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GEO-ENVIRONMENTAL INVESTIGATION AND ASSESSMENT

For the site at

STURRY ROAD, CANTERBURY

Undertaken for

THE CANTERBURY SYNDICATE

and

BANK OF SCOTLAND

SS016679-PE-08-266-R

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Report Title:	**Geo-environmental Investigation and Assessment For the site at Sturry Road, Canterbury**
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	For and on behalf of Capita Symonds (Structures) Ltd

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1. INTRODUCTION

1.1. Appointment

1.1.1. Capita Symonds (Structures) Ltd ("CSS") was appointed by The Canterbury Syndicate and Bank of Scotland to undertake a Phase 2 Geo-environmental Investigation and Assessment of the site situated on Sturry Road in Canterbury, Kent.

1.2. Proposed Development

1.2.1. It is understood that current development proposals comprise the construction of light industrial/commercial units with associated concrete-surfaced access roads and vehicle parking areas, and localised soft landscaping.

1.2.2. A proposed development layout drawing is presented as Figure 3.

1.3. Objectives of Investigation

1.3.1. This report follows a Phase 1 Desk Study of the site undertaken by CSS in March 2008.

1.3.2. The aim of the investigation was to provide an assessment of environmental risks posed by the site both in terms of its present and developed condition, together with the provision of geotechnical recommendations for construction purposes.

1.3.3. To achieve these aims, the following objectives were defined and undertaken:

- Establish the stratigraphy underlying the site;
- Identify potential hazards to the development by measuring and quantifying:
  - Soil contamination
  - Groundwater contamination
  - Ground gas concentrations
  - Geotechnical characteristics
- Undertake Generic Quantitative Risk Assessments (GQRA).
- Where risks are assessed as unacceptable, provide recommendations for appropriate cost-effective mitigation and/or remediation measures where considered necessary.
- Provide recommendations regarding suitable foundations, floor slabs and new pavement construction together with other geotechnical considerations affecting the development.

1.4. Scope of Works

1.4.1. The report comprises a review of the desk study including the site's location, environmental setting and conceptual model and discussed the findings of the ground investigation. The physical works were undertaken between 29th and 30th July 2008 and

comprised the following:

- 6no windowless sample boreholes (WS1 to WS6) to investigate near surface deposits. All window sample boreholes were installed with standpipes for subsequent monitoring of ground gas concentrations.
- 3no cable percussion boreholes (BH1 and BH3) to investigate deeper geological conditions and provide geotechnical information for construction purposes. All boreholes were installed with ground gas and groundwater monitoring standpipes.
- 8no mechanically excavated trial pits (TP1 to TP8) to provide further coverage of shallow ground conditions.
- Collection of representative soil samples and subsequent laboratory testing for ground contamination and geotechnical assessment.

1.4.2. On completion of the intrusive investigation three rounds of follow-up monitoring was undertaken to determine groundwater levels and ground gas concentrations. Groundwater samples were collected for laboratory chemical analysis during the first return visit.

1.4.3. All of the information and data obtained from the various sources is presented and discussed in the following sections and appendices of this report.

2. SITE LOCATION AND DESCRIPTION

2.1. Site Location

2.1.1. The subject site is located on the north side of Sturry Road (the A28) in Canterbury, Kent.

2.1.2. It is centred on approximate Ordnance Survey National Grid Reference 616770, 159590.

2.1.3. A location plan is presented in Figure 501.

2.2. Site Description

2.2.1. The site is irregular in plan shape and covers an area of approximately 1.4 ha (14,000m^2).

2.2.2. At the time of the ground investigation works (29 – 31 July 2008) the site comprised an undeveloped generally flat plot with unmade surfacing and sporadic vegetation cover. The majority of vegetation, including a number of mature and semi-mature trees, had been cleared in early July 2008. Small piles of wood chippings derived from this clearance were present at the site.

2.2.3. A stand of suspected Japanese Knotweed, which was not removed during the vegetation clearance due to ecological concerns, was situated near the northern end of the site, to the west of a telecoms mast. This is discussed further in Section 3.8.

2.2.4. A line of trees defines the site's south-eastern boundary with Sturry Road; a break in this tree line provides access to the site.

2.2.5. A wire mesh fence runs through the centre of the site, separating the main body from the eastern sector. A break was formed in this fence to allow access across the whole of the site during the ground investigation.

2.2.6. The telecommunications mast is situated in the north-east corner of the site, enclosed within a concrete post and wire mesh fenced compound. A metal cabin is located next to the mast within the compound. A gate providing access to the site and the mast compound from the neighbouring sewage treatment works (see surrounding land use below) is situated immediately north of the mast enclosure.

2.2.7. Overhead power lines pass over the site roughly from its north-west corner to over the centre of the south-east boundary.

2.2.8. 4no steel manhole covers (approx 600mm diameter) were identified at various locations. A separate services investigation report discusses these and other services below the site.

2.3. Site Boundaries and Surrounding Land-Use

2.3.1. The site is situated immediately beyond the eastern boundary of a retail park - Canterbury Trade Park – which comprises steel portal framed type commercial units. Access to the retail park is via Vauxhall Road, to the north of Sturry Road.

2.3.2. The site is bounded to the south-west by a low wooden post and/or wire fence, beyond which is the concrete service yard of the adjacent commercial property.

2.3.3. The south-eastern boundary is defined by a line of trees, with Sturry Road immediately beyond. A retail park including a fast food restaurant is situated opposite the main body of the site, and a Park and Ride facility is located to the north-east of this retail park opposite the eastern part of the subject site.

2.3.4. The north-eastern boundary is defined by a concrete post and wire mesh fence. A concrete surfaced road associated with the adjacent sewage works runs parallel to the fence outside the site boundary. A brief walkover of the sewage works indicated it to comprise numerous settlement tanks, digesters and associated plant and machinery.

2.3.5. The north-western boundary is defined by a steel palisade fence with Parker Steel, a steel distribution depot, beyond. Stockpiles of steel sheet piles were noted near the site boundary. The cubic plastic containers of an unidentified chemical stacked immediately north of the palisade fence at the time of the Phase 1 desk study were no longer present.

3. ENVIRONMENTAL SETTING

3.1. Introduction

3.1.1. Full details of the site's environmental setting are provided in the Phase 1 desk study. Outline details are provided in the following sections for quick reference.

3.2. Geology

3.2.1. British Geological Survey Sheet 289 'Canterbury' (1:50,000) indicates the site to be underlain by Alluvium (grey brown silty clay) over River Terrace Gravels (sandy gravel) and/or Head Brickearth (sand and clay). The underlying solid geology is indicated to comprise Thanet Beds, described as fine-grained grey and brown sands with local clayey intercalations.

3.3. Hydrology

3.3.1. The nearest identified surface watercourse is the River Great Stour, situated approximately 200m north of the site.

3.3.2. There are no known licensed surface water abstractions within 1km of the site.

3.4. Hydrogeology

3.4.1. Environment Agency Groundwater Vulnerability Sheet 47 'East Kent' (1:100,000) indicates the site is underlain by a Minor Aquifer.

3.4.2. The site is not located within a groundwater Source Protection Zone.

3.4.3. The nearest recorded groundwater abstraction is situated 675m north-west of the site, by Brett Waste Management Ltd. The abstraction is recorded as being from 'Point A at Sturry' from the Thanet Beds. The abstraction relates to make-up or top up water for refuse and recycling. There is 1no further abstraction within 1km and there are 4no within 2km of the site.

3.5. Landfill and Waste Management Activity

3.5.1. The desk study identified several waste management features situated within the site locale. The table below lists the most significant:

Feature	Distance from Site	Waste type
Former landfill	15m south-east (south of Sturry Road)	Inert, Commercial, Household and Special Waste
Former landfill	250m south-west	Inert and Household Waste.
Active landfill and	500-600m north-west	Various, including potentially

Feature	Distance from Site	Waste type
licensed waste management facility	at Shelford Quarry	hazardous materials
Historic landfill	550m north at Broad Oak Lodge	Inert
Sewage treatment works (Southern Water Services)	125m north-east	Biological
Waste Transfer site (licence defunct)	60m east	Chemical wastes, construction/ demolition wastes, excavated natural materials, household/ commercial/ industrial waste, and old machinery/ vehicles.

3.6. Potential Radon Risks

3.6.1. The site is not indicated to be within an area where statistical analysis has shown there to be a risk from radon.

3.7. Industrial Land Use Information

3.7.1. According to the Envirocheck Report the nearest fuel station is an ESSO garage situated 550m south-west of the site on Sturry Road.

3.8. Ecological Information

3.8.1. Ecological assessment does not form part of the brief of the geo-environmental investigation and report and is outside the agreed scope of works. The following is provided for information only.

3.8.2. The Desk Study indicated that the site does not lie within an ecologically sensitive area.

3.8.3. During the vegetation clearance a stand of suspected Japanese Knotweed, situated in the centre of the northern part of the site, was identified. Photographs have been passed to an ecological consultant who has confirmed this identification.

3.8.4. Japanese knotweed is designated as an invasive species and listed as a noxious weed under the Wildlife and Countryside Act 1981. It requires specialist treatment/removal.

3.9. Regulator Consultations

3.9.1. The March 2008 Desk Study reported that, at the time of issue, a response was awaited from the Environmental Protection Section at Canterbury City Council following a written request for information. This has since been received.

3.9.2. In a letter dated 1st April 2008 (received 7th April) the council advises that it is not aware of any previous ground investigation reports relating to the site and that the Park and Ride facility opposite the site is built on a former landfill which includes passive

gas ventilation within its construction. The letter also advises that a desk top study and intrusive investigation would be required for any future development of the site in line with the council's requirements.

4. SITE HISTORY

4.1.1. The history of the development of the site was determined in the desk study by reference to historical Ordnance Survey (OS) map extracts obtained from Landmark Information Group. A summary of the mapped development history follows.

4.1.2. Records indicate the site to have been unoccupied, likely agricultural land, at the time of the earliest available map extract (1885).

4.1.3. The neighbouring sewage treatment works, currently situated to the north and north-east of the site, is shown to have existed in some form since the late 1800s. When first constructed it appears to have occupied adjacent land to the north-west, and map extracts dated 1907 and 1937 indicate the facility expanded to incorporate the subject site as well as adjoining areas to the north, west and east.

4.1.4. Although apparently part of the sewage works during the first half 20th century, the site is shown to have remained predominantly clear of structures during that period, other than small buildings towards its northern boundary.

4.1.5. The map records do not clearly indicate at what stage the site ceased to form part of the sewage works; however a 1956 extract identifies the southern half of the site as 'allotment gardens'. By the early 1970s the sewage works appears to be in its present day layout to the north-east, although some structures including settlement tanks remain to the west and north of the site.

4.1.6. An early 1970s OS extract also shows a concrete mixing works immediately north of the site, and a refuse tip to the south-east on the opposite side of Sturry Road.

4.1.7. By the early 1990s the subject site is shown to be completely clear, other than occasional fence lines. A 1999 extract indicates the tip to the south-east of the site to be disused and Vauxhall Road industrial estate, abutting the site to the north and west, is shown in its present day layout.

4.1.8. The 2007 map indicates a Park and Ride and Sturry Road Community Park to be situated in the area of the disused tip south-east of the site.

5. PRELIMINARY CONCEPTUAL MODEL

5.1. Introduction

5.1.1. A Conceptual Site Model was developed in the desk study to establish the presence and nature of potential ground contamination sources, pathways and receptors.

5.1.2. Where a plausible SPR linkage was found to exist, the status was described as 'Potentially Active', meaning that further risk assessment is required.

5.1.3. Areas of Potential Concern were then defined, which bring together any groups of potentially active SPR linkages to form the basis/rationale for the intrusive investigation. Section 5.2 below summarises the preliminary risk assessment.

5.2. Preliminary Risk Assessment

5.2.1. The Potentially Active SPR linkages identified at the site were as follows:

Source		Pathways	Receptors
Primary	**Secondary**		
• Made Ground/ Fill Materials • Alluvial deposits • Off-site Sewage Works • Off-site Historical Landfill • Off-site active landfill • Off-site steel depot • Off-site former concrete works	• TPH • PAHs • VOCs • Organic Solvents • Metals • Pathogens • Ammonia • Ground Gases • pH • Asbestos • Inorganics	• Infiltration • Groundwater migration • Gas migration • Ingestion • Dermal contact • Inhalation	• Trespassers • Adjacent site occupants • Construction Workers • Site end users • Groundwater • Surface Water • Future Buildings

5.2.2. Areas of Potential Concern (APCs) requiring further assessment were considered to be:

APC	Comment
Made Ground	Assessment for a range of common contaminants including metals, PAHs, TPH and asbestos.
Ground Gas Sources	Made Ground and Alluvial deposits with high organic content may be present. On-site migration of ground gases produced by degradation of refuse from the historical off-site landfills south-east and south-west of the site may occur.
Off-site Landfill Leachates	On-site migration of landfill leachates may occur via groundwater migration.
Off-site Sewage Works	Potential impacts to soil and groundwater associated with sewage treatment processes.

APC	Comment
Areas adjacent to off-site Steel Distribution Depot/ former Concrete Mixing Works	Potential impacts to soil and groundwater associated with storage and use of paints/chemicals during steel treatment processes. Remnant by-products such as inorganic compounds, PFA, or blast furnace slag may exist.

6. SITE INVESTIGATION

6.1. Introduction

6.1.1. The intrusive ground investigation works took place between 29th and 30th July 2008 and comprised:

- 6no windowless sample boreholes (WS1 to WS6), all of which were installed with 50mm diameter standpipes for subsequent monitoring of ground gases.
- 3no cable percussion boreholes (BH1 and BH3), installed with 50mm diameter ground gas and groundwater monitoring standpipes.
- 8no mechanically excavated trial pits (TP1 to TP8), backfilled with arisings on completion.
- Collection of representative soil samples for laboratory chemical and geotechnical testing.

6.1.2. Exploratory hole locations are shown in relation to the current site layout on Figure 502 in Appendix A.

6.1.3. The geological conditions together with any other pertinent observations were recorded during the intrusive works and are presented on the exploratory hole logs provided in Appendix B.

6.2. Investigation Rationale

6.2.1. The investigation was designed to investigate the Areas of Potential Concern as outlined in the Conceptual Site Model and to provide a general assessment of potential impacts to groundwater and soils. In addition, geotechnical data was obtained for the proposed development.

6.2.2. The cable percussive boreholes were formed to depths of 8.5mbgl. These were intended to provide data on deeper ground conditions and to determine geotechnical parameters of the underlying strata below the footprints of the proposed new buildings.

6.2.3. Windowless sampling boreholes were formed to a maximum depth of 3.0m and were planned to provide ground gas monitoring along the site's southern boundary and below building footprints, as well as geotechnical assessment of shallow soils.

6.2.4. The trial pits extended to depths of between 2.0 and 2.8m and provided additional coverage across the site for the ground contamination assessment.

6.2.5. All cable percussive and windowless sampling boreholes were

installed with ground gas and groundwater monitoring/ sampling standpipes. Monitoring well construction details are provided on the logs in Appendix B.

6.2.6. Soil samples were obtained from all investigation locations for subsequent laboratory testing. Groundwater samples were collected from the monitoring wells in BH1, BH2 and BH3 during follow-up monitoring for laboratory chemical analysis.

6.3. Chemical Testing

6.3.1. 6no soil samples and 3no water samples were submitted to Alcontrol Laboratories, Langley, for analysis of a variety of chemical determinands.

6.3.2. Based on the visual inspection of the ground and the identified Areas of Potential Concern, soil samples were tested for one or more of the following potential contaminants:

- Metals (As, B, Ba, Be, Cd, Cr, Cu, Hg, Ni, Pb, Se, V, Zn);
- pH;
- Speciated (16) Polycyclic Aromatic Hydrocarbons (PAH);
- Total Petroleum Hydrocarbons (TPH) speciated for the Criteria Working Group (CWG) suite of hydrocarbon bands and determinands including BTEX compounds and MTBE.
- Asbestos.

6.3.3. 2no soil samples were subjected to artificial leaching with the eluate analysed for metals and speciated PAHs as listed above.

6.3.4. 3no groundwater samples were tested for the following suite of potential contaminants:

- Metals (As, B, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn);
- pH;
- Speciated (16) Polycyclic Aromatic Hydrocarbons (PAH);
- Total Petroleum Hydrocarbons (TPH) speciated for the Criteria Working Group (CWG) suite of hydrocarbon bands and determinands including BTEX compounds and MTBE.
- Sulphates.
- Ammoniacal Nitrogen

6.3.5. The results of the chemical testing are presented in the laboratory reports in Appendix C.

6.4. Geotechnical Testing

6.4.1. In-situ geotechnical testing was undertaken at regular intervals during the investigation in the form of Standard Penetration Tests (SPTs); the results of this testing are presented on the borehole and window sample logs.

6.4.2. Laboratory geotechnical testing was undertaken on selected samples at Geolabs Limited, Watford, as summarised below:

- 2no samples submitted for undrained sheer strength in triaxial compression (multistage);
- 6no samples submitted for classification tests (Atterburg Limits);
- 3no samples tested for particle size distributions;
- 6no samples tested for the BRE-SD1 suite of determinands aggressive to concrete (pH, sulphates, chloride and nitrate)
- 4no samples tested for fraction of organic carbon.

6.4.3. The results of the geotechnical testing are presented in the laboratory reports in Appendix D.

6.5. Gas and Groundwater Monitoring

6.5.1. Gas and groundwater monitoring was carried out on 5th, 12th and 27th August 2008. Results are presented in Appendix E.

7. GROUND CONDITIONS

7.1. Introduction

7.1.1. Ground conditions encountered during the ground investigation varied from those indicated in the published geological map of the region. In summary the stratigraphic sequence comprised superficial deposits of Topsoil and/or Made Ground over Brickearth over Terrace Gravels as mapped, however the underlying solid geology comprised London Clay. The Thanet Beds may underlie the London Clay however the recent investigation did not extend beyond the base of the clay stratum.

7.1.2. The table below summarises the stratigraphy encountered.

Stratum	Range of Depths to base (mAOD)	Thickness Range (m)
Topsoil	4.9 – 4.1	0.3 – 0.7
Made Ground	3.9 - 1.8	0.4 – 2.8
Brickearth	4.0 – 2.6	0.2 – 1.6
River Terrace Deposits	1.9 – 0.1	1.7 – 3.5
London Clay	n/p	n/p

n/p denotes not proven

7.2. Topsoil

7.2.1. Topsoil was encountered at surface across the majority of the site, extending to depths of between 0.3 and 0.7mbgl, with an average thickness of 0.5m.

7.2.2. The stratum composition was generally uniform, comprising gravelly silt/clay with frequent roots and rootlets.

7.3. Made Ground

7.3.1. Made Ground was encountered in 4no locations only, either as a thin layer below the topsoil or from ground level. The stratum thickness varied between 0.4 and 2.8m, its base level ranging from 3.9 to 1.8mAOD.

7.3.2. The stratum generally comprised soft to firm gravelly and sandy silt/clay with brick and concrete fragments. A hydrocarbon odour was noted within the Made Ground in BH3 as shown in Section 7.8.

7.4. Brickearth

7.4.1. Brickearth was encountered in 13 of the 17 exploratory locations; however no obvious special distribution was determined. The overlying Made Ground was generally (although not always) slightly thicker at locations at which the stratum was absent.

7.4.2. The Brickearth extended to levels of between 4.0 and 2.6mOAD, its thickness varying between 0.2 and 1.6m. The stratum comprised dark brown grading into orange-brown and grey gravelly silt and clay, locally with a sand fraction.

7.4.3. Classification testing undertaken on three samples of the Brickearth indicated liquid limits between 33 and 36%, a plastic limits of 19 to 21%, and plasticity indices ranging from 14 to 15%. The results indicate low plasticity silty clay soil.

7.4.4. Standard Penetration Testing undertaken within the Brickearth gave N values of between 13 and 17, indicating the soil to be firm.

7.5. River Terrace Deposits

7.5.1. River Terrace Deposits were recorded below the Brickearth (or Made Ground) in all locations. The top of the stratum was encountered at levels of between 4.2 and 1.8mAOD extending to base levels of between 1.9 and 0.1mAOD. The stratum thickness varied between 1.7 and 3.5m.

7.5.2. The stratum was generally uniform in composition, comprising sandy gravel with a lesser variable silt and/or clay fraction.

7.5.3. SPTs gave N values of between 8 and 49, corresponding to loose to very dense soils. It should be noted however that all but one N value exceeded 10, the average value was 28 and the median value 30, indicating predominantly medium dense to dense soils.

7.5.4. Two particle size distribution tests were carried out on samples of the River Terrace Deposits, from BH1 at 2.0m and BH2 at 3.0m. The grading curves confirm field descriptions of the stratum composition, recording sand fractions of 12.9 and 19.4%; gravel fractions of 85.4 and 75.2%; and fine grained (silt and clay) fractions 1.7 and 5.3% respectively.

