Ground Investigation

Soils LIMITED

Geotechnical & Environmental Consultants

Phase II Scoping Ground Investigation Report

At

Great Grovehurst Farm, Sittingbourne, Kent ME9 8RB

For

PFA Consulting Ltd

Soils Limited
Newton House
Cross Road
Tadworth
Surrey KT20 5SR
☎ 01737 814221
🗐 01737 812557

REPORT 13838/SGIR

Scoping Ground Investigation Report

Job Title: Great Grovehurst Farm, Sittingbourne, Kent ME9 8RB

Client: PFA Consulting Ltd

CONTROL DOCUMENT

SOILS LIMITED DOCUMENT REFERENCE NUMBER:
13838/SGIR

DOCUMENT TYPE:
Scoping Ground Investigation Report

DOCUMENT STATUS: Final REVISION: 1.00

DATE: November 2013

Note: This is not a valid document for use in the design of the project unless it is titled **Final** in the Document Status box.

	Name	Signature
Prepared by:	R Galinski	
Checked by:	R Biney	
	R B Higginson	

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Soils Limited
Newton House
Tadworth
Surrey KT20 5SR
Phone 01737 814221
Fax 01737 812557

Scoping Ground Investigation Report

At

Great Grovehurst Farm, Sittingbourne, Kent ME9 8RB

For

PFA Consulting Ltd

Commission

Soils Limited were commissioned by PFA Consulting Ltd to undertake a Phase II Scoping Ground Investigation on land at Great Grovehurst Farm, Sittingbourne, Kent ME9 8RB and the scope of the investigation was outlined in Soils Limited subsequent quotation reference Q14724 dated 18th September 2013.

This document comprises the Phase II Scoping Intrusive Report and incorporates the results, discussion and conclusions to the Intrusive Investigation. The works undertaken to prepare this report comprised a Phase I Desk Study, intrusive investigation, and laboratory contamination and geotechnical testing.

This report must be read in conjunction with the Phase I Desk Study for the site, undertaken by Soils Limited, Ref: 13838/DS dated October 2013.

Table of Contents

Figures

- Figure 1: Site Location Map
- Figure 2: Site Plan
- Figure 3: Trial-hole Location Plan

Appendices

- Appendix A: Fieldwork
- Appendix B: Geotechnical Laboratory Tests Results
- Appendix B: Chemical Laboratory Analyses
- Appendix C: Human Health Assessment Criteria

Standards

The site works were performed in accordance with the methods given in BS 5930+A2:2010 and BS EN ISO 22476-2:2005.

The geotechnical laboratory testing was performed by K4 Soils Laboratories in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses were undertaken by QTS Environmental Limited in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures.

This investigation did not comprise an environmental audit of the site or its environs.

Trial-hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce a trial-hole.

Section 1 Introduction

1.1 Objective of Investigation

The overall objective was understood to be to supply the client and their designers with scoping information regarding ground conditions, to assist them in preparing an overall foundation scheme for redevelopment that was appropriate to the conditions present on the site.

The investigation was to be undertaken to provide parameters for the design of foundations by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the trial holes.

Soil samples were to be taken and tested for a range of potential contaminants based on the Conceptual Site Model (CSM) in the Phase I Desk Study prepared by Soils Limited and the updated CSM (revision 1.1) found in this report.

1.2 Location

The site was located to the north of Sittingbourne, bordering with Grovehurst Road to the west, Swale Way to the north and a railway to the east. The site had an O.S. National Grid Reference of TQ 904 667 and the area approximately of 4.5ha.

The general site location map and plan are given in Figures 1 and 2 respectively. The trial-hole locations are given in Figure 3, all attached to the end of this report.

1.3 Proposed Redevelopment

The proposed development was to comprise the construction of a residential estate.

1.4 Limitations and Disclaimers

This Phase II Ground Investigation Report relates to the site located on land at Great Grovehurst Farm, Sittingbourne, Kent ME9 8RB and was prepared for the sole benefit of PFA Consulting Ltd (The "Client") to the brief described in Section 1.1 of this report.

Soils Limited disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contact of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot by plot basis prior to the construction of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data or any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping).

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. "Contaminated Land" is defined in Section 57 of the Environment Act 1995 as:

> *"Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused".*

The investigation, analysis or recommendations in respect of contamination are made solely in respect of the prevention of harm to vulnerable receptors, using where possible best practice at the date of preparation of the report. The investigation and report do not address, define or make recommendations in respect of environmental liabilities. A separate environmental audit and liaison with statutory authorities is required to address these issues.

Section 2 Site Work

2.1 Proposed Work

The proposed site work to be undertaken comprised the following items:

- The excavation of a number of trial pits at locations selected by Soils Limited;
- Soakage tests to provide an indication of the underlying soils soakage potential;
- Logging, sampling and in-situ testing as appropriate to the ground conditions encountered in the boreholes.

2.1.1 Work Undertaken

- The machine excavation of 21No trial pits (TP1-TP24) to a depth of between 2.00m and 3.50m below ground level (bgl), at locations across the site where access was gained and cleared of services;
- carrying out 6No soakage tests within trial pits (TP19-TP24)
- Logging, sampling and in-situ testing as appropriate to the ground conditions encountered in the boreholes.

2.2 Anticipated Geology

The 1:50,000 BGS Map showed the site to be located on bedrock of the London Clay Formation overlain by superficial deposits of Head with exception of northern area with no superficial deposit indicated.

2.2.1 Head

Head are drifts produced by solifluxion, the downslope movement of debris outwash during the periglacial period, and characteristically comprise poorly sorted sands, gravels and chalk of local derivation

2.2.2 London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The lowest parts of the formation are sandy beds with black rounded gravel and occasional layers of sandstone and are known as the Basement Beds.

2.3 Ground Conditions

The intrusive investigation was carried out between the 1st and 2nd October 2013 as itemised in Section 2.1.1 of this report.

Table 2.1 outlines the investigatory depths of the trial-holes and probes.

Table 2.1
Investigatory Depths Of Trial-hole

Trial-hole	Final Depth (m bgl)	Trial-hole	Final Depth (m bgl)
TP1	3.20	TP13	3.0
TP2	3.10	TP14	2.50
TP3	3.10	TP15	3.0
TP4	2.60	TP16	3.0
TP5	3.30	TP17	2.50
TP6	3.00	TP18	2.40
TP7	3.20	TP19	2.20
TP8	3.20	TP20	2.20
TP9	3.50	TP21	2.0
TP10	3.0	TP22	2.10
TP11	3.10	TP23	2.10
TP12	3.10	TP24	2.40

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the borehole logs and quoted in this report were measured from ground level directly adjacent to the boreholes.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots, or has been identified as part of the *in-situ* weathering profile, it has been described as Topsoil both on the logs and within this report. Where the soil has, in general, been found to have the same composition as the 'Topsoil' but also incorporated a minor constituent, e.g. less than an estimated 5%, of possibly non-naturally occurring material, or is of uncertain origin, the soil has been described as Topsoil/Made Ground both on the log and within this report. Where man has clearly either placed the soil, or the composition altered with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the logs and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion the succession of conditions encountered in the trial-holes, in descending order are:

Made Ground (MG)
Topsoil (TPS)
Head (HD)
London Clay Formation (LCF)

Table 2.2 summaries the ground conditions.

Table 2.2 Ground Conditions					
Strata	**Age**	**Depth Encountered (m bgl)**		**Typical Thickness (m)**	**Description**
		Top	**Bottom**		
MG	Recent	GL	0.30-1.30	0.60	Dark brown fine sandy silt with occasional gravel, fine brick, ash and gravel.
TPS	Recent	GL	0.20-0.60	0.40	Brown to dark brown clayey fine sandy silt with roots, occasional fine to medium sub-rounded gravel.
HD	Quaternary	0.20-1.30	1.90-3.30	2.70	Friable soft to firm orangish brown fine sandy silty CLAY.
LCF	Eocene	1.90-3.30	2.40*-3.50*	0.40+	Stiff grey brown, greenish grey and orange brown mottled silty CLAY.

Note - *Full investigatory depth

2.3.1 Made Ground

Made Ground was encountered from ground level in each trial-hole where it was present and comprised dark brown fine sandy silt with occasional gravel, fine brick, ash and gravel. The Made Ground was found sporadically across the site with highest concentration at the centre of the site.

The depths of the Made Ground as encountered in the trial-holes are given in Table 2.3, and appeared to be reasonably uniform across the site.

Table 2.3 Depth of Made Ground			
Trial-hole	**Final Depth (m bgl)**	**Trial-hole**	**Final Depth (m bgl)**
TP3	0.30	TP15	0.30
TP8	1.30	TP16	0.35
TP11	0.70	TP17	1.00
TP12	0.30	TP19	0.40
TP13	1.30	TP23	0.60

2.3.2 Topsoil

Topsoil was encountered from ground level in each trial-hole where it was present and comprised brown to dark brown clayey fine sandy silt with roots, occasional fine to medium sub-rounded gravel.

The depths of the Topsoil as encountered in the trial-holes are given in Table 2.4.

Table 2.4 Depth of Topsoil			
Trial-hole	**Final Depth (m bgl)**	**Trial-hole**	**Final Depth (m bgl)**
TP1	0.60	TP12	0.30
TP2	0.20	TP14	0.30
TP4	0.30	TP18	0.35
TP5	0.30	TP20	0.30
TP6	0.30	TP21	0.25
TP7	0.30	TP22	0.30

Table 2.4 Depth of Topsoil			
Trial-hole	**Final Depth (m bgl)**	**Trial-hole**	**Final Depth (m bgl)**
TP10	0.30	TP24	0.30

2.3.3 Head

The Head was encountered directly beneath the Made Ground or Topsoil in each of the trial-holes and comprised friable soft to firm orangish brown fine sandy silty CLAY. The Head was encountered across the site.

The soils of the Head was present from a minimum depth of 0.20m bgl (TP2) to the maximum depth of 3.30m bgl (TP5 (base of borehole) and TP9).

2.3.4 London Clay Formation

The London Clay Formation was encountered only in some of the trial-holes randomly across the site directly beneath the Head and comprised stiff grey brown, greenish grey and orange brown mottled silty CLAY.

The depths of the London Clay Formation as encountered in the trial-holes are given in Table 2.4.

Table 2.4 Depth of London Clay Formation			
Trial-hole	**Final Depth (m bgl)**	**Trial-hole**	**Final Depth (m bgl)**
TP4	2.60	TP14	2.50
TP9	3.50	TP15	3.00
TP13	3.00	TP18	2.40

2.3.5 Roots

Roots were observed to a maximum depth of 1.70m bgl.

Table 2.6 shows the observed depths of roots within each trial-hole.

