovering of disturbed samples for identification purposes. In gravelly soils and some soft rocks a solid cone is used in preference to the sampler.

The basis of the test consists in driving a sampler by dropping a hammer of 63.5 kg mass on from a height of 760 mm. The number of blows (N value) necessary to achieve a penetration of the sampler of 300 mm is recorded. The test is described in 'Geotechnical investigation and testing – Field testing – Part 3: Standard penetration test - BS EN ISO 22476-3:2005 Incorporating corrigendum no. 1', BSi, 2007.

The uncorrected N values of the SPT tests are recorded upon the borehole logs together with a record of blows for each 75mm test portion including the seating blows. Where the full test depth cannot be achieved due to refusal on hard stratum, the number of blows and the distance achieved is recorded and the N value given as >50. The abbreviation SPT(c) is used upon the logs indicates that the test was performed with a solid cone rather than a split spoon sampler.

It is necessary to apply a correction to the N values to account for the effects of energy delivery using the equation: $N_{60} = \frac{E_r}{60} N$ where E_r is the energy ratio of the specific test equipment.

In the case of tests in sand, for the effects of overburden and rod length the equation is modified to $N_{60} = \frac{E_r}{60} \times \lambda \times C_N \times N$ where λ is the correction factor for energy losses due to the rod length and C_N is the correction factor for vertical stress due to overburden of the soil.

Sulphate

In order to compare the laboratory soil test results with 'Concrete in aggressive ground. BRE Special Digest 1: 2005' (BRE, 2005) laboratory results are converted to SO_4 mg/l. QTS Environmental Ltd results are expressed as SO_4 g/l and so are multiplied by a factor of 1000 to convert to mg/l. Soil Property Testing Ltd laboratory results are expressed as SO_3 g/l and are multiplied by a factor of 1200 to express the results as SO_4 mg/l.

Index Property Tests

In accordance with National House Building Council (NHBC) Standards Chapter 4.2 - Building near trees, the laboratory plasticity indexes are assessed against their volume change potential. The Modified Plasticity Index is defined as the Plasticity Index of the soil multiplied by the percentage of particles with a nominal diameter of less than 425µm. Whilst the NHBC Standards were developed for residential buildings, the advice is equally applicable to a large number of other types of low rise structures.

Hand Shear Vane

The undrained shear strength of the fine (i.e. clay) soils at the site can be established using hand shear vane apparatus. Usually three readings are taken at every depth tested and the uncorrected results recorded on the exploratory point log. Shear vane readings from depths below 1.2m depth in trial pits are from tests performed on excavated soil. In accordance with Eurocode 7 – Geotechnical design – Part 2: Ground investigation and testing EN 1997-2:2007 the results should be corrected. BRD employ only simple correction methods as the more complex correction methodologies imply undue accuracy to a test that has distinct disadvantages and limitations.

Pocket Penetrometers

The Pocket Penetrometer is a lightweight instrument for use by field personnel to check visual classification of soils. It is a simple test and there is inherent uncertainty related to the small volume of soil being tested and so the results should be used with appropriate caution. Pocket penetrometers are calibrated in terms of unconfined compressive strength and once converted to undrained shear strength (divide by two) the results are further reduced by a factor of 1.5 - 2.0 as the device tends to overestimate strengths.

Instrument Reading (uncompressive strength in kg/cm ²)	Indicative Undrained Shear Strength (kN/m ²)	Indicative Consistency	Indicative strength
1.0	25 - 33	Soft	Low
1.5	38 - 50	Soft to firm	Low to medium
2.0	50 - 67	Firm	Medium
2.5	63 - 83	Firm to stiff	Medium to high
3.5	88 - 116	Stiff	High
4.5	113 - 150	Stiff to very stiff	High to very high

CONTAMINATION ASSESSMENT METHODOLOGY

UK Policy

The UK Government's policy in relation to land affected by historic contamination is based on a 'suitable for use' approach. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Contamination risks therefore need to be assessed on a site-by-site basis. The 'suitable for use' approach limits requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to either the current use or future use of the land.

The three main drivers for contamination assessment and remediation are:

- *Voluntary action.*
- *Development as part of the planning regime.*
- *Regulatory action to mitigate unacceptable risks e.g. Part 2A of the Environmental Protection Act 1990.*

Pollutant Linkages

For a contamination risk to exist there must be a 'pollutant linkage' from the contaminant (source) via a pathway (the route from contaminant to receptor) to a receptor (the entity that could be harmed). The absence of a contaminant, pathway or receptor breaks the pollutant linkage and therefore no contamination risk exists.

Contamination is typically present at a site (in the ground and/or in the underlying groundwater) as a result of a historic or current industrial use, usually as a result of leaks, spills or disposal of residues, wastes and excess raw materials from the industrial processes. Contamination may also be present due to:

- *The deliberate application of chemicals e.g. the spraying of herbicide/pesticide.*
- *Migration of pollutants from adjacent land.*

Naturally occurring processes e.g. elevated concentrations of particular heavy metals associated with specific geological strata.

Conceptual Site Model

The conceptual site model can be defined as a textual or graphical representation of the identified pollutant linkages for a given site. The model forms the basis for designing the investigation as the aim will be to target all of the potential pollutant linkages to determine, through the subsequent phases of risk assessment, whether or not they pose an actual risk.

It is important that the conceptual site model is updated with new information as the various investigation, risk assessment and remediation works are completed.

Technical Guidance

The technical and legal framework for contamination assessment is complex. The process adopted through this report for assessing contamination risks is in general accordance with the following guidance, as listed below:

- 'Investigation of Potentially Contaminated Sites - Code of Practice - BS 10175: 2011', BSi, 2011.
- 'Model Procedures for the management of Land Contamination - CLR Document No. 11', Environment Agency, 2004.
- 'Guidance for the safe development of housing on land affected by contamination - R&D66: 2008', NHBC/Environment Agency, 2008.

Risk Assessment Methodology

In line with the technical guidance, the contamination risk assessment follows a series of phased stages for each particular site:

PHASE	DESCRIPTION	RISK ASSESSMENT STAGE
PHASE 1	Generally limited to desk based research and a site walkover survey to develop an initial conceptual site model and identify what risks, if any, are likely to be presented by the site.	Hazard Identification and Assessment A preliminary stage of risk assessment concerned with identifying and characterising the hazards that may be associated with a particular site and identifying potential pollutant linkages.
PHASE 2	This phase is concerned with establishing whether contamination is present, usually through intrusive ground investigation, and then evaluating the degree and magnitude of the associated risks.	Risk Estimation A stage concerned with estimating the likelihood that receptors will suffer adverse effects if they come into contact with, or are otherwise affected by, a hazardous substance or agent under defined conditions. Risk Evaluation A stage of risk assessment concerned with evaluating the acceptability of estimated risks, taking into account the nature and scale of the risk estimates, any uncertainties associated with the assessment and the broad costs and benefits of taking action to mitigate risks.
PHASE 3	The appraisal and selection of remediation techniques, their implementation and verification.	Risk Management The process whereby decisions are made to accept a known or assessed risk and/or the implementation of action to reduce the consequences or probabilities of occurrence.

Risk Classification

The objective of risk assessment is to identify the nature and magnitude of the potential risks and should be based on a consideration of both:

- The likelihood/probability of an event [taking into account both the presence of the hazard and receptor and the integrity of the pathway].
- The severity of the potential consequence [taking into account both the potential severity of the hazard and the sensitivity of the receptor].

There is a need for a logical, transparent and repeatable system in defining the categories of severity of consequence and likelihood as well as for the risk itself and therefore the following risk rating matrix is employed:

		SEVERITY OF CONSEQUENCE			
		SEVERE	MEDIUM	MILD	MINOR
PROBABILITY	HIGH LIKELIHOOD	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	LIKELY	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	LOW LIKELIHOOD	Moderate Risk	Moderate/Low Risk	Low Risk	Negligible Risk
	UNLIKELY	Moderate/Low Risk	Low Risk	Negligible Risk	Negligible Risk

These risk classifications are defined as follows:

- **Very High Risk** - There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
- **High Risk** - Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
- **Moderate Risk** - It is possible that without appropriate remediation action harm could arise to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.
- **Low Risk** - It is possible that harm could arise to a designated receptor from an identified hazard. It is likely that, at worst if any harm was realised any effects would be mild.
- **Negligible Risk** - The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

This risk assessment matrix and classification system is based on guidance produced by Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency in connection with contaminated land assessment.

RISK ESTIMATION - SOILS

Introduction to Soil Human Health Generic Assessment Criteria (GAC)

The Environment Agency (EA) and Department of Environment Food and Rural Affairs (DEFRA) had previously issued revised guidance following the consultation about the DEFRA publication "Assessing risks from land contamination - a proportionate approach. Soil Guideline Values: the Way Forward". This resulted in a revised version of the Contaminated Land Exposure Model (CLEA) model (version 1.06) and a few of the previously published Soil Guideline Values (SGVs) were revised.

The main legislative driver for dealing with historical land affected by contamination is Part 2A of the Environmental Protection Act 1990. Revised Statutory Guidance to support Part 2A was published in April 2012. This Guidance introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health,¹ where Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is acceptably low. The impact assessment for the new Statutory Guidance stated "The new statutory guidance will bring about a situation where the current SGVs/GACs are replaced with more pragmatic (but still strongly precautionary) Category 4 screening levels (C4SLs) which will provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land". The C4SLs are still derived using the CLEA model, but adopt a slightly different approach to toxicological assessment and exposure modelling.

In March 2014, the outcome of "SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - Final Project Report" (CL:AIRE) was published. Due to slightly ambiguous wording within this report, Lord de Mauley, Parliamentary Under Secretary, DEFRA wrote to all local authorities on 3 September 2014 to confirm that the published C4SLs were final and that they can be used in risk assessment undertaken under the planning regime.

Whilst there are proposals for the industry to develop C4SLs for other contaminants, these have yet to produce any new values. BRD do not believe that C4SLs could be developed by a single organisation with sufficient confidence. BRD has therefore employed other, more conservative guidance based on the CLEA model (detailed below) within this assessment for compounds where C4SLs are not available. However, it should be noted that the results of this investigation may need to be reinterpreted as new C4SLs become available.

Due to the limited number of published C4SL values at this time, the Chartered Institute of Environmental health (CIEH) and Land Quality Management Ltd (LQM) have produced Generic Assessment Criteria (GAC) known as Suitable for Use Levels (S4ULs), for use in contaminated land human health risk assessment. These S4ULs (2014) have been derived for a large number of substances using the current CLEA model and are therefore consistent with current guidance. They also incorporate the revised exposure parameters as adopted by the C4SL programme, but have not adopted the revised toxicological approach adopted by the C4SLs and so remain a more conservative assessment criteria. The substances for which SGVs were previously published have also been revised as new S4ULs in light of the new exposure parameters proposed by the C4SL programme, and therefore effectively replace the existing SGVs.

In addition, in December 2009, other GAC for less common substances were produced by the Environmental Industries Commission (EIC), The Association of Geotechnical and Geoenvironmental Specialists (AGS) and Contaminated Land: Applications in Real Environments (CL:AIRE) using the CLEA model. These are referred to as the EIC/AGS/CLAIRE GAC.

In summary, C4SLs have been used where these are available. For those substances where C4SLs have yet to be issued, then the S4ULs have been adopted or in some cases, the EIC/AGS/CLAIRE GAC. All of the previously produced SGVs have now either been withdrawn, or superseded by the respective C4SLs or S4ULs.

The only exception to this approach is the PAH compound benzo(a)pyrene (BaP) where a C4SL guideline value has been produced, whereas BRD has adopted the S4UL value. The C4SL for BaP relates to its use as a surrogate marker compound representing all of the genotoxic PAH compounds as a mixture, rather than this individual compound. BRD has therefore adopted the compound specific S4UL value as the initial screening value, for consistency with the other PAH compounds before then employing the C4SL is necessary.

It should be noted that unless otherwise stated, all the assessment criteria adopted within this report have been derived based on a sandy loam soil at pH 7 and the values quoted are for a conservative soil organic matter content of 1% where applicable (i.e. organic contaminants).

Human Health - Soil Generic Assessment Criteria

The results of the soils analysis have been compared to generic assessment criteria for the default exposure scenarios comprising either residential land with plant uptake, residential land without plant uptake, or commercial/industrial land use. The criteria values selected are listed in the table below and full details on the source are referred to above. Where applicable, the results have also been assessed with reference to the required statistical tests presented within CLAIRE document "Guidance on comparing soil contamination data with a critical concentration".

ANALYSIS	GENERIC ASSESSMENT CRITERIA (mg/kg unless stated)			SOURCE
	RESIDENTIAL WITH PLANT UPTAKE	RESIDENTIAL WITHOUT PLANT UPTAKE	COMMERCIAL / INDUSTRIAL	
Arsenic	37	40	640	C4SL
Cadmium	22	150	410	
Chromium (total) ⁵	910	910	8,600	S4UL
Chromium VI	21	21	49	C4SL
Lead	200	310	2,330	
Mercury*	11	15	320	S4UL
Selenium	250	430	12,000	
Nickel	180	180	980	
Copper	2400	7,100	68,000	
Zinc	3,700	40,000	730,000	
pH	< 5 - 10> units			Professional judgement
Naphthalene	2.3	2.3	190	S4UL
Acenaphthylene	170	2,900	83,000	
Acenaphthene	210	3,000	84,000	
Fluorene	170	2,800	63,000	
Phenanthrene	95	1,300	22,000	
Anthracene	2,400	31,000	520,000	
Fluoranthene	280	1,500	23,000	
Pyrene	620	3,700	54,000	
Benzo(a)anthracene	7.2	11	170	
Chrysene	15	30	350	
Benzo(b)fluoranthene	2.6	3.9	44	
Benzo(k)fluoranthene	77	110	1,200	
Benzo(a)pyrene	2.2	3.2	35	
Indeno(1,2,3-cd)pyrene	27	45	500	

ANALYSIS	GENERIC ASSESSMENT CRITERIA (mg/kg unless stated)			SOURCE
	RESIDENTIAL WITH PLANT UPTAKE	RESIDENTIAL WITHOUT PLANT UPTAKE	COMMERCIAL / INDUSTRIAL	
Dibenzo(a,h)anthracene	0.24	0.31	3.5	S4UL
Benzo(ghi)perylene	320	360	3,900	
TPH Aliphatic C5-C6	42	42	3,200	
TPH Aliphatic C6-C8	100	100	7,800	
TPH Aliphatic C8-C10	27	27	2,000	
TPH Aliphatic C10-C12	130	130	9,700	
TPH Aliphatic C12-C16	1,100	1,100	59,000	
TPH Aliphatic C16-C35	65,000	65,000	1,600,000	
TPH Aliphatic C35-C44	65,000	65,000	1,600,000	
TPH Aromatic C5-C7	70	370	26,000	
TPH Aromatic C7-C8	130	860	56,000	
TPH Aromatic C8-C10	34	47	3,500	
TPH Aromatic C10-C12	74	250	16,000	
TPH Aromatic C12-C16	140	1,800	36,000	
TPH Aromatic C16-C21	260	1,900	28,000	
TPH Aromatic C21-C35	1,100	1,900	28,000	
TPH Aromatic C35-C44	1,100	1,900	28,000	
Benzene	0.87	3.3	98	C4SL
Toluene	130	880	56,000	S4UL
Ethylbenzene	47	83	5,700	
Xylene [^]	56	79	5,900	EIC/AGS/CL:AIRE GAC
MTBE	49	73	7,900	

Notes:

* The S4UL for methyl mercury has been adopted as the worst case mercury compound as generally there is no desk study evidence to suggest the potential for elemental mercury on the majority of sites.

[^] The lowest S4UL of either p-xylene, o-xylene or m-xylene has been adopted for each land use as a conservative measure.

⁵ S4UL for Chromium III adopted, as in the absence of Chromium VI it is likely that all of the chromium will be in this form as these are the two most common and stable forms of chromium in the soil environment.

Where no GAC is available, any concentrations exceeding the laboratory limit of detection are identified and discussed in more detail.

Water Environment - Soil Generic Assessment Criteria

There are no UK published Generic Assessment Criteria for soil test results in respect of the risk to the water environment and therefore risk estimation is on the basis of the professional judgement and experience of BRD to employ values that are a reasonable concentration above which concern for water resources is valid.

The Total PAH GAC employed is the sum of the 16No. priority PAH compounds regularly tested for in contaminated land analysis (i.e. US EPA 16PAHs). BRD employ a soil screening based upon the total PAH limit for 'inert waste' of 100mg/kg. The rationale is based on PAHs are recognised to be generally of low solubility and the risk to the water environment is correspondingly low.