7.6. London Clay

7.6.1. London Clay was identified underlying the River Terrace Deposits, in the three boreholes and 1no window sample (WS4), where the base of the RTD was breached. The top of the London Clay was encountered at levels of between 1.9 and 0.1mAOD (2.8 to 4.7mbgl) and its base depth/ thickness was not proven in any location.

7.6.2. The stratum was uniform in composition, comprising dark grey silty slightly sandy clay. SPTs N values ranged between 5 and 23, corresponding to soft to stiff soils. Below 1.0mAOD, all N values exceeded 9 (average 16, median 18), increasing with depth.

7.6.3. Two undrained multistage triaxial tests have been carried out on undisturbed samples of the London Clay. Results are tabulated below.

Location	Depth (mbgl)	Depth (mAOD)	Cu (kPa)
BH1	6.5	-1.7	74
BH3	5.0	-0.5	37

7.6.4. Classification testing on three samples of the London Clay indicated liquid limits between 55 and 89%, plastic limits from 24 to 36% and plasticity indices of 31 to 53%. These results indicate medium to high plasticity clay soil.

7.7. Obstructions

7.7.1. No impenetrable in-ground obstructions were encountered during the investigation. However concrete obstructions were recorded in BH2 and BH3, requiring chiselling to beak through, as tabulated below:

Location	Depth (mbgl)		Description	Chiselling duration
	From	To		
BH2	0.3	1.3	Brick/concrete fill	60 minutes
BH3	0.8	1.0	Brick/concrete fill	30 minutes
BH3	1.7	2.0	Concrete	45 minutes

7.8. Visual/ Olfactory Evidence of Contamination

7.8.1. Visual and/or olfactory evidence of contamination was identified during the investigation at the following locations:

Location	Depth (mbgl)		Stratum	Description
	From	To		
BH3	0.95	2.75	Made Ground	Diesel odour
BH3	2.75	4.4	RTD	Diesel odour
TP5	2.0	2.1	RTD	Hydrocarbon odour

7.9. Groundwater

7.9.1. Groundwater strikes were encountered in the boreholes and most trial pits during the intrusive investigation as tabulated below. No clear strikes were recorded in window samples during drilling.

Location	Strike depth and elevation		Stratum/ Notes
	mbgl	mAOD	
BH1	3.70	1.10	River Terrace Deposits
BH2	3.70	1.45	River Terrace Deposits
BH3	3.55	0.99	River Terrace Deposits
TP1	2.70	1.90	River Terrace Deposits
TP2	2.60	2.13	River Terrace Deposits
TP3	2.70	2.20	River Terrace Deposits
TP4	-	-	Not encountered
TP5	2.00	2.73	River Terrace Deposits

	Strike depth and elevation		
TP6	2.50	2.33	River Terrace Deposits
TP7	2.50	2.33	River Terrace Deposits
TP8	2.70	2.13	River Terrace Deposits

7.9.2. Monitoring standpipes were installed in all boreholes and window samples. The table below indicates resting groundwater depths and elevations recorded during the first two return monitoring visits (water levels were not measured during the third visit).

Location	Visit 1 5/8/08		Visit 2 12/8/08	
	mbgl	mAOD	mbgl	mAOD
BH1	2.02	2.78	1.96	2.84
BH2	2.19	2.96	2.14	3.01
BH3	1.73	2.81	1.68	2.86
WS1	1.83	2.79	1.78	2.84
WS2	Dry	-	1.80	2.92
WS3	2.08	2.72	2.05	2.75
WS4	1.89	2.77	1.82	2.84
WS5	2.09	2.80	2.05	2.84
WS6	2.02	2.78	1.96	2.84

7.9.3. The data indicates resting depths of between 1.7 and 2.2mbgl, with levels of between 3.0 and 2.7mAOD. In all locations this corresponds to the River Terrace Deposits. Groundwater flow direction is likely to be to the north towards the River Great Stour.

8. GEOTECHNICAL APPRAISAL

8.1. Proposed Development

8.1.1. The site is under consideration for development to comprise light industrial/commercial units with associated concrete-surfaced access roads and vehicle parking areas, and localised soft landscaping.

8.2. Site Preparation and Earthworks

8.2.1. Substantial below ground obstructions were not encountered during the recent investigation, although some buried concrete was encountered locally. Historical records indicate relatively small structures previously occupied northern parts of the site. As part of the redevelopment any existing buried obstructions, such as remnant foundations or disused services, will need to be broken out and removed. Subject to crushing, these materials may be suitable for re-use as engineered fill.

8.2.2. Records indicate several buried live services, including large diameter sewers, a gas main and a fresh water main pass under the site. The surveyed locations of known services are detailed on CSS drawing SS016679-503. Any future site development should take cognisance of the locations of these services and any associated easements.

8.2.3. It is also noted that electricity cables pass over the site at a level of around 17mAOD, location and level of which must be considered.

8.2.4. The site is relatively level, however it is envisaged that some earthworks will be required to broadly balance the cut-and-fill at the site and limit any surplus. It is envisaged that the shallow Brickearth soils will form the bulk of the material for engineered fill.

8.2.5. Subject to consultation with specialist contractors, initial assessment indicates that the available fill material will be suitable for re-use as engineered bulk fill. It is preferable that the earthworks are carried out during dry weather, and if required the material appears suitable for modification by the addition of lime/ cement (i.e. acceptable sulphate and organic contents) which can increase shear strength/ densities and reduce self settlement of the fill material.

8.2.6. The majority of the site is surfaced with around 0.5m of topsoil. This layer will require stripping as it is unsuitable for up-filling below the new development building. Stripped topsoil should be placed in landscaped areas only or alternatively may require removal from site.

8.3. Foundations and Floor Slabs

8.3.1. In their current condition the near surface Topsoil and Made Ground deposits are considered unsuitable as bearing media for the proposed development loads, because the predominantly loose/ soft nature and variable constituents of the material may result in unacceptable total and differential settlements. The underlying Brickearth is discontinuous across the site and relatively thin (average 0.8m thick). It is therefore suggested that conventional spread foundations bearing onto the medium dense granular River Terrace Deposits could be adopted for the proposed development. At a depth of 1.5mbgl a nett allowable bearing capacity of the order of 100kN/m^2 could be achieved, based on 2m wide pad or strip foundations and limiting total settlement to no more than 25mm.

8.3.2. Should the River Terrace Deposits not be encountered at this depth, foundation excavations should be extended through the overlying Made Ground and Brickearth deposits until competent granular soils are reached. It should be noted that average depth below surface at which the top of the stratum was encountered was 1.4m; however in three locations the depth was 2.0mbgl or greater (maximum 2.75m in BH3).

8.3.3. The Made Ground and Topsoil are not considered suitable bearing media for ground bearing floor slabs due to variability in composition and generally soft consistencies. The underlying Brickearth varies in consistency, being soft to firm, and it is considered a suitable bearing stratum for ground bearing floor slabs subject to improvement. Stabilization through the addition of lime/cement is considered an appropriate option; following such treatment it is likely that the floor slab could be designed on a presumed design pressure of up to 50kN/m^2.

8.4. Pavement Design

8.4.1. It is anticipated that Brickearth soils, either in-situ or as engineered fill, will form the majority of formations in external paved areas, although locally where Made Ground is thicker this may be present at formation level. These formations should be protected from the adverse effects of inclement weather. They should be inspected and proof-rolled prior to commencement of the construction layers. All loose or otherwise deleterious material must be removed. Each formation must exhibit a consistent CBR value in excess of 3%; material which fails to do so should be removed and replaced with other, more suitable compacted fill material.

8.4.2. In situ testing of sub-grade formation should be undertaken prior to construction to confirm the design CBR value.

8.4.3. A geo-membrane may need to be incorporated into the capping layer to re-enforce the pavement construction, reduce stone loss,

and limit settlement effects, particularly should existing ground levels be raised.

8.5. Concrete Classification

8.5.1. Design/mix of buried concrete should be undertaken in accordance with the "Aggressive Chemical Environment for Concrete" (ACEC) classification, of BRE Special Digest 1: 2005 (Concrete in Aggressive Ground). With reference to the site history, it is deemed necessary to classify the site as "Brownfield", in accordance with the BRE guidance.

8.5.2. Chemical test results indicate total sulphate concentrations in soil samples up to a maximum of 0.22%, and water soluble sulphate concentrations of between 20mg/l and 1900mg/l. Soil pH values were found to be in the range of 7.8 to 8.4.

8.5.3. Water soluble chloride and nitrate concentrations were below 50mg/l and 1mg/l respectively in all locations

8.5.4. Given the wide range of water sulphate concentrations it is important to consider the strata to which the results relate. The table below illustrates this:

Stratum	No. samples tested	Max water soluble SO_4 (mg/l)
Brickearth	2	70
RTD	3	90
London Clay	1	1900

8.5.5. Given the "mobile" groundwater conditions at the site, 3no groundwater samples were analysed for dissolved concentrations of Total Sulphate. Total Sulphate concentrations in groundwater were recorded as between 61 and 120mg/l. It should be noted that groundwater at the site is associated with the River terrace Deposits.

8.5.6. The data indicates that sulphate concentrations (both total and water soluble) within the Brickearth and River Terrace Deposits are relatively low; on the basis of the results it is considered that a design sulphate (DS) class of DS1 and an "Aggressive Chemical Environment for Concrete" (ACEC) classification of AC-1 would be appropriate for buried concrete within these strata.

8.5.7. The elevated soluble sulphate concentration of 1900mg/l is associated with the London Clay, a stratum known to contain pyritic minerals and therefore be potentially aggressive to concrete. Should foundations etc extend to such depth as to come into direct contact with this stratum revised classifications of DS3 and AC3 may be appropriate, although in this circumstance it is recommended that further laboratory analyses be undertaken to confirm this.

8.6. Excavations and Groundwater

8.6.1. Excavations at the site should be feasible using an appropriate scale of hydraulic plant. Collapse of excavations is likely to occur in all excavations where groundwater is reached in granular soils. Excavations at the site will require adequate lateral support, or battering back to a safe angle, to ensure their stability.

8.6.2. Groundwater ingress within trial pits occurred at depths of between 2.0 and 2.7mbgl (2.7 to 1.9mAOD). Resting groundwater has been encountered at depths of between 1.7 and 2.2mbgl (3.0 to 2.7mAOD). It is likely that groundwater will be encountered in shallow excavations at the site and appropriate provision for de-watering should be made. Disposal of groundwater from excavations requires careful management and due consideration of appropriate legislation, guidance and Duty of Care responsibilities.

9. GENERIC QUANTITATIVE RISK ASSESSMENT

9.1. Introduction

9.1.1. In line with CLR11 (DEFRA & EA, 2004), a Generic Quantitative Risk Assessment (GQRA) has been undertaken to determine the significance of chemical impact to soil and groundwater at the site. The GQRA comprises the comparison of the measured 'contaminant' concentrations with Generic Assessment Criteria (GACs).

9.1.2. An outline of the GQRA methodology is presented in Appendix F.

9.1.3. The GACs for soil concentrations comprise either authoritative UK standards (e.g. Soil Guideline Values (SGVs)) or where these have not been published values are derived using an in-house method comprising the use of a UK compliant version of BP-RISC (v4.03) to implement the principles of the CLEA model.

9.1.4. The GQRA has been undertaken on the assumption that the end-use will comprise a "commercial" land-use scenario as defined in CLR10.

9.1.5. The GACs for "liquid" concentrations (i.e. groundwater and eluate) comprise either drinking water standards or environmental quality standards protective of a good quality "Surface Water Receptor".

9.1.6. The relevant statistical tests have been undertaken where appropriate in accordance with CLR7. The tables in Appendix I present the results of the GQRA for soils and groundwater testing. A summary of the findings of the GQRA is presented below.

9.2. Soils

9.2.1. 6no soil samples were analysed for metals. None of the concentrations or 95th percentile concentrations exceeded the defined GACs, as indicated in the table below:

Determinand	CLEA SGV (mg/kg)*	Range of Results (mg/kg)	No. samples exceeding SGV
Arsenic	500	7.2 – 14	0
Barium	n/a	27 – 180	0
Beryllium	n/a	0.6 – 1.1	0
(WS) Boron	400_2	<0.5 – 1.3	0
Cadmium	1400	<0.5 – 0.7	0
Chromium	5000	18 – 120	0
Copper	250_1	13 – 90	0
Lead	750	26 – 260	0
Mercury	480	<0.6 – 0.9	0
Nickel	5000	11 – 26	0
Selenium	8000	<2.5	0
Vanadium	n/a	16 – 39	0

Determinand	CLEA SGV (mg/kg)*	Range of Results (mg/kg)	No. samples exceeding SGV
Zinc	1000[1]	27 – 170	0

Notes: * For industrial/ commercial end use
[1] ICRCL Note 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing
[2] CSS GAC

9.2.2. 1no sample (from TP1 at 0.5m) was laboratory screened for the presence of asbestos containing materials. Asbestos was reported as 'absent' in this sample.

9.2.3. 6no soil samples were analysed for the Total Petroleum Hydrocarbons Criteria Working Group (TPH-CWG) suite of Equivalent Carbon (EC) bands and determinands, which includes BTEX compounds and MTBE.

9.2.4. The table below shows the concentrations of Total Petroleum Hydrocarbons (TPH) recorded in these samples:

Location	Depth	TPH (C5-C35) Concentration (mg/kg)
WS6	0.75	7
TP1	0.5	170
TP3	1.0	25
TP4	2.0	14
TP5	2.0	710
BH3	2.7	11,000

9.2.5. A conservative GSV of 1000mg/kg has been adopted by CSS to provide an initial assessment of these concentrations. It is noted that the locations at which visual/olfactory evidence of hydrocarbon impact was identified correspond to the locations at which this screening value has been approached (TP5 at 2.0m) or exceeded (BH3 at 2.7m).

9.2.6. The table below shows the composition of TPH compounds within these two samples for all EC bands and determinands that comprise the CWG suite. CSS Generic Assessment Criteria, against which the results have been compared, are listed alongside (where available).

Determinand	GAC (where available)	Concentration (mg/kg)	
		TP5 2.0m	BH3 2.7m
Aliphatic C5-C6	360	0.02	0.11
Aliphatic >C6-C8	-	0.01	0.21
Aliphatic >C8-C10	38,000	0.89	1.8
Aliphatic >C10-C12	99,000	2.4	6.8
Aliphatic >C12-C16	107,000	310	2,100
Aliphatic >C16-C21	-	40	1,900
Aliphatic >C21-C35	-	180	4,000

		Concentration (mg/kg)	
Total Aliphatics (C5-C35)	-	540	7,900
Aromatic C6-C7	-	< 0.01	< 0.01
Aromatic >C7-C8	-	< 0.01	0.02
Aromatic >C8-C10	215	1.3	3.0
Aromatic >C10-C12	30,000	3.6	10
Aromatic >C12-C16	43,000	21	710
Aromatic >C16-C21	32,500	14	760
Aromatic >C21-C35	32,500	130	1,700
Total Aromatics (C5-C35)	-	170	3,100
Volatile Hydrocarbons (C5-C12)	-	8.2	22
Extractable Hydrocarbons (C12-C35)	-	700	11,000
Total Hydrocarbons (C5-C35)	-	710	11,000
MTBE	-	< 0.010	< 0.010
Benzene	1.5	< 0.010	< 0.010
Toluene	150	< 0.010	0.022
Ethylbenzene	48,000	< 0.010	< 0.010
m,p-Xylenes	200	< 0.010	0.17
o-Xylene	-	< 0.010	0.18
1,3,5-Trimethylbenzene	-	0.14	0.40
1,2,4-Trimethylbenzene	-	< 0.010	1.2

9.2.7. The above table illustrates that concentrations do not exceed the GACs for any of the individual TPH constituents in either sample. Further discussion is provided in Section 9.5 below.

9.2.8. 6no soil samples were analysed for the 16 US EPA priority Polycyclic Aromatic Hydrocarbons (PAHs). Concentrations were below laboratory method detection limits (0.1mg/kg) in four of these samples; PAH concentrations recorded in the remaining two samples are tabulated below, alongside the applicable GACs.

Determinand	GAC (where available)	Concentration (mg/kg)	
		TP5 2.0m	BH3 2.7m
Naphthalene	85	0.1	2.7
Acenaphthylene	-	0.2	0.8
Acenaphthene	-	< 0.1	4.6
Fluorene	-	< 0.1	4.3
Phenanthrene	-	1.2	12
Anthracene	-	0.3	2.9
Fluoranthene	-	3.4	12
Pyrene	-	2.9	11
Benzo(a)anthracene	215	1.3	4.7
Chrysene	720	2.0	5.2
Benzo(b)fluoranthene	200	2.4	7.1
Benzo(k)fluoranthene	720	0.9	2.4
Benzo(a)pyrene	22	1.6	4.9
Indeno(1,2,3-cd)pyrene	270	0.9	2.8
Dibenzo(a,h)anthracene	11	0.2	0.6
Benzo(g,h,i)perylene	-	1.2	3.6
PAH (Sum of EPA 16)	-	18.7	81.0

9.2.9. The table above illustrates that none of the recorded PAH concentrations exceed the applicable GACs for industrial/ commercial end use.

9.3. Groundwater Analysis

9.3.1. 3no groundwater samples, obtained form BH1, BH2 and BH3, were submitted for laboratory chemical analysis. CSS GACs for Minor Aquifers have been used as screening criteria to assess the measured contaminant concentrations. These generally comprise UK Drinking Water Quality Standards; however in the absence of such, Environmental Quality Standards for Freshwater have been adopted. Details are provided in Appendix F.

9.3.2. No exceedances of the adopted GACs were recorded for metals.

9.3.3. PAH concentrations were recorded at marginally elevated levels in all three locations. Concentrations of benzo-a-pyrene and total PAHs are tabulated below:

Determinand	GAC (µg/l)	Concentration (µg/l)		
		BH1	BH2	BH3
Benzo-a-pyrene	0.7	17	18	11
Total PAH (sum of EPA 16)	40	128	144	134

9.3.4. For TPH constituents, a Minor Aquifer screening value of 200µg/l has been adopted for all Equivalent Carbon (EC) fractions.

9.3.5. The laboratory data recorded TPH concentrations of <10µg/l (the laboratory method detection limit) for all EC fractions in BH1, and all concentrations in BH2 were below the screening value of 200µg/l.

9.3.6. In BH3, aliphatic and aromatic EC bands >C12 were recorded above the GACs. Concentrations of the remaining constituents of the CWG suite, including BTEX compounds, were recorded at <10µg/l in all three locations. All groundwater TPH data is presented in the table below, with concentrations exceeding 200µg/l printed in bold.

Determinand	Concentration (µg/l)		
	BH1	BH2	BH3
Aliphatic C5-C6	<10	<10	<10
Aliphatic >C6-C8	<10	<10	<10
Aliphatic >C8-C10	<10	<10	30
Aliphatic >C10-C12	<10	<10	110
Aliphatic >C12-C16	<10	<10	**520**
Aliphatic >C16-C21	<10	<10	**410**
Aliphatic >C21-C35	<10	80	**1000**
Total Aliphatics (C5-C35)	<10	80	**2080**
Aromatic C6-C7	<10	<10	<10

Aromatic >C7-C8	<10	<10	<10
Aromatic >C8-C10	<10	<10	40
Aromatic >C10-C12	<10	<10	160
Aromatic >C12-C16	<10	<10	**360**
Aromatic >C16-C21	<10	<10	**200**
Aromatic >C21-C35	<10	30	**260**
Total Aromatics (C5-C35)	<10	30	**1020**
Volatile Hydrocarbons (C5-C12)	<10	<10	**340**
Extractable Hydrocarbons (C12-C35)	<10	110	**2760**
Total Hydrocarbons (C5-C35)	<10	110	**3100**
MTBE	<5	<5	<5
Benzene	<5	<5	<5
Toluene	<5	<5	<5
Ethylbenzene	<5	<5	<5
m,p-Xylenes	<5	<5	<5
o-Xylene	<5	<5	<5
1,3,5-Trimethylbenzene	<5	<5	<5
1,2,4-Trimethylbenzene	<5	<5	<5

9.4. Eluate Analysis

9.4.1. Eluate from the 2no soil samples at which visual/olfactory evidence of hydrocarbon impact was recorded - BH3 at 2.7m and TP5 at 2.0m - was analysed for metals and speciated PAHs. The same screening criteria as those adopted for groundwater were applied to assess the measured contaminant impact. None of the concentrations or 95th percentile concentrations exceeded the GACs.

9.5. Discussion - Soils

9.5.1. The soil analysis data, alongside observations made during the intrusive investigation, indicates no significant chemical impact to shallow soils underlying the majority of the site.

9.5.2. Field observations and laboratory analysis data indicate some hydrocarbon impact within shallow soils at BH3 and TP5, at depths of between around 2.0 and 4.0mbgl.

9.5.3. The hydrocarbons predominantly consist of longer chain compounds (both aliphatic and aromatic) in the EC range >C12 to C35; this EC profile is indicative of 'heavier' hydrocarbons such as diesel, fuel oils or lubricating oils.