Table 2.6 Depth Of Roots Encountered			
Trial-hole	**Final Depth (m bgl)**	**Trial-hole**	**Final Depth (m bgl)**
TP1	0.60	TP18	0.35
TP2	0.20	TP21	1.70
TP4	0.30	TP22	1.70
TP7	0.30	TP24	1.30
TP14	0.30	-	-

It must be emphasised that the probability of determining the maximum depth of roots from the narrow diameter boreholes is low. Direct observation from trial pits would be necessary to gain a better indication of the maximum root depth.

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs. There was grass, mixed shrubs and woodland areas located across the site.

2.4 Groundwater

Groundwater was encountered during the intrusive investigation as a seepage in TP20 at 2.00m bgl and in TP16 the soils were recorded as being damp at 2.70m bgl.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in October (2013), when groundwater levels should typically be around their annual minimum (i.e. lowest) elevation.

Groundwater equilibrium conditions may only be conclusively established if a series of observations are made via groundwater monitoring wells.

Isolated pockets of groundwater may be perched within any Made Ground found at other locations around the site.

Section 3 Discussion of Geotechnical Insitu Testing

3.1 Atterberg Limit Tests

Atterberg Limits Tests were undertaken on five samples of the Head and a single sample from the London Clay Formation. Table 3.1 gives a précis of the results.

Table 3.1
Atterberg Limit Test Results

Location/ Depth (m bgl)	Moisture Content (%)	Passing 425μm Sieve (%)	Modified PI (%)	Soil Class	Volume Change Potential	
					BRE	NHBC
TP4/1.00	20	100	23	CI	Medium	
TP8/2.90	23	100	12	CL	Low	
TP11/1.60	23	100	9	CL	Low	None
TP12/3.00	29	96	54	CV	High	
TP14/2.20	31	100	49	CV	High	
TP16/1.20	23	100	16	CI	Low	

NB: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2 (based on Atterberg results)
Soil Classification based on British Soil Classification System

The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240.

The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates.

The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 μm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 μm and some particles, 'rock flour' for example, can be finer than 2 μm but are not clay minerals.

The test results are given in Appendix B.

(The Atterberg Limit Test was undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5).

3.2 Soakage Test

The BRE 365 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. It was not possible to carry out the soakage tests in accordance with BRE 365 due to the limited volume of water available and therefore only a single test with no refills was performed in each location.

The results of the infiltration tests are presented in Table 3.2

Table 3.2
Infiltration Test Results

Test Hole	Stratum	Infiltration Rate (m/sec)
T19	Firm friable and dry orange brown fine sandy silty CLAY / clayey silt becoming softer from 1.40m bgl	Insufficient head loss
T20	Friable soft to firm orange brown fine sandy silty CLAY / clayey silt	Insufficient head loss
T21	Stiff friable and dry orange brown fine sandy silty CLAY / clayey silt with occasional light brown mottling, silt pockets and fine rootlets	Insufficient head loss
T22	Stiff friable orange brown fine sandy silty CLAY with occasional roots	Insufficient head loss
T23	Firm friable fine sandy silty CLAY becoming softer with depth	Insufficient head loss
TP24	Dry and friable orange brown fine sandy silty CLAY with occasional rootlets	Insufficient head loss

Infiltration tests were conducted in accordance with BRE365 however these test were not repeated three times. Therefore the tests do not conform strictly to BRE 365.

Consultation with the Environment Agency **must** be sought prior to the construction of the soakaways.

3.3 California Bearing Ratio (CBR) Tests

Single near surface sample from Head and single from the Made Ground were tested in the laboratory in order to provide an indication of likely California Bearing Ration (CBR).

The results are summarised in Table 3.3.

Table 3.3
Summary of CBR Test Results

Sample	Stratum	Laboratory Description	Moisture Content	CBR Value (Top)	CBR Value (Base)
TP17 (0.50 – 0.70m)	**Made Ground**	Dry and friable brown fine sandy silty clay / clayey silt with occasional fine to medium sub-rounded to sub-angular gravel, occasional fine to coarse brick, concrete fragments up to 0.4m deep	14	22	26
TP21 (0.50 – 0.70m)	**Head**	Stiff friable and dry orange brown fine sandy silty CLAY / clayey silt with occasional light brown mottling, silt pockets and fine rootlets	17	18	18

(Laboratory CBR Tests were performed in accordance with BS1377: Part 4: 1990: Clause 7.4)

The laboratory tests indicated ***CBR values of 22-26%*** for the Made Ground tested and a ***CBR value of 18%*** for the underlying natural soil of the Head at the moisture contents presented. In-situ CBR testing along the line of the proposed pavement must be undertaken just prior to construction to confirm the design CBR.

The full test results are given in Appendix B.

3.4 Sulphate and pH Tests

The significance of the sulphate and pH test results is discussed later in section 4.4 of this report.

The test results are given in Appendix B and C.

Section 4 Preliminary Foundation Design

4.1 General

An engineering appraisal of the soil types and features encountered during the scoping site investigation are presented. The conclusions outlined within this section could change once the full ground investigation has been completed. Soil descriptions are based on the analysis of disturbed samples taken from the trial-holes.

4.1.1 Made Ground, Fill & Topsoil

The terms *Fill* and *Made Ground* are used to describe material which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:1986, Clause 2.2.2.3.5 Made Ground and Fill, includes the caveat that *'all made ground should be treated as suspect, because of the likelihood of extreme variability'*.

A result of the inherent variability, particularly of uncontrolled Fill and/or Made Ground the bearing capacity and settlement characteristics can be unpredictable and must not be used as a founding stratum. Similarly Topsoil can exhibit very low bearing and high settlement characteristic and should also not be used as a bearing stratum.

Therefore, foundations must be taken through any Fill, Made Ground and Topsoil and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Made Ground was encountered from ground level in nearly half of the trial-holes. The Made Ground comprised dark brown fine sandy silt with occasional gravel, fine brick, ash and gravel.

The Made Ground was encountered to a depth of between 0.30m – 2.50m bgl, which may be present to similar, if not greater depth elsewhere across the site. The Made Ground was found sporadically across the site with highest concentration at the centre of the site.

Topsoil was encountered from ground level in over half of the trial-holes. It comprised brown to dark brown clayey fine sandy silt with roots, occasional fine to medium sub-rounded gravel.

The Topsoil was encountered to a depth of between 0.20m – 0.60m bgl, which may be present to similar, if not greater depth elsewhere across the site.

4.1.2 Head

The Head were encountered directly beneath the Made Ground or Topsoil in each of the trial-holes and comprised friable soft to firm orangish brown fine sandy silty CLAY.

The soils of the Head were present from a minimum depth of 0.20m bgl (TP2) to the maximum depth of 3.30m bgl (TP5 (base of borehole) and TP9). The Head were found I each trial hole across the site.

Atterberg Limit tests showed that the samples obtained from the Head possessed ***low to high volume change potential*** as defined by the BRE Digest 240 and ***none to high*** as defined by the NHBC Standards Chapter 4.2 Building near trees.

The soils of the Head are normally consolidated cohesive and granular soils that are relatively recent deposits, in geological terms, and as such generally have low to moderate bearing and moderate settlement characteristics. For the proposed development it was considered suitable as a bearing stratum.

4.1.3 London Clay Formation

The London Clay Formation was encountered only in some of the trial-holes directly beneath the Head and comprised stiff grey brown, greenish grey and orange brown mottled silty CLAY.

Atterberg Limit test showed that the sample obtained from the London Clay Formation possessed ***high volume change potential*** as defined by the BRE Digest 240 and by the NHBC Standards Chapter 4.2 Building near trees.

The soils of the London Clay Formation are overconsolidated cohesive soils and as such generally have moderate to high bearing and moderate to low settlement characteristics. For the proposed development it was considered suitable as a bearing stratum.

4.1.4 Roots

Roots were encountered to a maximum depth of 1.70m bgl during the intrusive works. Roots could be found at greater depths, particularly in areas of dense vegetation or trees.

4.1.5 Groundwater

Groundwater was not encountered during the intrusive investigation.

4.2 Foundation Scheme and Recommendations

This ground investigation was undertaken as a scoping report and the following foundation scheme and recommendations are given as preliminary guidance, due to the limited ground investigation data.

This report was prepared in October 2013 and at this time the anticipated foundation loads were unknown to Soils Limited.

From the preliminary engineering appraisal outlined in Section 4.1 the Made Ground and Topsoil were not considered suitable as bearing stratum. Foundations would have to be taken through the Made Ground and any Topsoil, Fill, live roots, disturbed or desiccated cohesive soils encountered into the London Formation, which were considered suitable bearing strata for the proposed development.

Roots were encountered to a maximum depth of 1.70m bgl but may be encountered to greater depth in other areas of the site. If roots are encountered in soils with a volume change potential (such as cohesive Head or London Clay Formation) then foundations must be taken beyond any roots and into moisture stable non-desiccated soils.

Recommendations for the foundation scheme are outlined below.

4.2.1 Guidance On Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on 'best practice' for the design and construction of foundations on shrinkable soils.

A ***high volume change potential*** foundation design must be adopted for the proposed development where foundations are taken through or passes through the cohesive soils of the Head or the London Clay Formation.

The BRE Digest 241 states: *"An increasingly common, potentially damaging situation is where trees or hedges have been cut down prior to building. The subsequent long-term swelling of the zone of clay desiccated by the roots, as moisture slowly returns to the ground, can be substantial. The rate at which the ground recovers is very difficult to predict and if there is any doubt that recovery is complete then bored pile foundations with suspended beams and floors should be used".*

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building.

It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and cracking of brickwork might occur.

The BRE Digest 240 suggests: "*Two courses of action are open:*

- *Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.*

- *Accept that swelling or shrinkage will occur and take account of it. The foundations can be designed to resist resulting ground movements or the superstructure can be designed to accommodate movement without damage."*

The design of foundations suitable to withstand movements is presented in BRE Digest 241 "Low-rise buildings on shrinkable clay soils: Part 2".

4.2.2 Strip Foundations

No geotechnical laboratory testing for strength of soils has been undertaken in this phase of the investigation. In consequence the presumed allowable bearing values are recommended in accordance with BS 8004:1986 Table.1. Subsequent geotechnical laboratory testing could alter these assumptions. However, where assumptions are made a conservative approach (worst case) has been adopted.

Strip foundation were considered a suitable foundation design subject to the depth of live roots, groundwater conditions and cohesive/loose soils found during the construction phase of the works.

A suitably qualified person must inspect all foundation excavations prior to the placing of any concrete or reinforcement.

All loose material must be removed from the base of the excavations, these excavations then being either concreted or blinded as soon after excavation as possible. Failure to do so could result in additional settlement.

Field observations classified the Head as cohesive, soft to firm soils and the London Clay Formation as cohesive, stiff soils. Assuming more conservative approach the **presumed allowable bearing value** for soils of the Head for strip foundation of width not less than 1m in accordance with BS 8004:1986 Table.1 **would be 75kPa**. The **presumed allowable bearing value** for the same foundation for the London Clay Formation in accordance with BS 8004:1986 Table.1 **would be between 150 and 300kPa.**

As a maximum depth of unsuitable soils (maximum depth of Made Ground – 1.30m bgl), the minimum founding depth of 1.3m bgl is recommended.