In respect of Total Petroleum Hydrocarbons, BRD employ a value of 500 mg/kg as a screening value in comparison to the sum of the component aliphatic and aromatic TPH carbon bands. The employed soil screening value is based upon:

- In common with some other consultants, the professional judgement and experience of BRD suggests that this value is a reasonable concentration above which concern for water resources is valid. The rationale is based on the fact that lower concentrations of fuel based contaminants are more likely to naturally degrade than migrate any great distance.*
- BRD is aware of regional Environment Agency groundwater and contaminated land teams that employ 500 mg/kg as a screening value for considering whether or not TPH could represent a risk to water resources.*
- The value mirrors the mineral oil Waste Acceptance Criteria limits for what is considered 'inert waste'.*

Should elevated contaminants that pose a potential risk to the water environment be identified then site specific assessment criteria should be developed.

Building Materials and Services - Soil Generic Assessment Criteria

Some hydrocarbon compounds are known to both attack and permeate through certain plastic pipe materials, with the primary concern being the degradation and tainting of water supplies. The UK Water Industry Research (UKWIR) has therefore produced a document 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' (ref. 10/WM/03/21) that specifies threshold criteria for the adoption of 'standard' polythene (PE) or PVC pipes, protective barrier pipe and ductile iron/steel/copper pipes.

The UKWIR threshold assessment criteria from Table 3.1 of this document for standard PE pipes have been employed. It should be noted that the approach taken by UKWIR is very conservative, and both the document and research are flawed. However, it is these values that are being using to specify water pipe materials and therefore it is appropriate to consider them.

The UKWIR guidance is particularly flawed in respect of the chemical analysis it expects as it seeks a limit of detection that is generally below limits that are reasonable or commonly employed in contaminated land assessment. The UKWIR seeks that where a substance is below the limit of detection it should be taken as being present at half this concentration. For the larger suite of chemicals where the limit is against a sum of compounds, this approach would mean that a sample of virgin sub-soil from a greenfield site with absolutely no contamination would actually fail the criteria for using standard PE pipes. To avoid this situation, BRD have adopted the approach of summing only those compounds detected above their respective limits of detection.

In terms of building materials, the primary concern is in respect of concrete as certain commonly occurring natural ground conditions can adversely impact on buried concrete as discussed in 'Special digest 1:2005 Concrete in aggressive ground', BRE, 2005.

ANALYSIS	GENERIC ASSESSMENT CRITERIA	SOURCE
pH	<5.5	BRE Special Digest 1:2005
Sulphate (w/s)	500 mg/l	BRE Special Digest 1:2005
Sum of any VOC above detection limits	0.5 mg/kg	Relevant compounds adapted from UKWIR Table 3.1
Sum of SVOC + Aliphatic TPH >C5-C10 + Aromatic TPH >C5-C10 above detection limits	2 mg/kg	
Sum of Aliphatic TPH >C10-C21 + Aromatic TPH >C10-C21 above detection limits	10 mg/kg	
Sum of Aliphatic TPH >C21-C34 + Aromatic TPH >C10-C35 above detection limits	500 mg/kg	
Sum of BTEX + MTBE above detection limits	0.1 mg/kg	
Phenols	2 mg/kg	
Cresols and chlorinated phenols	2 mg/kg	
Naphthalene	0.5 mg/kg	
Benzo(a)pyrene	0.5 mg/kg	

RISK ESTIMATION – GROUNDWATER

The initial assessment of the contamination risk to groundwater is by comparing dissolved groundwater concentrations with screening values that are protective of groundwater resources.

The reference source for the target concentrations is generally the EA's Environmental Quality Standards (EQS), the Water Supply (Water Quality) Regulations (WSR) 1989 / 2000 and the DW1/DW2 criteria from the Surface Water (Abstraction for drinking water)(classification) Regulations 1996. The target concentrations are outlined in the table overleaf.

ANALYSIS	GENERIC ASSESSMENT CRITERIA	SOURCE
Arsenic	50 µg/l	EQS
Cadmium	5 µg/l	EQS
Chromium (total)	50 µg/l	DW2
Copper	50 µg/l	DW2
Nickel	20 µg/l	WSR
Lead	50 µg/l	DW2
Mercury	1 µg/l	EQS
Selenium	10 µg/l	WSR
Zinc	5 mg/l	DW2
Cyanide	50 µg/l	WSR
pH	6 to 9 units	EQS
Benzene	30 µg/l	EQS
Toluene	50 µg/l	EQS
Ethylbenzene	30 µg/l	EQS for benzene as a guide
Xylene	30 µg/l	EQS for benzene as a guide
Naphthalene	2.4 µg/l	EQS
Benzo(a)pyrene	0.05 µg/l	EQS
Total PAH	0.2 µg/l	DW1
TPH (dissolved or emulsified hydrocarbons)	50 µg/l	DW1

There are no available generic assessment criteria for some of the analytical parameters which have been scheduled, for example hexavalent chromium, and individual TPH and PAH and some VOC compounds. These parameters will be assessed based on professional judgement should they exceed the limit of detection.

RISK ESTIMATION - GROUND GAS

Introduction

A variety of potentially hazardous gases occur in naturally in the ground environment. Microbial decay of organic matter under anaerobic conditions and geological processes can lead to the generation of Methane and Carbon Dioxide, but can also include traces gases such as Hydrogen sulphide and Carbon monoxide.

Methane is a colourless and odourless gas that has the hazardous properties of being flammable and, at certain air/Methane mixtures, explosive. Methane has a low toxicity, but can be a simple asphyxiant due to the displacement of oxygen.

Carbon Dioxide is a colourless, odourless and non-combustible gas that has the hazardous property of being a highly toxic chemical. At concentrations of 3% by volume, shortness of breath and headaches will occur becoming acute by 6%. At levels of above 10% by volume headache, visual distortion, tremors and rapid loss of consciousness occur. Concentrations of Carbon Dioxide above 22% by volume are likely to be fatal. The effects of Carbon Dioxide poisoning are made more severe if there is accompanying reduction in oxygen concentrations.

Hydrogen sulphide is a colourless and flammable gas that has an odour of rotten eggs. It is important to that the sense of smell is over powered at higher concentrations. The gas is toxic and can be an asphyxiant.

Carbon monoxide is a colourless, odourless and explosive gas in air mixtures that has the hazardous property of being a highly toxic chemical.

Radon is a naturally occurring colourless and odourless gas that is radioactive. It is formed by the radioactive decay of radium which in turn is derived from the radioactive decay of uranium, both of which are minerals that can be found in many soil types. Whilst it is recognised that the air inside every house contains radon, some houses built in certain defined areas of the country might have unacceptably high concentrations and require special precautions to be taken. The maps contained within BRE211:2007 'Radon: guidance on protective measures for new buildings' identify areas where no radon protection measures are necessary or where higher concentrations are present that either basic or full radon protection measures are required to be fitted to all new dwellings.

Basis of Gas Assessment

In order to classify the level of risk and need, if any, for gas protection measures at a site with the potential for a gas problem, consideration of each of the following is necessary:

- The source of the gas.*
- The generation potential of the gas.*
- The location of the source and the geological setting.*
- Boreholes flow rate and estimated surface emission rate.*

- The nature of the proposed development.
- Confidence in the knowledge of the gas regime.

The gas assessment is made with reference to 'C665 - Assessing risks posed by hazardous ground gases to buildings', Construction Industry Research and Information Association (CIRIA), 2007.

Gas Screening Value

The method within CIRIA C665 uses both the gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow for Methane and Carbon Dioxide. This limiting borehole gas volume flow is called the Gas Screening Value (GSV) and is expressed below:

$$\text{Gas Screening Value (l /hr)} = \text{borehole flow rate (l/hr)} \times \text{gas concentration (fraction)}$$

The calculation of GSV is completed for both Methane and Carbon Dioxide and then the 'worse case' maximum values are used in the assessment. The assessment is to determine the gas regime at the site is dependent upon the nature of the development.

Situation A - All development types except low rise housing with gardens.

The characteristic situation for many sites is determined from evaluation of the Gas Screening Value derived against the criteria in the following table.

Characteristic situation	Risk classification	Gas Screening Value (CH ₄ or CO ₂ l/hr)	Additional factors	Typical sources of generation
1	Very low risk	<0.07	Typically Methane ≤1% and/or Carbon Dioxide ≤5%. Otherwise consider an increase to characteristic situation 2.	Natural soils with low organic matter content and 'typical' made ground.
2	Low risk	<0.7	Borehole air flow rate not to exceed 70 l/hr. Otherwise consider an increase to characteristic situation 3.	Natural soil with high organic peat/organic content and 'typical' made ground.
3	Moderate risk	<3.5		Old landfill, inert waste and flooded mine working.
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protection measures.	Mine working susceptible to flooding and landfill completed to WMP 26B criteria.
5	High risk	<70		Mine working unflooded inactive with shallow workings near surface.
6	Very high risk	>70		Recent landfill site.

Situation B - Low rise housing with gardens - NHBC 'Traffic Lights'

The NHBC model for low rise housing development considered a typical residential house with a ground floor area of 64m², suspended floor and ventilated sub-floor void of height 150mm. Where the proposed development of a site is consistent with this model, the NHBC traffic light situation of the site is determined from evaluation of the Gas Screening Value against the criteria in the following table.

Traffic Lights	Methane		Carbon Dioxide	
	Typical maximum concentrations (%)	Gas Screening Value (l/hr)	Typical maximum concentrations (%)	Gas Screening Value (l/hr)
Green	≤1	≤0.16	≤5	≤0.78
Amber 1	1 > to ≤5	>0.16 to ≤0.63	>5 to ≤10	>0.78 to ≤1.56
Amber 2	5 > to ≤20	>0.63 to ≤1.56	>10 to ≤30	>1.56 to ≤3.13
Red	>20	>1.56	>30	>3.13

APPENDIX 1

Site Location Plan



Not to scale.

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Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP1-A
Date Issued: November 2015

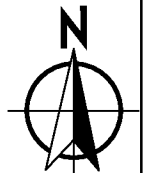
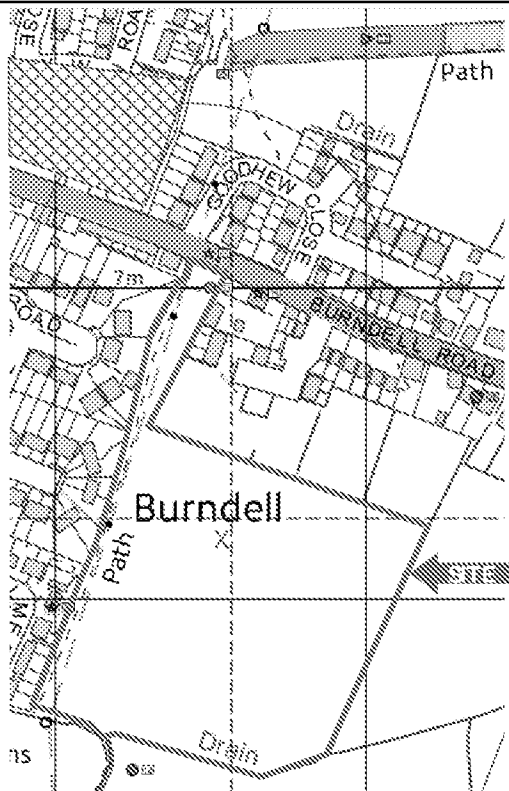
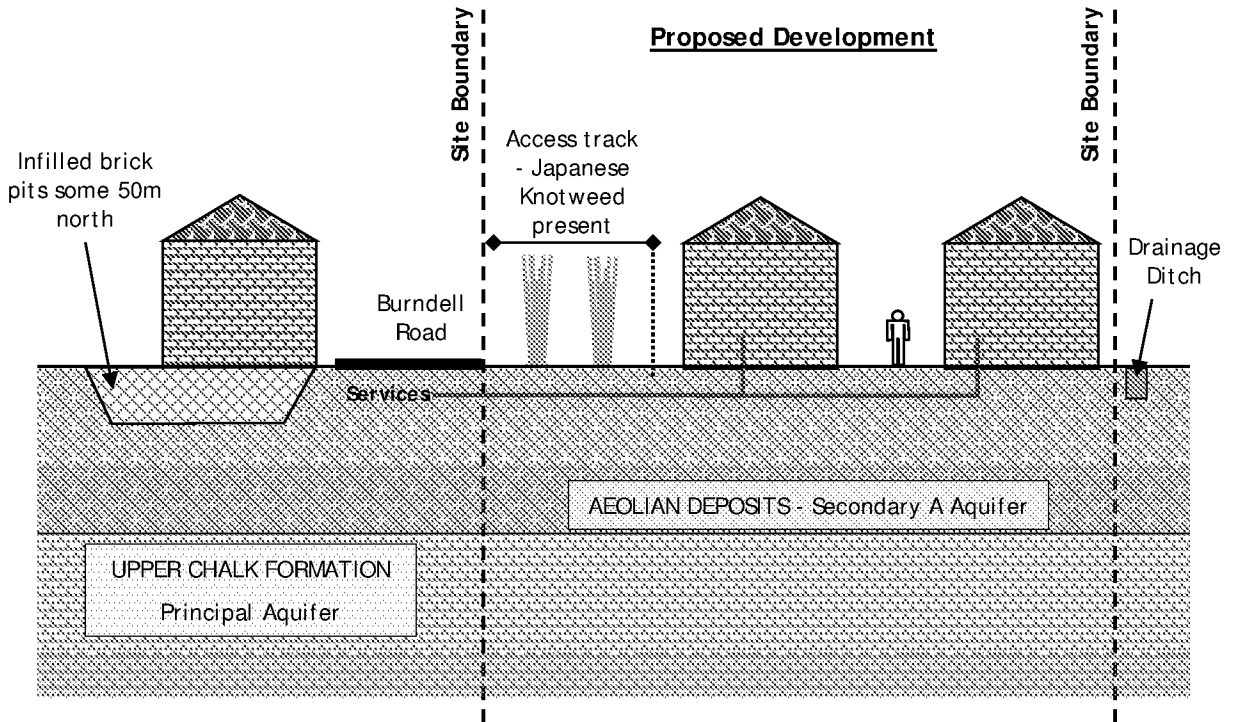


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Revised Conceptual Model

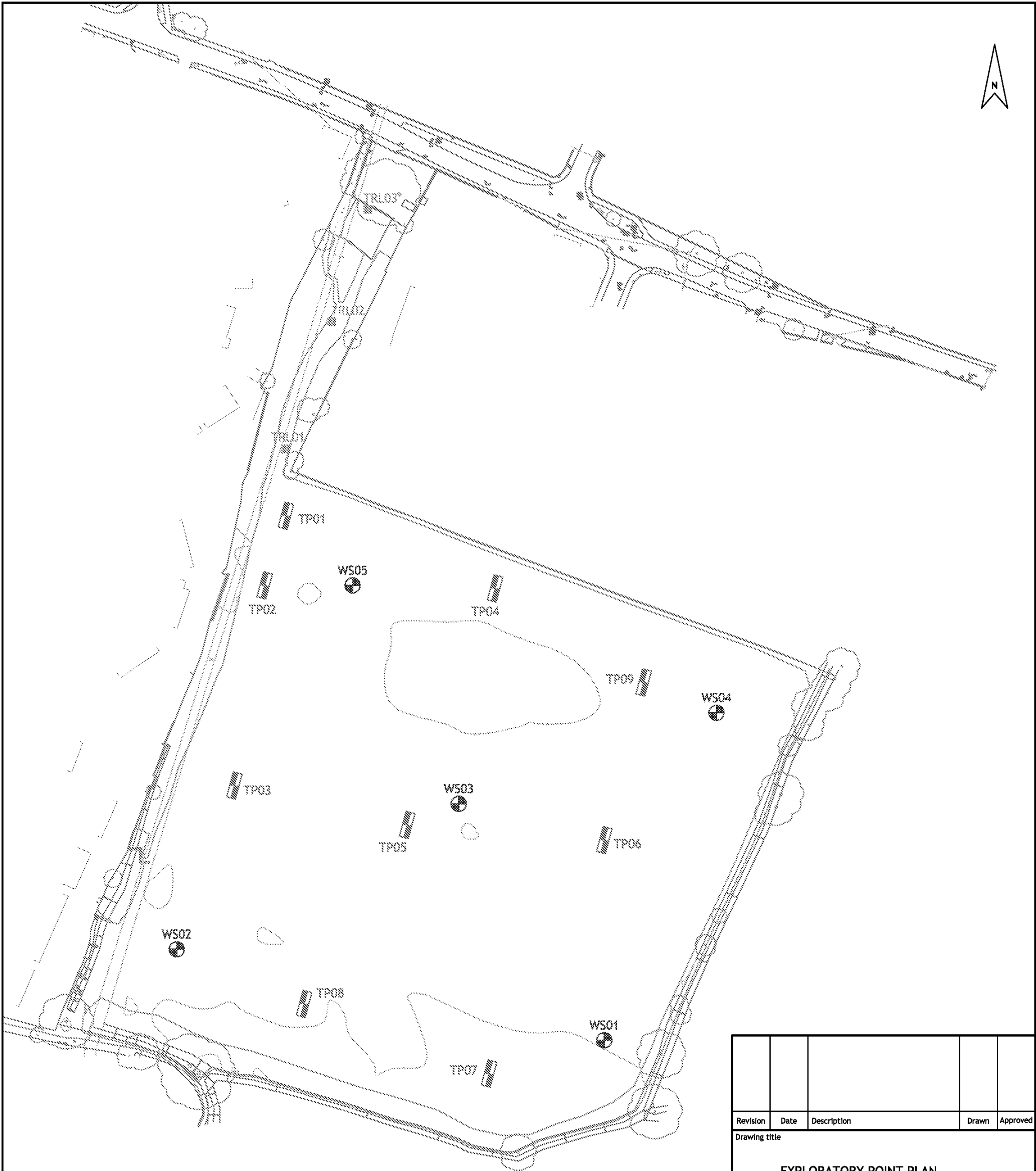
No Pollution Linkages Identified



Project Title: Land south of Burndell Road, Yapton
 Client: Gleeson Developments
 BRD Reference: BRD2484-OP6-A
 Date Issued: November 2015



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- Key:**
- WS Windowless Sample Borehole
 - TP Trial Pit
 - TRL TRL Test
 - Site Boundary (Approximate Position)

Notes:

Reproduced from Digital Terrain Surveys LLP, 'Site Survey', drawing ref. DTS220414-7Q1, dated April 2014.