9.5.4. The data has been compared to CSS in house GACs, derived using TPH-CWG toxicity information. This indicates the measured concentrations to be well below GQRA risk assessment levels for sites of a commercial/industrial end use, and are therefore considered to present a Low risk in the context of the proposed development.

9.5.5. Notwithstanding this assessment, it is recognised that chemically impacted materials are likely to be encountered locally during development ground works. The potential presence of such

materials, although not likely to constitute a significant risk to environmental receptors / future users, will have to be taken into account in the design and implementation of the site's development.

9.5.6. During redevelopment, appropriate PPE is recommended for construction workers, and dust control measures should be implemented as necessary throughout the construction period to control the potential risks to site workers and users of adjacent properties.

9.6. Discussion - Groundwater

9.6.1. Groundwater samples were recovered from the three cable percussion boreholes drilled at the site: BH1, BH2 and BH3. Standpipe installations were installed with response zones through the water-bearing River Terrace Deposits.

9.6.2. As outlined in section 9.3 above, exceedances of the adopted GACs were recorded for hydrocarbon constituents in groundwater in BH3 only. Assessment of the composition indicates the majority to be in the EC range >C12 – C21, characteristic of heavier hydrocarbons such has diesel.

9.6.3. The concentrations recorded in BH3, in exceeding the adopted GACs, are classed as "potentially unacceptable", because they exceed the quality standards set for the substances in Controlled Water (Drinking Water). However this comparison does not take account of possible attenuation mechanisms active between the site boundary and Controlled Water receptors.

9.6.4. At the subject site the nearest Controlled Water receptor is considered to comprise the River Great Stour, situated approximately 200m to the north. Another potential receptor is the underlying Minor Aquifer, and a groundwater abstraction well (drawing water from the deep Thanet Beds stratum) is located approximately 675m north-west of the site This abstraction can also be considered a sensitive receptor, although the recorded stratigraphy indicates the London Clay would act as an aquitard between the Thanet Beds and the shallow Terrace Gravels largely preventing downward vertical contaminant migration towards the deep aquifer.

9.6.5. At this stage, risks to Controlled Water are considered to be of a Low to Medium order.

9.7. Updated Risk Assessment and Conceptual Site Model

9.7.1. With reference to the site conceptual model and Preliminary Risk Assessment, the physical investigation indicates that the majority of potentially active pollutant linkages can now be considered inactive. Shallow subsurface soils are considered to present a Low order of risk to future site users, adjacent properties and

future buildings, however risks to construction workers can be considered Low to Medium. Risks to Controlled Waters from the recorded impact to groundwater are also considered to be Low to Medium.

9.7.2. It should be recognised that localised unidentified chemically impacted / deleterious materials may be encountered during development ground works, particularly in any areas previously occupied by sewage treatment works infrastructure. The potential presence of such materials will have to be taken into account in the design and implementation of the site's development.

9.7.3. During redevelopment, appropriate PPE is recommended for construction workers, and dust control measures should be implemented as necessary throughout the construction period to control the potential risks to site workers and users of adjacent properties.

10. GROUND GAS ASSESSMENT

10.1. Current Guidance

10.1.1. The assessment of potential risks from concentrations of methane and/or carbon dioxide within ground gas is based on BS 8485:2007 'Code of Practise for the Characterization and Remediation from Ground Gas in Affected Developments' and CIRIA publication C665 'Assessing Risks posed by Hazardous Ground Gases to Buildings' (Wilson et al., 2007).

10.1.2. The methodology utilises the determination of hazardous gas flow rates based upon gas concentrations multiplied by borehole flow rates, to help define a "characteristic gas situation" (CS) for a site.

10.1.3. On the basis of the characteristic situation, BS 8485 provides guidance values in the range 0 to 7. The table below shows the relationship between hazardous gas flow rates and Characteristic Situations as defined in Table 1 of the document.

Characteristic Gas Situation	Hazardous gas flow rate (l/hr)	Additional factors
1	<0.07	Typically ≤1% CH_4 and ≤5% CO_2
2	≥0.07, <0.7	Typical flow ≤70l/hr
3	≥0.7, <3.5	-
4	≥3.5, <15	-
5	≥15, <70	-
6	≥70	-

10.2. Assessment

10.2.1. 3no rounds of ground gas monitoring have been undertaken by CSS, of 8no monitoring points. The monitoring was carried out on 5th, 12th and 27th August 2008. All monitoring was undertaken using a Geotechnical Instruments GA2000 infra red gas analyser with flow pod attachment.

10.2.2. The table below summarises the field data obtained during the monitoring visits:

Standpipe	Max Flow (l/hr)	Max CH_4 concentration (%v/v)	Max CO_2 concentration (%v/v)	Min Oxygen concentration (%v/v)
BH1	0.0	0.0	0.6	19.9
BH2	0.0	0.0	4.4	16.2
BH3	0.0	0.0	0.8	19.6
WS1	0.0	0.0	3.8	18.0
WS2	0.0	0.0	1.3	18.1
WS3	0.0	0.0	3.7	17.2
WS4	0.0	0.0	3.4	17.8

Standpipe	Max Flow (l/hr)	Max CH_4 concentration (%v/v)	Max CO_2 concentration (%v/v)	Min Oxygen concentration (%v/v)
WS5	0.0	0.0	3.3	17.3
WS6	0.0	0.0	1.2	19.0

n/d – no data
b/d – Below Detection limit (<0.1% by volume)

10.2.3. In summary, methane was not recorded at detectable concentrations; a maximum carbon dioxide concentration of 4.4% by volume was recorded (BH2 during the third visit); and depleted oxygen concentrations (<18% by volume) were recorded in four locations. No positive gas flows were detected in any of the locations during any of the monitoring rounds. The data is provided in full in Appendix E.

10.2.4. In the absence of positive gas flows, hazardous gas flow rates of zero have been calculated for all locations during all three monitoring visits, corresponding to characteristic gas situation 1 at all monitoring points. The absence of methane at detectable concentrations, and carbon dioxide levels of less than 5%, both serve to support this designation.

10.2.5. Table 2 of BS 8485 sets out the extent of gas protection requirements by characteristic gas situation and building type, by providing a protection 'score' that should be achieved. Table 3 of the same document provides details of the various protection elements or systems that can be incorporated into developments in order to reach that score.

10.2.6. The site can be considered as falling within the 'commercial buildings' category on the basis of the proposed development scheme. On this basis a guidance value or 'score' of zero applies to the site (it is noted that under BS 8485 a site in category CS1 would have a guidance value of zero regardless of building type) meaning, therefore, that in accordance with the published guidance no special hazardous gas protection measures are required.

10.2.7. Nevertheless, given the close proximity of the closed landfill opposite the site, it is recommended that precautionary measures comprising a reinforced concrete cast *in situ* floor slab with at least 1200g DPM be included in the building design.

10.2.8. The recorded ground gas regime and the development proposals should be discussed with the Local Authority's Environmental Health and Building Control departments (in this case at Canterbury City Council). The final design would be subject to agreement following such consultation and further monitoring may be required by the LA.

11. OTHER POTENTIAL DEVELOPMENT CONSIDERATIONS

11.1. Waste Soils Characterisation

11.1.1. Any excavation works will potentially produce waste soils for which appropriate waste management will be required.

11.1.2. Assessment of chemical analysis data indicates that soils would likely be classified as Non-Hazardous Waste across the site should off-site disposal be required, although subject to further analysis the localised hydrocarbon-impacted soils may fall under more the onerous Hazardous Waste category. This would need to be confirmed by appropriate classification testing prior to disposal.

11.1.3. Any off-site disposal of soil requires careful management and due consideration of appropriate legislation, guidance and Duty of Care responsibilities.

11.2. Imported Fill

11.2.1. Any imported fill will be subject to specific quality requirements, particularly in any proposed areas of landscaping. Allowance should be made for the testing of imported fill materials prior to emplacement to ensure suitability.

11.3. Construction Activities

11.3.1. Due consideration should be given to the suppression of noise, dust and vibration emissions from the site during construction, and the provision of adequate PPE for site workers.

12. SUMMARY

12.1. Investigation Aim

12.1.1. The site is proposed to undergo development comprising commercial (retail) units, including service yards, public parking and soft landscaping.

12.1.2. The geo-environmental investigation and assessment detailed in this report was undertaken to identify and assess ground conditions to determine ground contamination risks, quantify ground gas concentrations, and provide geotechnical information for the proposed development.

12.2. Site Setting

12.2.1. The site is situated on Sturry Road in Canterbury, Kent. It is centred on approximate Ordnance Survey National Grid Reference 616770, 159590.

12.2.2. Historical OS map records do not indicate any substantial previous development on the site. A sewage treatment works, currently abutting the site's north-eastern boundary, may have encompassed parts of the site in the mid 20th century. The site appears to have been completely vacant other than vegetation since the 1990s.

12.2.3. A disused landfill is situated approximately 15m to the south-east on the opposite side of Sturry Road.

12.2.4. The nearest surface water course is the River Great Stour approximately 200m to the north, and the site is located on a designated Minor Aquifer but is not within a groundwater Source Protection Zone.

12.3. Site Investigations

12.3.1. An intrusive ground investigation was undertaken in July 3008 by CSS and comprised 3no cable percussion boreholes (BH1 to BH3), 6no window sample boreholes (WS1 to WS6) and 8no trail pits (TP1 to TP8). Soil and groundwater samples were obtained for laboratory testing, and ground gas monitoring was undertaken during three return site visits.

12.4. Ground Conditions

12.4.1. Ground conditions generally comprised Topsoil (around 0.5m thick) over localised Made Ground, over Brickearth (approximately 0.8m thick) over River Terrace Deposits (around 2.0 to 3.5m thick). The underlying solid geology comprised the London Clay, the top of which was recorded at between 2.8 and 4.6mbgl and the base of which was not proven.

12.4.2. The Brickearth comprised soft to firm silty sandy clay; the River Terrace Deposits comprised medium dense to dense sandy gravel; and the London Clay comprised firm becoming stiff silty clay.

12.4.3. The Made Ground, encountered locally between the Topsoil and the Brickearth, comprised gravelly silty clay with brick and concrete fragments, and extended to a maximum depth of 2.75mbgl (BH3).

12.4.4. Groundwater monitoring data indicated resting levels of between 1.7 and 2.2mbgl (elevations of between 2.7 and 3.0mAOD), corresponding with the River Terrace Deposits stratum. Groundwater flow direction is likely to be to the north towards the River Great Stour.

12.5. Geotechnical Considerations

12.5.1. Several buried live services pass under the site, and a set of power lines passes overhead. Any future site development should take cognisance of the locations of these services and any associated easements/ restrictions.

12.5.2. Subject to consultation with specialist contractors, initial assessment indicates that the available fill material will be suitable for re-use as engineered bulk fill and if required the material appears suitable for modification by the addition of lime/ cement.

12.5.3. The topsoil across most of the site will require stripping as it is unsuitable for up-filling below the new development building. Stripped topsoil should be placed in landscaped areas only or alternatively may require removal.

12.5.4. Conventional spread foundations bearing onto the medium dense granular River Terrace Deposits could be adopted for the proposed development. At a depth of 1.5mbgl a nett allowable bearing capacity of the order of 100kN/m^2 could be achieved, based on 2m wide pad or strip foundations and limiting total settlement to no more than 25mm. Should the River Terrace Deposits not be encountered at this depth, foundation excavations should be extended through the overlying Made Ground and Brickearth deposits until competent granular soils are reached.

12.5.5. The Brickearth is considered a suitable bearing stratum for ground bearing floor slabs subject to improvement. Stabilization through the addition of lime/cement is considered an appropriate option; following such treatment it is likely that the floor slab could be designed on a presumed design pressure of up to 50kN/m^2.

12.5.6. For pavements a consistent CBR value in excess of 3% should be achieved; material at formation level which fails to do so should be removed and replaced with other, more suitable compacted fill material.

12.5.7. Chemical test results indicate that sulphate concentrations (both total and water soluble) within the Brickearth and River Terrace Deposits are such that a design sulphate (DS) class of DS1 and an "Aggressive Chemical Environment for Concrete" (ACEC) classification of AC-1 would be appropriate for buried concrete within these strata.

12.5.8. Should foundations etc extend to such depth as to come into direct contact with the London Clay a revised classification of DS3 and AC3 may be appropriate.

12.6. Environmental Assessment

12.6.1. 6no soil samples were submitted for laboratory chemical analysis, of which 2no was also submitted for leachate testing. 3no groundwater samples were tested.

12.6.2. The soil analysis data, alongside observations made during the intrusive investigation, indicates no significant chemical impact to shallow soils underlying the majority of the site. However some hydrocarbon impact, likely diesel, has been recorded within shallow soils at BH3 and TP5, at depths of between around 2.0 and 4.0mbgl.

12.6.3. When compared to CSS in house screening criteria the measured concentrations in soils and soil leachate were below generic quantitative risk assessment levels for sites with a commercial/ industrial end use.

12.6.4. Groundwater samples were recovered from the three cable percussion boreholes. Exceedances of the adopted GACs were recorded for hydrocarbon constituents in groundwater in BH3 only, again likely associated with 'heavier' compounds such has diesel.

12.6.5. The concentrations recorded in BH3, in exceeding the adopted GACs, can be classed as "potentially unacceptable" because they exceed the quality standards set for the substances in Controlled Water (Drinking Water).

12.6.6. The qualitative assessment of risks to Controlled Water as a result of the recorded groundwater impact has been determined to be Low to Medium.

12.6.7. With reference to the site conceptual model and Preliminary Risk Assessment developed at desk study stage, the physical investigation has indicated that the majority of potentially active pollutant linkages can now be considered inactive. Shallow subsurface soils are considered to present a Low order of risk to future site users, adjacent properties and future buildings, however risks to construction workers can be considered Low to Medium. Potentially active pollutant linkages remain with respect to groundwater, with a Low to Medium risk rating.

12.6.8. Localised unidentified chemically impacted / deleterious materials may be encountered during development ground works, particularly in any areas previously occupied by sewage treatment works infrastructure. The potential presence of such materials will have to be taken into account in the design and implementation of the site's development.

12.6.9. During redevelopment, appropriate PPE is recommended for construction workers, and dust control measures should be implemented as necessary throughout the construction period to control the potential risks to site workers and users of adjacent properties.

12.7. Ground Gas Assessment

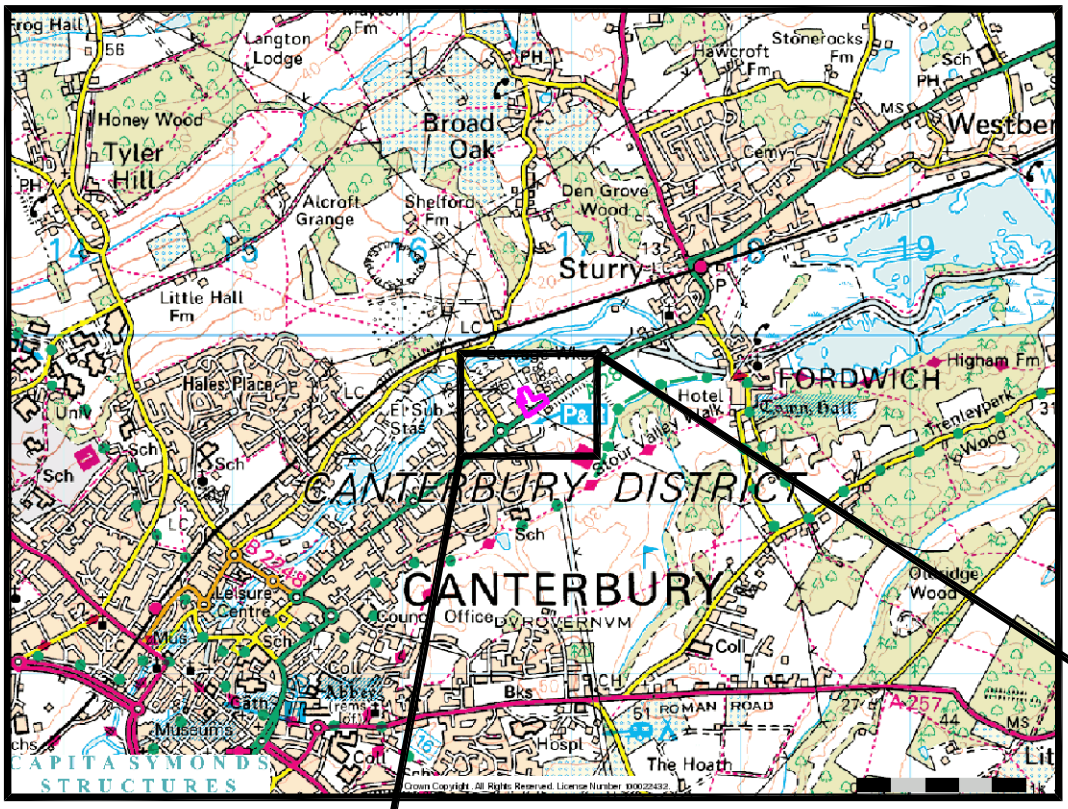
12.7.1. In accordance with BS 8485 and CIRIA C665, the recorded ground gas concentrations and flow rates indicate the site falls within the CS1 designation and requires no special gas protection measures. Precautionary measures comprising a reinforced concrete cast in situ floor slab with at least 1200g DPM are recommended to be included in the building design.

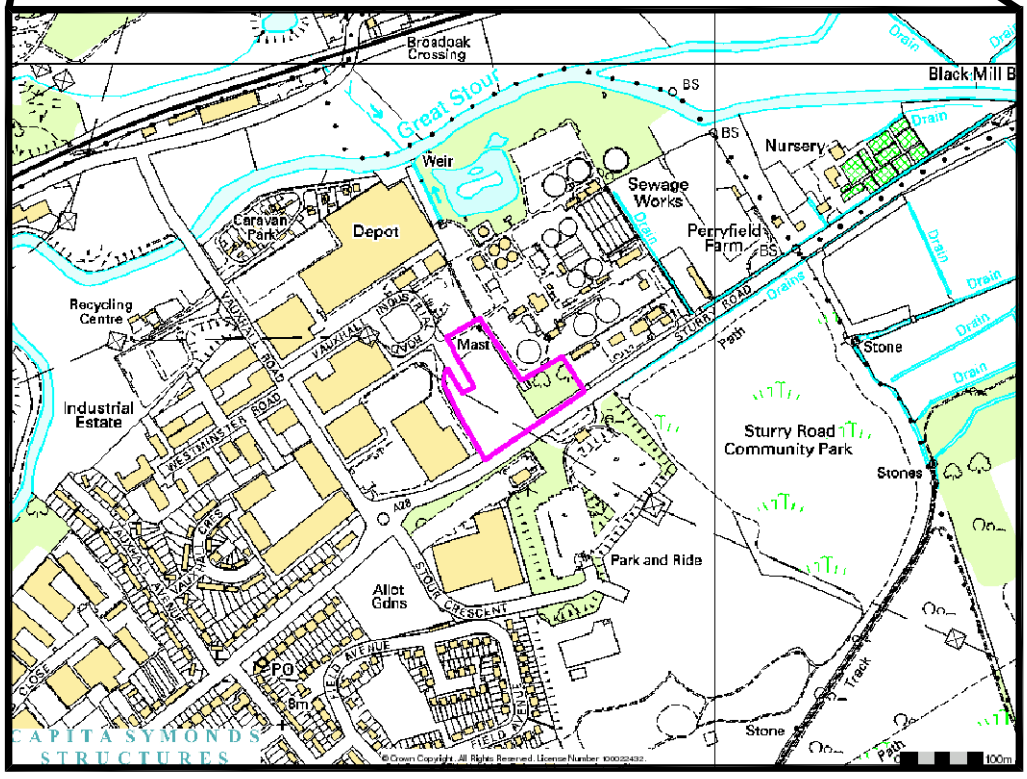
APPENDIX A

FIGURES

FIGURE 501

Site Location Plan





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SITE LOCATION PLAN

DRAWN AT OFFICE	DRAWN BY C.A.D.
WATFORD	NDH
SCALE	DATE	CHECKED BY
NTS	MARCH 2008	PE

STURRY ROAD, CANTERBURY

THE CANTERBURY SYNDICATE & BANK OF SCOTLAND

DRAWING No

SS/016679–501

FIGURE 502

Exploratory Hole Location Plan

WS XX — Window Sample.

BH XX — Borehole.

TP XX — Trial Pit.