Considering that the minimum depth of the Head of 1.90m bgl and founding depth of 1.30m bgl, the **presumed allowable bearing value of 75kPa** should be assumed.

For the allowable bearing values given, settlements should not exceed 25mm, provided that excavation bases are carefully bottomed out and blinded, or concreted as soon after excavation as is possible and kept dry.

At the time of investigation (October 2013), a groundwater strike was observed in TP20 at 2.00m bgl and thje soils, in TP16, were noted as being damp at 2.70m bgl.

The thickness of Made Ground and Topsoil, in places, and the high VCP of the Head and the London Clay Formation is likely to dictate suspended ground floor slabs over much of the site for new build.

4.3 Excavations

Shallow short excavations in the Made Ground, Topsoil, the Head and the London Clay Formation are likely to be marginally stable at best in the short term. Long, deep excavations will become unstable, as would be those taken below the groundwater table.

Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should be therefore be taken to ensure that such earth faces are adequately supported before excavations are entered by personnel.

4.4 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class DS-1 of the BRE Special Digest 1, 2005, *'Concrete in Aggressive Ground'.* Table C2 of the Digest indicated an ACEC (Aggressive Chemical Environment for Concrete) site classification of AC-1s. For the classification

given, the "static" case was adopted, as the bedrock aquifer was classified as Unproductive Strata. The pH of the soil was ranging between 7.5 and 7.6.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1, 2005, *'Concrete in Aggressive Ground'* taking into account the pH of the soils.

4.5 Soakaway Design

Taking account of the geology encountered of the Head and the London Clay Formation it was anticipated that soakaways would not meet the required standard according to BRE 365 Soakaway Design.

The soils classification was supported by soakage tests results which showed the infiltration rate as low as $3.0*10^{-6}$ m/sec, which was calculated for a minimal head loss, which proves adoption of **soakaway drainage system to be unsuitable** for proposed development.

Consultation with the Environment Agency must be sought regarding any use which may have an impact on groundwater resources.

Section 5 Conceptual Site Model (CSM) & Sampling Strategy

5.1 Site Characterisation and Revised CSM

Taking account of the data collected during the Phase II Ground Investigation, the site can be characterised and the CSM reviewed from the Phase I Desk Study undertaken on the site, Ref: 13838/DS dated November 2013.

5.1.1 Characterisation of Made Ground

The Soils Limited Phase II Intrusive investigation revealed the presence of Made Ground in nearly half of all the trial-holes to a depth of between 0.30m – 1.30m bgl.

The Made Ground found on-site comprised dark brown fine sandy silt with occasional gravel, fine brick, ash and gravel. The Made Ground did not contain significant putrescible materials and therefore, was not anticipated to be a potential soil gas source.

5.1.2 Revised Conceptual Site Model

The preliminary CSM outlined in the Phase I Desk Study, undertaken by Soils Limited, Ref: 13838/DS dated October 2013 was revised to take account of the Soils Limited Phase II Intrusive Investigation (Table 5.1).

Table 5.1
Conceptual Site Model (Revised 1.1)

	Potential Sources	Potential Migration Pathway	Potential Absorption Pathway	Potential Receptor
Onsite	Contaminants introduced onsite by previous and current site usage (Former/Current site use (Car dealers, former farm), Aboveground tanks, Septic tank spillage, Electric sub-station), Made Ground: • Metal and metallic compounds (like; Arsenic, Chromium, Copper, Lead, Mercury). • Inorganic compounds (like; ammonia, sulphate). • Organic solvents (like; chlorinated solvents, non-chlorinated solvents). • Organic compounds (like; diesel, oils, PAHs, BTEX/MTBE, TPH). • Others (like; PCB, Asbestos, pH). **RISK: MODERATE**	• Via soils. • Via anthropogenic pathways such as service trenches. • Airborne dust fibres or volatile contaminants. • Via surface water.	• Dermal Exposure to uncovered ground. • Dust or volatiles from uncovered ground becoming airborne and inhaled. • Dust from the ground outside, collecting inside the building where occupants are subject to dermal exposure or contaminants become airborne and are inhaled. • Ingestion of soil via elevated concentration of determinands.	**Human Health:** • Future users of the site. • Visitors to the site. • Construction workers on-site. • Service and maintenance workers. • Site neighbours and wider public. **Groundwater/Controlled Waters** • Surface waters. **Buildings and Materials:** • Constructions materials. **Ecological:** • Constructions materials.
		• Growth of vegetables.	• Consumption of vegetables.	**Human Health:** • Future users of the site. • Visitors to the site.
Offsite	**RISK: NONE**			

5.2 Sampling Strategy

It must be noted that this ground investigation was undertaken as a scoping report and therefore the sampling strategy could be considered limited and further sampling would be required when the full ground investigation was undertaken.

The strategy for the selection of the locations of exploratory positions was based on:

- The conceptual source, pathway and receptor model;
- Contaminative activities identified by the Conceptual Site Model Report.

CLR4 (DOE 1994) and EA R&D P5-066/TR were used to inform the decision regarding the number of sampling locations appropriate to the investigation.

A non-targeted sampling strategy is appropriate when there is:

- No adequate information available regarding the likely locations of contamination;
- No sensitive areas where there is a need for a high degree of confidence.

A targeted sampling strategy is appropriate when there is:

- Adequate information available regarding the likely locations of contamination;
- Sensitive areas where there is a need for a high degree of confidence.

A non-targeted sampling strategy was generally adopted with sampling locations restricted to where access could be gained and no services were identified.

The sampling depths reflected both receptor and exposure scenarios of concern for the human health receptor, this being end users, ground workers and future maintenance workers and are presented in Table 5.2.

Table 5.2
Potential Receptors And Sampling Depths

Sampling Range (m bgl)	Receptors
0.30-1.30	Future users of the site; Visitors to the site; Construction workers on-site; Service and maintenance workers; Site neighbours and wider public; Surface and controlled waters; Construction materials.

5.3 Determination of Contaminants of Concern for Soil Samples

The driver for the determination of the analysis suite was the information obtained from the Phase I Desk Study, undertaken by Soils Limited, Ref: 13838/DS dated November 2013 and the CSM (Revision 1.1) presented in Table 5.1 of this report.

Six samples of Made Ground and single of Topsoil were taken from across the site tested as outlined in Table 5.3.

Table 5.3
Chemical Analysis

Stratum	Trial Hole	Depth (m bgl)	pH; Sulphate; Phenol; Asbestos Screening; SOM	Metals & Semi-Metals	PAH	EPH/VPH	Pest/herb screen	PCB
MG/TPS	TP1	0.30	X	X	X	X		
	TP3	0.20	X	X	X		X	
	TP8	0.30	X	X	X	X		
	TP9	0.20	X	X	X		X	
	TP12	0.20	X	X	X	X		
	TP13	0.50	X	X	X			
	TP16	0.30	X	X	X			X

Test suite: *pH, Sulphate, Phenol* Metals & Semi-Metals: *Cd, Cr, Pb, Hg, Ni, Se, CN, Cu, Zn, V, B, As,* Asbestos Screening, Organics: USEPA 16 speciated PAH (*includes assessment on benzo(a)pyrene, naphthalene, fluorene and dibenz(a,h)anthracene), Soil Organic Matter (SOM), TPH, BTEX/MTBE, VOC/SVOC, Ammonia.*

The results of the soil chemical testing are discussed in Sections 6.3 of this report.

Section 6 Qualitative Risk Assessment

6.1 Assessment Criteria

The assessment criteria used to determine risks to human health are derived and explained within Appendix D.

6.2 Representative Contamination Concentration

It was understood that proposals for the site were for continued residential land use. The results of the comparison of the representative contaminants concentration for human health receptor to the Soil Guideline Values (SGV), Atkins ATRISKsoil Soil Screening Values (SSV) for Lead, General Assessment Criteria (GAC) and Dutch Criteria are presented in Table 6.1.

The SGV and GAC are assessed against the "Residential" land-use scenario, which was considered the most appropriate land-use scenario, given the type of the proposed redevelopment (residential dwellings).

The assessment for lead was undertaken based on the ATRISKsoil Soil Screening Value (SSV) for the "Residential with plant uptake" land-use scenario.

The screening value for p,p' – DDE was corrected for SOM from equation:

$I_e = I_{st}*(SOM/10)$, where:
I_e – intervention value applying for the soil being evaluated (mg/kg)
I_{st} – intervention value for the standard soil (4.0mg/kg for p,p' DDE)

Table 6.1
Summary of Chemical Analysis of Soil Samples

Determinand	Sample Location (where relevant guideline value was exceeded for *Residential* Scenario)
Arsenic	None
Beryllium	
W/S Boron	
Cadmium	
Chromium	
Copper	
Lead*	**TP13/0.50**
Mercury (inorganic)	None
Nickel	
Selenium	
Vanadium	
Zinc	
Naphthalene	
Acenapthylene	
Acenapthene	
Flourene	
Phenanthrene	
Anthracene	
Flouranthene	
Pyrene	
Benzo(a)anthracene	
Chrysene	
Benzo(b)flouranthene	
Benzo(k)flouranthene	

Table 6.1 **Summary of Chemical Analysis of Soil Samples**	
Determinand	**Sample Location (where relevant guideline value was exceeded for *Residential* Scenario)**
Benzo(a)pyrene	**TP8/0.30**
Indeno(1,2,3-cd)pyrene	None
Dibenzo(a,h)anthracene	
Benzo(ghi)perylene	
PCB Congener 28	
PCB Congener 52	
PCB Congener 101	
PCB Congener 118	
PCB Congener 138	
PCB Congener 153	
PCB Congener 180	
Aldrin	
alpha-HCH	
beta-HCH	
cis-chlordane	
delta-HCH	
Dieldrin	
Endosulfan A	
Endosulfan B	
Endrin	
gamma-HCH (Lindane)	
Heptachlor	
Heptachlor epoxide	
Hexachlorobenzene (HCB)	
Isodrin	
Methoxychlor	
o,p' - DDD	
o,p' - DDE	
o,p' - DDT	
p,p' - DDD	
p,p' - DDE	
p,p' - DDT	
trans-chlordane	
Trifluralin	
Chloroxuron (S)	
Chlortoluron (S)	
Diflubenzuron (S)	
Dimefuron (S)	
Diuron (S)	
Isoproturon (S)	
Linuron (S)	
Methabenzthiazuron (S)	
Metoxuron (S)	
Monolinuron (S)	
Monuron (S)	
Pencycuron (S)	
Asbestos	

*** Screening value adopted was ATRISK^{soil} 'Residential with Plant Uptake'**

To assess the potential toxicity to the human health receptor from the concentrations of organic compounds tested for such as benzo(a)pyrene, naphthalene, fluorene, dibenzo(a,h)anthracene and aliphatic and aromatic hydrocarbons, Soil Organic Matter Tests were undertaken that revealed concentrations of organic material ranging between 2.7% and 6.9%. The assessment was based on the Soil Organic Matter relevant to each sample and where there were no SOM a value of 1% was used.