All exploratory holes positioned by recreational GPS.

Revision	Date	Description	Drawn	Approved
Drawing title				
EXPLORATORY POINT PLAN				
Project title				
LAND SOUTH OF BURDELL ROAD, YAPTON				
Client				
GLEESON DEVELOPMENTS				
Scale	Original drg. size/colour	Date		
1:1250	A3 / C	23/11/2015		
Drawn	Checked	Approved		
RD	JM	BD		
Drawing Number				Rev
BRD2484-OD1				A
		BRD Environmental Ltd 01295 272244 info@brduk.com www.brduk.com		

APPENDIX 2

TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP01			
				Sheet 1 of 1			
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend	
Depth	Type & No	Value					
0.20	J1		MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.35 0	MG		
			Soft to firm, brown and orange brown, silty, gravelly CLAY. Gravel of fine to coarse, angular to rounded flint.		AEOLIAN DEPOSITS		
			Firm, orange brown, silty, slightly gravelly CLAY. Gravel of fine to coarse, angular to rounded flint.	0.95 0			
1.50	D1			2			
			2.00 m: Becoming sandy.				
2.40	D2		Firm, slightly moist, orange brown, gravelly, very sandy CLAY / very clayey SAND.	2.30 0			
				2.65 0			
				3			
				4			
Pit Stability: Generally stable throughout Groundwater: Not encountered					Surface Elevation Level:		
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 2.65 m bgl to undertake soakage test.		All dimensions in metres Log Scale 1:25 		

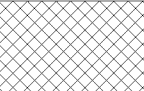
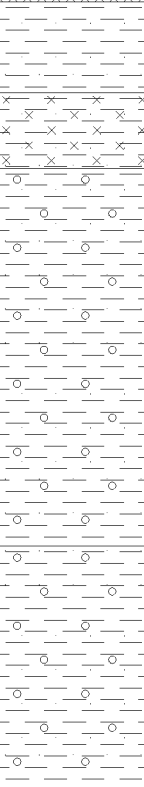
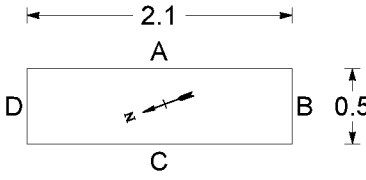
TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)			Trial Pit No. TP02	
			Sheet 1 of 1	

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.30 0	MG	
0.80	J2		Firm, orange brown, gravelly, sandy CLAY.		AEOLIAN DEPOSITS	
0.90	D1		0.70 m: Gravelly, very sandy CLAY / very clayey SAND.	1		
1.50	D2		Soft to firm, grey brown, sandy, silty CLAY with some flint gravel.	1.30 0		
2.10	D3		1.80 m: Very sandy, silty CLAY with flint gravel.	2		
				2.10 0		
				3		
				4		

Pit Stability: Generally stable throughout Groundwater: Not encountered		Surface Elevation Level:
Plan of Trial Pit: 	General Remarks: Trial pit terminated at 2.10 m bgl to undertake soakage test.	
		All dimensions in metres Log Scale 1:25

TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP03		
				Sheet 1 of 1		
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.30 0	MG	
			Firm, orange brown, gravelly, sandy CLAY.	0.60 0		
0.70	J2		Firm, light brown, sandy, silty CLAY.	0.85 0		
0.90	D1		Firm to stiff, orange brown with brown mottling, sandy, gravelly, silty CLAY. Gravel of fine to coarse, angular to rounded flint. Recovered as coarse gravel and cobbles.	1 0		
1.80	D2			2 0		
2.40	D3		Firm to stiff, light brown and cream, sandy, gravelly CLAY. Gravel of fine to coarse, subangular to rounded flint and much chalk.	2.10 0	AEOLIAN DEPOSITS	
				2.90 0		
				3 0		
				4 0		
Pit Stability: Generally stable throughout Groundwater: Not encountered					Surface Elevation Level:	
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 2.90 m bgl.			
			All dimensions in metres Log Scale 1:25			
						

TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP04		
				Sheet 1 of 1		
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1	53/66/74 kPa	MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.30 0	MG	
0.90	J2		Firm, orange brown, sandy, gravelly, silty CLAY. Gravel of fine to coarse, angular to rounded flint.	1	AEOLIAN DEPOSITS	
1.00	D1					
1.00	SV					
2.00	D2		Soft to firm, orange brown, sandy, gravelly, silty CLAY. Gravel of fine to coarse, angular to rounded flint.	1.80 0	2	
2.50	D3	Loose to medium dense, orange, clayey / silty, gravelly SAND. Gravel of fine to coarse, angular to rounded flint.	2.40 0			
3.20	D4	Loose to medium dense, orange / grey brown, silty, gravelly SAND. Gravel of fine to coarse, angular to rounded flint.	2.90 0	3		
				3.30 0		
				4		
Pit Stability: Generally stable throughout Groundwater: Not encountered					Surface Elevation Level:	
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 3.30 m bgl. Relative densities based on side wall stability and ease of excavation observations.		All dimensions in metres Log Scale 1:25 	

TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP05		
				Sheet 1 of 1		
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.30	J1	58/52/52 kPa	MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.40 0	MG	
0.80	J2		Firm, orange brown, gravelly, sandy CLAY.	1	AEOLIAN DEPOSITS	
0.90	D1					
0.90	SV					
1.90	D2	Soft to firm, orange brown, slightly gravelly, sandy, silty CLAY. Gravel of fine to coarse, angular to rounded flint.	1.70 0			
2.50	D3	Loose to medium dense, orange / yellow brown, moist, gravelly, very silty SAND. Gravel of fine to coarse, angular to rounded flint and fine chalk with pockets / layers of silty, sandy clay.	2.40 0			
				2.90 0		
				3		
				4		
Pit Stability: Generally stable throughout Groundwater: Not encountered				Surface Elevation Level:		
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 2.90 m bgl. Relative densities based on side wall stability and ease of excavation observations.		All dimensions in metres Log Scale 1:25 	

TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP06		
				Sheet 1 of 1		
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.30 0	MG	
0.70 0.80	J2 D1		Firm, orange brown, gravelly, sandy CLAY.		AEOLIAN DEPOSITS	
1.80	D2		1.20 m: Orange / grey brown in colour and very	1		
			1.90 m: Gravelly, silty SAND.	2		
2.60	D3		Soft to firm, light grey and orange / orange mottled brown, sandy, gravelly CLAY. Gravel of fine to coarse, angular to rounded flint and occasional chalk.	2.30 0		
3.10	D4		2.70 m: Light orange / grey brown, gravelly, sandy CLAY / very clayey SAND.	3		
				3.20 0		
				4		
Pit Stability: Generally stable throughout Groundwater: Not encountered				Surface Elevation Level:		
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 3.20 m bgl.			
			All dimensions in metres Log Scale 1:25			

TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP07		
				Sheet 1 of 1		
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.35 0	MG	
0.70 0.80	J2 D1		Orange brown and brown, silty, gravelly, sandy CLAY. Gravel of fine to coarse, angular to rounded flint. 0.40 - 0.60 m: Face A / D: Light grey brown.	1	AEOLIAN DEPOSITS	
1.70	D2		2.00 m: Very sandy.	2		
2.40	D3		Loose to medium dense, orange / yellow brown, silty, very gravelly SAND. Gravel of fine to coarse, angular to rounded flint.	2.25 0		
3.05	D4		Firm, moist, light grey and orange brown with some yellow brown, gravelly, sandy, silty CLAY. Gravel of fine to coarse, angular to rounded flint and chalk.	3 3.00 3.15 0		
Pit Stability: Generally stable throughout Groundwater: Seepage at base of pit.				Surface Elevation Level:		
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 3.15 m bgl. Relative densities based on side wall stability and ease of excavation observations.			
			All dimensions in metres Log Scale 1:25 			

TRIAL PIT RECORD

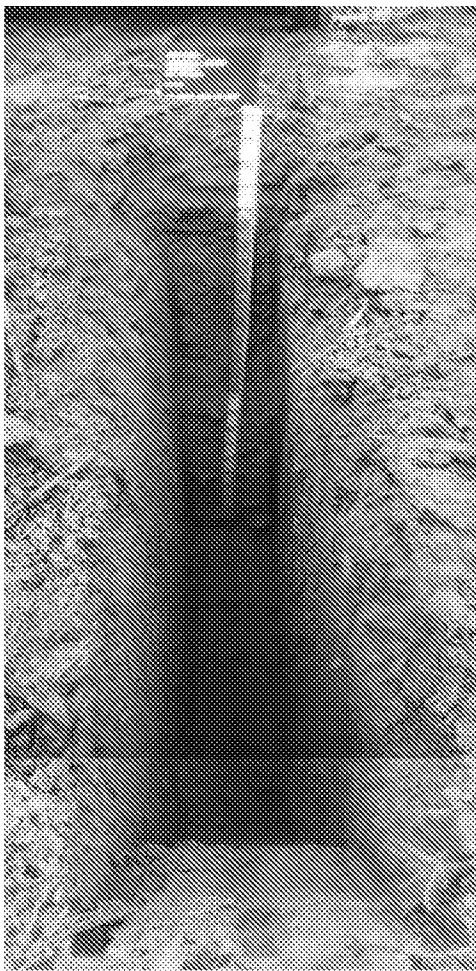
Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP08		
				Sheet 1 of 1		
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.30	J1		MADE GROUND / TOPSOIL: Crop stubble over soft, brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.30 0	MG	
0.70 0.70	J2 D1		Orange brown and brown, silty, gravelly, sandy CLAY. Gravel of fine to coarse, angular to rounded flint.		AEOLIAN DEPOSITS	
1.60	SV	30/28/28 kPa	1.40 m: Yellow brown and sandy.	1		
1.80	D2					
			Firm, yellow / orange brown, gravelly, very sandy CLAY. Gravel of fine to coarse, angular to rounded flint and chalk.	2 2.00 0		
2.70 2.80	SV D3	32/43/32 kPa	Soft to firm, light yellow grey and orange brown, slightly sandy, gravelly, silty CLAY. Gravel of fine to coarse, chalk and flint.	2.60 0		
				3 3.10 0		
				4		
Pit Stability: Generally stable throughout Groundwater: Slight seepage at base of pit.					Surface Elevation Level:	
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 3.10 m bgl.			
All dimensions in metres Log Scale 1:25						

TRIAL PIT RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Completed: 06/11/2015 Method Used: 180° Backhoe excavator (JCB 3CX type)				Trial Pit No. TP09		
				Sheet 1 of 1		
Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND / TOPSOIL: Crop stubble over soft, wet, brown, sandy, gravelly clay.	0.30 0	MG/TS	
			Orange brown / orange and brown, silty, gravelly, sandy CLAY. Gravel of fine to coarse, angular to rounded flint.			
0.80 0.85	D1 J2			1	AEOLIAN DEPOSITS	
1.60	SV	43/44/43 kPa		1.70 0		
2.00	D2		Soft to firm, moist, orangey brown, gravelly, silty CLAY. Gravel of fine to coarse flint.	2		
2.30	SV	28/19/32 kPa				
2.90	D3		Loose to medium dense, yellow grey and brown, very gravelly, very sandy CLAY. Gravel of fine to coarse, angular to rounded flint.	2.80 0		
				3		
				3.30 0		
				4		
Pit Stability: Generally stable throughout Groundwater: Not encountered					Surface Elevation Level:	
Plan of Trial Pit: 			General Remarks: Trial pit terminated at 3.30 m bgl. Relative densities based on side wall stability and ease of excavation observations.			
			All dimensions in metres Log Scale 1:25 			

Trial Pit Photographs

TP01



Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP5-A
Date Issued: November 2015

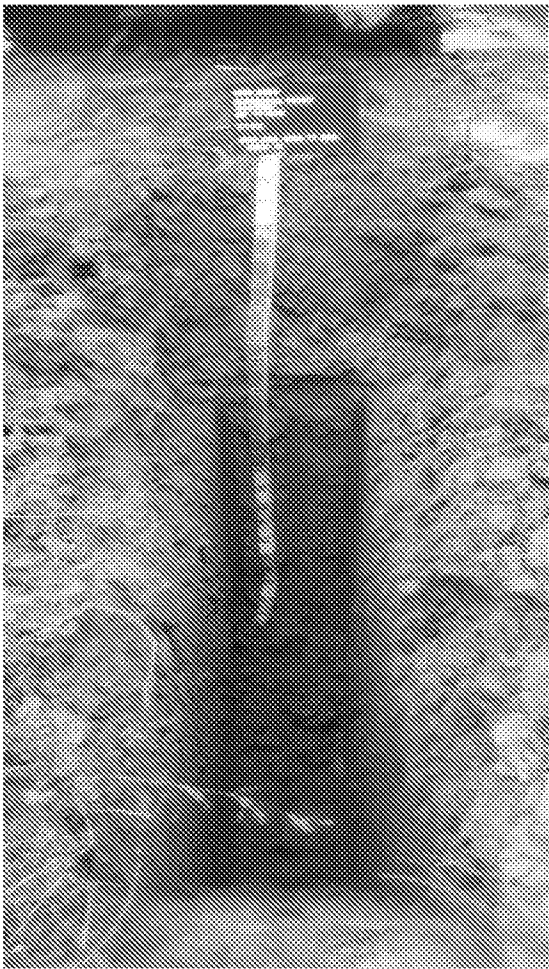


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Trial Pit Photographs

TP02



Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP5-A
Date Issued: November 2015

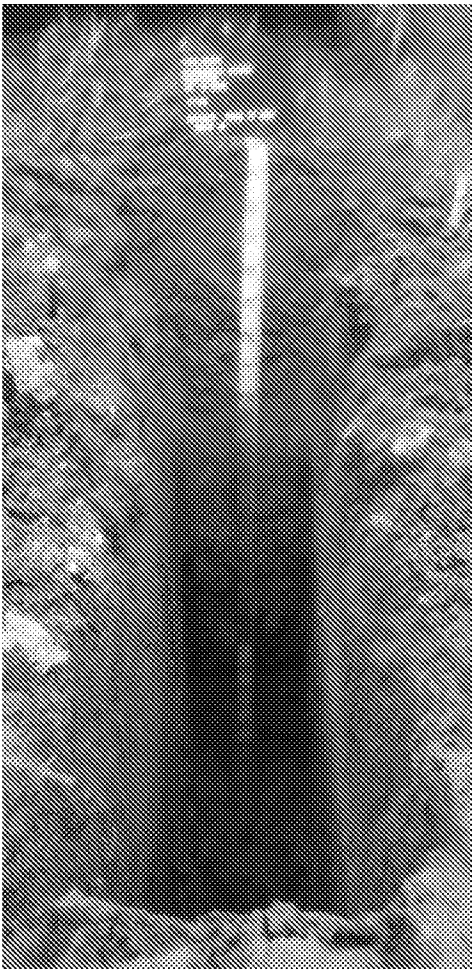


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Trial Pit Photographs

TP03



Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP5-A
Date Issued: November 2015

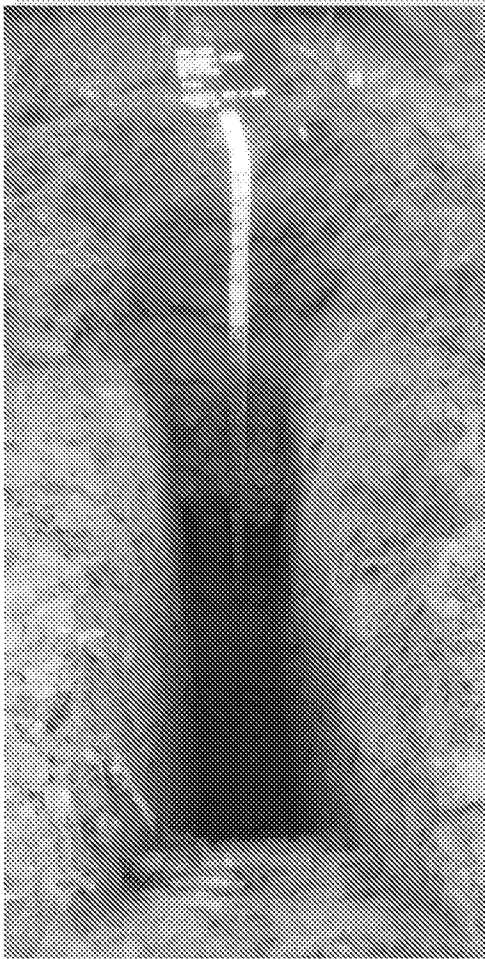


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Trial Pit Photographs

TP04



Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP5-A
Date Issued: November 2015