REV	DATE	NAME	REVISION	REV' CHECK

EXPLORATORY HOLE INVESTIGATION PLAN

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ALL SETTING OUT TO BE IN ACCORDANCE WITH THE ARCHITECT'S DETAILS. (THE ARCHITECT'S DRAWINGS TO TAKE PRECEDENCE OVER ANY SETTING OUT SHOWN ON THIS DRAWING)

DRAWN AT OFFICE	DRAWN BY	C.A.D.
WATFORD	NDH	
SCALE: NTS	DATE: August 2008	CHECKED BY
DRAWING STATUS: PRELIMINARY		

DRAWING No: SS/016679–502

THE CANTERBURY SYNDICATE & BANK OF SCOTLAND STURRY ROAD CANTERBURY

FIGURE 3

Proposed Development Drawing

NOTES:

SUBJECT TO STATUTORY CONSENTS

SUBJECT TO SURVEY

BASED ON OS MAP REPRODUCED BY PERMISSION OF CONTROLLER OF HM STATIONARY OFFICE (c) CROWN COPYRIGHT

DO NOT SCALE THIS DRAWING

01/01 SITE LAYOUT

1:500

REV	DATE	COMMENT	DRAW	CHCK

MICHAEL SPARKS ASSOCIATES

CHARTERED ARCHITECTS

11 PLATO PLACE
STUDIOS ROAD
LONDON SW6 4TU

TELEPHONE 020 7736 6162
FAX 020 7736 3896
info@msa-architects.co.uk

TITLE
STURRY ROAD, CANTERBURY

DRAWING
SITE LAYOUT PLAN

CLIENT
GLENBEIGH DEVELOPMENTS LTD

DATE	SCALE	DRAWN
JUNE 2004	1:500	AC
	STATUS: FEASIBILITY	CHECKED: MS

DRAWING NUMBER
2449 / FE / 05

APPENDIX B

EXPLORATORY HOLE LOGS

CAPITA SYMONDS
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Fax : 01923 228 516

Project : Sturry Road, Canterbury			Borehole Number BH1
Job Number : SS016679			Sheet 1 of 2
Client : The Canterbury Syndicate			
E Coord : -	N Coord : -	G.L. 4.80	Logged By : GT
Date : 30/07/2008	Method : Cable Percussion		Checked By :

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level	Depth (m)	Description	Water	Standpipe
					Soft brown gravelly sandy silt/clay TOPSOIL.		
0.50	D		4.40	0.40			
1.00	B	N = 13 (5,7,4,3,3,3)			Firm brown silty sandy very gravelly CLAY. Gravel is fine to coarse flint. (BRICKEARTH)		
1.50	D		3.60	1.20			
2.00	B	N = 30 (6,6,7,7,7,9)			Medium dense brown silty sandy GRAVEL of flint. (RIVER TERRACE GRAVELS)		
2.50	D						
3.00	B	N = 41 (5,7,9,9,11,12)				▼	
4.00	B	N = 26 (3,5,6,6,7,7)				▽	
4.50	D						
5.00	B	N = 11 (1,2,2,3,3,3)	0.15	4.65	Firm dark grey silty sandy CLAY. (LONDON CLAY)		
5.75	D						
6.50	U						
7.00	D						
7.50	D						
					Continued next sheet		

SAMPLE/TEST KEY
D - Small Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
* - Partial Seating Penetration
Cu - Undrained Shear Strength kPa

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Observation Depths (m)

Date	Strike	Level	Minutes	Casing	Sealed
30/07/2008	3.70	3.06	20	-	-

Chiselling			Water Added		Driller
From	To	Hours	From	To	
					MT

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Project : Sturry Road, Canterbury			Borehole Number BH1
Job Number : SS016679			Sheet 2 of 2
Client : The Canterbury Syndicate			
E Coord : -	N Coord : -	G.L. 4.80	Logged By : GT
Date : 30/07/2008	Method : Cable Percussion		Checked By :

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
8.00	D	N = 20 (4,4,4,5,5,6)	-3.70		8.50	Firm dark grey silty sandy CLAY. (LONDON CLAY)		
						End of Borehole at 8.50 m		

SAMPLE/TEST KEY
D - Small Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
* - Partial Seating Penetration
Cu - Undrained Shear Strength kPa

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Observation Depths (m)

Date	Strike	Level	Minutes	Casing	Sealed
30/07/2008	3.70	3.06	20	-	-

Chiselling			Water Added		Driller
From	To	Hours	From	To	
					MT

CAPITA SYMONDS

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Project : Sturry Road, Canterbury			Borehole Number **BH2**
Job Number : SS016679			Sheet 1 of 2
Client : The Canterbury Syndicate			
E Coord : -	N Coord : -	G.L. 5.15	Logged By : GT
Date : 30/07/2008	Method : Cable Percussion		Checked By :

SAMPLING DATA

Depth (m)	Type	Test Result
0.50	D	
1.00	B	N = 27 (5,9,9,6,6,6)
1.50	D	
2.00	B	N = 23 (1,2,3,3,5,12)
2.50	D	
3.00	B	N = 45 (5,9,9,10,11,15)
4.00	B	N = 22 (6,5,5,6,6,5)
4.50	D	
5.00	B	N = 19 (2,4,4,5,5,5)
5.75	D	
6.50	U	
7.00	D	
7.50	D	

GROUND STRATA

Level	Depth (m)	Description
4.85	0.30	Soft brown gravelly sandy silt/clay TOPSOIL with roots and rootlets.
3.85	1.30	Firm brown silty sandy gravelly clay with some brick and concrete fragments. (MADE GROUND)
2.85	2.30	Medium dense brown silty SAND and GRAVEL of flint. (RIVER TERRACE GRAVELS)
0.85	4.30	Medium dense brown sandy GRAVEL with some silt/ clay lenses. (RIVER TERRACE GRAVELS)
		Firm dark grey silty sandy CLAY. (LONDON CLAY)

Continued next sheet

SAMPLE/TEST KEY
D - Small Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
* - Partial Seating Penetration
Cu - Undrained Shear Strength kPa

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Observation Depths (m)

Date	Strike	Level	Minutes	Casing	Sealed
30/07/2008	3.70	3.00	20	-	-

Chiselling From	Chiselling To	Hours	Water Added From	Water Added To	Driller
					MT

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Project : Sturry Road, Canterbury			Borehole Number BH2
Job Number : SS016679			Sheet 2 of 2
Client : The Canterbury Syndicate			
E Coord : -	N Coord : -	G.L. 5.15	Logged By : GT
Date : 30/07/2008	Method : Cable Percussion		Checked By :

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
8.00	D	N = 23 (3,5,6,5,6,6)	-3.35		8.50	Firm dark grey silty sandy CLAY. (LONDON CLAY)		
						End of Borehole at 8.50 m		

SAMPLE/TEST KEY
D - Small Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
* - Partial Seating Penetration
Cu - Undrained Shear Strength kPa

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Observation Depths (m)

Date	Strike	Level	Minutes	Casing	Sealed
30/07/2008	3.70	3.00	20	-	-

Chiselling			Water Added		Driller
From	To	Hours	From	To	
					MT

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Project : Sturry Road, Canterbury			Borehole Number BH3
Job Number : SS016679			Sheet 1 of 2
Client : The Canterbury Syndicate			
E Coord : -	N Coord : -	G.L. 4.54	Logged By : GT
Date : 31/07/2008	Method : Cable Percussion		Checked By :

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.50	D					Firm brown very gravelly silt/clay with frequent brick and concrete fragments. (MADE GROUND)		
1.00	B	N = 37 (3,5,9,8,9,11)	3.59		0.95			
1.50	D					Firm dark grey/black gravelly silt/clay. Hydrocarbon odour noted. (MADE GROUND)		
2.00	B	N = 5 (1,2,1,1,1,2)						
2.70	D		1.79		2.75			
3.00	B	N = 35 (6,7,9,8,9,9)				Medium dense brown/black sandy GRAVEL with some silt/ clay lenses. Hydrocarbon odour noted. (RIVER TERRACE GRAVELS)	▼	
4.00	B	N = 22 (5,5,6,5,6,5)						
4.50	D		0.14		4.40	Firm dark grey silty sandy CLAY. (LONDON CLAY)		
5.00	U							
5.75	D							
6.50	D	N = 17 (2,2,3,5,4,5)						
7.00	D							
7.50	D							
						Continued next sheet		

SAMPLE/TEST KEY
D - Small Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
* - Partial Seating Penetration
Cu - Undrained Shear Strength kPa

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Observation Depths (m)

Date	Strike	Level	Minutes	Casing	Sealed
30/07/2008	3.55	2.96	20	-	-

Chiselling			Water Added		Driller
From	To	Hours	From	To	
					MT

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Project : Sturry Road, Canterbury			Borehole Number BH3
Job Number : SS016679			Sheet 2 of 2
Client : The Canterbury Syndicate			
E Coord : -	N Coord : -	G.L. 4.54	Logged By : GT
Date : 31/07/2008	Method : Cable Percussion		Checked By :

SAMPLING DATA / GROUND STRATA

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
8.00	D		-3.96		8.50	Firm dark grey silty sandy CLAY. (LONDON CLAY)		
						End of Borehole at 8.50 m		

SAMPLE/TEST KEY
D - Small Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
* - Partial Seating Penetration
Cu - Undrained Shear Strength kPa

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Observation Depths (m)

Date	Strike	Level	Minutes	Casing	Sealed
30/07/2008	3.55	2.96	20	-	-

Chiselling			Water Added		Driller
From	To	Hours	From	To	
					MT

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Project : Sturry Road, Canterbury

Trial Pit Number
TP1

Job Number : SS016679

Client : The Canterbury Syndicate

Sheet 1 of 1

E Coord: -	N Coord: -	G.L. 4.60	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
0.50	D1			4.05	Soft dark brown gravelly silt/clay TOPSOIL with some roots and rootlets. Occasional gravel size concrete fragments.	0.55	
					Soft dark brown becoming orange-grey slightly gravelly silty sandy CLAY (BRICKEARTH)		
1.40	D2			3.50	Firm orange-brown and grey mottled SILT/CLAY. (BRICKEARTH)	1.10	
				3.10	Medium dense orange-brown clayey silty sandy GRAVEL of fine to coarse flint. (RIVER TERRACE GRAVELS)	1.50	
2.50	D3						▽
				1.80	End of Trial Pit at 2.80 m	2.80	

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
W - Water Sample
▽ Water Strike
▼ Water Level

Comments :

Stability : Unstable below 2.8m

Groundwater Remarks

Steady ingress at 2.7m

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Project : Sturry Road, Canterbury

Job Number : SS016679

Client : The Canterbury Syndicate

Trial Pit Number

TP2

Sheet 1 of 1

E Coord: -	N Coord: -	G.L. 4.73	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
0.50	D1			4.13	Soft dark brown sandy silt/clay TOPSOIL with some roots and rootlets. Some brick fragments.	0.60	
1.00	D2			3.78	Soft to firm brown and grey silty sandy slightly gravelly clay. Occasional brick fragments. (MADE GROUND)	0.95	
				3.63	Soft to firm orange-brown and grey mottled slightly sandy SILT/CLAY. (BRICKEARTH)	1.10	
2.00	D3				Medium dense orange-brown silty sandy GRAVEL of fine to coarse flint. (RIVER TERRACE GRAVELS)		
				2.03	End of Trial Pit at 2.70 m	2.70	

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
W - Water Sample
Water Strike
Water Level

Comments :

Stability : Unstable below 2.6m

Groundwater Remarks

Steady ingress at 2.6m

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Project : Sturry Road, Canterbury

Trial Pit Number
TP3

Job Number : SS016679

Client : The Canterbury Syndicate

Sheet 1 of 1

E Coord: -	N Coord: -	G.L. 4.90	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
					Soft dry and friable brown slightly gravelly silt/clay TOPSOIL with some roots and rootlets.		
				4.30		0.60	
					Soft dark brown silty sandy gravelly CLAY. (BRICKEARTH)		
1.00	D2			4.00		0.90	
				3.80	Soft to firm orange-brown and grey very gravelly SILT/CLAY. (BRICKEARTH)	1.10	
					Medium dense orange-brown locally grey silty clayey sandy GRAVEL of fine to coarse flint. (RIVER TERRACE GRAVELS)		
2.00	D3						
				2.20		2.70	▽
					End of Trial Pit at 2.70 m		

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
W - Water Sample
▽ Water Strike
▼ Water Level

Comments :

Stability : Pit wall collapse below 2.7m.

Groundwater Remarks

Seepage at 2.7m.

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Project : Sturry Road, Canterbury

Job Number : SS016679

Client : The Canterbury Syndicate

Trial Pit Number

TP4

Sheet 1 of 1

E Coord: -	N Coord: -	G.L. 4.91	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
0.50	D1			4.31	Soft dry and friable brown slightly gravelly silt/clay TOPSOIL with some roots and rootlets.	0.60	
					Firm dark brown silty sandy gravelly CLAY. (BRICKEARTH)		
1.30	D2			3.81	Soft orange-brown and grey very gravelly SILT/CLAY. (BRICKEARTH)	1.10	
				3.51	Medium dense orange-brown locally grey silty clayey sandy GRAVEL of fine to coarse flint. (RIVER TERRACE GRAVELS)	1.40	
2.00	D3						
				2.41	End of Trial Pit at 2.50 m	2.50	

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
W - Water Sample
Water Strike
Water Level

Comments :
Groundwater not encountered.

Stability : Pit wall collapse below 2.5m.

Groundwater Remarks

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Project : Sturry Road, Canterbury

Job Number : SS016679

Client : The Canterbury Syndicate

Trial Pit Number

TP5

Sheet 1 of 1

E Coord: -	N Coord: -	G.L. 4.73	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
					Soft brown gravelly silt/clay TOPSOIL with roots and rootlets.		
0.50	D1			4.28	Firm brown dry and friable very gravelly SILT/CLAY. (BRICKEARTH)	0.45	
				3.03		1.70	
2.00	D3			2.73	Medium dense orange-brown locally grey silty clayey sandy GRAVEL of fine to coarse flint. Pocket of dark grey very gravelly silt/clay at 2.0m with strong hydrocarbon odour and oily sheen. (RIVER TERRACE GRAVELS)	2.00	▽
					End of Trial Pit at 2.00 m		

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
W - Water Sample
▽ Water Strike
▼ Water Level

Comments :
Trial pit terminated at 2.0m due to suspected service pipe at base of excavation.

Stability : Stable.

Groundwater Remarks

Slow ingress at 2.0m.

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Project : Sturry Road, Canterbury

Trial Pit Number
TP6

Job Number : SS016679

Client : The Canterbury Syndicate

Sheet 1 of 1

E Coord: -	N Coord: -	G.L. 4.83	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
					Soft to firm brown very gravelly silt/clay. Occasional brick fragments. (MADE GROUND)		
				2.83		2.00	
					Medium dense orange-brown silty sandy cobbly GRAVEL of fine to coarse flint. (RIVER TERRACE GRAVELS)		▽
				2.33		2.50	
					End of Trial Pit at 2.50 m		

SAMPLE/TEST KEY
B - Bulk Sample
W - Water Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
▽ Water Strike
▼ Water Level

Comments :

Groundwater Remarks

Slow ingress at 2.5m.

Stability : Pit wall collapse below 2.5m.

CAPITA SYMONDS

Radius House
51 Clarendon Road
Watford
WD17 1HU
Tel: 01923 817537
Fax: 01923 228516

Project : Sturry Road, Canterbury			Trial Pit Number TP7
Job Number : SS016679			
Client : The Canterbury Syndicate			Sheet 1 of 1
E Coord: -	N Coord: -	G.L. 4.83	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
0.25	D1				Soft brown gravelly silt/clay TOPSOIL.		
				4.28	Firm dark brown silty sandy gravelly CLAY. (BRICKEARTH)	0.55	
				3.73	Medium dense orange-brown silty sandy cobbly GRAVEL of fine to coarse flint. (RIVER TERRACE GRAVELS)	1.10	
2.50	D2			2.33	End of Trial Pit at 2.50 m	2.50	▽

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
W - Water Sample
▽ Water Strike
▼ Water Level

Comments :

Stability : Pit wall collapse at 2.5m.

Groundwater Remarks

Slow ingress at 2.5m.

CAPITA SYMONDS

Radius House
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Tel: 01923 817537
Fax: 01923 228516

Project : Sturry Road, Canterbury

Trial Pit Number

TP8

Job Number : SS016679

Client : The Canterbury Syndicate

Sheet 1 of 1

E Coord: -	N Coord: -	G.L. 4.83	Logged By : PE
Scale : 1:50	Date : 31/07/2008	Plant : JCB-3CX	Checked By :

SAMPLING DATA

Depth (m)	Type	Test Results / Remarks	Legend	Level	Description	Depth (m)	Water
0.50	D1				Soft brown dry and friable very gravelly silt/clay TOPSOIL with many roots and rootlets.		
				4.18	Soft brown silty sandy gravelly CLAY. (BRICKEARTH)	0.65	
				3.63	Firm very gravelly SILT/CLAY. (BRICKEARTH)	1.20	
2.00	D2						
				2.63	Medium dense orange-brown silty sandy cobbly GRAVEL. (RIVER TERRACE GRAVELS)	2.20	▽
				2.03	End of Trial Pit at 2.80 m	2.80	

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
V - Vane Test Result
W - Water Sample
▽ Water Strike
▼ Water Level

Comments :

Stability : Pit wall collapse below 2.7m.

Groundwater Remarks

Steady ingress at 2.7m.

CAPITA SYMONDS

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Fax: 01923 228516

Project : Sturry Road, Canterbury			Probehole Number WS1
Job Number : SS016679			
Client : The Canterbury Syndicate			Sheet 1 of 1
E Coord : -	N Coord : -	G.L. 4.62	Logged By: PE
Date : 29/07/2008	Method : Competitor Rig		Checked By:

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
			4.17		0.45	Soft brown gravelly silt/clay TOPSOIL with some roots/rootlets. Gravel is fine and medium flint.		
1.00	C	N = 41 (5,11,11,11,10,9)				Medium dense light grey and orange sandy GRAVEL of flint. (RIVER TERRACE GRAVELS)		
1.00	D					. . . clayey and silty 0.45 to 1.2m	1	
2.00	C	N = 13 (1,2,3,1,4,5)					2 ▽	
3.00	C	N = 31 (1,1,2,5,12,12)	1.62		3.00	End of Probehole at 3.00 m	3	
							4	
							5	
							6	
							7	
							8	

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

▽ Water Strike
▼ Water Level

REMARKS
Refusal at 3.0m on dense gravel.