The summary of contamination testing in Table 6.1 was based on the results from QTS Environmental Ltd report, reference: 13-17146, presented in Appendix C.

Single sample outlined in Table 6.1 had determinand that was in exceedances of its relevant LQM CIEH GAC and single sample in exceedances of its relevant Atkins ATRISKsoil Soil Screening Values (SSV) for Lead for a residential land-use scenario. Table 6.2 gives a summary of the exceedances for each determinand.

Table 6.2
Summary of Exceedances

Determinand	Location	Recorded Concentration (mg/kg)	SOM (%)	Screening Value* (mg/kg)
Lead	TP13/0.50	**474**	4.6	276
Benzo(a)pyrene	TP8/0.30	**1.55**	2.7	0.94

The concentration of these determinands, found in the Made Ground **would** pose a risk to human health based on the land-use adopted.

None of the **other** determinands were in excess of their relevant DEFRA SGV, ATRISK^{soil} SSV, LQM CIEH GAC and of Dutch Criteria for Soil a residential land-use scenario.

6.3 Tier 1 Quantitative Risk Assessment

Tier 1 Quantitative risk assessment established the presence of ***benzo(a)pyrene in excess*** of its relevant LQM CIEH GAC in a single sample (TP8/0.30m bgl) and presence of ***lead in excess*** of its relevant AtRisk SSV Guideline Values in a single sample (TP13/0.50).

Note on Asbestos: The asbestos screening ***did not detect*** any materials that contained asbestos within soil from the samples collected during the intrusive investigation.

The Tier 1 Quantitative risk assessment therefore established that there was ***a risk to the human health receptors*** of construction workers or future end-users.

Further sampling would be required around TP8 and TP13 to delineate the extent of the impacted soil.

Demolition of the structures on the site may uncover new areas of contamination, therefore a discovery strategy would need to be in place and further sampling and chemical testing of the soils was considered likely.

Full results of the contamination testing are presented in Appendix C.

6.4 Groundwater Risk Assessment

Groundwater was encountered during the intrusive investigation but was not considered a vulnerable receptor given the low permeability of the Head and of overlying the London Clay Formation.

6.5 Revised Conceptual Site Model

The results of the contamination assessment of risk to human health can now be used to test the source pathway and receptor model, constructed in Section 5.1 of this report to determine, which sources are present and if any pathways have become active. Based on the results of the chemical laboratory testing, Table 6.3 outlines the CSM (Revised 1.2).

Table 6.3
Conceptual Site Model (Revised 1.2)

	Potential Sources	Potential Migration Pathway	Potential Absorption Pathway	Potential Receptor
Onsite	Contaminants introduced onsite by previous and current site usage (Former/Current site use (Car dealers, former farm), Aboveground tanks), Made Ground: • Lead, benzo(a)pyrene **RISK: MODERATE**	• Via soils. • Via anthropogenic pathways such as service trenches. • Airborne dust fibres or volatile contaminants. • Via surface water.	• Dermal Exposure to uncovered ground. • Dust or volatiles from uncovered ground becoming airborne and inhaled. • Dust from the ground outside, collecting inside the building where occupants are subject to dermal exposure or contaminants become airborne and are inhaled. • Ingestion of soil via elevated concentration of determinands.	**Human Health:** • Future users of the site. • Visitors to the site. • Construction workers on-site. • Service and maintenance workers. • Site neighbours and wider public. **Groundwater/Controlled Waters** • Surface waters. **Buildings and Materials:** • Constructions materials. **Ecological:** • Constructions materials.
		• Growth of vegetables.	• Consumption of vegetables.	**Human Health:** • Future users of the site. • Visitors to the site.
Offsite	**RISK: NONE**			

6.6 Plausible Sources and Pathways

Re-evaluation of the revised CSM (Table 6.1) has revealed that plausible pollutant linkages remain and that remediation was required.

Elevated concentrations of determinants were identified in samples:

- Benzo(a)pyrene identified within trial hole TP8/0.30;
- Lead within TP13/0.5;

The above indicated an unacceptable risk to the human health receptor. Once the proposed layout has been finalised and the site strip has taken place any areas around the impacted trial-holes that are not covered by impermeable hardstanding would require further sampling and testing.

6.7 Remedial Objective

The remediation objective for the site is to ensure site clean-up removes any unacceptable risk to the identified receptors of human health, buildings and materials, groundwater/controlled waters.

Provided that the full ground investigation does not identify any further or mitigate the existing contaminative sources the remediation scheme outlined in Section 6.5 could be considered.

The preceding assessment was achieved using a risk based approach that considered the circumstances of the site, such as its location and intended use, engineering considerations and the need to ensure suitable amenities for any development.

In essence the remedial objective should sever any source-pathway-receptor pollutant linkages that have been established for the site in Section 6.5 of this report. Once this has been achieved, by whatever means, there can theoretically be no risk.

The advice and recommendations presented in Section 6.8 are made solely on the basis of the chemical analyses results obtained during this intrusive investigation.

In respect to the groundworkers and site operatives, it is understood that in order to minimise the effect of dust inhalation and dermal contact as exposure pathways, a good standard of personal hygiene must be adopted, as discussed in detail in Section 6.13.

6.8 Development of a Remediation Scheme

It was identified in the sample TP8 from a depth of 0.30m an elevated concentrations of Benzo(a)pyrene and in TP13/0.50 of Lead. This was considered to pose an unacceptable risk to the human health receptor.

In areas of soft landscaping around the impacted trial-holes further sampling would be recommended to help reduced the cost of any remediation scheme required.

Without carrying out any further investigations, a worse-case remedial option of 'dig and dump' could potentially be considered.

Possible remediation schemes are outlined below.

6.8.1 Trial Hole With Impacted Soil

It could be proposed to excavate and stockpile the impacted material on the site in

preparation for classification and subsequent disposal off-site to a suitable licensed facility. The excavation could be centred on the impacted trial-hole and extended in all directions so that the impacted soil can be 'chased' out. The Made Ground was encountered from ground level and to a maximum depth of 1.30m bgl. Depending on the site levels, significant thickness of Made Ground and underlying contaminated soil could be excavated, and thereby removing the impacted soils.

The stockpiled soils must be placed on an impermeable liner with raised edges. During periods of rainfall, the stockpile must be covered over to minimise leaching and run-off into the underlying soils. Covering of the stockpile may be required to prevent fumes impacting receptors off-site.

Upon completion of the hotspot excavation, a representative number of validation samples from the sides and base of the excavation would need to be recovered and sent off for chemical laboratory analysis as part of the validation process.

Any voids resulting from the removal of impacted soil must be backfilled with a suitable certified clean granular soil.

The remedial works must be inspected and independently validated by a suitable person.

On completion of the development, a Validation and Closure Report must be supplied to both the Local Authority and the NHBC detailing the remediation works undertaken on the site.

Delineating the impacted area around the trial-hole by means of further trial-holes and chemical laboratory testing may be required prior to undertaking the remediation. Further leachate testing may also be required to fully assess the risk to the groundwater receptor from the previous site usage, as leachate testing and the undertaking of a groundwater risk assessment may determine that Made Ground can remain under areas of permanent hardstanding and that the only areas requiring remediation are soft landscaped areas within the impacted hotspot.

6.8.2 Soft Landscaped Areas

To minimise costs it is recommended that additional shallow samples be taken from the proposed soft landscaping areas after the site has been reduced in level and the depth of the cover system calculated using BRE Cover System.

The BRE *"Cover Systems For Land Regeneration, Thickness Design of Cover Systems for Contaminated Land, BRE, March 2004",* allows for the design of cover systems to impacted soils where the concentration of determinands within the ground does not exceed any of the respective SSV, SGV's or GAC's by more than six. In such a situation a maximum cover thickness of 600mm is given. However, the concentration of determinands within the certified clean soil/topsoil, which comprises the cover system, determines the overall thickness of the system and can reduce the required thickness markedly below 600mm. Where the concentration of determinands within the ground does exceed any of the respective SSV, SGV's or GAC's by more than six then an engineered capping system must be considered, unless the areas of soft landscaping are isolated from the impacted ground using raised planters or the like.

However, given the concentrations of the elevated determinands were less than six times the relevant SSV, SGV or GAC for the 'Residential' land-use scenario, BRE Cover System can be adopted, in consultation with the Environmental Health Officer (EHO) of the council in those areas.

Where this is not possible then an engineered capping system must be considered.

The engineered capping system should comprise geotextile and/or mesh underlying a 200mm thick layer of gap graded crushed concrete (5-75mm) or the like with geotextile underlying 450mm thickness of clean certified topsoil.

Any soil, which is to be imported onto the site, must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

Any Made Ground material excavated should either be classified and removed from site to a suitably licensed facility or alternatively, can be used to raise ground levels under areas of permanent hardstanding.

Made Ground excavated from foundation excavations and service excavations should be dealt with using the same method of disposal or re-use under areas of hardstanding. Service excavations must be over-dug and must be backfilled with certified clean material unless they can be shown to be passing through clean ground.

Excavated Made Ground material must be stockpiled on a waterproof polythene sheet with raised edges to avoid mixing with clean soils and to prevent leachate run-off.

6.8.3 Asbestos

Asbestos containing materials were **not** identified within the soil samples tested, but could be present in other areas. The contractor must be made aware of the possibility of asbestos and a suitable discovery strategy put in place.

6.8.4 Groundwater

Groundwater was not considered to be a receptor due to the low permeability of the Head and of underlying the London Clay Formation, which were classified as Non-Aquifers (Unproductive Stratum).

6.9 Validation Strategy

All remedial works must be inspected and independently validated by a suitable person.

All remedial excavations will need to be inspected and photographed. The imported subsoil and/or Topsoil will also need to be verified prior to placement.

6.10 Excavated Material

All waste going to landfill must be subjected to "basic characterisation", which includes up to 3 steps as listed below.

The three steps of Basic Characterisation

1. Initial description and physical/chemical testing of the solids,

2. A risk-based hazard assessment based on the chemical testing
3. If hazardous, leachability testing to check compliance with Waste Acceptance Criteria (WAC).

Basic characterisation is the responsibility of the waste producer and compliance checking is generally the responsibility of the landfill operator. Therefore landfill operators will be unlikely to accept waste that does not meet the Waste Acceptance Criteria for their class of site.

There is an obligation to 'treat' all soils destined for landfill, including non-hazardous waste. This treatment must now be documented and presented to the landfill operator or waste may be refused entry. Note that all liquids are banned from landfill. For the purposes of legal compliance, 'treatment' must comprise three things (the 'three-point test'):

1. It must be a physical, thermal, chemical or biological process.
2. It must change the characteristics of the waste.
3. It must do so in order to:
   (a) Reduce its volume, or
   (b) Reduce its hazardous nature, or
   (c) Facilitate its handling, or enhance its recovery.