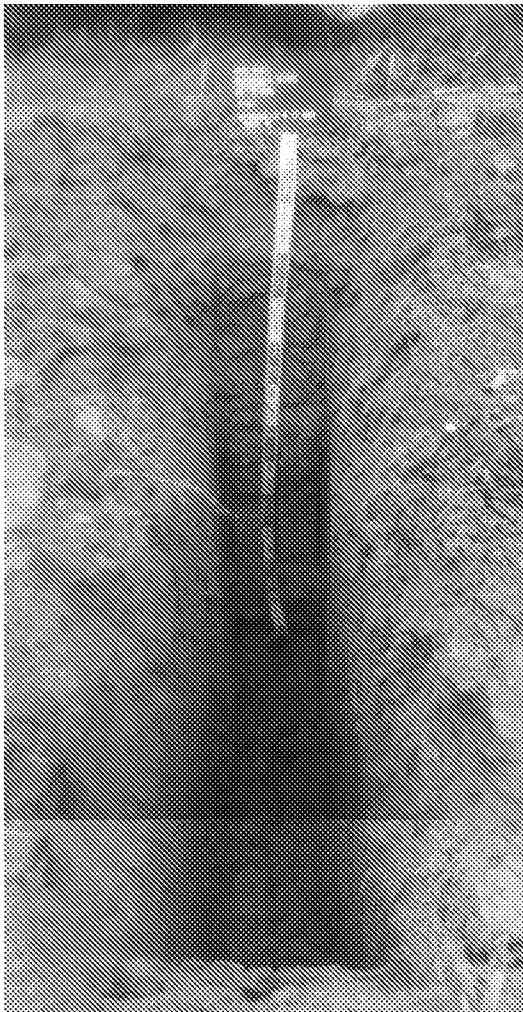


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Trial Pit Photographs

TP05



Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP5-A
Date Issued: November 2015

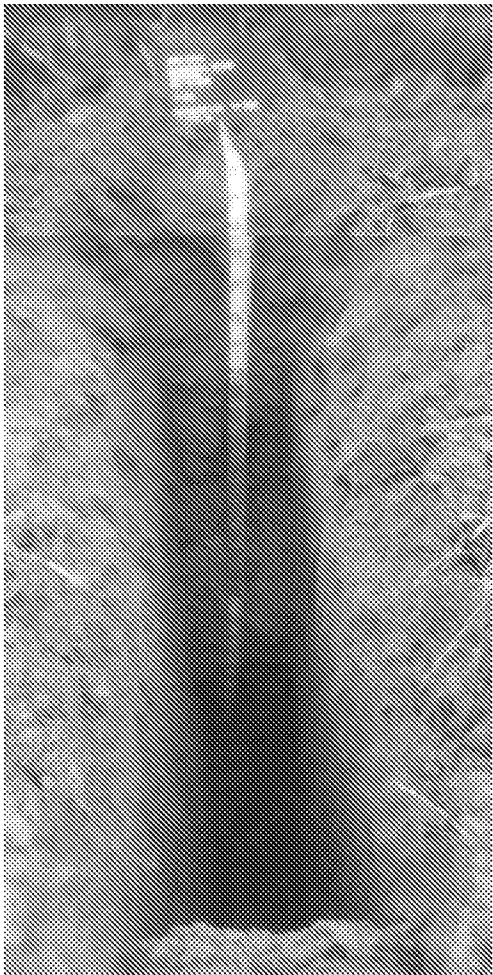


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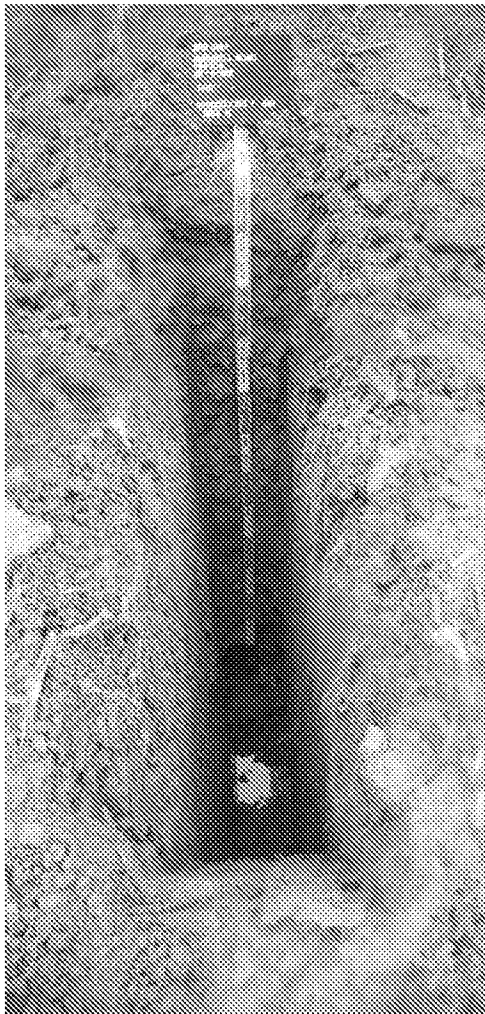
Trial Pit Photographs

TP06



Trial Pit Photographs

TP07



Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP5-A
Date Issued: November 2015



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Trial Pit Photographs

TP08



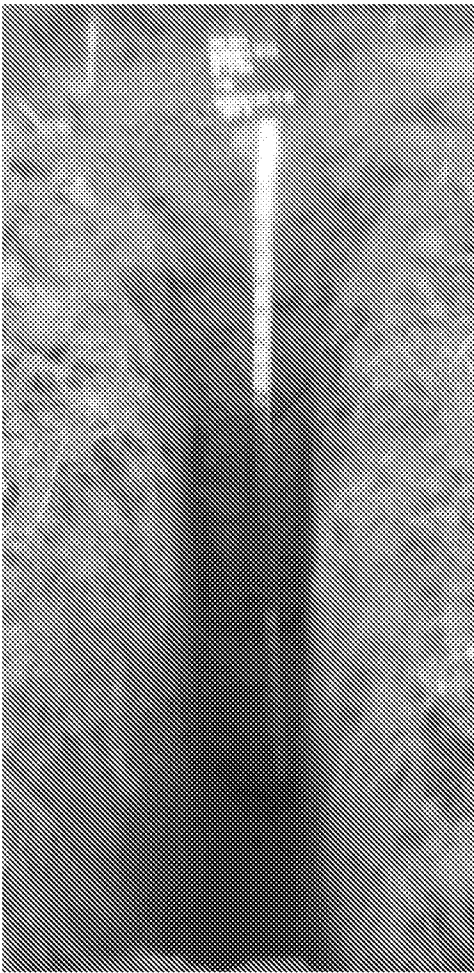
Project Title: Land south of Burndell Road, Yapton
Client: Gleeson Developments
BRD Reference: BRD2484-OP5-A
Date Issued: November 2015



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Trial Pit Photographs

TP09



PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS01		
						Sheet 1 of 2		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
0.20	J1			MADE GROUND / TOPSOIL: Crop stubble over soft to firm, brown, gravelly, silty clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.			MG/TS	
0.30	PEN	2.25 kg/cm²		Firm, yellow brown, gravelly, very silty CLAY. Gravel of fine to coarse, subangular to rounded flint and cobbles of flint.	0.35			
0.60	PEN	1.75 kg/cm²					AEOLIAN DEPOSITS	
0.70	J2							
0.80	PEN	2.25 kg/cm²						
1.00	SPT	5 N		1.00 m: SPT: 2,1/1,1,1,2.	1.0			
				1.30 m: Becoming very sandy.				
1.60	PEN	1.50 kg/cm²						
1.70	D2							
2.00	SPT	11 N		1.90 m: Light brown in colour. 2.00 m: SPT: 3,2/2,3,3,3.	2.0			
				Firm, light orange / yellow brown, sandy, gravelly CLAY. Gravel of fine to coarse, angular to rounded flint, siltstone and chalk.	2.20			
2.70	D3			2.55 m: Becoming slightly moist.				
3.00	SPT	13 N		3.00 m: SPT: 2,2/2,3,4,4.	3.0			
				Firm, yellow brown, gravelly, sandy CLAY. Gravel of fine to coarse, angular to rounded flint.	3.15			
3.50	PEN	2.75 kg/cm²					CH	
3.60	D4							
3.70	PEN	2.25 kg/cm²		3.65 m: Slightly moist with some chalk gravel.	3.85			
3.90	PEN	2.50 kg/cm²		Firm, light brown / cream brown, sandy, gravelly CLAY. Gravel of fine to coarse, angular to rounded flint and chalk.	4.0			
4.00	SPT	50 *		4.00 m: SPT: 8,10/12,13,16, 9 for 50mm.	4.30			
				CHALK recovered as: Firm, becoming stiff, moist, gravelly clay. Gravel of fine to coarse, angular to rounded flint and	4.50			
General Remarks: Borehole terminated at 5.40 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS01		
						Sheet 2 of 2		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
4.50	PEN	1.25 kg/cm²		chalk.			CHALK	
4.75	PEN	2.50 kg/cm²		Continued from 4.30 m: CHALK recovered as: Firm, becoming stiff, moist, gravelly clay. Gravel of fine to coarse, angular to rounded flint and chalk.				
4.80	D5							
4.95	PEN	4.25 kg/cm²			5.0			
5.00	SPT	50 *		5.00 m: SPT: 9,10/10,12,14,14 for 70mm. 5.00 m: No recovery in SPT.	5.40			
					6.0			
					7.0			
					8.0			
					9.0			
General Remarks: Borehole terminated at 5.40 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS02		
						Sheet 1 of 2		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
0.20	J1			MADE GROUND / TOPSOIL: Crop stubble over soft to firm, brown, gravelly, silty clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.35		MGTS	
0.35	PEN	2.25 kg/cm²		Soft to firm, orange / yellow brown, gravelly, silty CLAY. Gravel of fine to coarse, subangular to rounded flint.				
0.50	D1	1.00 kg/cm²		0.60 m: Firm with less gravel.	1.0			
0.50	PEN	1.00 kg/cm²						
0.70	PEN	3.50 kg/cm²						
0.80	J2	4.75 kg/cm²						
0.90	PEN	4.75 kg/cm²		1.00 m: SPT: 1,2/2,2,2,3.	1.0			
1.00	SPT	9 N						
1.50	PEN	3.25 kg/cm²		1.65 m: Abundant flint gravel and shattered cobbles.	1.95			
1.70	D2							
2.00	SPT	5 N		Soft to firm, light brown / cream, brown, moist, sandy, gravelly CLAY. Gravel of fine to coarse, subangular to rounded flint and chalk. 2.00 m: SPT: 1,1/1,1,1,2.	2.0		AEOLIAN DEPOSITS	
2.60	D3							
2.70	PEN	1.00 kg/cm²		2.85 - 3.15 m: Light brown, sandy, silty CLAY. 3.00 m: SPT: 2,3/3,3,3,3. 3.15 m: Much chalk gravel and some siltstone with occasional flint.	3.0			
2.90	PEN	2.75 kg/cm²						
3.00	SPT	12 N						
3.70	PEN	2.00 kg/cm²						
3.80	D4			4.00 m: SPT: 6,9/12,13,15, 10 for 65mm. CHALK recovered as: Firm, white, moist, silty, gravelly clay. Gravel of fine to coarse, angular to rounded flint and chalk.	4.05		CHALK	
3.95	PEN	2.50 kg/cm²						
4.00	SPT	50 *						
General Remarks: Borehole terminated at 5.37 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

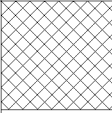
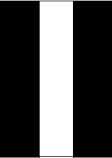
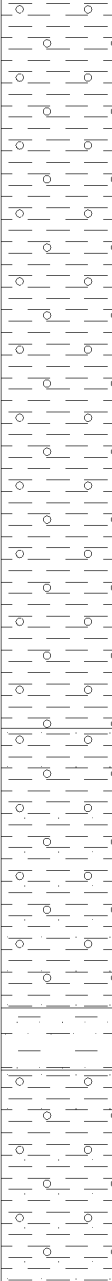
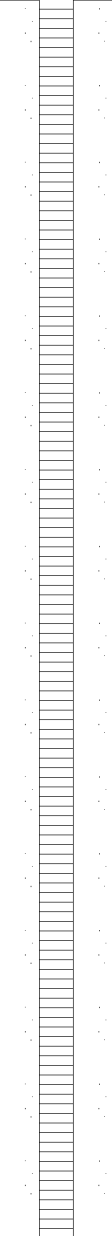
PROBEHOLE RECORD

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PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS03		
						Sheet 1 of 1		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
0.20	J1			MADE GROUND / TOPSOIL: Crop stubble over soft to firm, brown, gravelly, silty clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.30		MG/TS	
0.35	PEN	1.75 kg/cm²		Firm, orange / yellow brown, gravelly, silty CLAY. Gravel of fine to coarse, subangular to rounded flint.			AEOLIAN DEPOSITS	
0.60	PEN	2.25 kg/cm²						
0.80	D1							
0.90	J2	2.50 kg/cm²						
0.90	PEN	6 N		1.00 m: SPT: 1,1/1,1,2,2.	1.0			
1.00	SPT							
1.50	PEN	2.25 kg/cm²						
1.80	D2			Soft to firm, orange brown, gravelly, very sandy CLAY / very clayey SAND. Gravel of fine to coarse, angular to rounded flint.	1.60			
2.00	SPT	4 N		2.00 m: SPT: 1,1/0,1,1,2. 2.05 m: Orange SAND.	2.0			
				2.25 m: Orange brown, silty / clayey SAND.				
2.70	D3			Firm becoming stiff, light brown / cream-brown, moist, sandy, gravelly CLAY. Abundant gravel of fine to coarse, subangular to rounded flint and chalk.	2.52			
3.00	SPT	15 N		3.00 m: SPT: 2,1/2,3,4,6.	3.0			
3.85	D4							
4.00	SPT	50 *		4.00 m: SPT: 3,6/12,16,18, 4 for 15mm.	4.0			
					4.39			
General Remarks: Borehole terminated at 4.39 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

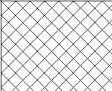
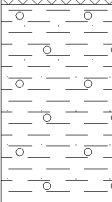
PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS04		
						Sheet 1 of 2		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
0.20	J1			MADE GROUND / TOPSOIL: Crop stubble over soft to firm, brown, gravelly, silty clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.35		MG/TS	
0.30	PEN	1.25 kg/cm²		Firm, orange / yellow brown, slightly gravelly CLAY. Gravel of fine to coarse, subangular to rounded flint.				
0.60	PEN	2.00 kg/cm²					AEOLIAN DEPOSITS	
0.70	J2							
0.80	D1							
0.85	PEN	3.25 kg/cm²						
1.00	SPT	6 N		1.00 m: SPT: 1,1/1,1,2,2.				
				1.20 - 1.35 m: Much flint gravel.				
				1.50 m: Becoming very sandy.				
1.60	PEN	1.25 kg/cm²						
1.70	D2							
1.85	PEN	1.00 kg/cm²						
2.00	SPT	5 N		2.00 m: SPT: 1,0/1,1,1,2.	2.0			
						2.70		
2.80	D3			Firm, light brown / cream, brown, moist, sandy, gravelly CLAY. Gravel of fine to coarse, subangular to rounded flint and chalk.				
3.00	SPT	13 N		3.00 m: SPT: 3,4/3,3,3,4.	3.0			
				Loose to medium dense, moist, orange brown, slightly clayey SAND.	3.60			
3.85	D4			Firm, light brown / cream, brown, moist, sandy, gravelly CLAY. Gravel of fine to coarse, subangular to rounded flint and chalk.	3.80			
4.00	SPT	? N		4.00 m: Saturated, very gravelly and sandy. 4.00 m: SPT: 6,6/5,5,7,?.	4.0			
						4.50		
General Remarks: Borehole terminated at 5.40 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS04		
						Sheet 2 of 2		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
5.00	D5 SPT	50 *		Continued from 3.80 m: Firm, light brown / cream, brown, moist, sandy, gravelly CLAY. Gravel of fine to coarse, subangular to rounded flint and chalk.	4.95		AD	
5.00			CHALK recovered as: Dense, white, silty / clayey gravel of chalk and flint. 5.00 m: SPT: 5,5/10,12,14, 14 for 70mm. 5.00 - 5.40 m: No recovery in SPT.	5.40	CHALK			
					6.0			
					7.0			
					8.0			
					9.0			
General Remarks: Borehole terminated at 5.40 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