Scale =1:50

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
29/07/2008	2.00				

Groundwater Remarks:
Slow ingress at 2.0m

Driller
JD

CAPITA SYMONDS

Radius House
51 Clarendon Road
Watford
WD17 1HU
Tel: 01923 817537
Fax: 01923 228516

Project : Sturry Road, Canterbury

Job Number : SS016679

Client : The Canterbury Syndicate

Probehole Number
WS2
Sheet 1 of 1

E Coord : 0.00 | N Coord : 0.00 | G.L. 4.72 | Logged By: PE

Date : 29/07/2008 | Method : Competitor Rig | Checked By:

SAMPLING DATA / GROUND STRATA

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
			4.32		0.40	Soft brown gravelly silt/clay TOPSOIL with some roots/rootlets. Gravel is fine and medium flint.		
						Soft to firm silty sandy gravelly CLAY. (BRICKEARTH)		
1.00	C	N = 17 (3,3,3,4,4,6)					1	
1.20	D							
			3.12		1.60	light grey and orange-brown silty sandy GRAVEL of flint. (RIVER TERRACE GRAVELS)		
2.00	C	N = 31 (5,9,8,7,7,9)					2	
3.00	C	N = 8 (2,1,2,1,3,2)	1.72		3.00	End of Probehole at 3.00 m	3	
							4	
							5	
							6	
							7	
							8	

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed

Groundwater Remarks:

Driller
JD

CAPITA SYMONDS

Radius House
51 Clarendon Road
Watford
WD17 1HU
Tel: 01923 817537
Fax: 01923 228516

Project : Sturry Road, Canterbury			Probehole Number WS3
Job Number : SS016679			
Client : The Canterbury Syndicate			Sheet 1 of 1
E Coord : 0.00	N Coord : 0.00	G.L. 4.80	Logged By: PE
Date : 29/07/2008	Method : Competitor Rig		Checked By:

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
			4.40		0.40	Soft brown gravelly silt/clay TOPSOIL with some roots/rootlets. Gravel is fine and medium flint.		
1.00	C	N = 15 (4,4,3,3,4,5)				Firm reddish-brown very gravelly silty sandy CLAY. (BRICKEARTH)	1	
			3.30		1.50			
2.00	C	N = 14 (1,3,4,4,3,3)				Medium dense grey and brown silty sandy GRAVEL of flint. (RIVER TERRACE GRAVELS)	2	
3.00	C	N = 49 (3,12,15,12,12,10)	1.80		3.00		3	
3.00	D					End of Probehole at 3.00 m		
							4	
							5	
							6	
							7	
							8	

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed

Groundwater Remarks:

Driller: JD

CAPITA SYMONDS

Radius House
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Project : Sturry Road, Canterbury			Probehole Number WS4
Job Number : SS016679			
Client : The Canterbury Syndicate			Sheet 1 of 1
E Coord : 0.00	N Coord : 0.00	G.L. 4.66	Logged By: PE
Date : 29/07/2008	Method : Competitor Rig		Checked By:

SAMPLING DATA

GROUND STRATA

Depth (m)	Type	Test Result	Level	Depth (m)	Description	Water
0.50	D		4.16	0.50	Soft brown gravelly silt/clay TOPSOIL with some roots/rootlets. Gravel is fine and medium flint.	
			3.81	0.85	Firm reddish-brown gravelly silty sandy CLAY. (BRICKEARTH)	
1.00	C	N = 32 (4,7,7,7,8,10)			Medium dense grey and brown silty sandy GRAVEL of flint. (RIVER TERRACE GRAVELS)	
2.00	C	N = 30 (4,7,8,8,7,7)				
			1.86	2.80		
3.00	C	N = 5 (2,1,2,1,1,1)	1.66	3.00	Firm bluish-grey silty CLAY. (LONDON CLAY)	
					End of Probehole at 3.00 m	

Standpipe

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed

Groundwater Remarks:

Driller: JD

CAPITA SYMONDS

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Watford
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Project : Sturry Road, Canterbury

Job Number : SS016679

Client : The Canterbury Syndicate

Probehole Number

WS5

Sheet 1 of 1

E Coord : 0.00	N Coord : 0.00	G.L. 4.89	Logged By: PE
Date : 29/07/2008	Method : Competitor Rig		Checked By:

SAMPLING DATA

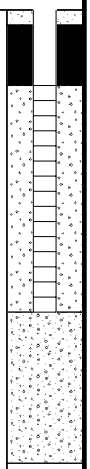
Depth (m)	Type	Test Result
1.00	C	N = 14 (1,3,3,3,4,4)
1.00	D	
2.00	C	N = 28 (3,3,7,7,7,7)
3.00	C	N = 43 (5,6,9,11,11,12)

GROUND STRATA

Level	Legend	Depth (m)	Description
4.44		0.45	Soft brown gravelly silt/clay TOPSOIL with some roots/rootlets. Gravel is fine and medium flint.
3.99		0.90	Firm reddish-brown gravelly silty sandy CLAY. (BRICKEARTH)
			Medium dense orange-brown locally clayey and silty sandy GRAVEL of flint. (RIVER TERRACE GRAVELS)
1.89		3.00	End of Probehole at 3.00 m

Water

Standpipe



SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

▽ Water Strike

▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
29/07/2008	1.80				

Groundwater Remarks:	Driller
Slow ingress below 1.8m	JD

CAPITA SYMONDS

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Project : Sturry Road, Canterbury			Probehole Number WS6
Job Number : SS016679			
Client : The Canterbury Syndicate			Sheet 1 of 1
E Coord : 0.00	N Coord : 0.00	G.L. 4.57	Logged By: PE
Date : 29/07/2008	Method : Competitor Rig		Checked By:

SAMPLING DATA / GROUND STRATA

Depth (m)	Type	Test Result	Level	Depth (m)	Description	Water	Standpipe
			4.27	0.30	Soft brown dry and friable slightly gravelly silt/clay TOPSOIL with some roots/rootlets.		
0.75	D				Firm orange-brown locally grey gravelly SILT/CLAY. Occasional rootlets. (BRICKEARTH)		
1.00	C	N = 15 (2,3,3,4,4,4)	3.62	0.95	Medium dense orange-brown locally clayey and silty sandy GRAVEL of flint. (RIVER TERRACE GRAVELS)		
2.00	C	N = 31 (5,6,5,9,9,8)					
3.00	C	N = 11 (2,1,3,3,2,3)	1.57	3.00	End of Probehole at 3.00 m		

SAMPLE/TEST KEY
B - Bulk Sample
D - Small Disturbed Sample
ES - Environmental Sample
U - Undisturbed Sample (& Blows)
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane Test, kPa
* - Partial Seating Penetration

▽ Water Strike
▼ Water Level

REMARKS

Scale =1:50

Boring Progress & Water Strikes (m)

Date	Strike	Level	Minutes	Casing	Sealed
29/07/2008	1.80				

Groundwater Remarks: Driller

Slow ingress below 1.8m — JD

APPENDIX C

CHEMICAL TESTING RESULTS

Paul Edwards
Capita Symonds (Structures) Ltd
Radius House
51 Clarendon Road
Watford
Hertfordshire
WD17 1HU

19 August 2008

TEST REPORT

Our Report Number: 08-53500

Your Order Reference: N/A

6 soil samples received on 05/08/2008

Final instructions received on 04/08/2008 (CoC No. 24339)

Project Name: Sturry Road, Canterbury

Project Code: SS-016679

Laboratory analysis started on 06 August 2008
All laboratory analysis completed by 19 August 2008

Rexona Rahman
Analytical Reporting Manager
ALCONTROL LABORATORIES

Luis Nunes
Project Co-Ordinator
ALCONTROL LABORATORIES

ALcontrol Laboratories
Sample Description

Job Number: 08-53500
Client: Capita Symonds
Project Code: SS-016679

Matrix: Soil
Project Name: Sturry Road, Canterbury

Laboratory Reference No	Sample Reference	Sample Depth (m)	Date Sampled	Sample Description
331413	WS6	0.75	29/07/08	Light brown sandy clay with vegetation
331414	TP1	0.5	31/07/08	Dark brown top soil with gravel
331418	TP3	1	31/07/08	Light brown sandy clay with gravel and vegetation
331421	TP4	2	31/07/08	Light brown sand with gravel
331423 †	TP5	2	31/07/08	Grey sludge with gravel
331430 †	BH3	2.7	31/07/08	Dark grey sludge with gravel

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Soil
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	WS6	TP1	TP3	TP4	TP5	Method No	Units	LOD
Sample Depth (m)	0.75	0.5	1.0	2.0	2.0			
Date Sampled	29/07/08	31/07/08	31/07/08	31/07/08	31/07/08			
Date Scheduled	05/08/08	05/08/08	05/08/08	05/08/08	05/08/08			
Laboratory Reference No	331413	331414	331418	331421	331423 †			
Analysis								
Moisture Content (Dry Weight)	14.3	19.5	11.4	7.9	34.7		%	0.1
Moisture Content (Wet Weight)	12.5	16.3	10.3	7.3	25.7		%	0.1
Asbestos (Screen)	-	Absent	-	-	-	001a		
Arsenic	9.7	13	14	12	7.2	069S[I,M]	mg/kg	3
Barium	140	170	180	27	43	069S[I,M]	mg/kg	10
Beryllium	1.0	1.1	0.9	0.7	0.6	069S[I,M]	mg/kg	0.5
Boron (W/S)	0.7	1.3	0.7	< 0.5	0.6	016S[I,M]	mg/kg	0.5
Cadmium	0.5	0.7	< 0.5	< 0.5	< 0.5	069S[I,M]	mg/kg	0.5
Chromium	29	55	27	28	18	069S[I,M]	mg/kg	10
Copper	14	90	19	13	15	069S[I,M]	mg/kg	5
Lead	32	260	59	26	29	069S[I,M]	mg/kg	10
Mercury	< 0.6	0.9	< 0.6	< 0.6	< 0.6	069S[I,M]	mg/kg	0.6
Nickel	26	17	16	19	12	069S[I,M]	mg/kg	4
Selenium	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	069S[I,M]	mg/kg	2.5
Vanadium	39	34	33	22	19	069S[I,M]	mg/kg	3
Zinc	40	170	49	58	27	069S[I,M]	mg/kg	10
pH	7.0	6.7	6.5	7.6	6.5	084S[I,M]	pH Units	1

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Soil
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH3					Method No	Units	LOD
Sample Depth (m)	2.70							
Date Sampled	31/07/08							
Date Scheduled	05/08/08							
Laboratory Reference No	331430 †							
Analysis								
Moisture Content (Dry Weight)	129						%	0.1
Moisture Content (Wet Weight)	56.4						%	0.1
Asbestos (Screen)	-					001a		
Arsenic	9.0					069S[I,M]	mg/kg	3
Barium	82					069S[I,M]	mg/kg	10
Beryllium	0.5					069S[I,M]	mg/kg	0.5
Boron (W/S)	0.8					016S[I,M]	mg/kg	0.5
Cadmium	0.7					069S[I,M]	mg/kg	0.5
Chromium	120					069S[I,M]	mg/kg	10
Copper	34					069S[I,M]	mg/kg	5
Lead	84					069S[I,M]	mg/kg	10
Mercury	< 0.6					069S[I,M]	mg/kg	0.6
Nickel	11					069S[I,M]	mg/kg	4
Selenium	< 2.5					069S[I,M]	mg/kg	2.5
Vanadium	16					069S[I,M]	mg/kg	3
Zinc	93					069S[I,M]	mg/kg	10
pH	9.2					084S[I,M]	pH Units	1

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Soil
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	WS6	TP1	TP3	TP4	TP5	Method No	Units	LOD
Sample Depth (m)	0.75	0.5	1.0	2.0	2.0			
Date Sampled	29/07/08	31/07/08	31/07/08	31/07/08	31/07/08			
Date Scheduled	05/08/08	05/08/08	05/08/08	05/08/08	05/08/08			
Laboratory Reference No	331413	331414	331418	331421	331423 †			
Analysis								
* * PAH SUITE * *								
Naphthalene	< 0.1	0.14	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Acenaphthylene	< 0.1	0.23	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Fluorene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Phenanthrene	< 0.1	1.2	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Anthracene	< 0.1	0.33	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Fluoranthene	< 0.1	3.4	0.18	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Pyrene	< 0.1	2.9	0.14	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Benzo(a)anthracene	< 0.1	1.3	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Chrysene	< 0.1	2.0	0.12	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Benzo(b)fluoranthene	< 0.1	2.4	0.11	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Benzo(k)fluoranthene	< 0.1	0.91	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Benzo(a)pyrene	< 0.1	1.6	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Indeno(1,2,3-cd)pyrene	< 0.1	0.94	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Dibenzo(a,h)anthracene	< 0.1	0.22	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
Benzo(g,h,i)perylene	< 0.1	1.2	< 0.1	< 0.1	< 0.1	022S[IM]	mg/kg	0.1
PAH (Sum of EPA 16)	ND	18.73	ND	ND	ND	022S[I]	mg/kg	1.6

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Soil
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH3					Method No	Units	LOD
Sample Depth (m)	2.70							
Date Sampled	31/07/08							
Date Scheduled	05/08/08							
Laboratory Reference No	331430 †							
Analysis								
* * PAH SUITE * *								
Naphthalene	2.7					022S[IM]	mg/kg	0.1
Acenaphthylene	0.76					022S[IM]	mg/kg	0.1
Acenaphthene	4.6					022S[IM]	mg/kg	0.1
Fluorene	4.3					022S[IM]	mg/kg	0.1
Phenanthrene	12					022S[IM]	mg/kg	0.1
Anthracene	2.9					022S[IM]	mg/kg	0.1
Fluoranthene	12					022S[IM]	mg/kg	0.1
Pyrene	11					022S[IM]	mg/kg	0.1
Benzo(a)anthracene	4.7					022S[IM]	mg/kg	0.1
Chrysene	5.2					022S[IM]	mg/kg	0.1
Benzo(b)fluoranthene	7.1					022S[IM]	mg/kg	0.1
Benzo(k)fluoranthene	2.4					022S[IM]	mg/kg	0.1
Benzo(a)pyrene	4.9					022S[IM]	mg/kg	0.1
Indeno(1,2,3-cd)pyrene	2.8					022S[IM]	mg/kg	0.1
Dibenzo(a,h)anthracene	0.62					022S[IM]	mg/kg	0.1
Benzo(g,h,i)perylene	3.6					022S[IM]	mg/kg	0.1
PAH (Sum of EPA 16)	81.01					022S[I]	mg/kg	1.6

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Soil
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	WS6	TP1	TP3	TP4	TP5	Method No	Units	LOD
Sample Depth (m)	0.75	0.5	1.0	2.0	2.0			
Date Sampled	29/07/08	31/07/08	31/07/08	31/07/08	31/07/08			
Date Scheduled	05/08/08	05/08/08	05/08/08	05/08/08	05/08/08			
Laboratory Reference No	331413	331414	331418	331421	331423 †			
Analysis								
* * CWG SUITE * *								
Aliphatic C5-C6	< 0.01	0.02	0.02	< 0.01	0.02	CWGS	mg/kg	0.01
Aliphatic >C6-C8	< 0.01	< 0.01	< 0.01	< 0.01	0.01	CWGS	mg/kg	0.01
Aliphatic >C8-C10	< 0.01	< 0.01	< 0.01	< 0.01	0.89	CWGS	mg/kg	0.01
Aliphatic >C10-C12	< 0.01	< 0.01	< 0.01	< 0.01	2.4	CWGS	mg/kg	0.01
Aliphatic >C12-C16	1.2	2.9	< 1	1.1	310	CWGS[I]	mg/kg	1
Aliphatic >C16-C21	2.4	6.2	2.7	3.6	40	CWGS[I]	mg/kg	1
Aliphatic >C21-C35	< 5	54	7.9	7.6	180	CWGS[I]	mg/kg	5
Total Aliphatics (C5-C35)	< 5	63	11	12	540	CWGS	mg/kg	5
Aromatic C6-C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	CWGS	mg/kg	0.01
Aromatic >C7-C8	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	CWGS	mg/kg	0.01
Aromatic >C8-C10	< 0.01	< 0.01	< 0.01	< 0.01	1.3	CWGS	mg/kg	0.01
Aromatic >C10-C12	< 0.01	< 0.01	< 0.01	< 0.01	3.6	CWGS	mg/kg	0.01
Aromatic >C12-C16	1.8	4.1	1.4	< 1	21	CWGS[I]	mg/kg	1
Aromatic >C16-C21	1.6	12	2.7	1.8	14	CWGS[I]	mg/kg	1
Aromatic >C21-C35	< 5	95	9.8	< 5	130	CWGS[I]	mg/kg	5
Total Aromatics (C5-C35)	< 5	110	14	< 5	170	CWGS	mg/kg	5
Volatile Hydrocarbons (C5-C12)	< 0.01	0.02	0.02	< 0.01	8.2	CWGS	mg/kg	0.01
Extractable Hydrocarbons (C12-C35)	7.0	170	25	14	700	CWGS	mg/kg	5
Total Hydrocarbons (C5-C35)	7.0	170	25	14	710	CWGS	mg/kg	5
MTBE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	CWGS[IM]	mg/kg	0.01
Benzene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	CWGS[IM]	mg/kg	0.01
Toluene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	CWGS[IM]	mg/kg	0.01
Ethylbenzene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	CWGS[IM]	mg/kg	0.01
m,p-Xylenes	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	CWGS[IM]	mg/kg	0.01
o-Xylene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	CWGS[IM]	mg/kg	0.01
1,3,5-Trimethylbenzene	< 0.010	< 0.010	< 0.010	< 0.010	0.14	CWGS[IM]	mg/kg	0.01
1,2,4-Trimethylbenzene	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	CWGS[IM]	mg/kg	0.01

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Soil
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH3					Method No	Units	LOD
Sample Depth (m)	2.70							
Date Sampled	31/07/08							
Date Scheduled	05/08/08							
Laboratory Reference No	331430 †							
Analysis								
* * CWG SUITE * *								
Aliphatic C5-C6	0.11					CWGS	mg/kg	0.01
Aliphatic >C6-C8	0.21					CWGS	mg/kg	0.01
Aliphatic >C8-C10	1.8					CWGS	mg/kg	0.01
Aliphatic >C10-C12	6.8					CWGS	mg/kg	0.01
Aliphatic >C12-C16	2100					CWGS[I]	mg/kg	1
Aliphatic >C16-C21	1900					CWGS[I]	mg/kg	1
Aliphatic >C21-C35	4000					CWGS[I]	mg/kg	5
Total Aliphatics (C5-C35)	7900					CWGS	mg/kg	5
Aromatic C6-C7	< 0.01					CWGS	mg/kg	0.01
Aromatic >C7-C8	0.02					CWGS	mg/kg	0.01
Aromatic >C8-C10	3.0					CWGS	mg/kg	0.01
Aromatic >C10-C12	10					CWGS	mg/kg	0.01
Aromatic >C12-C16	710					CWGS[I]	mg/kg	1
Aromatic >C16-C21	760					CWGS[I]	mg/kg	1
Aromatic >C21-C35	1700					CWGS[I]	mg/kg	5
Total Aromatics (C5-C35)	3100					CWGS	mg/kg	5
Volatile Hydrocarbons (C5-C12)	22					CWGS	mg/kg	0.01
Extractable Hydrocarbons (C12-C35)	11000					CWGS	mg/kg	5
Total Hydrocarbons (C5-C35)	11000					CWGS	mg/kg	5
MTBE	< 0.010					CWGS[IM]	mg/kg	0.01
Benzene	< 0.010					CWGS[IM]	mg/kg	0.01
Toluene	0.022					CWGS[IM]	mg/kg	0.01
Ethylbenzene	< 0.010					CWGS[IM]	mg/kg	0.01
m,p-Xylenes	0.17					CWGS[IM]	mg/kg	0.01
o-Xylene	0.18					CWGS[IM]	mg/kg	0.01
1,3,5-Trimethylbenzene	0.40					CWGS[IM]	mg/kg	0.01
1,2,4-Trimethylbenzene	1.2					CWGS[IM]	mg/kg	0.01

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Leachate
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	TP5	BH3				Method No	Units	LOD
Sample Depth (m)	2.0	2.70						
Date Sampled	31/07/08	31/07/08						
Date Scheduled	05/08/08	05/08/08						
Laboratory Reference No	331423 †	331430 †						
Analysis								
Arsenic (Dissolved)	< 0.005	0.019				080L[I]	mg/l	0.005
Boron	0.039	0.094				080L[I]	mg/l	0.005
Cadmium (Dissolved)	< 0.001	< 0.001				080L[I]	mg/l	0.001
Chromium (Dissolved)	< 0.005	0.020				080L[I]	mg/l	0.005
Copper (Dissolved)	< 0.005	0.011				080L[I]	mg/l	0.005
Lead (Dissolved)	< 0.005	0.009				080L[I]	mg/l	0.005
Mercury (Dissolved)	< 0.00005	0.00006				080L[I]	mg/l	0.00005
Nickel (Dissolved)	< 0.005	0.009				080L[I]	mg/l	0.005
Selenium (Dissolved)	< 0.005	< 0.005				080L[I]	mg/l	0.005
Zinc (Dissolved)	0.006	0.021				080L[I]	mg/l	0.005

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53500
Matrix : Leachate
Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	TP5	BH3				Method No	Units	LOD
Sample Depth (m)	2.0	2.70						
Date Sampled	31/07/08	31/07/08						
Date Scheduled	05/08/08	05/08/08						
Laboratory Reference No	331423 †	331430 †						
Analysis								
* * PAH SUITE * *								
Naphthalene	0.0001	0.0005				022L[I]	mg/l	0.0001
Acenaphthylene	< 0.0001	0.0004				022L[I]	mg/l	0.0001
Acenaphthene	0.0004	0.0081				022L[I]	mg/l	0.0001
Fluorene	0.0002	0.0055				022L[I]	mg/l	0.0001
Phenanthrene	0.0005	0.0005				022L[I]	mg/l	0.0001
Anthracene	< 0.0001	0.0008				022L[I]	mg/l	0.0001
Fluoranthene	0.0001	0.0017				022L[I]	mg/l	0.0001
Pyrene	0.0001	0.0012				022L[I]	mg/l	0.0001
Benzo(a)anthracene	< 0.0001	0.0002				022L[I]	mg/l	0.0001
Chrysene	< 0.0001	0.0001				022L[I]	mg/l	0.0001
Benzo(b)fluoranthene	< 0.0001	< 0.0001				022L[I]	mg/l	0.0001
Benzo(k)fluoranthene	< 0.0001	< 0.0001				022L[I]	mg/l	0.0001
Benzo(a)pyrene	< 0.0001	< 0.0001				022L[I]	mg/l	0.0001
Indeno(1,2,3-cd)pyrene	< 0.0001	< 0.0001				022L[I]	mg/l	0.0001
Dibenzo(a,h)anthracene	< 0.0001	< 0.0001				022L[I]	mg/l	0.0001
Benzo(g,h,i)perylene	< 0.0001	< 0.0001				022L[I]	mg/l	0.0001
PAH (Sum of EPA 16)	0.0014	0.0188				022L[I]	mg/l	0.0001

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results - Appendix

Job Number : 08-53500

Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Summary of methods contained within report :

Method No.	Reference	Description	Wet/Dry Analysis
022S	In-house method	Determination of PAH compounds in soil samples by hexane / acetone extraction followed by GC-MS detection [Note: this method does not separate benzo(j)fluoranthene, and this PAH will be included in the sum of benzo(b)fluoranthene & benzo(k)fluoranthene]	W
CWGS	In-house method based on "Total Petroleum Hydrocarbon Criteria Working Group" series, 1998-9	Determination of "CWG" banded petroleum hydrocarbons in soil samples using a combination of headspace GC-FID (C5-C12) and hexane:acetone extraction / silica-alumina aliphatic - aromatic split / GC-FID (C12-C35) techniques with banding by comparison to alkane standards	W
080L	In-house method based on MEWAM "Inductively Coupled Plasma Spectrometry", HMSO, 1996	Determination of metals in aqueous samples by nitric acid digestion followed by Inductively Coupled Plasma - Mass Spectrometry detection (ICP-MS)	W
022L	In-house method	Determination of PAH compounds in aqueous samples by pentane extraction followed by GC-MS detection [Note: this method does not separate benzo(j)fluoranthene, and this PAH will be included in the sum of benzo(b)fluoranthene & benzo(k)fluoranthene]	W
084S	In-house method referencing BS1377: Part 3: 1990 and Second Site Property: Environmental Assessment Guidance Version 3: March 2003	Determination of pH by addition of water followed by electrometric measurement	D
069S	In-house method based on MEWAM "Methods for the Determination of Metals in Soil", HMSO, 1986	Determination of metals in soil samples by aqua-regia digestion followed by ICP OES detection	D
016S	In-house method	Determination of water soluble boron by 2:1 extraction in hot water followed by ICP-OES detection	D

ALcontrol Laboratories
Table Of Results - Appendix

Job Number : 08-53500

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Project Code: SS-016679

Summary of methods contained within report :

Method No.	Reference	Description	Wet/Dry Analysis
001a	In-house method based on HSG 248	Visual screening of soil samples for fibrous material requiring further identification according to method 001 (note for samples > approximately 1kg it may be necessary to sub-sample prior to screening)	

Soil results are expressed on a dry weight basis. Where the test uses as-received sample, a moisture correction factor is applied to the wet weight result. This factor is determined gravimetrically using weight loss on drying at 30º (+/-5) C.