6.10.1 Waste Acceptance Criteria Testing

Where a risk based hazard assessment shows that the waste is not inert then Waste Acceptance Criteria Testing (WAC 2-stage leachate testing) is required to decide whether contaminated soil either:

Meets WAC limits for hazardous landfill – so is acceptably insoluble/non-degradable and can be disposed therein,

Or

Fails hazardous WAC – is so mobile, or degradable that it would breach the operator's Permit, so cannot even go to hazardous landfill without treatment.

It **must** be mentioned that the WAC results provide an indication for off-site disposal at the suitable landfill however the responsibility regarding the acceptance of waste at a landfill site lies entirely with landfill operator.

Where naturally occurring soils need to be disposed off-site then these soils can be classified as 'listed' ***inert*** waste.

6.11 Reuse of Excavated Material On-Site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste

and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site specific risk assessment for the receptor site to demonstrate that the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment.

Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a 'Qualified Person' as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

6.12 Imported Material

Any soil which is to be imported onto the site must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

The Topsoil must be fit for purpose and to BS3882:2007 and must either be supplied with traceable chemical laboratory test certificates or be tested, either prior to placing or after placing, to ensure that the human receptor cannot come into contact with any compounds that could be detrimental to human health. The compounds that are to be tested for are those given Assessment Criteria, which can be viewed in Appendix D of this report.

6.13 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust were generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

6.14 Discovery Strategy

The developer/groundworker must be made aware of the former use of the site and for the potential for sources not identified in the Phase I Desk Study or the Phase II Intrusive Investigation to be found within the site both during demolition and the excavation of trenches for services and foundations.

Such occurrences may also be discovered during the demolition and construction phases for the redevelopment of the site.

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil; discolouration, or odours and emission. Upon discovery, advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

Should a new source of contamination be suspected or identified then the Engineer and if appropriate the Local Authority must be informed.

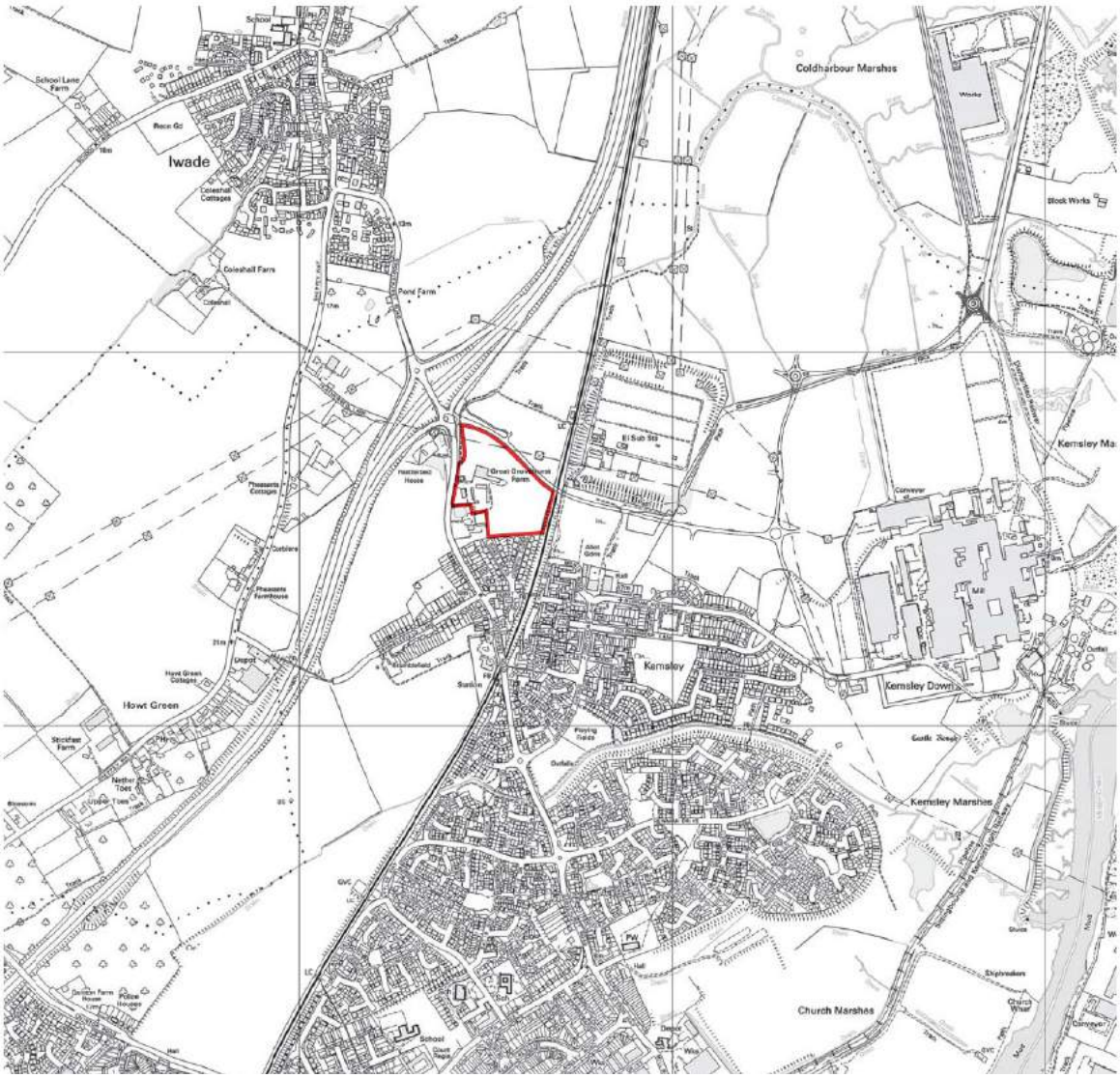
The following figures and appendices complete this report:

Figure 1	Site Location Map
Figure 2	Site Plan
Figure 3	Trial-hole Location Plan

Appendix A	Field Work
Appendix B	Geotechnical Laboratory Analysis
Appendix C	Chemical Laboratory Analysis
Appendix D	Human Health Assessment Criteria
Appendix E	Soakage Test Data

Roland Galinski BEng.
Geo-Environmental Engineer

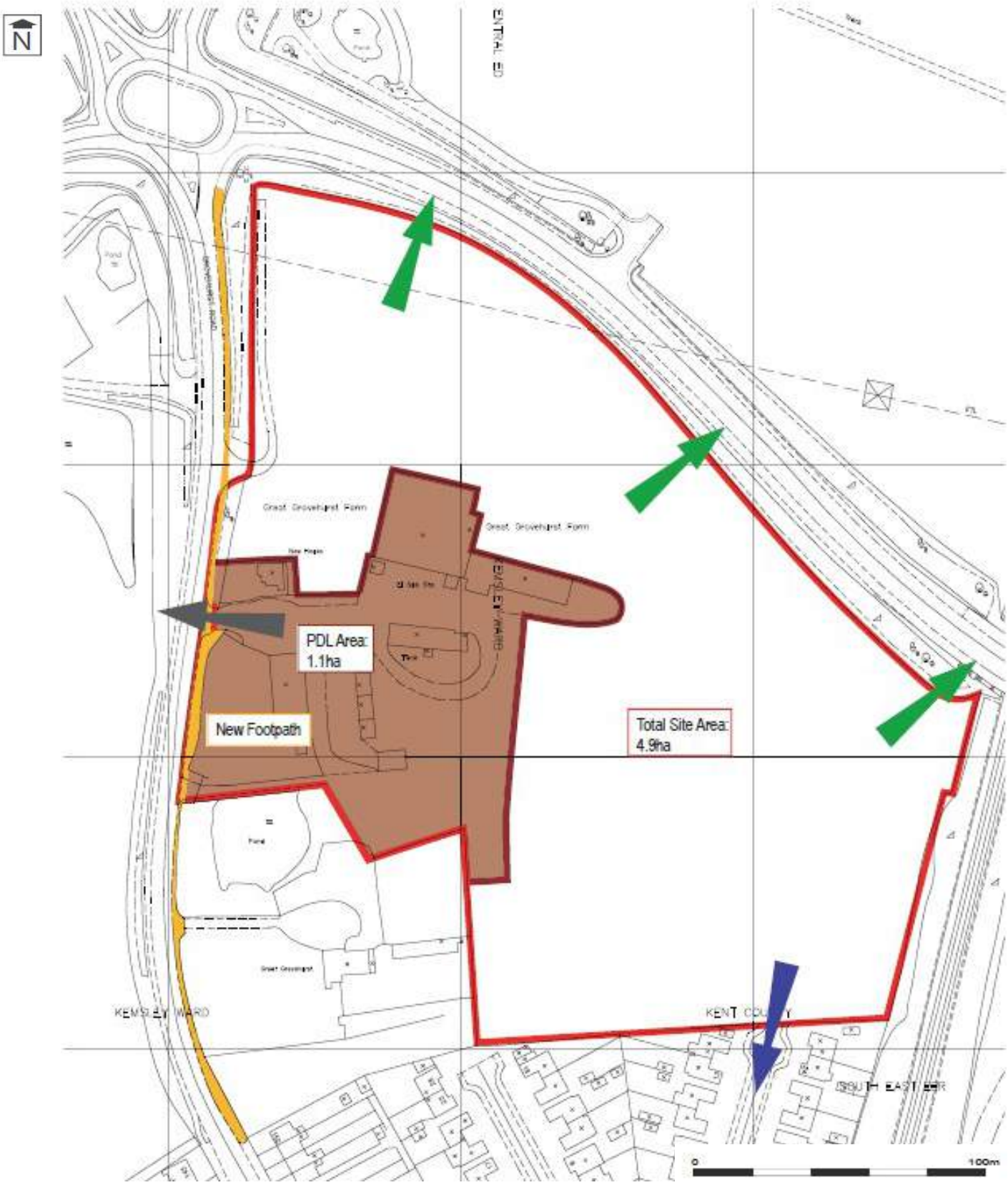
Eur Ing. R. B. Higginson B.Sc., PG. Dip., C.Eng., MICE., FGS.
Geotechnical Advisor



Project: **Great Grovehurst Farm, Grovehurst Road, SITTINGBOURNE, Kent, ME9 8RB**	
Client: **PFA Consulting Ltd**	Date: **November 2013**
Title: **Site Location Map**	Ref: **13838**