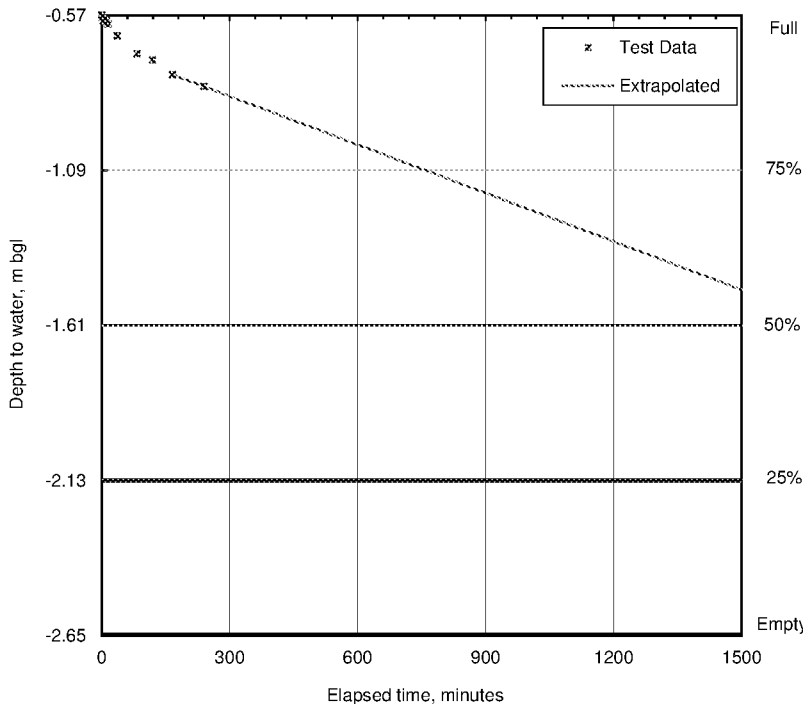
PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS05		
						Sheet 1 of 2		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
0.20	J1			MADE GROUND / TOPSOIL: Crop stubble over soft to firm, brown, gravelly, silty clay. Gravel of fine to coarse, subangular to rounded flint and occasional clinker.	0.30		MG/TS	
				Firm, orange brown, gravelly, sandy CLAY. Gravel of fine to coarse, subangular to rounded flint.				
0.70	D1							
0.80	J2	1.25						
0.80	PEN	kg/cm²						
1.00	SPT	8 N		0.95 m: Orange brown in colour. 1.00 m: SPT: 1,1/2,2,2,2.	1.0			
1.50	PEN	1.75		1.45 m: Very sandy.				
1.70	PEN	1.25						
1.80	D2	kg/cm²						
2.00	SPT	5 N		2.00 m: SPT: 1,1/1,1,1,2.	2.0			
2.60	D3							
2.70	PEN	0.50		2.70 m: Light orange brown in colour with chalk gravel.				
2.85	PEN	0.50		2.80 m: Clayey SAND.				
3.00	SPT	11 N			3.0 3.00			
				Firm, cream / light brown, sandy, gravelly CLAY. Gravel of fine to coarse, angular to rounded chalk and flint. 3.00 m: No recovery in SPT. 3.00 m: SPT: 2,2/2,3,2,4.				
3.70	D4							
4.00	D5	50 *		4.00 m: SPT: 8,5/9,11,14, 16 for 70mm.	4.0			
4.00	SPT			CHALK recovered as: Firm, white / cream, moist, silty, gravelly clay. Gravel of fine to coarse, angular to rounded flint and chalk.	4.10		CHALK	
					4.50			
General Remarks: Borehole terminated at 5.45 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

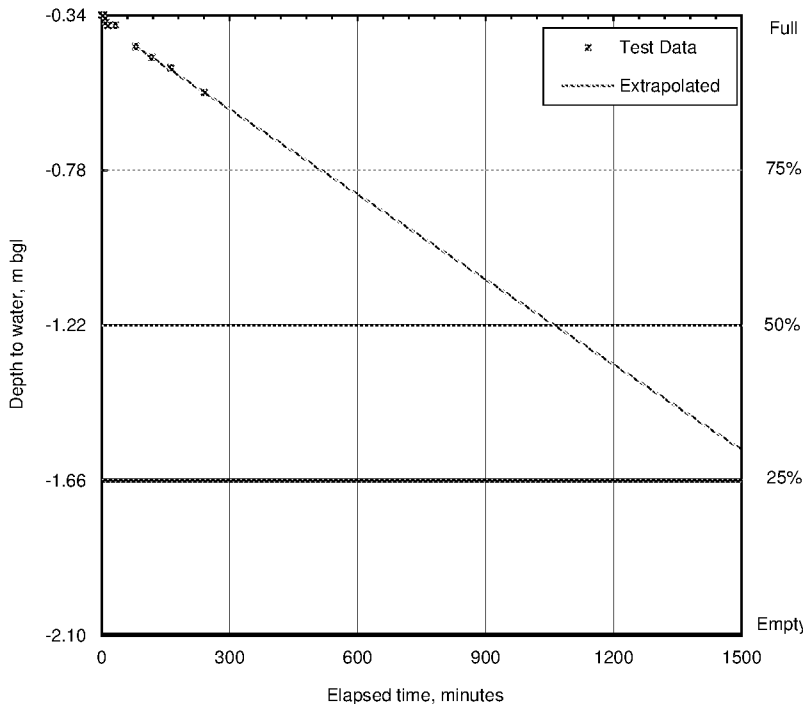
PROBEHOLE RECORD

Client: Gleeson Developments Project Title: Land South of Burndell Road, Yapton Project No: BRD2484 Logged By: J McDermott Date Commenced: 05/11/2015 Date Completed: 05/11/2015 Method Used: Windowless Percussive Sampling Rig						Borehole No. WS05		
						Sheet 2 of 2		
Samples & Tests			Water	Description of Strata	Depth / (Level)	Legend	Geology	Installation /Backfill
Depth	Type & No	Value						
4.70	D6			Continued from 4.10 m: CHALK recovered as: Firm, white / cream, moist, silty, gravelly clay. Gravel of fine to coarse, angular to rounded flint and chalk. 4.75 m: Slightly grey in colour (flint).		CHALK		
5.00	SPT	50 *		5.00 m: SPT: 4,9/11,12,13, 14	5.0			
					5.45			
					6.0			
					7.0			
					8.0			
					9.0			
General Remarks: Borehole terminated at 5.45 m bgl.					Surface Elevation Level:			
					All dimensions in metres Log Scale 1:25			

SOAKAGE TEST RECORD

SOIL INFILTRATION RATE (BRE Digest 365 : Soakaway Test)		
Client: Gleeson Project Title: Burndell Road, Yapton Project No.: BRD2484		
Test Details		
Trial Pit Number	TP01	
Test Number	1	
Pit Depth	2.65	m
Pit Length	2.60	m
Pit Width	0.45	m
Depth to groundwater prior to test	Dry	m
Date of Test	06/11/2015	
Logged by	HKA	
Description of Soil under Test	Soft to firm, silty, gravelly CLAY.	
Test Record		
Elapsed Time min	Depth to Water m	Plot of water level against elapsed time 
0	0.57	
3	0.58	
4	0.59	
6	0.59	
11	0.59	
15	0.60	
36	0.64	
84	0.70	
120	0.72	
166	0.77	
240	0.81	
Summary of Calculations and Result		
RESULT COULD NOT BE CALCULATED AS TEST PIT WOULD NOT REACH HALF EMPTY WITHIN 24 HOURS		
Comments Calculation based on extrapolated results. Use as a guide only.		

SOAKAGE TEST RECORD

SOIL INFILTRATION RATE (BRE Digest 365 : Soakaway Test)		
Client: Gleeson Project Title: Burndell Road, Yapton Project No.: BRD2484		
Test Details		
Trial Pit Number Test Number Pit Depth Pit Length Pit Width Depth to groundwater prior to test Date of Test Logged by Description of Soil under Test	TP02 1 2.10 2.30 0.50 Dry 06/11/2015 HKA Firm, gravelly, sandy, CLAY	m m m m
Test Record		
Elapsed Time min	Depth to Water m	Plot of water level against elapsed time
0 2 5 10 15 32 80 117 163 240	0.34 0.34 0.34 0.36 0.37 0.37 0.43 0.46 0.49 0.56	
Summary of Calculations and Result		
Soil infiltration rate, f, is calculated from the time taken for the water to fall from 75% to 25% effective storage depth in the pit. $f = (V_{75}-V_{25})/A_{50}(T_{75}-T_{25})$ where, T_{75} (515* mins) is the time for the water level to fall to 75% effective depth (0.78m bgl) and T_{25} (1608* mins) is the time for the water level to fall to 25% effective depth (1.66m bgl) thus, $T_{75}-T_{25}$ is the time for the water level to fall from 75% to 25% effective depth: $T_{75}-T_{25} = 1093$ mins $V_{75}-V_{25}$ is the effective storage volume in the trial pit between 75% and 25% effective depth: $V_{75}-V_{25} = 1.01 \text{ m}^3$ and A_{50} is the internal surface area of the trial pit up to 50% effective depth and including the base area: $A_{50} = 6.08 \text{ m}^2$ Soil Infiltration Rate $f = 2.54 \times 10^{-6} \text{ m/s}$		
Comments Calculation based on extrapolated results. Use as a guide only.		

TRL DYNAMIC CONE PENETROMETER TEST



Client Name:	Gleeson	Test No:
Project Name:	Burndell Road, Yapton	CBR01
Project No:	BRD2484	
Tested By:	HKA	
Date:	09/11/2015	

Blow Count	Depth (mm)	mm per blow	CBR %	Plot of CBR (%) against Depth (mm)
0	166	0	-	Notes: California Bearing Ratio (CBR) values calculated on the basis of <i>Operating instructions for the TRL dynamic cone penetrometer (2nd ed)</i>. Transport Research Laboratory, 1991, wherein: $\text{Log}_{10}(\text{CBR}) = 2.48 - 1.057 \log_{10}(\text{penetration rate})$ Values more than 25% CBR are plotted as 25% CBR.
1	219	53	4.5	
2	254	35	7.0	
3	279	25	10	
4	308	29	8.6	
5	348	40	6.1	
6	392	44	5.5	
7	432	40	6.1	
8	472	40	6.1	
9	503	31	8.0	
10	550	47	5.2	
11	601	51	4.7	
12	642	41	6.0	
13	678	36	6.8	
14	711	33	7.5	
15	745	34	7.3	
16	776	31	8.0	
17	803	27	9.3	
18	827	24	10	
20	875	24	10	
22	919	22	12	
24	960	21	12	
26	1000	20	13	

Test No:

CBR02

ARUN DISTRICT COUNCIL Y/98/18/RES

TRL DYNAMIC CONE PENETROMETER TEST



Client Name:	Gleeson	Test No: CBR03
Project Name:	Burndell Road, Yapton	
Project No:	BRD2484	
Tested By:	HKA	
Date:	09/11/2015	

Blow Count	Depth (mm)	mm per blow	CBR %	Plot of CBR (%) against Depth (mm)
0	120	0	-	
1	132	12	22	
2	145	13	20	
3	152	7	39	
4	160	8	34	
5	170	10	26	
6	172	2	150	
7	185	13	20	
8	195	10	26	
9	200	5	55	
10	209	9	30	
12	225	8	34	
14	245	10	26	
16	297	26	9.6	
18	373	38	6.5	
20	434	31	8.1	
22	490	28	8.9	
24	550	30	8.3	
26	594	22	12	
28	636	21	12	
30	682	23	11	
32	726	22	12	
34	773	24	11	
36	824	26	9.8	
38	873	25	10	
40	919	23	11	
42	969	25	10	
44	1000	16	17	
				Notes: California Bearing Ratio (CBR) values calculated on the basis of <i>Operating instructions for the TRL dynamic cone penetrometer (2nd ed)</i> . Transport Research Laboratory, 1991, wherein: $\text{Log}_{10}(\text{CBR}) = 2.48 - 1.057 \log_{10}(\text{penetration rate})$ Values more than 25% CBR are plotted as 25% CBR.

Groundwater Monitoring Record

Project: Land South of Burndell Road, Yapton
Client: Gleeson Developments
Project No: BRD2484

[illegible]



Gas Monitoring Record

Project Name: Land South of Burndell Road, Yapton

Client: Gleeson Developments

Project No: BRD2484

Date:	27/ 11/ 2015	Ground conditions:	Very wet	Recorded by:	HKA
Time at start:	11:55 AM	Weather conditions:	Light to heavy rain	Pressure trend:	Steady
Time at finish:	12:25 PM	Air Temperature (°C):	13	Monitor serial no:	G501688

The gas monitoring equipment is a Geotech GA5000 portable analyser. As per manufacturers recommendations this is factory calibrated every six months and in addition BRD undertake calibration checks against bottled standard gases on at least a monthly basis. Gas monitor pump is run for three minutes unless otherwise stated and the steady readings are an average reading taken over this pump run time. Vapour monitoring equipment is miniRAE lite PGM-7350 Photo Ionisation Detector (PID) with 10.6 eV lamp calibrated for isobutylene. PID calibration check is performed on site against ambient air and also against a 100ppm isobutylene standard gas. Barometric pressure trend and ambient air temperature is recorded from weather websites at the nearest reported weather station.

CH₄ = Methane CO₂ = Carbon Dioxide O₂ = Oxygen H₂S = Hydrogen Sulphide CO = Carbon Monoxide NR = Not Recorded PID = Photo Ionisation Detector

GWL = Groundwater level measured from ground surface and top of standpipe.

Base = Base of standpipe measured from ground surface.

Monitoring point				Gas Concentration								Pressure	Flow rate	Vapour	Comments
Borehole	GWL Ground (m)	GWL Pipe (m)	Base Ground (m)	Steady			Peak		Minimum	Peak		Baro - metric (mb)	Steady (l/ hr)	PID (ppm)	
				CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)				
WS01	2.40	2.40	4.92	0.0	3.2	11.9	0.0	3.2	11.9	0	0	1010	0.1	0.6	
WS02	1.64	1.64	4.92	0.0	2.2	15.3	0.0	2.2	15.3	0	0	1010	0.0	1.7	
WS04	2.87	2.87	4.50	0.0	0.6	15.9	0.0	0.6	15.9	0	0	1011	0.0	1.0	
WS05	2.73	2.73	4.91	0.0	2.9	14.4	0.0	2.9	14.4	0	0	1011	0.0	1.3	



Gas Monitoring Record

Project Name: Land South of Burndell Road, Yapton

Client: Gleeson Developments

Project No: BRD2484

Date:	03/ 12/ 2015	Ground conditions:	Damp	Recorded by:	HKA
Time at start:	12:04 PM	Weather conditions:	Cloudy	Pressure trend:	Steady
Time at finish:	12:26 PM	Air Temperature (°C):	13	Monitor serial no:	G501688

The gas monitoring equipment is a Geotech GA5000 portable analyser. As per manufacturers recommendations this is factory calibrated every six months and in addition BRD undertake calibration checks against bottled standard gases on at least a monthly basis. Gas monitor pump is run for three minutes unless otherwise stated and the steady readings are an average reading taken over this pump run time. Vapour monitoring equipment is miniRAE lite PGM-7350 Photo Ionisation Detector (PID) with 10.6 eV lamp calibrated for isobutylene. PID calibration check is performed on site against ambient air and also against a 100ppm isobutylene standard gas. Barometric pressure trend and ambient air temperature is recorded from weather websites at the nearest reported weather station.

CH₄ = Methane CO₂ = Carbon Dioxide O₂ = Oxygen H₂S = Hydrogen Sulphide CO = Carbon Monoxide NR = Not Recorded PID = Photo Ionisation Detector

GWL = Groundwater level measured from ground surface and top of standpipe.

Base = Base of standpipe measured from ground surface.

Monitoring point				Gas Concentration								Pressure	Flow rate	Vapour	Comments
Borehole	GWL Ground (m)	GWL Pipe (m)	Base Ground (m)	Steady			Peak		Minimum	Peak		Baro - metric (mb)	Steady (l/ hr)	PID (ppm)	
				CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)				
WS01	2.37	2.37	4.92	0.0	3.9	9.1	0.1	3.9	9.1	0	0	1021	0.0	N/ A	
WS02	1.90	1.90	4.92	0.0	2.2	17.3	0.0	2.2	17.3	0	0	1021	0.0	N/ A	
WS04	2.90	2.90	4.50	0.0	0.8	17.0	0.1	0.8	17.0	0	0	1021	0.0	N/ A	
WS05	2.84	2.84	4.91	0.0	3.1	14.5	0.0	3.1	14.5	0	0	1021	0.0	N/ A	



Gas Monitoring Record

Project Name: Land South of Burndell Road, Yapton

Client: Gleeson Developments

Project No: BRD2484

Date:	10/ 12/ 2015	Ground conditions:	Wet	Recorded by:	HKA
Time at start:	11:25 AM	Weather conditions:	Overcast	Pressure trend:	Falling
Time at finish:	11:50 AM	Air Temperature (°C):	12	Monitor serial no:	G501315

The gas monitoring equipment is a Geotech GA5000 portable analyser. As per manufacturers recommendations this is factory calibrated every six months and in addition BRD undertake calibration checks against bottled standard gases on at least a monthly basis. Gas monitor pump is run for three minutes unless otherwise stated and the steady readings are an average reading taken over this pump run time. Vapour monitoring equipment is miniRAE lite PGM-7350 Photo Ionisation Detector (PID) with 10.6 eV lamp calibrated for isobutylene. PID calibration check is performed on site against ambient air and also against a 100ppm isobutylene standard gas. Barometric pressure trend and ambient air temperature is recorded from weather websites at the nearest reported weather station.