ALcontrol Laboratories
Table Of Results - Appendix

Job Number : 08-53500

Project Code: SS-016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Summary of methods contained within report :

Method No.	Reference	Description	Wet/Dry Analysis

Appendix

Code	Description
On Results	
*	Detection limit(s) raised due to matrix interference
¥	Detection limit(s) raised due to reduced amount of sample available for analysis
‡	Dilution factor applied due to nature of sample
NAD	No asbestos detected
$	Analysis sub-contracted
U/S	Analysis unsuitable for sample due to its matrix or properties
I/S	Insufficient sample
M/S	Sample cannot be located within the laboratory
ND	Not detected (below relevant analytical detection limit)
ç	Sample filtered prior to analysis
§	Please note product present, therefore this result is for indicative purpose only
On the Sample Numbers	
†	Sample type outside the scope of our MCERTS accreditation since matrix not included in method validation
¢	Unsuitable for analysis due to asbestos content
General Statements	
æ	Please note TOC's & LOI's have been repeated and the apparently anomalous results confirmed
¶	UKAS and/or MCERTS accreditation removed due to duration of sample in laboratory prior to testing
¤	The BOD analysis was carried out prior to the COD analysis and included an oily layer, which is the likely cause of the anomalous results
Note:	Analysis carried out for organic compounds on water samples containing free product is on a "best endeavour" basis
Note:	All results calculated from organic carbon on a dry weight basis
Note:	Fe(II) and dissolved Fe are analysed by different methods, sometimes leading to slight discrepancy between results
Note:	"Total" results calculated by summing individual components are not rounded
Note:	The reporting limit stated in the LOD column is the standard method reporting limit, derived statistically from validation data, however it is occasionally necessary to raise reporting limits due to matrix interference or limited sample availability
Note:	During soil preparation, best efforts are made to produce analytical subsamples representative of the entire submitted sample, without exclusion of stones

Paul Edwards
Capita Symonds (Structures) Ltd
Radius House
51 Clarendon Road
Watford
Hertfordshire
WD17 1HU

14 August 2008

TEST REPORT

Our Report Number: 08-53508

Your Order Reference: N/A

3 water samples received on 06/08/2008

Final instructions received on 06/08/2008 (CoC No. 42160)

Project Name: Sturry Road, Canterbury

Project Code: SS016679

Laboratory analysis started on 06 August 2008
All laboratory analysis completed by 14 August 2008

Rexona Rahman
Analytical Reporting Manager
ALCONTROL LABORATORIES

Rhys Ashton
Project Co-Ordinator
ALCONTROL LABORATORIES

ALcontrol Laboratories
Table Of Results

Job Number : 08-53508
Matrix : Water
Project Code: SS016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH1	BH2	BH3			Method No	Units	LOD
Sample Depth (m)	-	-	-					
Date Sampled	05/08/08	05/08/08	05/08/08					
Date Scheduled	06/08/08	06/08/08	06/08/08					
Laboratory Reference No	331540	331541	331542					
Analysis								
Arsenic (Dissolved)	< 0.005	< 0.005	0.008			080W[I]	mg/l	0.005
Barium (Dissolved)	0.045	0.046	0.050			080W[I]	mg/l	0.005
Beryllium (Dissolved)	< 0.001	< 0.001	< 0.001			080W[I]	mg/l	0.001
Boron (Dissolved)	0.18	0.23	0.18			080W[I]	mg/l	0.005
Cadmium (Dissolved)	< 0.001	< 0.001	< 0.001			080W[I]	mg/l	0.001
Chromium (Dissolved)	< 0.005	< 0.005	0.005			080W[I]	mg/l	0.005
Copper (Dissolved)	< 0.005	< 0.005	< 0.005			080W[I]	mg/l	0.005
Lead (Dissolved)	< 0.005	< 0.005	< 0.005			080W[I]	mg/l	0.005
Mercury (Dissolved)	< 0.00005	< 0.00005	< 0.00005			080W[I]	mg/l	0.00005
Nickel (Dissolved)	< 0.005	< 0.005	0.007			080W[I]	mg/l	0.005
Selenium (Dissolved)	< 0.005	< 0.005	< 0.005			080W[I]	mg/l	0.005
Vanadium (Dissolved)	< 0.005	< 0.005	< 0.005			080W[I]	mg/l	0.005
Zinc (Dissolved)	0.005	0.006	0.007			080W[I]	mg/l	0.005
Ammoniacal Nitrogen as NH4	0.15	< 0.065	8.4			057W[I]	mg/l	0.065
Ammoniacal Nitrogen as N	0.11	< 0.05	6.5			057W[I]	mg/l	0.05
pH	7.4	7.6	7.4			084W[I]	pH Units	1
Sulphate as SO4	120	93	61			086W[I]	mg/l	10

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53508
Matrix : Water
Project Code: SS016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH1	BH2	BH3			Method No	Units	LOD
Sample Depth (m)	-	-	-					
Date Sampled	05/08/08	05/08/08	05/08/08					
Date Scheduled	06/08/08	06/08/08	06/08/08					
Laboratory Reference No	331540	331541	331542					
Analysis								
* * PAH SUITE * *								
Naphthalene	< 0.0001	< 0.0001	0.0003			022W[I]	mg/l	0.0001
Acenaphthylene	< 0.0001	< 0.0001	< 0.0001			022W[I]	mg/l	0.0001
Acenaphthene	0.0002	0.0005	0.0002			022W[I]	mg/l	0.0001
Fluorene	0.0001	0.0003	0.0002			022W[I]	mg/l	0.0001
Phenanthrene	0.0005	0.0008	0.0004			022W[I]	mg/l	0.0001
Anthracene	0.0002	0.0003	0.0001			022W[I]	mg/l	0.0001
Fluoranthene	0.0018	0.0019	0.0024			022W[I]	mg/l	0.0001
Pyrene	0.0021	0.0020	0.0034			022W[I]	mg/l	0.0001
Benzo(a)anthracene	0.0008	0.0009	0.0008			022W[I]	mg/l	0.0001
Chrysene	0.0006	0.0007	0.0009			022W[I]	mg/l	0.0001
Benzo(b)fluoranthene	0.0019	0.0021	0.0015			022W[I]	mg/l	0.0001
Benzo(k)fluoranthene	0.0009	0.0008	0.0005			022W[I]	mg/l	0.0001
Benzo(a)pyrene	0.0017	0.0018	0.0011			022W[I]	mg/l	0.0001
Indeno(1,2,3-cd)pyrene	0.0008	0.0010	0.0005			022W[I]	mg/l	0.0001
Dibenzo(a,h)anthracene	0.0003	0.0003	0.0002			022W[I]	mg/l	0.0001
Benzo(g,h,i)perylene	0.0010	0.0011	0.0007			022W[I]	mg/l	0.0001
PAH (Sum of EPA 16)	0.0128	0.0144	0.0134			022W[I]	mg/l	0.0001

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53508
Matrix : Water
Project Code: SS016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH1	BH2	BH3			Method No	Units	LOD
Sample Depth (m)	-	-	-					
Date Sampled	05/08/08	05/08/08	05/08/08					
Date Scheduled	06/08/08	06/08/08	06/08/08					
Laboratory Reference No	331540	331541	331542					
Analysis								
* * CWG SUITE * *								
Aliphatic C5-C6	< 0.01	< 0.01	< 0.01			CWGW	mg/l	0.01
Aliphatic >C6-C8	< 0.01	< 0.01	< 0.01			CWGW	mg/l	0.01
Aliphatic >C8-C10	< 0.01	< 0.01	0.03			CWGW	mg/l	0.01
Aliphatic >C10-C12	< 0.01	< 0.01	0.11			CWGW	mg/l	0.01
Aliphatic >C12-C16	< 0.01	< 0.01	0.52			CWGW	mg/l	0.01
Aliphatic >C16-C21	< 0.01	< 0.01	0.41			CWGW	mg/l	0.01
Aliphatic >C21-C35	< 0.01	0.08	1.0			CWGW	mg/l	0.01
Total Aliphatics (C5-C35)	< 0.01	0.08	2.08			CWGW	mg/l	0.01
Aromatic C6-C7	< 0.01	< 0.01	< 0.01			CWGW	mg/l	0.01
Aromatic >C7-C8	< 0.01	< 0.01	< 0.01			CWGW	mg/l	0.01
Aromatic >C8-C10	< 0.01	< 0.01	0.04			CWGW	mg/l	0.01
Aromatic >C10-C12	< 0.01	< 0.01	0.16			CWGW	mg/l	0.01
Aromatic >C12-C16	< 0.01	< 0.01	0.36			CWGW	mg/l	0.01
Aromatic >C16-C21	< 0.01	< 0.01	0.20			CWGW	mg/l	0.01
Aromatic >C21-C35	< 0.01	0.03	0.26			CWGW	mg/l	0.01
Total Aromatics (C5-C35)	< 0.01	0.03	1.02			CWGW	mg/l	0.01
Volatile Hydrocarbons (C5-C12)	< 0.01	< 0.01	0.34			CWGW	mg/l	0.01
Extractable Hydrocarbons (C12-C35)	< 0.01	0.11	2.76			CWGW	mg/l	0.01
Total Hydrocarbons (C5-C35)	< 0.01	0.11	3.10			CWGW	mg/l	0.01
MTBE	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005
Benzene	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005
Toluene	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005
Ethylbenzene	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005
m,p-Xylenes	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005
o-Xylene	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005
1,3,5-Trimethylbenzene	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005
1,2,4-Trimethylbenzene	< 0.005	< 0.005	< 0.005			CWGW[I]	mg/l	0.005

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53508
Matrix : Water
Project Code: SS016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH3					Method No	Units	LOD
Sample Depth (m)	-							
Date Sampled	05/08/08							
Date Scheduled	06/08/08							
Laboratory Reference No	331542							
Analysis								
* * VOC SUITE * *								
Vinyl Chloride	< 0.01					040W[I]	mg/l	0.01
Chloroethane	< 0.001					040W[I]	mg/l	0.001
Trichlorofluoromethane	< 0.001					040W[I]	mg/l	0.001
1,1-Dichloroethene	< 0.001					040W	mg/l	0.001
112-Trichloro-122-Trifluoroethane	< 0.025					040W[I]	mg/l	0.025
Dichloromethane	< 0.050					040W[I]	mg/l	0.05
Trans-1,2 Dichloroethene	< 0.001					040W[I]	mg/l	0.001
MTBE	< 0.001					040W[I]	mg/l	0.001
1,1 -Dichloroethane	< 0.001					040W[I]	mg/l	0.001
Cis-1,2 Dichloroethene	< 0.001					040W[I]	mg/l	0.001
Chloroform	< 0.001					040W[I]	mg/l	0.001
1,1,1-Trichloroethane	< 0.001					040W[I]	mg/l	0.001
1,2-Dichloroethane	< 0.001					040W[I]	mg/l	0.001
Benzene	< 0.001					040W[I]	mg/l	0.001
Carbon Tetrachloride	< 0.001					040W[I]	mg/l	0.001
Trichloroethene	< 0.001					040W[I]	mg/l	0.001
Bromodichloromethane	< 0.001					040W[I]	mg/l	0.001
Cis-1,3 Dichloropropene	< 0.001					040W[I]	mg/l	0.001
Trans-1,3 Dichloropropene	< 0.001					040W[I]	mg/l	0.001
1,1,2-Trichloroethane	< 0.001					040W[I]	mg/l	0.001
Toluene	< 0.001					040W[I]	mg/l	0.001
Dibromochloromethane	< 0.001					040W[I]	mg/l	0.001
Tetrachloroethene	< 0.001					040W[I]	mg/l	0.001
Chlorobenzene	< 0.001					040W[I]	mg/l	0.001
Ethyl Benzene	< 0.001					040W[I]	mg/l	0.001
m,p-Xylenes	< 0.001					040W[I]	mg/l	0.001
Bromoform	< 0.001					040W[I]	mg/l	0.001
o-Xylene	< 0.001					040W[I]	mg/l	0.001
1,1,2,2 Tetrachloroethane	< 0.001					040W	mg/l	0.001

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results

Job Number : 08-53508
Matrix : Water
Project Code: SS016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Sample Reference	BH3					Method No	Units	LOD
Sample Depth (m)	-							
Date Sampled	05/08/08							
Date Scheduled	06/08/08							
Laboratory Reference No	331542							
Analysis								
* * VOC SUITE Cont.. * *								
1,3,5 Trimethylbenzene	< 0.001					040W[I]	mg/l	0.001
1,2,4 Trimethylbenzene	< 0.001					040W[I]	mg/l	0.001
1,3 Dichlorobenzene	< 0.001					040W[I]	mg/l	0.001
1,4 Dichlorobenzene	0.002					040W[I]	mg/l	0.001
1,2 Dichlorobenzene	0.001					040W[I]	mg/l	0.001

[I] ISO 17025 accredited.
[M] MCERTS accredited for sand, loam and clay.

ALcontrol Laboratories
Table Of Results - Appendix

Job Number : 08-53508

Project Code: SS016679

Project Name: Sturry Road, Canterbury
Client : Capita Symonds

Summary of methods contained within report :

Method No.	Reference	Description	Wet/Dry Analysis
CWGW	In-house method based on "Total Petroleum Hydrocarbon Criteria Working Group" series, 1998-9	Determination of "CWG" banded petroleum hydrocarbons in aqueous samples using a combination of headspace GC-FID (C5-C12) and pentane extraction / silica-alumina aliphatic - aromatic split / GC-FID (C12-C35) techniques with banding by comparison to alkane standards	
086W	In-house method	Determination of anion content in aqueous samples using ion chromatographic determination with electrical conductivity detector	
084W	In-house method	Determination of pH in aqueous samples by direct electrometric measurement	
080W	In-house method based on MEWAM "Inductively Coupled Plasma Spectrometry", HMSO, 1996	Determination of metals in aqueous samples by nitric acid digestion followed by Inductively Coupled Plasma - Mass Spectrometry detection (ICP-MS)	
057W	In-house method based on Method 18.13 "Environmental Assessment Guidance" Version 3, Second Site Property, March 2003	Determination of ammoniacal nitrogen in aqueous samples by ion selective electrode	
040W	In-house method based on EPA624 "Volatile Organic Compounds in Waste Waters"	Determination of volatile organic compounds in aqueous samples by headspace GC-MS	
022W	In-house method	Determination of PAH compounds in aqueous samples by pentane extraction followed by GC-MS detection [Note: this method does not separate benzo(j)fluoranthene, and this PAH will be included in the sum of benzo(b)fluoranthene & benzo(k)fluoranthene]	

Soil results are expressed on a dry weight basis. Where the test uses as-received sample, a moisture correction factor is applied to the wet weight result. This factor is determined gravimetrically using weight loss on drying at 30º (+/-5) C.

Appendix

Code	Description
On Results	
*	Detection limit(s) raised due to matrix interference
¥	Detection limit(s) raised due to reduced amount of sample available for analysis
‡	Dilution factor applied due to nature of sample
NAD	No asbestos detected
$	Analysis sub-contracted
U/S	Analysis unsuitable for sample due to its matrix or properties
I/S	Insufficient sample
M/S	Sample cannot be located within the laboratory
ND	Not detected (below relevant analytical detection limit)
ç	Sample filtered prior to analysis
§	Please note product present, therefore this result is for indicative purpose only
On the Sample Numbers	
†	Sample type outside the scope of our MCERTS accreditation since matrix not included in method validation
¢	Unsuitable for analysis due to asbestos content
General Statements	
æ	Please note TOC's & LOI's have been repeated and the apparently anomalous results confirmed
¶	UKAS and/or MCERTS accreditation removed due to duration of sample in laboratory prior to testing
¤	The BOD analysis was carried out prior to the COD analysis and included an oily layer, which is the likely cause of the anomalous results
Note:	Analysis carried out for organic compounds on water samples containing free product is on a "best endeavour" basis
Note:	All results calculated from organic carbon on a dry weight basis
Note:	Fe(II) and dissolved Fe are analysed by different methods, sometimes leading to slight discrepancy between results
Note:	"Total" results calculated by summing individual components are not rounded
Note:	The reporting limit stated in the LOD column is the standard method reporting limit, derived statistically from validation data, however it is occasionally necessary to raise reporting limits due to matrix interference or limited sample availability
Note:	During soil preparation, best efforts are made to produce analytical subsamples representative of the entire submitted sample, without exclusion of stones

APPENDIX D

GEOTECHNICAL LABORATORY RESULTS

PROJECT NAME **STURRY ROAD, CANTERBURY**
SS016679
PROJECT NO: **GEO / 13648**

Date	27/08/2008
Approved	*J Sturges*
Page	1 of 2

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression Tests					Chemical Tests			
Borehole No.	Depth (m)	No.	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 mic (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Mean Shear Stress (kPa)	Apparent Cohesion (kPa)	Angle of Shearing Resistance (º)	pH	2:1 W/S SO4 (g/l)	Ground Water SO4 (g/l)	Other tests and comments
BH1	1.00	-	D																	Chemical testing
BH1	1.50	-	D																	Chemical testing
BH1	2.00	-	B	Brown-grey sandy fine to coarse GRAVEL																Particle Size Distribution Test
BH1	2.50	-	D																	Chemical testing
BH1	3.00	-	D																	Chemical testing
BH1	5.00	-	D	Grey sandy SILT / CLAY with occasional fine to medium gravel																Particle Size Distribution Test
BH1	5.75	-	D	Dark grey silty CLAY with traces of rootlets	32	65	27	38	100											
BH1	6.50	-	U	Stiff grey clayey SILT	31					1.92	1.46	65 130 260	202 236 285	120	74	10				
BH2	1.50	-	D																	Chemical testing
BH2	2.50	-	D																	Chemical testing
BH2	3.00	-	B	Mottled brown and grey slightly silty sandy fine to coarse GRAVEL																Particle Size Distribution Test
BH2	4.50	-	D																	Chemical testing

SUMMARY OF GEOTECHNICAL TESTING

GEOLABS

Client: Capita Symonds Structures, Prospect House, 20 Mellor Road, Cheadle Hume, Cheshire SK8 5AU

PROJECT NAME STURRY ROAD, CANTERBURY

SS016679

PROJECT NO: GEO / 13648

Date	27/08/2008
Approved	J Sturges
Page	2 of 2

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression Tests					Chemical Tests			
Borehole No.	Depth (m)	No.	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 mic (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Mean Shear Stress (kPa)	Apparent Cohesion (kPa)	Angle of Shearing Resistance (º)	pH	2:1 W/S SO4 (g/l)	Ground Water SO4 (g/l)	Other tests and comments
BH2	7.00	-	D	Grey silty CLAY	33	89	36	53	100											
BH3	4.50	-	D	Brown sandy silty CLAY and fine to coarse GRAVEL with traces of rootlets	24	55	24	31	50											
BH3	5.00	-	U	Firm grey clayey SILT	34					1.72	1.28	50 100	110 132	61	37	10				
TP1	2.50	-	D																	Chemical testing
TP2	1.00	-	D	MADE GROUND: (Dark brown slightly sandy silty clay with traces of fine to medium gravel and gravel sized brick fragments)	17	36	21	15	96											
TP4	1.30	-	D	Orange-brown slightly sandy silty CLAY with traces of fine to medium gravel	20	33	19	14	98											
TP8	2.00	-	D																	Chemical testing
WS2	1.20	-	D	MADE GROUND: (Mottled brown and dark brown silty clay with abundant fine to medium gravel and traces of brick fragments)	13	35	21	14	71											
WS5	1.00	-	D																	Chemical testing