Fig No. 1

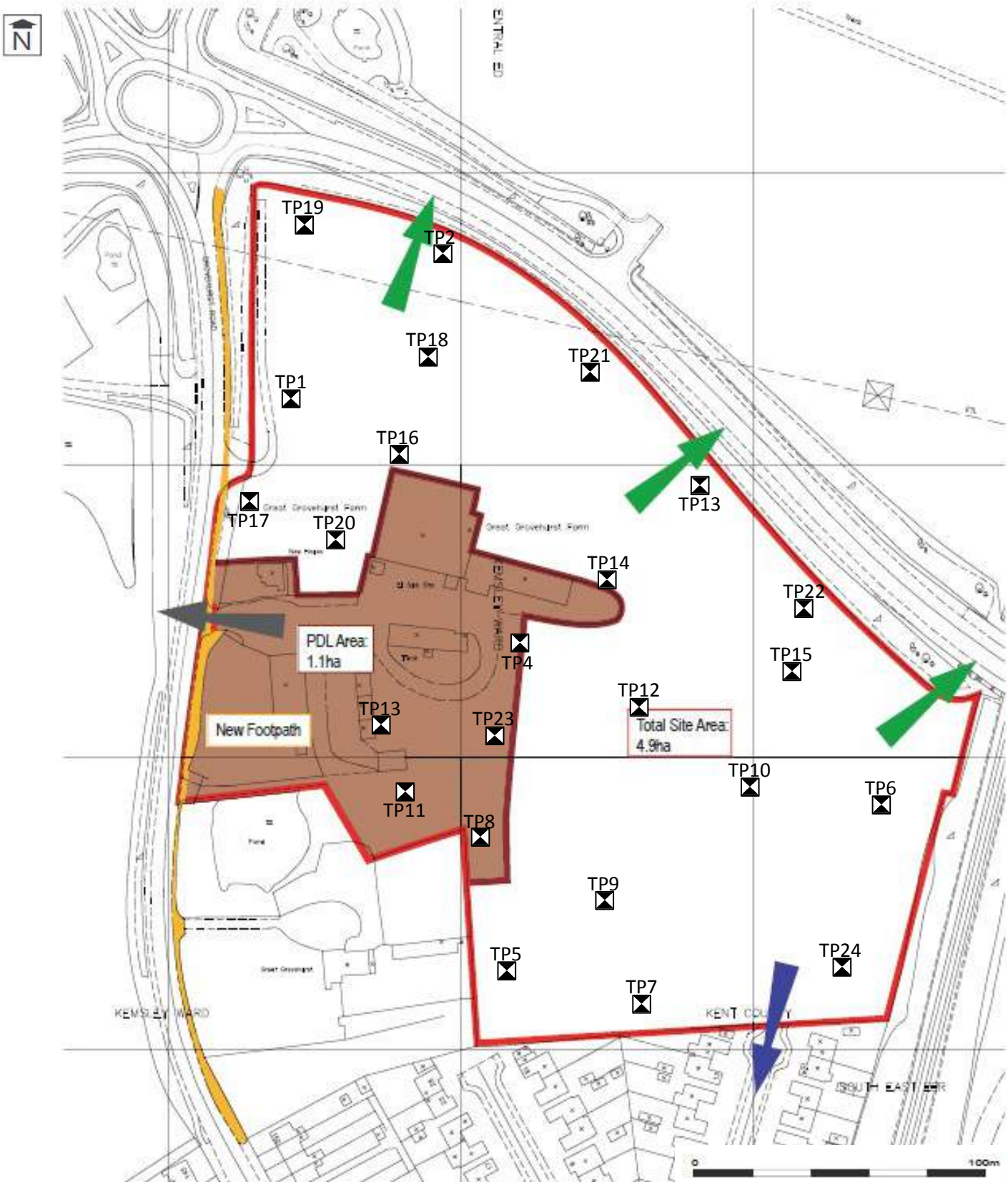
soils LIMITED
Geotechnical & Environmental Consultants



Project: **Great Grovehurst Farm, Grovehurst Road, SITTINGBOURNE, Kent ME9 8RB**	
Client: **PFA Consulting Ltd**	Date: **November 2013**
Title: **Site Location Plan**	Ref: **13838**

Fig No. 2

soils LIMITED
Geotechnical & Environmental Consultants



Project: **Great Grovehurst Farm, Grovehurst Road, SITTINGBOURNE, Kent ME9 8RB**	**Fig No. 3**
Client: **PFA Consulting Ltd**	Date: **November 2013**
Title: **Trial-hole Location Plan**	Ref: **13838**

soils LIMITED
Geotechnical & Environmental Consultants

Appendix A
Field Work

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 1

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth Thick	Description
0.30 -	D					0.60	TOPSOIL Brown to dark brown clayey fine sandy silt with roots, occasional fine to medium sub-rounded gravel
						0.60	
1.00 -	D		100.0				HEAD DEPOSITS Soft to firm slightly fine sandy silty CLAY becoming orange brown with depth and friable
1.80 -	D		100.0			2.20	
2.90 -	D		150.0			2.80	
						0.40	HEAD DEPOSITS Firm fissured orange brown and green grey mottled fine sandy silty CLAY with occasional fine to medium sub-rounded gravel
						3.20	End of Trial Pit at 3.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	Roots observed to 0.60m bgl

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 2

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth / Thick	Description
0.10 -	D					0.20 / 0.20	TOPSOIL Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel and rootlets
0.60 -	D						HEAD DEPOSITS Firm friable orange brown fine sandy silty CLAY
1.50 -	D		250.0			2.00	
2.30 -	D		225.0			2.20 / 0.90	HEAD DEPOSITS Lightly fissured firm stiff green grey and orange brown mottled very slightly fine sandy silty CLAY with occasional fine to medium sub-rounded gravel
3.00 -	D		250.0			3.10	End of Trial Pit at 3.10 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	Roots observed to 0.20m bgl

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 3

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	MADE GROUND Brown to dark brown fine sandy silty with occasional fine to medium sub-rounded to sub-angular gravel and occasional brick
							HEAD DEPOSITS Friable orange brown clayey sandy SILT
1.40 -	D					1.70	
2.20 -	D		150.0			2.00 (0.70)	HEAD DEPOSITS Friable firm to stiff orange brown and green grey mottled fine sandy silty CLAY with occasional fine to medium sub-rounded gravel and very occasional fine sand partings
3.00 -	D		175.0			2.70 (0.40)	HEAD DEPOSITS Stiff closely fissured green grey and orange brown mottled silty CLAY with very occasional fine to medium sub-rounded gravel
						3.10	End of Trial Pit at 3.10 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 4

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	TOPSOIL Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel and roots
1.00 -	D		100.0			1.90	HEAD DEPOSITS Soft firm friable orange brown fine sandy silty CLAY
1.70 -	D		75.0				
2.40 -	D		250.0			2.20 (0.40)	LONDON CLAY FORMATION Stiff orange brown and grey brown mottled silty CLAY
						2.60	End of Trial Pit at 2.60 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:

Dry

Stability:

Stable

General Remarks:

Roots observed to 0.30m bgl

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 5

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	TOPSOIL Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel
0.60 -	D						HEAD DEPOSITS Friable soft orange brown fine sandy silty CLAY
1.50 -	D					3.00	
2.50 -	D					3.30	End of Trial Pit at 3.30 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 6

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	TOPSOIL Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel
0.50 -	D					0.70 (0.40)	HEAD DEPOSITS Dry brown clayey fine sand SILT / clay dry with occasional fine to medium sub-rounded gravel
1.20 -	D					1.00 (0.30)	HEAD DEPOSITS Friable soft to firm orange brown fine sandy CLAY
2.50 -	D					2.00 (1.00)	
						3.00	End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 7

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth Thick	Description
0.20 -	D					0.30	TOPSOIL Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel and rootlets
0.80 -	D					0.30	HEAD DEPOSITS Soft friable orange brown clayey fine sandy SILT / fine sandy silty clay
2.00 -	D					2.70	
3.20 -	D		175.0			3.00 0.20 3.20	HEAD DEPOSITS Fissured stiff grey brown and orange brown mottled silty CLAY
							End of Trial Pit at 3.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:

Dry

Stability:

Stable

General Remarks:

Roots observed to 0.30m bgl

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 8

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.30 -	D					1.30	MADE GROUND Brown slightly clayey sandy silt with abundant fine to coarse brick gravel, ceramic and occasional ash
1.10 -	D					1.30	
1.40 -	D		100.0			1.90	HEAD DEPOSITS Soft to firm friable orange brown fine sandy silty CLAY / clayey silt
2.90 -	D					3.20	End of Trial Pit at 3.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 9

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth Thick	Description
0.20 -	D					0.35	
						0.35	HEAD DEPOSITS Friable firm becoming softer with depth orange brown fine sandy silty CLAY
1.00 -	D		200.0				
						2.95	
2.00 -	D		50.0				
3.00 -	D						
						3.30	
3.40 -	D		275.0			0.20	LONDON CLAY FORMATION Stiff fissured grey brown and orange brown mottled silty CLAY
						3.50	End of Trial Pit at 3.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 10

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	TOPSOIL Brown to dark brown fine sandy silt with occasional fine to medium sub-rounded gravel
1.20 -	D					2.40	HEAD DEPOSITS Friable soft to firm fine sandy silty CLAY
2.20 -	D						
2.80 -	D		225.0			2.70 (0.30) 3.00	HEAD DEPOSITS Stiff fissured grey brown and orange brown mottled silty CLAY with occasional fine sub-angular to sub-rounded gravel
							End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 11

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details				
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth	Thick	Description
						0.10	0.10	MADE GROUND Tarmac
						0.40	0.30	MADE GROUND Brick rubble
0.60 -	D					0.70	0.30	MADE GROUND Green grey sandy silty clay with chalk and brick fragments
0.80 -	D							HEAD DEPOSITS Friable soft orange brown fine sandy silty CLAY
1.60 -	D					2.40		
2.90 -	D					3.10		End of Trial Pit at 3.10 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 12

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	MADE GROUND Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel and possible occasional fine ash
							HEAD DEPOSITS Friable soft orange brown fine sandy silty CLAY
1.50 -	D					2.60	
3.00 -	D		225.0			2.90 (0.20)	HEAD DEPOSITS Stiff fissured greyish brown, orange brown and yellow brown mottled silty CLAY with occasional fine to coarse sub-rounded gravel
						3.10	End of Trial Pit at 3.10 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 13

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.50 -	D & J					1.30	MADE GROUND Dark brown silty sand / sandy silt with abundant chalk, ash, clinker, glass, tarmac, brick, ceramics and gravel
1.20 -	D & J						
1.40 -	D					1.30	HEAD DEPOSITS Soft orange brown fine sandy silty CLAY
2.70 -	D		175.0			2.60	
						0.40	LONDON CLAY FORMATION Stiff orange brown and green grey mottled silty CLAY
						3.00	End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 14

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	TOPSOIL Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel and roots
1.40 -	D					1.70 (1.70)	HEAD DEPOSITS Friable soft orange brown and grey brown mottled fine sandy silty CLAY
2.20 -	D					2.00 (0.50)	LONDON CLAY FORMATION Stiff orange brown and grey brown mottled silty CLAY
						2.50	End of Trial Pit at 2.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	Roots observed to 0.30m bgl