CH₄ = Methane CO₂ = Carbon Dioxide O₂ = Oxygen H₂S = Hydrogen Sulphide CO = Carbon Monoxide NR = Not Recorded PID = Photo Ionisation Detector

GWL = Groundwater level measured from ground surface and top of standpipe.

Base = Base of standpipe measured from ground surface.

Monitoring point				Gas Concentration								Pressure	Flow rate	Vapour	Comments
Borehole	GWL Ground (m)	GWL Pipe (m)	Base Ground (m)	Steady			Peak		Minimum	Peak		Baro - metric (mb)	Steady (l/ hr)	PID (ppm)	
				CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)				
WS01	2.32	2.32	4.92	0.0	3.3	10.3	0.0	3.3	10.3	1	0	1027	0.0	0.0	
WS02	1.84	1.84	4.92	0.0	2.0	18.0	0.0	2.0	18.0	0	0	1027	0.0	0.0	
WS04	2.84	2.84	4.50	0.0	0.8	17.4	0.0	0.8	17.4	0	0	1028	0.0	0.0	
WS05	2.81	2.81	4.91	0.1	3.1	13.8	0.1	3.1	13.8	1	0	1028	0.0	0.0	

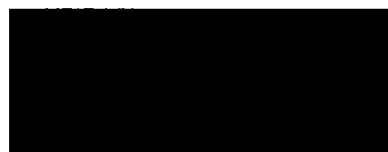
APPENDIX 3



Jess McDermott
BRD Environmental Ltd
Hawthorne Villa
1 Old Parr Road
Banbury
Oxfordshire
OX16 5HT



QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent



QTS Environmental Report No: 15-37508

Site Reference: Burndell Road, Yapton

Project / Job Ref: BRD2484

Order No: None Supplied

Sample Receipt Date: 10/11/2015

Sample Scheduled Date: 10/11/2015

Report Issue Number: 1

Reporting Date: 16/11/2015

Authorised by:

Russell Jarvis
Director

On behalf of QTS Environmental Ltd



Authorised by:

Kevin Old
Director

On behalf of QTS Environmental Ltd





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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN



Soil Analysis Certificate						
QTS Environmental Report No: 15-37508	Date Sampled	05/11/15	05/11/15	05/11/15	05/11/15	06/11/15
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Burndell Road, Yapton	TP / BH No	WS01	WS02	WS03	WS04	TP01
Project / Job Ref: BRD2484	Additional Refs	J1	J1	J2	J	J1
Order No: None Supplied	Depth (m)	0.20	0.20	0.90	0.20	0.20
Reporting Date: 16/11/2015	QTSE Sample No	176940	176941	176942	176943	176944

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.6	6.8	8.7	7.0	7.2
Total Sulphate as SO ₄	mg/kg	< 200	NONE					
Total Sulphate as SO ₄	%	< 0.02	NONE					
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	140	41	27	14	23
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.14	0.04	0.03	0.01	0.02
Total Sulphur	%	< 0.02	NONE					
Organic Matter	%	< 0.1	MCERTS	2.6	2.7	1.3	2.6	2.6
Arsenic (As)	mg/kg	< 2	MCERTS	8	7	11	7	7
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	20	19	30	19	19
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	9	8	12	8	8
Lead (Pb)	mg/kg	< 3	MCERTS	18	15	11	17	18
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	10	10	20	10	10
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	44	40	52	41	40

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

Subcontracted analysis ⁽⁹⁾



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Soil Analysis Certificate						
QTS Environmental Report No: 15-37508	Date Sampled	06/11/15	06/11/15	06/11/15	05/11/15	05/11/15
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Burndell Road, Yapton	TP / BH No	TP02	TP03	TP05	WS01	WS05
Project / Job Ref: BRD2484	Additional Refs	J2	J1	J1	D2	D3
Order No: None Supplied	Depth (m)	0.80	0.20	0.30	1.70	2.60
Reporting Date: 16/11/2015	QTSE Sample No	176945	176946	176947	176948	176949

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	6.9	7.7	6.3	6.9	7.2
Total Sulphate as SO ₄	mg/kg	< 200	NONE					
Total Sulphate as SO ₄	%	< 0.02	NONE					
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	< 10	< 10	< 10	13	< 10
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	< 0.01	< 0.01	< 0.01	0.01	< 0.01
Total Sulphur	%	< 0.02	NONE					
Organic Matter	%	< 0.1	MCERTS	0.9	1.6	1.8		
Arsenic (As)	mg/kg	< 2	MCERTS	9	6	7		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	20	19	20		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	10	7	8		
Lead (Pb)	mg/kg	< 3	MCERTS	11	10	13		
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	18	9	11		
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3		
Zinc (Zn)	mg/kg	< 3	MCERTS	37	42	41		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

Subcontracted analysis ⁽⁹⁾



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Soil Analysis Certificate						
QTS Environmental Report No: 15-37508	Date Sampled	06/11/15	06/11/15	06/11/15	06/11/15	06/11/15
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Burndell Road, Yapton	TP / BH No	TP01	TP03	TP05	TP06	TP08
Project / Job Ref: BRD2484	Additional Refs	D1	D3	D1	J2	D2
Order No: None Supplied	Depth (m)	1.50	2.40	0.90	0.70	1.80
Reporting Date: 16/11/2015	QTSE Sample No	176950	176951	176952	176953	176954

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.5	7.5	7.2	6.7	7.1
Total Sulphate as SO ₄	mg/kg	< 200	NONE			338	395	230
Total Sulphate as SO ₄	%	< 0.02	NONE			0.03	0.04	0.02
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total Sulphur	%	< 0.02	NONE			< 0.02	< 0.02	< 0.02
Organic Matter	%	< 0.1	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS					
Cadmium (Cd)	mg/kg	< 0.2	MCERTS					
Chromium (Cr)	mg/kg	< 2	MCERTS					
Chromium (hexavalent)	mg/kg	< 2	NONE					
Copper (Cu)	mg/kg	< 4	MCERTS					
Lead (Pb)	mg/kg	< 3	MCERTS					
Mercury (Hg)	mg/kg	< 1	NONE					
Nickel (Ni)	mg/kg	< 3	MCERTS					
Selenium (Se)	mg/kg	< 3	NONE					
Zinc (Zn)	mg/kg	< 3	MCERTS					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

Subcontracted analysis ⁽⁹⁾



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Soil Analysis Certificate						
QTS Environmental Report No: 15-37508	Date Sampled	06/11/15				
BRD Environmental Ltd	Time Sampled	None Supplied				
Site Reference: Burndell Road, Yapton	TP / BH No	TP09				
Project / Job Ref: BRD2484	Additional Refs	D2				
Order No: None Supplied	Depth (m)	2.00				
Reporting Date: 16/11/2015	QTSE Sample No	176955				

Determinand	Unit	RL	Accreditation				
pH	pH Units	N/a	MCERTS	7.2			
Total Sulphate as SO ₄	mg/kg	< 200	NONE	224			
Total Sulphate as SO ₄	%	< 0.02	NONE	0.02			
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	< 10			
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	< 0.01			
Total Sulphur	%	< 0.02	NONE	< 0.02			
Organic Matter	%	< 0.1	MCERTS				
Arsenic (As)	mg/kg	< 2	MCERTS				
Cadmium (Cd)	mg/kg	< 0.2	MCERTS				
Chromium (Cr)	mg/kg	< 2	MCERTS				
Chromium (hexavalent)	mg/kg	< 2	NONE				
Copper (Cu)	mg/kg	< 4	MCERTS				
Lead (Pb)	mg/kg	< 3	MCERTS				
Mercury (Hg)	mg/kg	< 1	NONE				
Nickel (Ni)	mg/kg	< 3	MCERTS				
Selenium (Se)	mg/kg	< 3	NONE				
Zinc (Zn)	mg/kg	< 3	MCERTS				

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Analysis carried out on the dried sample is corrected for the stone content

Subcontracted analysis ⁽⁹⁾



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 15-37508	Date Sampled	05/11/15	05/11/15	05/11/15	05/11/15	06/11/15
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Burndell Road, Yapton	TP / BH No	WS01	WS02	WS03	WS04	TP01
Project / Job Ref: BRD2484	Additional Refs	J1	J1	J2	J	J1
Order No: None Supplied	Depth (m)	0.20	0.20	0.90	0.20	0.20
Reporting Date: 16/11/2015	QTSE Sample No	176940	176941	176942	176943	176944

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 15-37508	Date Sampled	06/11/15	06/11/15	06/11/15		
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Burndell Road, Yapton	TP / BH No	TP02	TP03	TP05		
Project / Job Ref: BRD2484	Additional Refs	J2	J1	J1		
Order No: None Supplied	Depth (m)	0.80	0.20	0.30		
Reporting Date: 16/11/2015	QTSE Sample No	176945	176946	176947		

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - TPH LQM Banded

QTS Environmental Report No: 15-37508	Date Sampled	05/11/15	06/11/15	06/11/15		
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Burndell Road, Yapton	TP / BH No	WS03	TP01	TP02		
Project / Job Ref: BRD2484	Additional Refs	J2	J1	J2		
Order No: None Supplied	Depth (m)	0.90	0.20	0.80		
Reporting Date: 16/11/2015	QTSE Sample No	176942	176944	176945		

Determinand	Unit	RL	Accreditation					
Aliphatic > C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aliphatic > C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aliphatic > C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic > C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic > C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic > C16 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aliphatic > C35 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10		
Aliphatic (C5 - C44)	mg/kg	< 30	NONE	< 30	< 30	< 30		
Aromatic > C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aromatic > C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aromatic > C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic > C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic > C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic > C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aromatic > C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aromatic > C35 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10		
Aromatic (> C5 - C44)	mg/kg	< 30	NONE	< 30	< 30	< 30		
Total > C5 - C44	mg/kg	< 60	NONE	< 60	< 60	< 60		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 15-37508	Date Sampled	05/11/15	06/11/15	06/11/15		
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Burndell Road, Yapton	TP / BH No	WS03	TP01	TP02		
Project / Job Ref: BRD2484	Additional Refs	J2	J1	J2		
Order No: None Supplied	Depth (m)	0.90	0.20	0.80		
Reporting Date: 16/11/2015	QTSE Sample No	176942	176944	176945		

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5		
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Semi Volatile Organic Compounds (SVOC)

QTS Environmental Report No: 15-37508	Date Sampled	05/11/15	06/11/15			
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Burndell Road, Yapton	TP / BH No	WS03	TP02			
Project / Job Ref: BRD2484	Additional Refs	J2	J2			
Order No: None Supplied	Depth (m)	0.90	0.80			
Reporting Date: 16/11/2015	QTSE Sample No	176942	176945			

Determinand	Unit	RL	Accreditation			
Phenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
1,2,4-Trichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
2-Nitrophenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
Nitrobenzene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
0-Cresol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
bis(2-chloroethoxy)methane	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
bis(2-chloroethyl)ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
2,4-Dichlorophenol	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
2-Chlorophenol	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
1,3-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
1,4-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
1,2-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
2,4-Dimethylphenol	mg/kg	< 0.15	ISO17025	< 0.15	< 0.15	
Isophorone	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
Hexachloroethane	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
p-Cresol	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15	
2,4,6-Trichlorophenol	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
2,4,5-Trichlorophenol	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15	
2-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
4-Chloro-3-methylphenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
2-Methylnaphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
Hexachlorocyclopentadiene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
Hexachlorobutadiene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
2,6-Dinitrotoluene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
Dimethyl phthalate	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
2-Chloronaphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
4-Chloroaniline	mg/kg	< 0.15	NONE	< 0.15	< 0.15	
4-Nitrophenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
4-Chlorophenyl phenyl ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
3-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
4-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
4-Bromophenyl phenyl ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
Hexachlorobenzene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
2,4-Dinitrotoluene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
Diethyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
Dibenzofuran	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
Azobenzene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	
Dibutyl phthalate	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
Carbazole	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	
bis(2-ethylhexyl)phthalate	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15	
Benzyl butyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	
Di-n-octyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN

Soil Analysis Certificate - Organochlorine Pesticides						
QTS Environmental Report No: 15-37508	Date Sampled	06/11/15				
BRD Environmental Ltd	Time Sampled	None Supplied				
Site Reference: Burndell Road, Yapton	TP / BH No	TP03				
Project / Job Ref: BRD2484	Additional Refs	J1				
Order No: None Supplied	Depth (m)	0.20				
Reporting Date: 16/11/2015	QTSE Sample No	176946				

Determinand	Unit	RL	Accreditation				
Aldrin	mg/kg	< 0.02	NONE	< 0.02			
alpha-HCH	mg/kg	< 0.02	NONE	< 0.02			
beta-HCH	mg/kg	< 0.02	NONE	< 0.02			
cis-chlordane	mg/kg	< 0.02	NONE	< 0.02			
delta-HCH	mg/kg	< 0.02	NONE	< 0.02			
Dieldrin	mg/kg	< 0.02	NONE	< 0.02			
Endosulfan A	mg/kg	< 0.02	NONE	< 0.02			
Endosulfan B	mg/kg	< 0.02	NONE	< 0.02			
Endrin	mg/kg	< 0.02	NONE	< 0.02			
gamma-HCH (Lindane)	mg/kg	< 0.02	NONE	< 0.02			
Heptachlor	mg/kg	< 0.02	NONE	< 0.02			
Heptachlor epoxide	mg/kg	< 0.02	NONE	< 0.02			
Hexachlorobenzene (HCB)	mg/kg	< 0.02	NONE	< 0.02			
Isodrin	mg/kg	< 0.02	NONE	< 0.02			
Methoxychlor	mg/kg	< 0.02	NONE	< 0.02			
o,p' - DDD	mg/kg	< 0.02	NONE	< 0.02			
o,p' - DDE	mg/kg	< 0.02	NONE	< 0.02			
o,p' - DDT	mg/kg	< 0.02	NONE	< 0.02			
p,p' - DDD	mg/kg	< 0.02	NONE	< 0.02			
p,p' - DDE	mg/kg	< 0.02	NONE	< 0.02			
p,p' - DDT	mg/kg	< 0.02	NONE	< 0.02			
trans-chlordane	mg/kg	< 0.02	NONE	< 0.02			
Trifluralin	mg/kg	< 0.02	NONE	< 0.02			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Sample Descriptions

QTS Environmental Report No: 15-37508

BRD Environmental Ltd

Site Reference: Burndell Road, Yapton

Project / Job Ref: BRD2484

Order No: None Supplied

Reporting Date: 16/11/2015

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
176940	WS01	J1	0.20	18.2	Light brown sandy clay
176941	WS02	J1	0.20	18.3	Brown sandy clay
176942	WS03	J2	0.90	17.1	Light brown sandy clay
176943	WS04	J	0.20	19.3	Light brown sandy clay
176944	TP01	J1	0.20	17.2	Light brown sandy clay
176945	TP02	J2	0.80	14.4	Light brown sandy clay
176946	TP03	J1	0.20	17	Light brown sandy clay
176947	TP05	J1	0.30	19.1	Brown sandy clay
176948	WS01	D2	1.70	8.9	Brown sandy clay with stones
176949	WS05	D3	2.60	16.8	Light brown sandy clay
176950	TP01	D1	1.50	18.7	Light brown sandy clay
176951	TP03	D3	2.40	13.8	Light grey sandy clay with chalk
176952	TP05	D1	0.90	16.2	Light brown sandy clay
176953	TP06	J2	0.70	18.6	Brown sandy clay
176954	TP08	D2	1.80	15.4	Brown sandy clay
176955	TP09	D2	2.00	16.5	Light brown sandy clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{I/S}

Unsuitable Sample ^{U/S}



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Maidstone
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Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 15-37508

BRD Environmental Ltd

Site Reference: Burndell Road, Yapton

Project / Job Ref: BRD2484

Order No: None Supplied

Reporting Date: 16/11/2015

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 dphenylcarbazine followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : 26/11/15 PAGE 1 of 13 Pages

Contract

Serial No.

Burndell Road, Yapton

S29451



CLIENT:

BRD Environmental Ltd
Hawthorne Villa
1 Old Parr Road
Banbury
Oxfordshire
OX16 5HT

Soil Property Testing Ltd.

15,16 & 18 Halcyon Court, St Margarets Way,
Stukeley Meadows, Huntingdon,
Cambs. PE29 6DG.