SUMMARY OF GEOTECHNICAL TESTING

GEOLABS

Client: Capita Symonds Structures, Prospect House, 20 Mellor Road, Cheadle Hume, Cheshire SK8 5AU

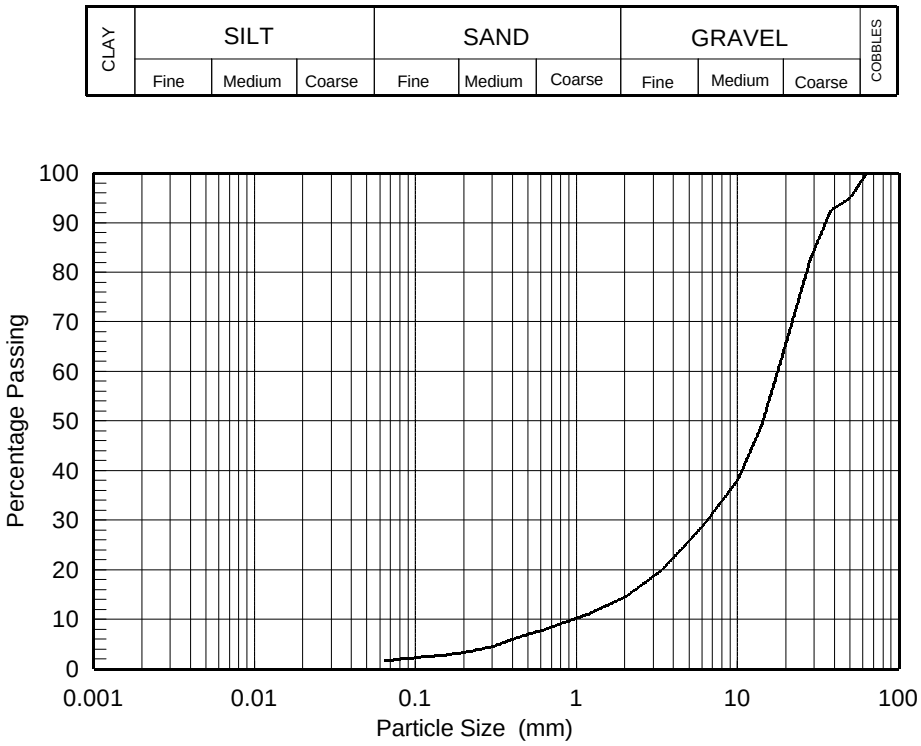
BS1377 : Part 2 : Clause 9 : 1990

Determination of Particle Size Distribution

Borehole Number: BH1	Description:
Sample Number: -	Brown-grey sandy fine to coarse GRAVEL
Depth (m): 2.00	

BS1377 : Part 2 : Clause 9.3 : 1990 Dry Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	95
37.5 mm	92
28 mm	83
20 mm	66
14 mm	49
10 mm	38
6.3 mm	30
5 mm	26
3.35 mm	20
2 mm	15
1.18 mm	11
600 µm	8
425 µm	6
300 µm	5
212 µm	3
150 µm	3
63 µm	2



Particle Proportions		
Cobbles	0.0	%
Gravel	85.4	%
Sand	12.9	%
Silt & Clay	1.7	%

Checked and Approved Initials: JS Date: 27/08/2008	Project Number: **GEO / 13648** Project Name: **STURRY ROAD, CANTERBURY** **SS016679**	GEOLABS

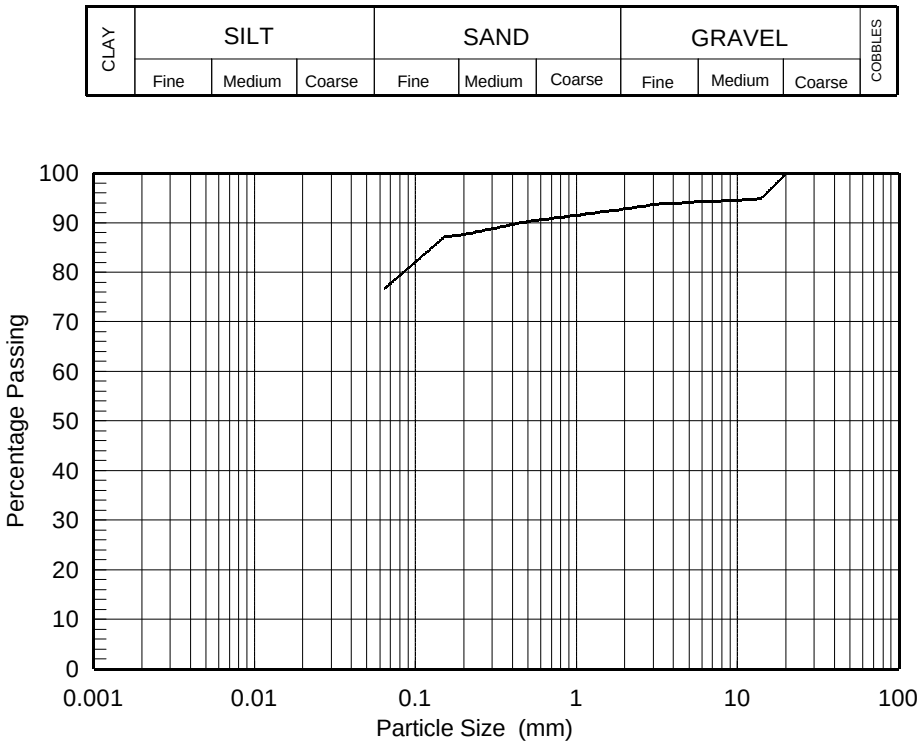
BS1377 : Part 2 : Clause 9 : 1990

Determination of Particle Size Distribution

Borehole Number: BH1	Description:
Sample Number: -	Grey sandy SILT / CLAY with
Depth (m): 5.00	occasional fine to medium gravel

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	95
10 mm	95
6.3 mm	94
5 mm	94
3.35 mm	94
2 mm	93
1.18 mm	92
600 µm	91
425 µm	90
300 µm	89
212 µm	88
150 µm	87
63 µm	77



Particle Proportions		
Cobbles	0.0	%
Gravel	7.1	%
Sand	16.3	%
Silt & Clay	76.7	%

Checked and Approved Initials: JS Date: 27/08/2008	Project Number: **GEO / 13648** Project Name: **STURRY ROAD, CANTERBURY** **SS016679**	GEOLABS

BS1377 : Part 2 : Clause 9 : 1990

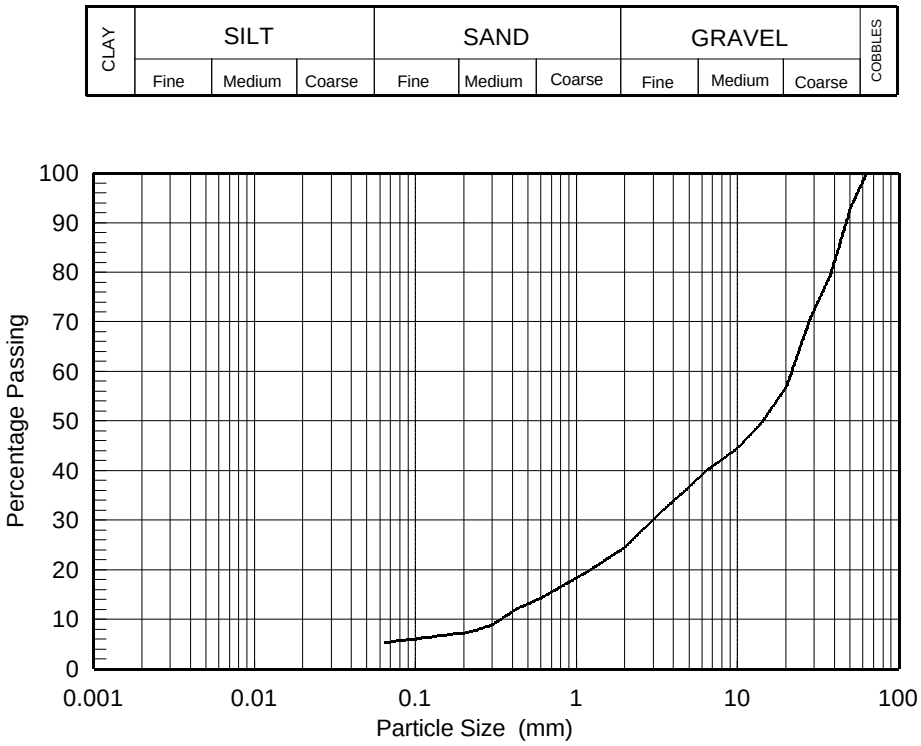
Determination of Particle Size Distribution

Borehole Number:	BH2
Sample Number:	-
Depth (m):	3.00

Description:
Mottled brown and grey slightly silty sandy fine to coarse GRAVEL
All sample used - insufficient to be representative

BS1377 : Part 2 : Clause 9.3 : 1990 Dry Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	93
37.5 mm	80
28 mm	71
20 mm	57
14 mm	50
10 mm	45
6.3 mm	40
5 mm	37
3.35 mm	32
2 mm	25
1.18 mm	20
600 µm	14
425 µm	12
300 µm	9
212 µm	7
150 µm	7
63 µm	5



Particle Proportions		
Cobbles	0.0	%
Gravel	75.2	%
Sand	19.4	%
Silt & Clay	5.3	%

Checked and Approved
Initials: JS
Date: 27/08/2008

Project Number: **GEO / 13648**
Project Name: **STURRY ROAD, CANTERBURY**
SS016679

GEOLABS

BS1377 : Part 7 : Clause 9 : 1990

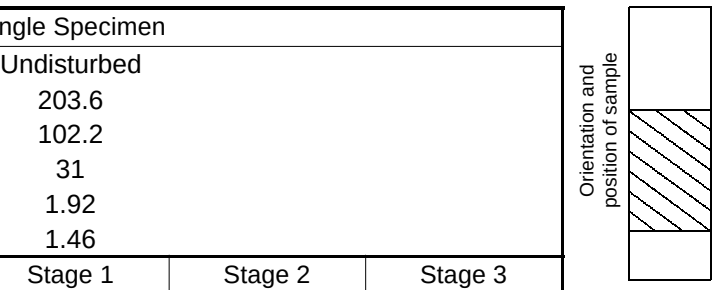
Quick Undrained Triaxial Test

Borehole Number: BH1 Sample Number: - Depth (m): 6.50	Description: Stiff grey clayey SILT

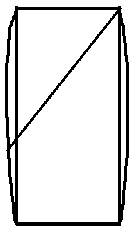
3 Stage Specimen

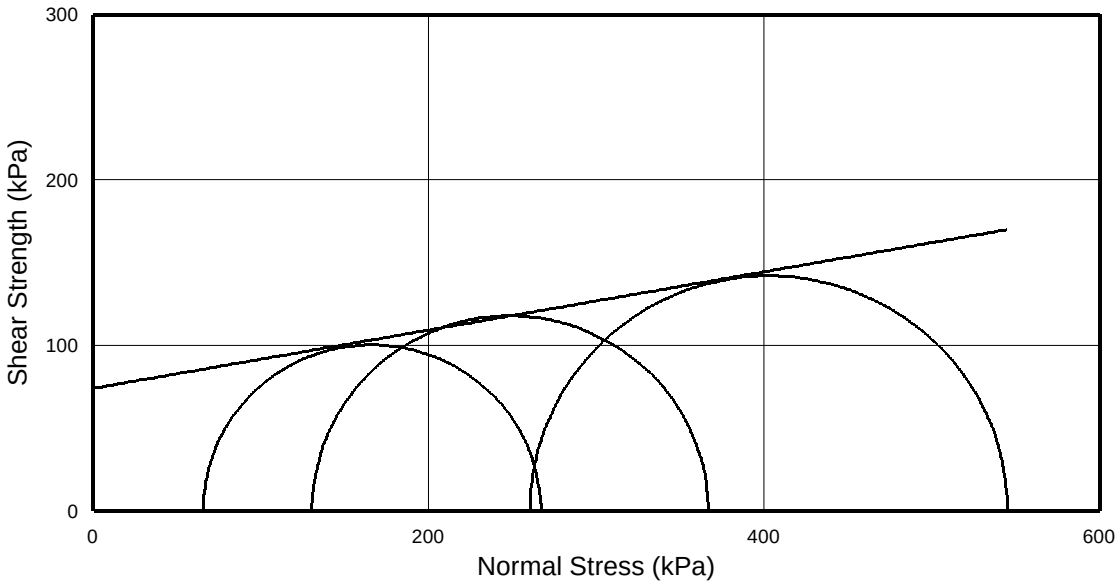
Specimen details	Single Specimen		
Specimen conditions:	Undisturbed		
Length (mm):	203.6		
Diameter (mm):	102.2		
Moisture Content (%):	31		
Bulk Density (Mg/m³):	1.92		
Dry Density (Mg/m³):	1.46		
Test details	**Stage 1**	**Stage 2**	**Stage 3**
Latex membrane thickness (mm):	0.3	0.3	0.3
Membrane correction (kPa):	0.6	0.7	1.1
Axial displacement rate (%/min):	1.9	1.9	1.9
Cell pressure (kPa):	65	130	260
Strain at failure (%):	8.8	11.3	19.6
Maximum Deviator Stress (kPa):	202	236	285
Shear Stress Cu (kPa):	101	118	142

Orientation and position of sample



Mode of failure:





c = 74 kPa Ø = 10 °

Checked and Approved	Project Number:	
Initials: JS Date: 27/08/2008	**GEO / 13648** Project Name: **STURRY ROAD, CANTERBURY** **SS016679**	*GEOLABS*

Client: Capita Symonds Structures, Prospect House, 20 Mellor Road, Cheadle Hume, Cheshire SK8 5AU

BS1377 : Part 7 : Clause 9 : 1990

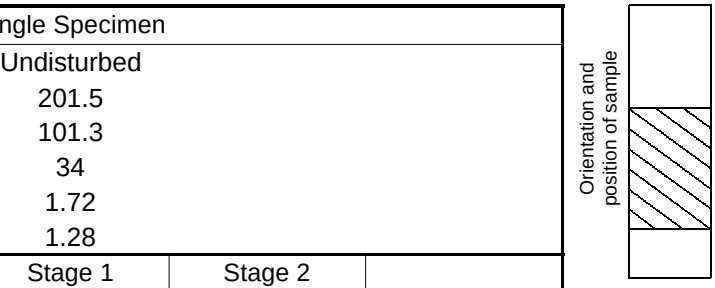
Quick Undrained Triaxial Test

Borehole Number: BH3	Description:
Sample Number: -	Firm grey clayey SILT
Depth (m): 5.00	

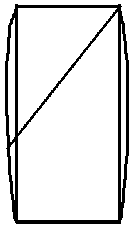
2 Stage Specimen

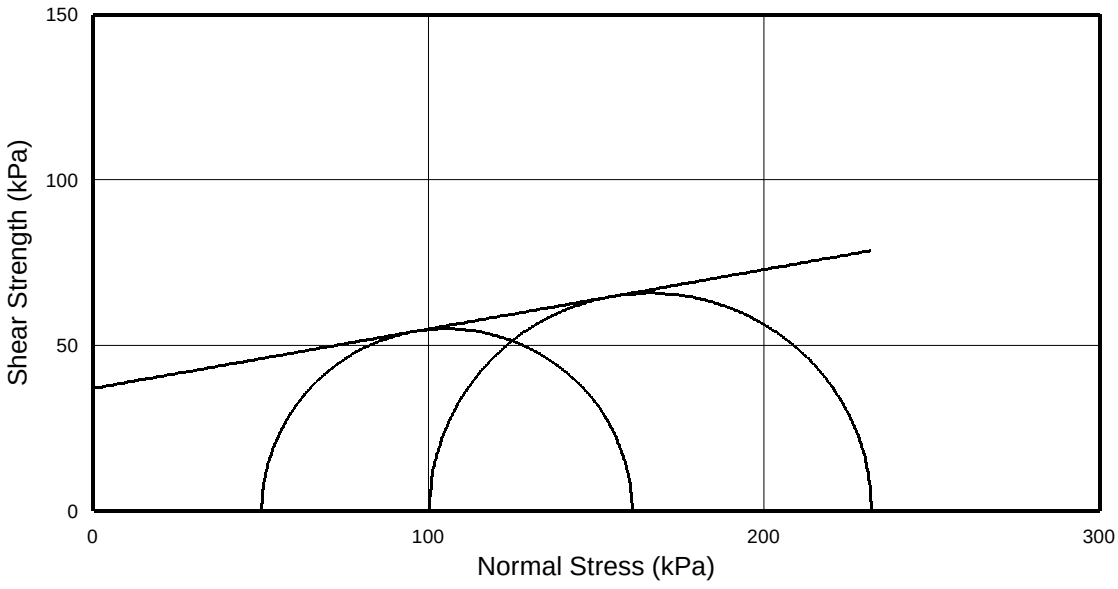
Specimen details	Single Specimen		
Specimen conditions:	Undisturbed		
Length (mm):	201.5		
Diameter (mm):	101.3		
Moisture Content (%):	34		
Bulk Density (Mg/m³):	1.72		
Dry Density (Mg/m³):	1.28		
Test details	**Stage 1**	**Stage 2**	
Latex membrane thickness (mm):	0.3	0.3	
Membrane correction (kPa):	1.0	1.1	
Axial displacement rate (%/min):	1.9	1.9	
Cell pressure (kPa):	50	100	
Strain at failure (%):	16.4	19.9	
Maximum Deviator Stress (kPa):	110	132	
Shear Stress Cu (kPa):	55	66	

Orientation and position of sample



Mode of failure:





c = 37 kPa Ø = 10 °

Checked and Approved	Project Number:	
Initials: JS	**GEO / 13648**	*GEOLABS*
Date: 27/08/2008	Project Name: **STURRY ROAD, CANTERBURY**	
	SS016679	

Client: Capita Symonds Structures, Prospect House, 20 Mellor Road, Cheadle Hume, Cheshire SK8 5AU

GEOLABS

PROJECT NAME :	STURRY ROAD, CANTERBURY SS016679
PROJECT NO:	GEO / 13648

BH	Sample No.	Depth (m)	pH	Total (Acid-soluble) SO4 (%)	Water-soluble (2:1 extract) SO4 (g/L)	Total Sulphur (%)	Water Soluble Chloride (mg/l)	Water Soluble Nitrate (mg/l)	Magnesium (mg/l)	Organic Content (%)	Carbonate Content (%)
BH1	-	1.00	7.9	0.130	0.070	0.055	<50	<1.0	-	-	-
BH1	-	1.50	-	-	-	-	-	-	-	1.3	-
BH1	-	2.50	8.4	<0.010	0.090	<0.010	<50	<1.0	-	-	-
BH1	-	3.00	-	-	-	-	-	-	-	1.3	-
BH2	-	1.50	-	-	-	-	-	-	-	1.5	-
BH2	-	2.50	-	-	-	-	-	-	-	0.49	-
BH2	-	4.50	8.0	0.220	1.900	0.096	<50	<1.0	-	-	-
TP1	-	2.50	8.3	0.013	0.100	<0.010	<50	<1.0	-	-	-
TP8	-	2.00	8.3	0.028	0.050	0.014	<50	<1.0	-	-	-
WS5	-	1.00	7.8	0.037	0.020	0.013	<50	<1.0	-	-	-

Checked and approved: JS

Initials:

Date: 27/08/2008

SUMMARY OF CHEMICAL TESTS ON SOIL

APPENDIX E

GROUNDWATER AND GROUND GAS MONITORING RESULTS

CAPITA SYMONDS

Land Gas and Groundwater Monitoring Data Sheet

Project name: Sturry Road, Canterbury **Project number:** SS016679 **Date of Monitoring:** 5/8/08

Monitoring Location	Methane	Carbon Dioxide	Oxygen	Flow	Atmospheric Pressure	Water Level	Base Depth
	(% by vol)	(% by vol)	(% by vol)	(l/hr)	(mbar)	(mbgl)	(mbgl)
BH1	0.0	0.3	20.0	0.0	1014	2.02	8.10
BH2	0.0	1.3	17.4	0.0	1014	2.19	8.05
BH3	0.1	0.4	20.2	0.0	1014	1.73	7.75
WS1	0.1	3.8	18.3	*	1014	1.83	1.97
WS2	0.0	1.3	18.1	*	1014	Dry	-
WS3	0.0	3.4	18.0	0.0	1014	2.08	2.12
WS4	0.0	3.4	18.3	0.0	1014	1.89	2.11
WS5	0.0	3.3	18.0	0.0	1014	2.09	
WS6	0.0	1.0	19.7	0.0	1014	-	

* Free venting

CAPITA SYMONDS

Land Gas and Groundwater Monitoring Data Sheet

Project name: Sturry Road, Canterbury **Project number:** SS016679 **Date of Monitoring:** 12/8/08

Monitoring Location	Methane	Carbon Dioxide	Oxygen	Flow	Atmospheric Pressure	Water Level	Base Depth
	(% by vol)	(% by vol)	(% by vol)	(l/hr)	(mbar)	(mbgl)	(mbgl)
BH1	0.0	0.3	21.0	0.0	986	1.96	8.04
BH2	0.0	3.2	16.2	0.0	986	2.14	7.97
BH3	0.0	0.5	19.6	0.0	986	1.68	7.61
WS1	0.0	3.4	18.0	*	986	1.78	1.99
WS2	0.0	1.2	19.5	0.0	986	1.80	1.95
WS3	0.0	3.7	17.2	0.0	986	2.05	2.12
WS4	0.0	3.3	17.8	0.0	986	1.82	2.10
WS5	0.0	3.3	17.3	0.0	986	2.05	2.11
WS6	0.0	1.2	19.0	0.0	986	-	-

* free venting

CAPITA SYMONDS

Land Gas and Groundwater Monitoring Data Sheet

Project name: Sturry Road, Canterbury **Project number:** SS016679 **Date of Monitoring:** 27/8/08

Monitoring Location	Methane	Carbon Dioxide	Oxygen	Flow	Atmospheric Pressure	Water Level	Base Depth
	(% by vol)	(% by vol)	(% by vol)	(l/hr)	(mbar)	(mbgl)	(mbgl)
BH1	0.0	0.6	19.9	0.0	1020	-	-
BH2	0.0	4.4	16.6	0.0	1020	-	-
BH3	0.0	0.8	19.6	0.0	1020	-	-
WS1	0.0	2.8	18.4	*	1020	-	-
WS2	0.0	0.7	20.1	0.0	1020	-	-
WS3	0.0	2.5	18.8	0.0	1020	-	-
WS4	0.0	2.7	18.6	0.0	1020	-	-
WS5	0.0	2.2	18.9	0.0	1020	-	-
WS6	0.0	1.2	19.5	0.0	1020	-	-

* free venting

APPENDIX F

GQRA METHODOLOGY

ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY

This section details the approach by Capita Symonds Structures to the assessment of risks from potentially contaminated land.