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 15

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	MADE GROUND Dark brown fine sandy silt with occasional gravel and occasional brick
0.70 -	D						HEAD DEPOSITS Friable soft to firm orange brown fine sandy silty CLAY
1.60 -	D					2.40	
2.80 -	D					2.70 (0.30)	LONDON CLAY FORMATION Fissured stiff grey brown and orange brown mottled silty CLAY
						3.00	End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 16

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.30 -	D					0.35 (0.35)	MADE GROUND Dark brown fine sandy silt with occasional fine to medium sub-rounded gravel and occasional fine to medium brick
0.50 -	D					0.90 (0.55)	HEAD DEPOSITS Dry and very stiff fine sandy clayey SILT / silty clay with occasional fine to medium gravel
1.20 -	D					2.30 (1.40)	HEAD DEPOSITS Soft friable orange brown and grey brown mottled fine sandy silty CLAY
2.40 -	B		100.0			3.00 (0.70)	HEAD DEPOSITS Soft to firm orange brown, yellow brown and grey brown fine sandy silty CLAY with occasional ferruginous staining
2.90 -	D						End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:

No water seepage visible in unstable corner. Soil Damp at 2.70m bgl

Stability:

Unstable on one corner of pit in gravelly material

General Remarks:

No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 17

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D						MADE GROUND Dry and friable brown fine sandy silty clay / clayey silt with occasional fine to medium sub-rounded to sub-angular gravel, occasional fine to coarse brick, concrete fragments up to 0.4m deep
0.50 -	B					1.00 (1.00)	
1.20 -	D						HEAD DEPOSITS Soft friable orange brown fine sandy silty CLAY
2.20 -	D					1.50	
						2.50	End of Trial Pit at 2.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 18

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.25 -	D					0.35	TOPSOIL Dark brown fine sandy silt with occasional fine to medium gravel and roots
0.80 -	D					0.35	HEAD DEPOSITS Friable soft orange brown fine sandy silty CLAY / clayey silt
2.10 -	D		200.0			1.55 1.90 0.50	LONDON CLAY FORMATION Stiff grey brown, greenish grey and orange brown mottled silty CLAY
						2.40	End of Trial Pit at 2.40 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:

Dry

Stability:

Stable

General Remarks:

Roots observed to 0.35m bgl

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 19

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.30 -	D					0.40	MADE GROUND Dark brown fine sandy silt with brick and gravel
0.60 -	D					0.40	HEAD DEPOSITS Firm friable and dry orange brown fine sandy silty CLAY / clayey silt becoming softer from 1.40m bgl
1.10 -	D						
1.60 -	D		100.0			1.80	
2.20 -	D					2.20	End of Trial Pit at 2.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:

Dry

Stability:

Stable

General Remarks:

No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 20

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	TOPSOIL Brown to dark brown fine sandy silt with occasional fine to medium gravel
1.20 -	D					1.90	HEAD DEPOSITS Friable soft to firm orange brown fine sandy silty CLAY / clayey silt
2.20 -	D					2.20	End of Trial Pit at 2.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:

Very slow seep at 2.00m bgl

Stability:

Stable

General Remarks:

No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 21

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.25 (0.25)	TOPSOIL Dark brown fine sandy silt with occasional sub-rounded to sub-angular flint gravel and rootlets
0.50 -	B						HEAD DEPOSITS Stiff friable and dry orange brown fine sandy silty CLAY / clayey silt with occasional light brown mottling, silt pockets and fine rootlets
1.30 -	D		500.0			1.45	
1.80 -	D		250.0			1.70 (0.30)	HEAD DEPOSITS Fissured stiff grey brown and orange brown mottled silty CLAY with occasional fine to medium sub-rounded gravel
						2.00	End of Trial Pit at 2.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	Roots observed to 1.70m

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 22

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth Thick	Description
0.20 -	D					0.30	TOPSOIL Dark brown fine sandy silt with fine to medium sub-rounded gravel and roots
0.60 -	B					0.30	HEAD DEPOSITS Stiff friable orange brown fine sandy silty CLAY with occasional roots
1.20 -	D		500.0			1.40	
1.80 -	B					1.70	
						0.40	HEAD DEPOSITS Orange brown and light grey brown mottled fine to coarse sub-rounded to sub-angular flint GRAVEL in a fine sandy clay matrix
						2.10	End of Trial Pit at 2.10 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	Roots observed to 1.70m bgl

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 23

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.60	MADE GROUND Dark brown fine sandy silt with occasional fine brick, ash and gravel
0.70 -	B					0.60	HEAD DEPOSITS Firm friable fine sandy silty CLAY becoming softer with depth
1.50 -	D		100.0			1.50	
2.10 -	D					2.10	End of Trial Pit at 2.10 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	No roots observed

Soils Limited
Newton House
Cross Road
Tadworth KT20 5SR
Tel: 01737 814221 Fax: 01737 812557

Trial Pit: TP 24

Site:	Great Grovehurst Farm, Sittingbourne	Start Date: 01/10/2013	Ground Level: -
Client:	PFA Consulting Ltd	End Date: 02/10/2013	Easting: -
Project No:	13838	Logged By: GJ	Northing: -
Site National Grid Reference:		Excavation Method:	
Site Level (mOD):	0.000	Plant:	
		Shoring/Support: None	
		Trial Pit Length: -	Trial Pit Width: -

Samples & Tests				Strata Details			
Depth	Type	Result	Hand Pen.	Elev.	Legend	Depth (Thick)	Description
0.20 -	D					0.30 (0.30)	TOPSOIL Dark brown fine sandy silt with fine to medium sub-rounded gravel and rootlets
1.00 -	D					1.00 (0.70)	HEAD DEPOSITS Dry and friable orange brown fine sandy silty CLAY with occasional rootlets
1.80 -	D					1.30 (0.30)	HEAD DEPOSITS Orange brown silty SAND
						2.20 (0.90)	End of Trial Pit at 2.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptioins are based only on field observations and available in-situ test data.
3. Trial pit logged from the ground surface below 1.2 m depth.

Groundwater Observations:	Stability:	General Remarks:
Dry	Stable	Roots observed to 1.30m bgl

Appendix B
Geotechnical Laboratory Analysis

Project Name:	Great Grovehurst Farm			**Samples Received:**	11/10/2013
				Project Started:	11/10/2013
Client:	Soils Ltd			**Testing Started:**	24/10/2013
Project No:	13838	**Our job/report no:**	15425	**Date Reported:**	25/10/2013

K4 SOILS

Borehole No:	Sample No:	Depth (m)	Description	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425 mm (%)	Remarks
TP4	D	1.00	Brown and orangey brown slightly sandy slightly silty CLAY	20	43	20	23	100	
TP8	D	2.90	Brown sandy silty CLAY	23	30	18	12	100	
TP11	D	1.60	Brown sandy silty CLAY	23	29	20	9	100	
TP12	D	3.00	Brownish grey and occasional orange slightly gravelly CLAY (gravel is fine and sub-angular)	29	84	28	56	96	
TP14	D	2.20	Brown and pale grey CLAY	31	78	29	49	100	
TP16	D	1.20	Brown slightly sandy silty CLAY	23	37	21	16	100	

UKAS TESTING 2519

Summary of Test Results

BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method.

BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index.

BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.

Checked and Approved

Initials: K.P

Date: 25/10/2013

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

Test Results relate only to the sample numbers shown above. Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

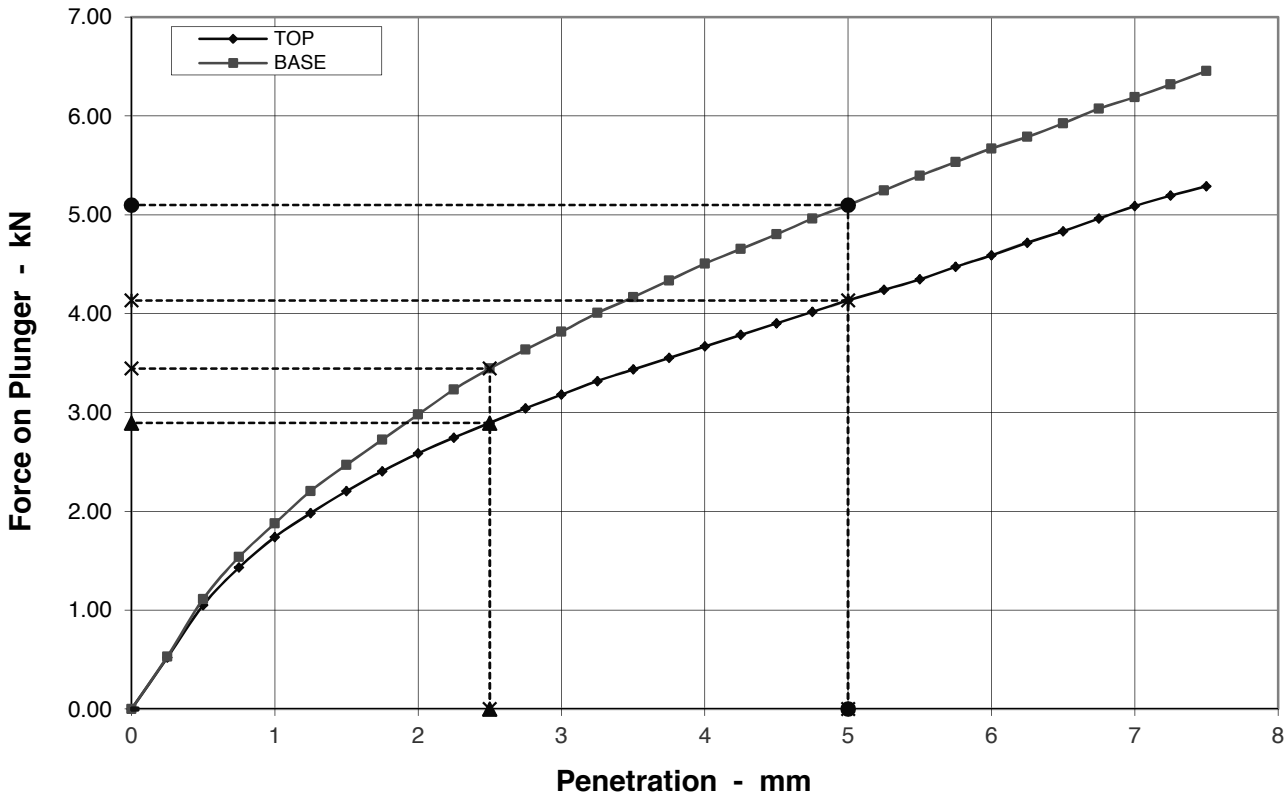
K4 SOILS

Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name:	Great Grovehurst Farm			**Samples Received:**	11/10/2013
				Project Started:	11/10/2013
Client:	Soils Ltd			**Testing started:**	15/10/2013
Project no:	13838	**Our job /report no:**	15425	**Date reported:**	25/10/2013
BH / TP no:	TP17	**Sample no:**	D	**Depth (m):**	0.50 - 0.70