Telephone [REDACTED] Fax [REDACTED]
Email [REDACTED]

SAMPLES SUBMITTED BY:

BRD Environmental Ltd

APPROVED SIGNATORIES:

- ☒ J.C.GARNER B.Eng (Hons.) FGS
Technical Director
- ☐ S.P.TOWNEND FGS
Quality Manager
- ☐ W.JOHNSTONE
Materials Lab Manager

SAMPLES LABELLED:

Burndell Road, Yapton

DATE RECEIVED: 11/11/15

SAMPLES TESTED BETWEEN 11/11/15 **and** 26/11/15

REMARKS: For the attention of Jess McDermot
Your reference BRD2484

- NOTES:**
- 1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.
 - 2 (a) UKAS - United Kingdom Accreditation Service.
(b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
 - 3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.
 - 4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.



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S29451



TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 3 of 3

Contract
Burndell Road, Yapton

Serial No.
S29451



SUMMARY OF MOISTURE CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasti- city Index (%)	Liqu- idity Index (%)	SAMPLE PREPARATION				Description	CLASS
								Method S/N	Ret'd 0.425mm (%)	Corr'd M/C <0.425mm	Curing Time (hrs.)		
TP04	1.00	D1	21	44	20	24	0.04	N	0 (A)		28	Stiff dark yellowish brown silty CLAY with rare recently active roots	CI
TP04	2.00	D2	30	41	19	22	0.50	N	0 (A)		27	Soft yellowish brown silty CLAY	CI
TP07	2.40	D3	15	28	14	14	0.93*	S	44 (M)	27	24	Soft yellowish brown slightly gravelly sandy silty CLAY. Gravel is black, white and brown angular and subangular flint	CL
TP09	0.80	D1	25	45	19	26	0.23	N	0 (A)			Firm yellowish brown silty CLAY with rare recently active and decayed roots	CI
WS02	0.50	D1	22	39	20	19	0.11	N	0 (A)		26	Stiff yellowish brown slightly sandy silty CLAY with rare recently active roots	CI
WS04	1.70	D2	20	35	16	19	0.21*	N	2 (A)	20	28	Firm yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is brown and black fine and medium angular to subrounded flint	CL/ CI

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

S = Wet Sieved Specimen
N = prepared from Natural

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter. A = Assumed, M = Measured

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.



TEST REPORT.

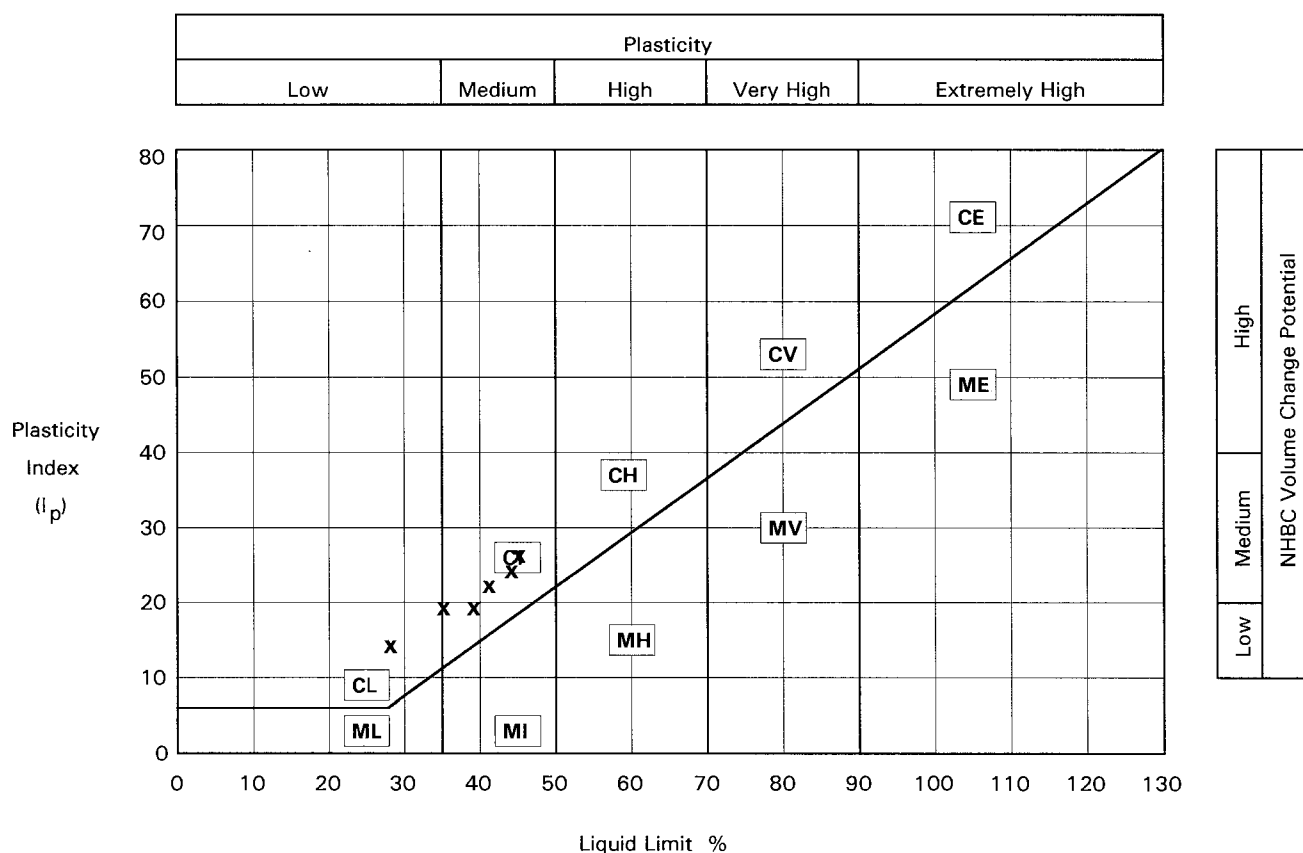
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Contract
Burndell Road, Yapton

Serial No.
S29451

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index PLASTICITY CHART BS5930:1999:Figure 18



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Burndell Road, Yapton

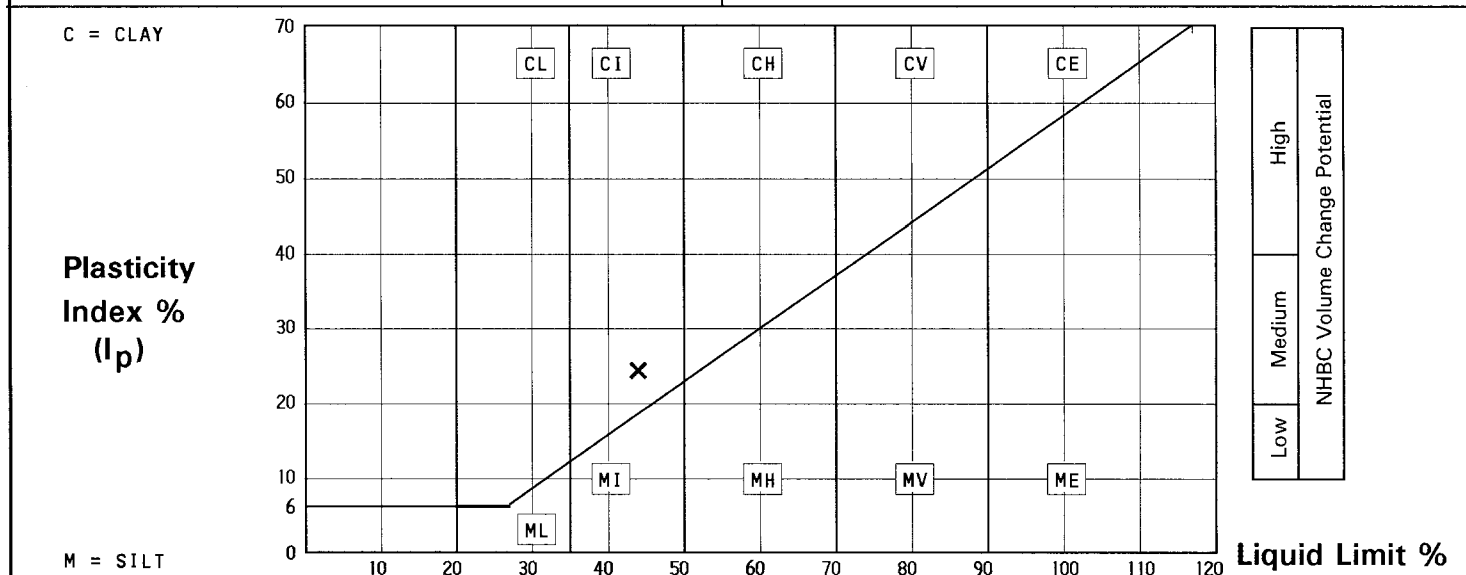
Serial No.
S29451



DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
TP04	1.00	D1	21	Stiff dark yellowish brown silty CLAY with rare recently active roots	

PREPARATION				Liquid Limit	44 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	20 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	24 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.04
Curing Time 28 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'_p = I_p × (% less than 425 microns/100)
<1% gravel by dry mass picked out by hand and excluded from limits tests.



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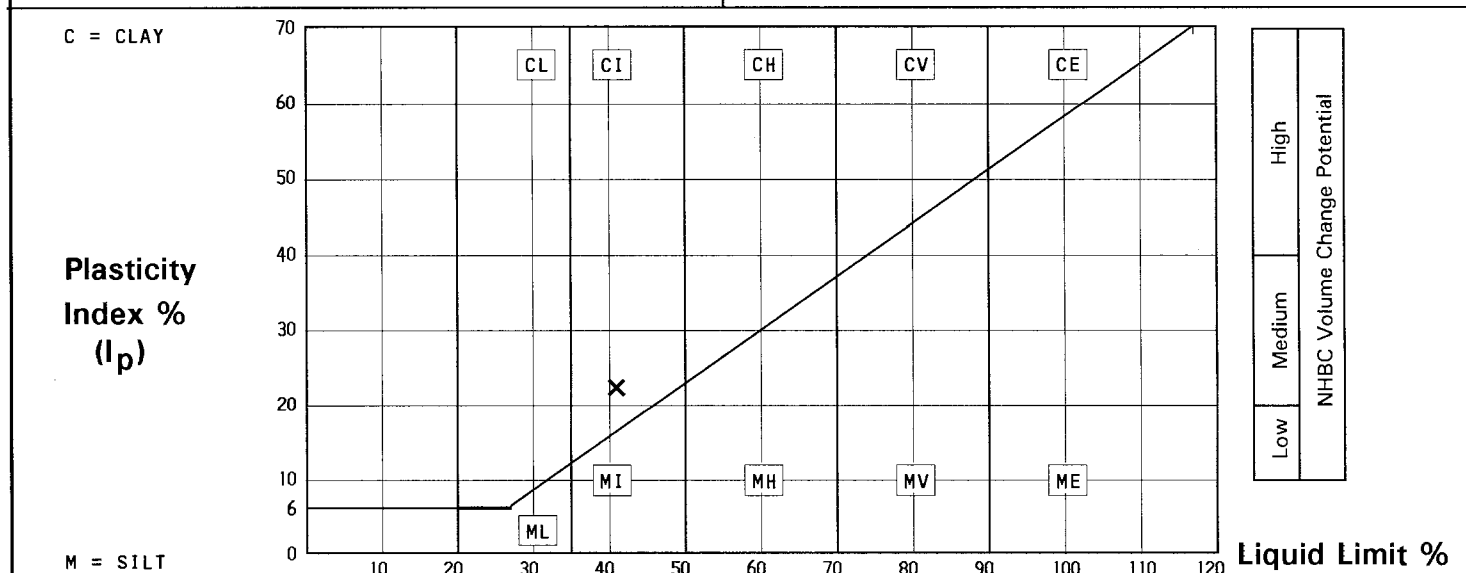
Serial No.
S29451



DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
TP04	2.00	D2	30	Soft yellowish brown silty CLAY	

PREPARATION				Liquid Limit	41 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	19 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	22 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.50
Curing Time 27 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p' = I_p x (% less than 425 microns/100)



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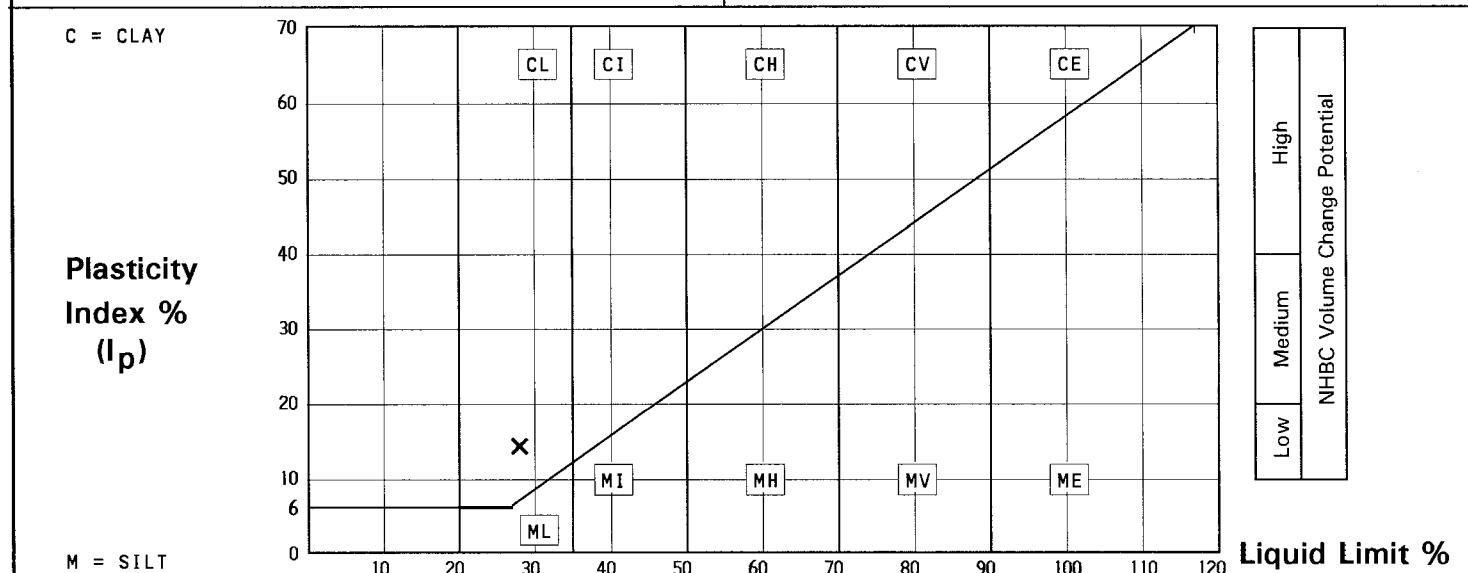
Serial No.
S29451



DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
TP07	2.40	D3	15	Soft yellowish brown slightly gravelly sandy silty CLAY. Gravel is black, white and brown angular and subangular flint	

PREPARATION				Liquid Limit	28 %
Method of Preparation Sieved Specimen				Plastic Limit	14 %
Sample retained 0.425 sieve (Measured) 44 %				Plasticity Index	14 %
Corrected moisture content for material passing 0.425mm 27 %				Liquidity Index	0.93
Curing Time 24 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p' = I_p x (% less than 425 microns/100)
30% retained on 2mm sieve.
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.



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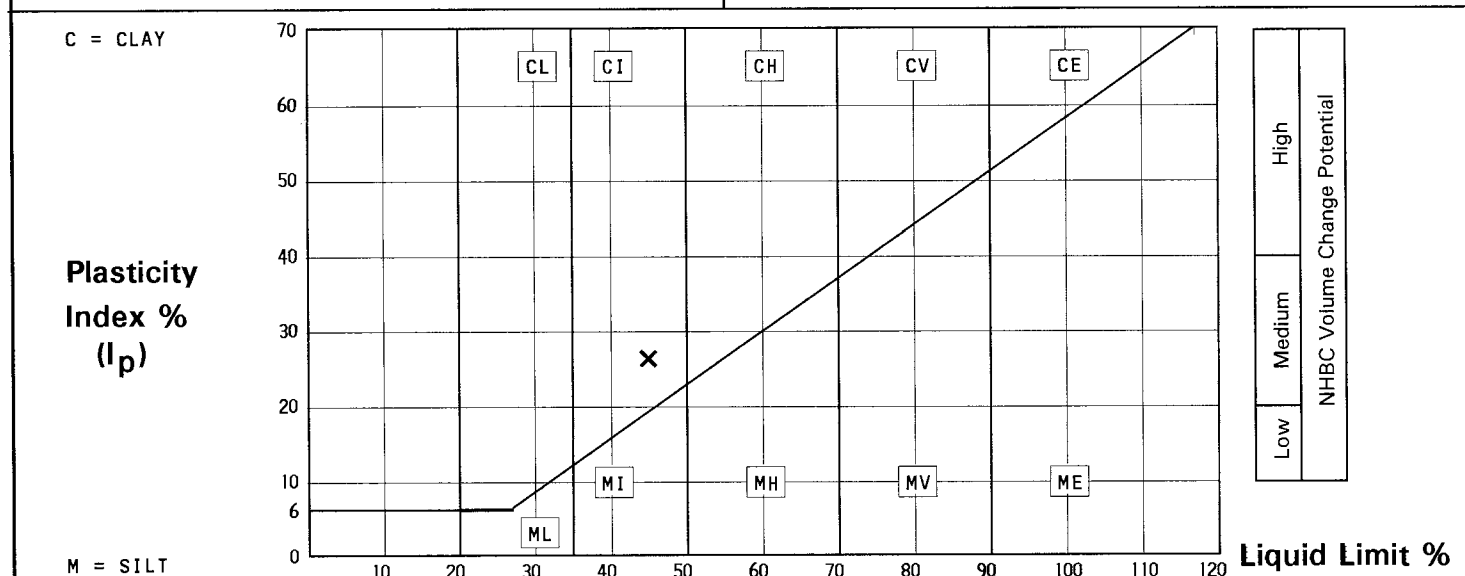
Serial No.
S29451



DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
TP09	0.80	D1	25	Firm yellowish brown silty CLAY with rare recently active and decayed roots	

PREPARATION				Liquid Limit	45 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	19 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	26 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.23
Curing Time				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p' = I_p x (% less than 425 microns/100)



TEST REPORT.