Legislative Setting and Definitions

There are a number of pieces of legislation through which a potentially contaminated site can be assessed. This section describes the key areas and aspects of those pieces of legislation that form the framework through which CSS's assessments are carried out.

Part IIA of the Environmental Protection Act 1990 (as inserted by Section 57 of the Environment Act 1995) provides a regime for the control of specific threats from existing land contamination. The main regulators of Part IIA and subsequent secondary legislation (the Contaminated Land (England) Regulations 2000) are the Local Authorities, which have a statutory obligation to develop inspection strategies, carry out site investigations, and enforce action where necessary. Statutory guidance on the application of the legislation was published in a Governmental Circular on 20th March 2000 (DETR Circular 02/2000). The legislation lays down several key definitions which form the basis for the assessment of land contamination. These definitions are as follows:

- **Contaminated Land:**
  Land is designated as "Contaminated Land" where it appears to the regulatory authority, by reason of substances in, on, or under the land that:

  1. *Significant harm is being caused or there is the significant possibility of such harm being caused; or*
  2. *Significant pollution of controlled water is being, or there is a significant possibility of such pollution being caused.*

  The above definition includes amendments to the "Controlled Waters" limb implemented through the Water Act 2003.

- **Harm:**
  Harm is defined under section 78A of the Environmental Protection Act as meaning *'harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property'*.

- **Controlled Water:**
  Controlled Water is defined by Part III of the Water Resources Act 1991 (in England & Wales) and Section 30A of the Control of Pollution Act 1974 (in Scotland) and includes:

  - Relevant Territorial Waters
  - Coastal Waters
  - Inland Freshwaters (including the bottom, channel or bed)
  - Ground Waters

- **Suitable for Use:**
  The Government considers the "suitable for use" approach to be the most appropriate approach to achieving sustainable development in this field. The approach consists of three elements:
  - Ensure the land is suitable for its current use
  - Ensure the land is made suitable for any new use, subject to planning permission

- Limit remediation to the work necessary for preventing unacceptable risk to human health or the environment

- **Risk Assessment:**
  The definition of contaminated land is based upon the principles of risk assessment. For the purposes of this guidance, "risk" is defined as the combination of:
  - the probability, or frequency, of occurrence of a defined hazard (for example, exposure to a property of a substance with the potential to cause harm); and
  - The magnitude (including the seriousness) of the consequences.

- **Source Pathway Receptor:**
  For there to be significant harm or the significant possibility of harm, there must be a "*significant pollutant linkage*". This is defined in terms of having one of each of the following:

  - Source - Presence of substances (potential contaminants/pollutants) that may cause harm (Source of Pollution);
  - Receptor - The presence of a receptor which may be harmed, e.g. the water environment or humans, buildings, fauna and flora (The Receptor);
  - Pathway - The existence of a linkage between the source and the receptor

The characteristics of the potential sources, pathways and receptors, which are relevant to any given site, can vary considerably according to the intended end-use of the site and the environmental characteristics of the site and its surroundings. The method for assessing the subject site is described in the following paragraphs.

Risk Assessment Framework

In September 2004 the Environment Agency of England and Wales published CLR11: Model Procedures for the Management of Land Contamination. The document is "*intended to provide the technical framework for structured decision-making about land contamination*".

The model procedure outlines a three tiered risk assessment process comprising:

Tier 1 **Preliminary Risk Assessment (PRA)**
An initial appraisal of the site environmental conditions in terms of potential source-pathway-receptor pollutant linkages. The aim of this is to focus further assessment on those complete linkages.

Tier 2 **Generic Quantitative Risk Assessment (GQRA)**
Comprising the comparison between measured site contaminant concentrations with Generic Assessment Criteria and interpretation of the results to develop conclusions.

Tier 3 **Detailed Quantitative Risk Assessment (DQRA)**
Detailed site specific assessment comprising potential further data collection and/or the use of analytical or numerical models to derive highly site specific assessment criteria.

Preliminary Risk Assessment (PRA)

Using the definitions relevant to the assessment of contaminated land, the investigation and assessment of a subject site must consider potential risks to the following:

- Human Health
- Natural Habitats
- Buildings
- Controlled Waters

At the source-pathway-receptor stage (i.e. Phase I Desk Study); all potential pollutant linkages are assessed, for all of the potential receptors outlined above. The Phase II investigation is then designed around these findings with the aim of collecting measured values for the condition of the site.

The measured concentrations are then used in the GQRA.

Generic Quantitative Risk Assessment (GQRA)

Potential risks to "Buildings" are assessed through the "Geotechnical" and "Hazardous Gases" investigations and assessments, which are carried out for any redevelopment project. Please refer to the relevant sections within the main body of the report for further information.

Potential risks to "Habitats" are reviewed on a site by site basis and often require detailed quantitative risk assessment as a preliminary step should a complete linkage be identified.

Potential risks to "Human Health" and "Controlled Waters" are determined through the comparison of measured concentrations (soil, groundwater and leachate) with Generic Assessment Criteria (for both soil and groundwater). These are described in the paragraphs below.

Generic Assessment Criteria (GAC)

- **Human Health – Soil GACs**
  Over the past 5 years the Government has researched and published a number of technical documents to assist in the assessment of contaminated land with particular focus on potential risks to human health from soils.

  The publications relate to the Contaminated Land Exposure Assessment (CLEA) model and have culminated (to date) in the production of 22 Toxicology (TOX) reports and the derivation of 9 Soil Guideline Value (SGV) reports.

  Capita Symonds Structures have derived in-house GACs for use at the GQRA stage:

  1. Where an SGV value has been derived, this has been adopted as the authoritative GAC for that particular contaminant of concern.
  2. Where an alternative UK specific GAC has been derived, this has been adopted as the authoritative GAC for that particular contaminant of concern.
  3. Where no UK specific GAC exists, the modelling procedures outlined in CLR 10 and updates have been used to derive UK specific GACs. This has been carried out for all potential contaminants of concern with a TOX report, the total petroleum

hydrocarbon criteria working group (TPHCWG) fractions and known/suspected carcinogenic poly-aromatic-hydrocarbons (PAHs).

For use in the initial GQRA it has been assumed that the site end-use will comprise a residential re-development including private gardens with the potential to grow vegetables for home consumption. The GACs derived in-house assume all the following pathways are active for this end-use:

1. Ingestion of soil
2. Ingestion of household dust
3. Ingestion of vegetables
4. Ingestion of soil attached to vegetables
5. Dermal contact with soil
6. Inhalation of vapours in outdoor air
7. Inhalation of vapours in indoor air

Pathways relating to dust inhalation and dermal contact with dust have not been considered at this time, as for this end-use, the pathways above are expected to dominate the GAC derivation.

To derive a GAC, each pathway was modelled using an acceptable algorithm, as outlined in CLR10 and associated Briefing Notes. For example, for the calculation of an indoor air GAC for volatile organic compounds, the Johnson and Ettinger Model as included in the BP-RISC version 4 software has been used.

Assumptions within the generic conceptual model include all parameters associated with a "sandy soil" with a default pH = 7 and a soil organic matter = 1%. For exposure parameters, time averaged values of the distributions presented in CLR10 have been used. Whilst these do not allow Monte Carlo simulations, the GACs are considered to be more conservative. Where SGVs have been derived, the corresponding in-house GACs are either equal to or more conservative that the published SGVs.

Pathway specific assessment criteria have been combined using the following formula:

$$1/GAC = 1/PV_{ingestion} + 1/ PV_{dermal} + 1/PV_{vegetable} + 1/PV_{inhalation}$$

GAC = Generic Assessment Criteria
PV = Pathway Value

- **Controlled Water – Groundwater GACs**
  The main guidance relating to the risk assessment of potentially contaminated land to controlled waters is held in the Environment Agency's R&D Publication 20: "Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources" (1999).

  For the assessment of the subject site, Tier 1 of the EA's risk assessment methodology is carried out.

  For the assessment of potential risks from the soils on-site, Tier 1 assessments consider whether the concentrations of 'pore water' in contaminated soil are sufficient to impact upon a given receptor, ignoring the effects of dilution, dispersion and attenuation. Soil samples are collected and the quality of pore water has been quantified by way of soil leaching tests. The resultant water concentrations are compared to the Groundwater GACs.

For the assessment of potential impacts to groundwater, monitoring wells are installed and groundwater samples are collected for laboratory analysis. The resultant groundwater concentrations are compared to the selected groundwater GACs. This is consistent with the Tier 1 approach of the EA methodology.

From the Site Investigation information collected, a decision is made as to which suite of GACs is most appropriate for the site sensitivity. The selection is made from the following three categories:

1. "Major Aquifers and/or Source Protection Zone." Mainly drinking water standards from the water Supply (Water Quality) Regulations 1989 and 2000 (as amended). The GACs are the most stringent for groundwater protection.
2. "Minor Aquifers and Non-aquifers." To reflect the lower utilisation of these resources and the (normally) lower permeability of the geological media, the GACs for this category are environmental quality standards (EQSs) for the protection of freshwater eco-systems and or drinking water standards where appropriate.
3. "Risk to Surface Water." For certain potential contaminants of concern, the potential risk to surface water eco-systems is greater than the potential risk to human health. This is reflected in the EQSs outlined for this potential scenario.

GQRA Conclusions

It is critical to the effective use of a GQRA that the user acknowledges that if a measured site concentration exceeds the specified GAC, this does not indicate that a risk is posed.

Risk assessment is a decision making tool. Therefore, the correct conclusion is that further assessment is required. The further assessment could comprise one or more of the following:

- **GAC Evaluation**
  The GACs presented are based on a series of assumptions, which if additional information is available, could be modified to change the GAC value for any particular set of circumstances. Modifications could include: soil type; pH; soil organic matter content; and end-use specifics.
- **Statistical Testing**
  It is the intention of the government bodies that GACs (including SGVs) are to be used with full consideration of the statistical relevance of site investigation data. Several statistical tests are available for data representation and data interpretation where site investigation data is at an adequate level of density and the end-use is fully appreciated. Two such tests are outlined in the DEFRA & EA publication CLR7: Assessment of Risks to Human Health from Land Contamination – An Overview of the development of Soil Guideline Values and Related Research:

  - **The Mean Value Test**, which calculates the Upper Bound Value (UBV) of a set of chemical data; statistically, there is 95% confidence that the mean of a population (from which the data set is taken) is below the UBV.
  - **The Maximum Value Test**, which calculates the Outlier Critical Value (OCV). This enables an assessment to be made of whether the highest value in a set of results belongs to the general 'population', or whether it represents a statistical outlier.

  The statistical tests may be used where appropriate.

- **Further Site Investigation**
  Site investigation is not an exact science and statistical uncertainty is present throughout the investigation and assessment. The uncertainty is present within the conceptual site model through to the interpretation of data and chemical test results. To combat this, further targeted site investigation data can be collected to reduce uncertainty. Examples include: extra boreholes to determine depths and thicknesses of critical geological units; extra exploratory holes to delineate source volumes; the collection of additional samples for more precise analytical testing; greater sampling and analysis to improve the statistical population.
- **Detailed Quantitative Risk Assessment (DQRA or Tier 3)**
  An alternative to reducing uncertainty through site investigation, is to carry out site specific fate and transport modelling where migration pathways are the critical pathways (for example groundwater impacts or potential volatility issues). The use of an analytical or numerical model to assess the specific site scenario can remove some of the conservatism inherent in the development of generic assessment criteria. A DQRA also allows the focus of further site investigation by outlining which pathways are critical and which parameter values are critical in the assessment.
- **Remediation**
  The risk assessor should always have in mind that if a specific risk is identified from site investigation data, action should be taken immediately. On occasion it may be necessary or more beneficial to instigate remediation proceedings without conducting further site investigation of risk assessment.

CAPITA SYMONDS STRUCTURES

GENERIC ASSESSMENT CRITERIA

FOR

GENERIC QUANTITATIVE RISK ASSESSMENT

TOX Rpt	Compound	Residential with Plant Uptake		Residential without Plant Uptake		Commercial / Industrial		Major Aquifer &/or Groundwater SPZ		Minor Aquifers or Non-aquifers		Surface Water Receptor	
		mg/kg	Ref	mg/kg	Ref	mg/kg	Ref	µg/l	Ref	µg/l	Ref	µg/l	Ref
	Metals												
1	Arsenic	20	A	20	A	500	A	10	1	50	2 & 3	50	2 & 3
	Boron	7.6	F	400	F	36800	F	1000	1	1000	1	1000	1 & 3
3	Cadmium (pH 6, 7, 8)	1, 2, 8	A	30	A	1400	A	3	4	5	1 & 2	5	1 & 2
4	Chromium VI	130	A	200	A	5000	A	50	1	50	1	5-250	5
	Copper	250	B	250	B	250	B	2000	1	2000	1	1-28	5
6	Lead	450	A	450	A	750	A	10	4	25	1	4-250	5
7	Mercury (Inorganic)	8	A	15	A	480	A	1	1	1	2	1	2
8	Nickel	50	A	75	A	5000	A	20	1	50-200	5	50-200	5
10	Selenium	35	A	260	A	8000	A	10	1	10	1	10	1
	Zinc	1000	B	1000	B	1000	B	5000	1	5000	1	8-500	5
	Non-Metals												
5	Free-Cyanide	240	C	260	C	13000	C	50	1	70	4	70	4
	Petroleum Hydrocarbon Fractions												
	Aliphatic C5-6	8	D	8	D	360	D						
	Aliphatic>C6-8	15	D	15	D	N/P	D						
	Aliphatic>C8-10	3	D	3	D	38000	D						
	Aliphatic>C10-12	14	D	14	D	99000	D						
	Aliphatic>C12-16	850	D	1250	D	107000	D						
	Aliphatic>C16-35	31900	D	37600	D	N/P	D	10	6	200	7	50	3
	Aromatic >C8-10	4	D	4.5	D	215	D						
	Aromatic >C10-12	15	D	25	D	30000	D						
	Aromatic >C12-16	35	D	110	D	43000	D						
	Aromatic >C16-21	70	D	560	D	32500	D						
	Aromatic >C21-35	2520	D	5480	D	32500	D						
	Petroleum Hydrocarbon Indicators												
11	Benzene	0.03	C	0.035	C	1.5	C	1	1	30	2	30	2
14	Toluene (%SOM 1, 2.5, 5)	3, 7, 14	A	3, 8, 15	A	150, 350, 680	A	24	8	50	2	50	2
17	Ethylbenzene (%SOM 1, 2.5, 5)	9, 21, 41	A	16, 41, 80	A	48000	A	2	8	20	9	20	9
19	Xylenes	5	C	5	C	200	C	20	8	30	2	30	2
	Poly Aromatic Hydrocarbons												
2	Benzo(a)pyrene	0.95	C	1.3	C	22	C	0.01	1	0.7	4	0.7	4
20	Naphthalene	2	C	2	C	85	C	10	2	10	2	10	2
	Benzo(a)anthracene	6.4	E	9.5	E	215	E	-	-	-	-	-	-
	Chrysene	1	E	45	E	720	E	-	-	-	-	-	-
	Benzo(b)fluoranthene	7.5	E	11.6	E	200	E						
	Benzo(k)fluoranthene	33	E	44.6	E	720	E	0.1	1				
	Indeno(123cd)pyrene	12	E	16.6	E	270	E						
	Benzo(ghi)perylene	-	-	-	-	-	-						
	Dibenzo(ah)anthracene	0.5	E	0.7	E	11	E	-	-	-	-	-	-
	Other Volatile Organic Compounds												
	MTBE	-	-	-	-	-	-	5	10	20	11	2600	12
16	Tetrachloroethanes	3	C	56	C	200	C	0.05	13	0.05	13	0.05	13
23	Tetrachloroethene	2	C	2.3	C	95	C	10	1	40	4	10	14
25	1,1,1-Trichloroethane	11	C	11	C	470	C	100	2	100	2	100	2
24	Trichloroethene	0.13	C	0.13	C	55	C	10	1	70	4	10	14
22	1,2-Dichloroethane	0.045	C	0.058	C	1.6	C	3	1	30	4	10	14
18	Vinyl Chloride	0.0007	C	0.0007	C	0.05	C	0.5	1	5	4	5	4
21	Carbon Tetrachloride	0.04	C	0.04	C	2	C	2	4	12	14	12	14
	Other Semi-Volatile Organic Compounds												
9	Phenol (%SOM 1, 2.5, 5)	78, 150, 280	A	21900	A	21900	A	0.5	1	30	15	300	15

CAPITA SYMONDS STRUCTURES

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Soil GAC Source Reference	
A	UK (CLEA) Soil Guideline Value
B	ICRCL Guidance Note 70/90: Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing.
C	Capita Symonds in-house GAC using DEFRA & EA TOX Report (assuming 1% Soil Organic Matter)
D	Capita Symonds in-house GAC using TPHCWG toxicity information (assuming 1% Soil Organic Matter)
E	Capita Symonds in-house GAC using relative potency factors based on benzo(a)pyrene (assuming 1% Soil Organic Matter)
F	Capita Symonds in-house GAC using toxicological value derived using CLR9 methodology
Groundwater GAC Source Reference	
1	Drinking Water Standard from Water Supply (Water Quality) Regulations 2000 (SI 2000/3184) (as amended)
2	Environmental Quality Standard from List 2 EC Dangerous Substances Directive (76/464/EEC) - Freshwater
3	Environmental Quality Standard from EC Surface Water Abstraction Directive (75/440/EEC) - Imperative (A1)
4	Drinking Water Standard from World Health Organisation (WHO) Guidelines for Drinking Water Quality, 1984 - health value
5	Environmental Quality Standard from List 2 EC Dangerous Substances Directive (76/464/EEC) - Freshwater (hardness related)
6	Drinking Water Standard from Water Supply (Water Quality) Regulations 1989 (SI 1989/1147) (as amended)
7	Environmental Quality Standard from EC Surface Water Abstraction Directive (75/440/EEC) - Imperative (A2)
8	Drinking Water Standard from World Health Organisation (WHO) Guidelines for Drinking Water Quality, 1984 - ATO
9	Ayscough *et al.* (2002) Proposed Environmental Quality Standards for Ethylbenzene in Water (EA R&D Technical Report P2-115/TR4).
10	UK Drinking Water Inspectorate - threshold for objectionable odour/taste of 5µg/l to 10µg/l
11	US EPA advisory limits (1997). As published in Environment Agency "The fuel additive MTBE a groundwater protection issue?" booklet.
12	Ahlberg *et al.* (2001) An Environmental Risk Assessment of MTBE use in Europe. ECETOC/EFOA Task Force on ERA of MTBE.
13	USEPA Region 9 and Region 3 standards for "Tap Water"
14	Environmental Quality Standard from List 1 EC Dangerous Substances Directive (76/464/EEC) - Freshwater
15	As Presented in Appendix 8 "Selected Water Quality Standards" in Hydrogeological Risk Assessments for Landfills (LFTGN01 - Environment Agency, March 2003).
Abbreviations	
SOM	Soil Organic Matter
N/P	No pathway - no risk is posed by this substance under the specific land-use scenario
MTBE	Methyl Tertiary Butyl Ether - a petroleum fuel additive which is a common groundwater contaminant