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DATE OF ISSUE : As page 1 PAGE 9 of 13

Contract
Burndell Road, Yapton

Serial No.
S29451



DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

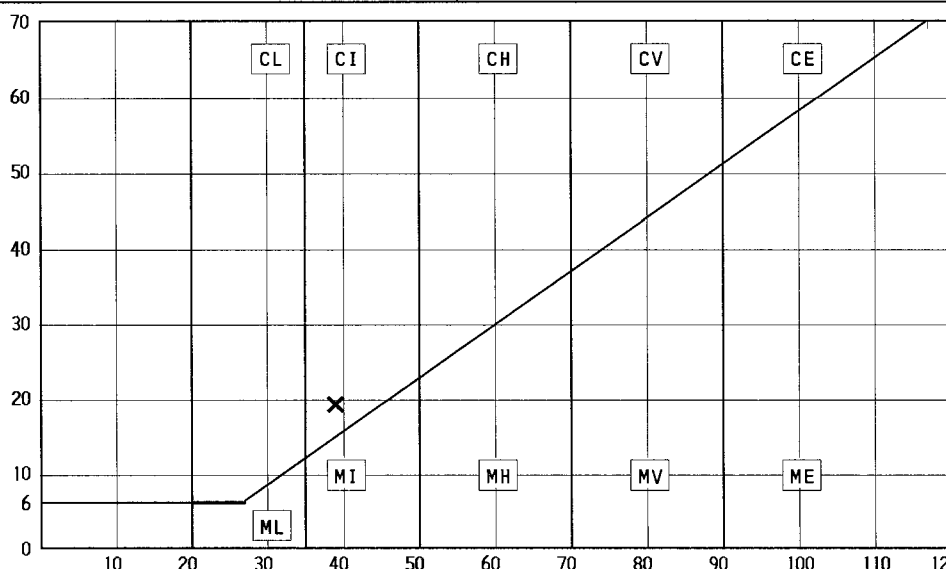
Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
WS02	0.50	D1	22	Stiff yellowish brown slightly sandy silty CLAY with rare recently active roots	

PREPARATION				Liquid Limit	39 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	20 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	19 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.11
Curing Time 26 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.

C = CLAY

Plasticity
Index %
(I_p)

M = SILT



High
Medium
Low

NHBC Volume Change Potential

Liquid Limit %

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p' = I_p x (% less than 425 microns/100)

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 PAGE 10 of 13

Contract
Burndell Road, Yapton

Serial No.
S29451



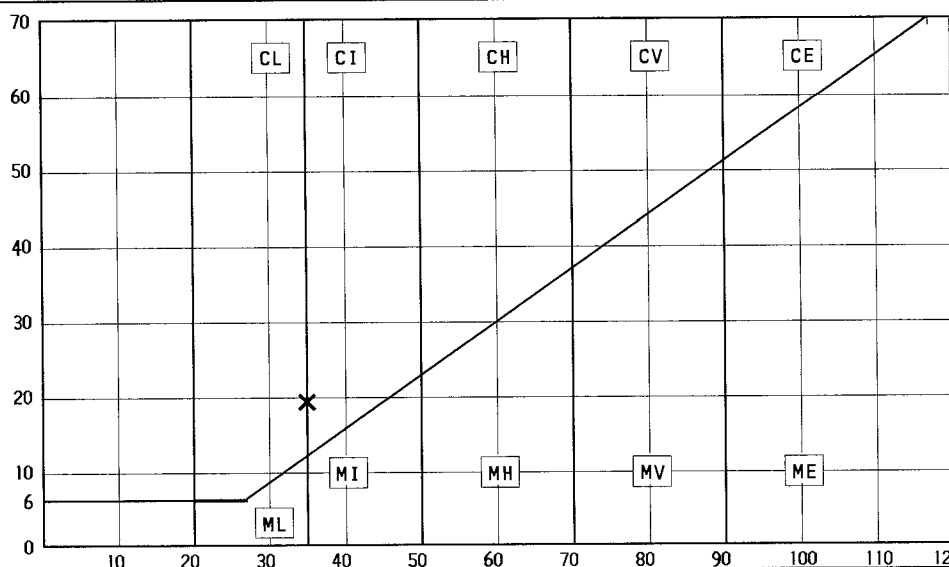
**DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT
AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX**

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
WS04	1.70	D2	20	Firm yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is brown and black fine and medium angular to subrounded flint	

PREPARATION			Liquid Limit	35 %
Method of Preparation	Specimen from Natural Soil		Plastic Limit	16 %
Sample retained 0.425 sieve	(Assumed)	2 %	Plasticity Index	19 %
Corrected moisture content for material passing 0.425mm			Liquidity Index	0.21
Curing Time	28 Hours		Clay Content	Not analysed. %
			Derived Activity (PI/CC)	Not analysed.

C = CLAY

**Plasticity
Index %
(I_p)**



M = SILT

Low	Medium	High
NHBC Volume Change Potential		

Liquid Limit %

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample,
C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index $I_p = I_p \times (\% \text{ less than } 425 \text{ microns}/100)$
Approximately 2% gravel by dry mass picked out by hand and excluded from limits tests.
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm
non porous. See BS1377:Part2:1990 Clause 3 Note 1.



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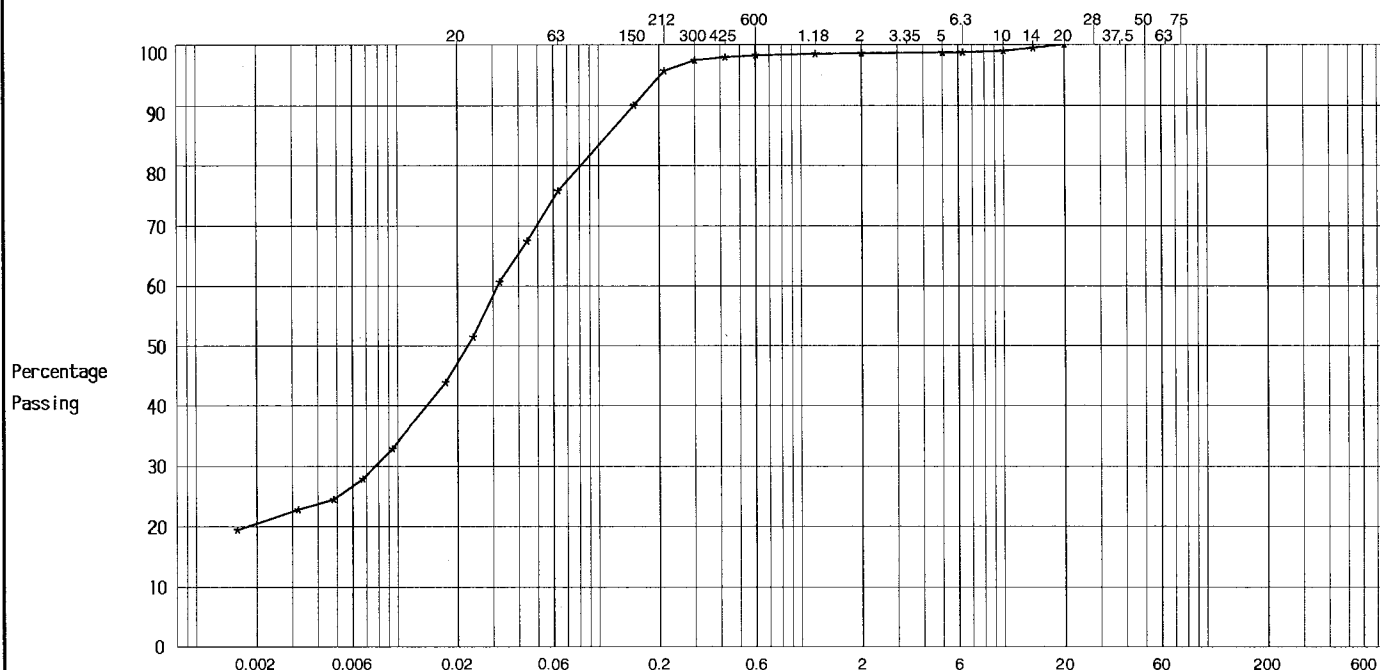
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
TP02	1.50 -2.10	B1	Firm brown slightly gravelly slightly sandy silty CLAY. Gravel is brown, white and black angular flint	

Method
of Test: Wet Sieve + Hydrometer

Method of
pre-treatment: Not required

Size (microns)															Size (mm)															
Sieve Size					1.6	3.2	4.8	6.7	9.4	17.4	23.8	32.2	44.2	63	150	212	300	425	600	1.18	2	5	6.3	10	14	20	28	37.5	50	75
Percentage by Mass passing Sieve					19	23	24	28	33	44	51	61	67	76	90	96	97	98	98	98	99	99	99	99	99	100	-	-	-	-



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3 & 7.4.5

METHOD OF TEST : BS 1377:PART 2:1990:9.2 + 9.5

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample,
C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin
of test specimen within original sample. Oven drying temperature if not 105-110 deg C.



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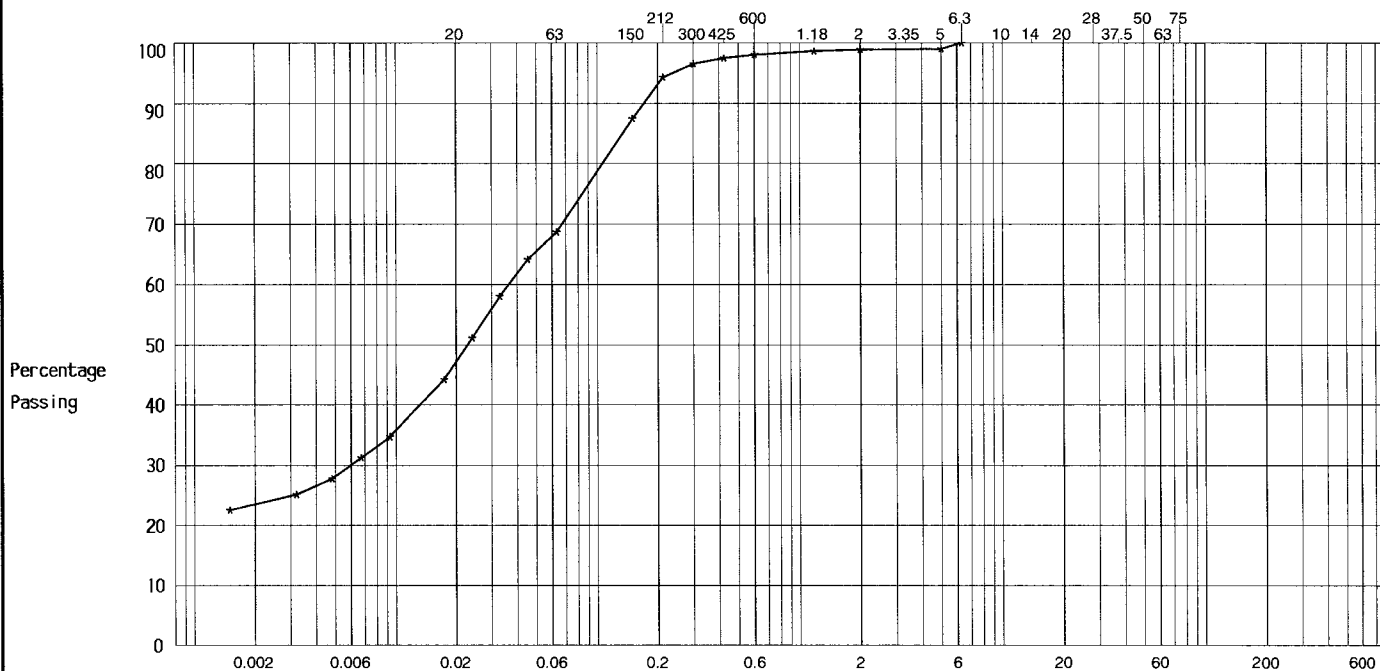
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
TP06	0.80 -1.80	B1	Stiff orangey brown slightly sandy silty CLAY with occasional brown, light orangey brown and yellowish brown mottling and rare fine subangular and subrounded	

Method
of Test: Wet Sieve + Hydrometer

Method of
pre-treatment: Not required

Size (microns)																Size (mm)									
Sieve Size																									
Percentage by Mass passing Sieve																									



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3 & 7.4.5

METHOD OF TEST : BS 1377:PART 2:1990:9.2 + 9.5

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.



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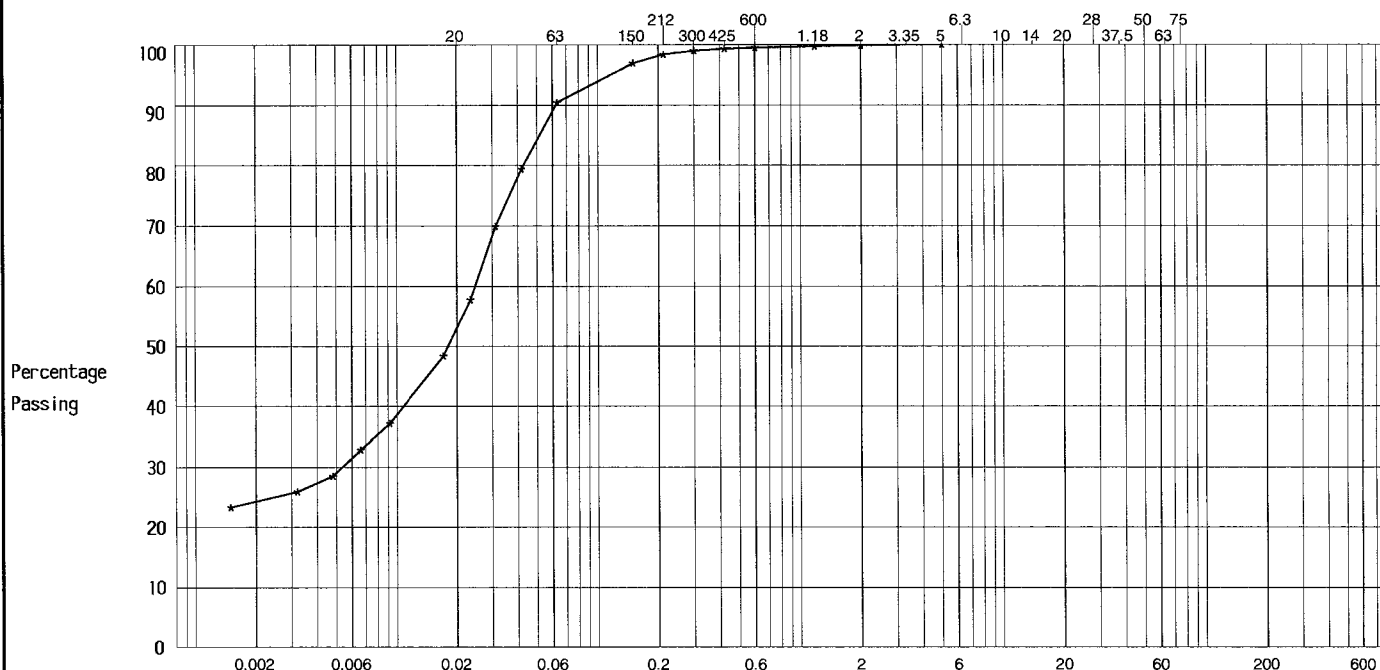
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
TP07	0.80 -1.70	B1	Firm light orangey brown slightly sandy silty CLAY with occasional brown mottling and rare fine subrounded gravel	

Method of Test: Wet Sieve + Hydrometer

Method of pre-treatment: Not required

Size (microns)																Size (mm)											
Sieve Size																											
Percentage by Mass passing Sieve																											



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3 & 7.4.5

METHOD OF TEST : BS 1377:PART 2:1990:9.2 + 9.5

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.