Soil Description: Brown slightly gravelly silty/fine sandy CLAY with occasional rootlets and brick fragments (gravel is fmc and sub-rounded to angular)



Preparation	Method of Compaction		
	Rammer compaction with specified effort		
	Hammer type		2.5kg Rammer
	Soaking Period	days	N/A
	Amount of Swell	mm	N/A

Sample Conditions		
Natural Moisture Content	%	14
Moisture Content - TOP	%	14
Moisture Content - BASE	%	14
Bulk Density	Mg/m³	1.86
Dry Density	Mg/m³	1.63

Test Conditions		
Sample Retained on 20 mm sieve	%	3.0
Sample Retained on 37.5 mm sieve	%	2.9
Seating Load - TOP	N	50
Seating Load - BASE	N	50
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	22	26
5	21	25
Accepted CBR	**22**	**26**

K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311.
E-mail: k4soils@aol.com

Approved Signatories: K.Phaure(Tech.Mgr)
J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 25/10/2013

UKAS TESTING 2519

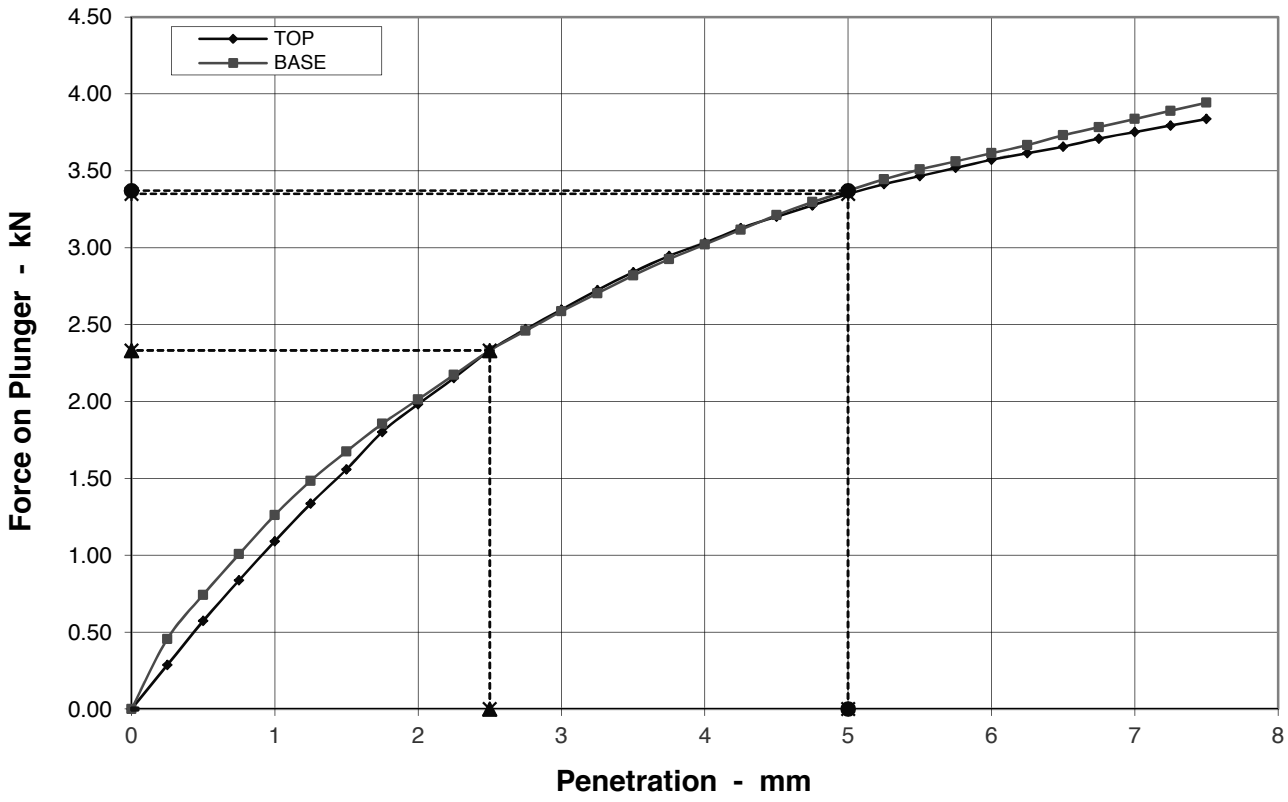
K4 SOILS

Report of California Bearing Ratio Test

BS 1377 : Part 4 : 1990:Clause 7.4

Project name:	Great Grovehurst Farm			**Samples Received:**	11/10/2013
				Project Started:	11/10/2013
Client:	Soils Ltd			**Testing started:**	15/10/2013
Project no:	13838	**Our job /report no:**	15425	**Date reported:**	25/10/2013
BH / TP no:	TP21	**Sample no:**	D	**Depth (m):**	0.50 - 0.70

Soil Description: Brown slightly gravelly silty/fine sandy CLAY (gravel is course and angular)



Preparation	Method of Compaction		
	Rammer compaction with specified effort		
	Hammer type		2.5kg Rammer
	Soaking Period	days	N/A
	Amount of Swell	mm	N/A

Sample Conditions		
Natural Moisture Content	%	17
Moisture Content - TOP	%	17
Moisture Content - BASE	%	18
Bulk Density	Mg/m³	1.95
Dry Density	Mg/m³	1.66

Test Conditions		
Sample Retained on 20 mm sieve	%	0.2
Sample Retained on 37.5 mm sieve	%	0.0
Seating Load - TOP	N	50
Seating Load - BASE	N	50
Surcharge	kg	4.4

Penetration mm	CBR Values %	
	TOP	BASE
2.5	18	18
5	17	17
Accepted CBR	**18**	**18**

K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311.
E-mail: k4soils@aol.com

Approved Signatories: K.Phaure(Tech.Mgr)
J.Phaure(Lab.Mgr)

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 25/10/2013

UKAS TESTING 2519

Richard Biney
Soils Ltd
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 13-17166

Site Reference:	Grey Grovehurst Farm
Project / Job Ref:	13838
Order No:	None Supplied
Sample Receipt Date:	14/10/2013
Sample Scheduled Date:	14/10/2013
Report Issue Number:	1
Reporting Date:	18/10/2013

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate						
QTS Environmental Report No: 13-17166	**Date Sampled**	01/10/13	01/10/13	01/10/13		
Soils Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: Grey Grovehurst Farm	**TP / BH No**	TP13	TP14	TP17		
Project / Job Ref: 13838	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	**Depth (m)**	1.40	1.40	2.20		
Reporting Date: 18/10/2013	**QTSE Sample No**	82566	82567	82568		

Determinand	Unit	MDL	Accreditation					
pH	pH Units	N / a	MCERTS	7.7	7.5	7.5		
Total Sulphate as SO_4	mg/kg	< 200	NONE	476	559	505		
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	NONE	0.08	0.05	0.04		
Total Sulphur	mg/kg	< 200	NONE	< 200	< 200	< 200		
Ammonium as NH_4	mg/kg	< 0.5	NONE	3.8	2.2	1		
W/S Chloride (2:1)	mg/kg	< 1	NONE	30	11	13		
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	NONE	4	< 3	< 3		
W/S Magnesium	mg/kg	< 10	NONE	13	14	< 10		

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 13-17166	
Soils Ltd	
Site Reference: Grey Grovehurst Farm	
Project / Job Ref: 13838	
Order No: None Supplied	
Reporting Date: 18/10/2013	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
82566	TP13	None Supplied	1.40	16.1	Light brown clay
82567	TP14	None Supplied	1.40	15.8	Light brown clay
82568	TP17	None Supplied	2.20	16.3	Light brown clay

Insufficient sample I/S
Unsuitable Sample U/S

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 13-17166

Soils Ltd

Site Reference: Grey Grovehurst Farm

Project / Job Ref: 13838

Order No: None Supplied

Reporting Date: 18/10/2013

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

Key

D Dried
AR As Received

Appendix C
Chemical Laboratory Analysis

Richard Biney
Soils Ltd
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 13-17146

Site Reference:	Great Grovehurst Farm
Project / Job Ref:	13838
Order No:	None Supplied
Sample Receipt Date:	14/10/2013
Sample Scheduled Date:	14/10/2013
Report Issue Number:	1
Reporting Date:	21/10/2013

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate						
QTS Environmental Report No: 13-17146	**Date Sampled**	01/10/13	01/10/13	01/10/13	01/10/13	01/10/13
Soils Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Great Grovehurst Farm	**TP / BH No**	TP1	TP3	TP8	TP9	TP12
Project / Job Ref: 13838	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	**Depth (m)**	0.30	0.20	0.30	0.20	0.20
Reporting Date: 21/10/2013	**QTSE Sample No**	82422	82423	82424	82425	82426

Determinand	Unit	MDL	Accreditation					
Asbestos Screen [S]	N/a	N/a	ISO17025	None Detected	None Detected	None Detected	None Detected	None Detected
pH	pH Units	N / a	MCERTS	6.2	6.8	6.9	6.4	6.7
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	NONE	0.04	0.03	0.02	0.03	0.05
Sulphide	mg/kg	< 5	NONE	< 5	< 5	< 5	< 5	< 5
Organic Matter	%	< 0.1	NONE	4.3	5	2.7	4.9	6.9
Total Organic Carbon (TOC)	%	< 0.1	NONE	2.5	2.9	1.6	2.9	4
Arsenic (As)	mg/kg	< 2	MCERTS	9	8	28	10	11
Beryllium (Be)	mg/kg	< 0.5	NONE	1.1	1.1	1.3	1	1.2
W/S Boron	mg/kg	< 1	NONE	< 1	1.4	1.3	< 1	1.9
Cadmium (Cd)	mg/kg	< 0.5	MCERTS	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chromium (Cr)	mg/kg	< 2	MCERTS	21	23	15	19	22
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	15	21	29	15	22
Lead (Pb)	mg/kg	< 3	MCERTS	36	45	106	44	43
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	16	17	13	14	18
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Vanadium (V)	mg/kg	< 2	NONE	34	34	27	29	35
Zinc (Zn)	mg/kg	< 3	MCERTS	58	104	113	59	74
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
VPH (C6 - C10)	mg/kg	< 0.05	NONE	< 0.05		< 0.05		< 0.05
EPH (C10 - C40)	mg/kg	< 6	MCERTS	< 6		152		24

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis [S]

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
QTS Environmental Report No: 13-17146	**Date Sampled**	01/10/13	01/10/13			
Soils Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Great Grovehurst Farm	**TP / BH No**	TP13	TP16			
Project / Job Ref: 13838	**Additional Refs**	None Supplied	None Supplied			
Order No: None Supplied	**Depth (m)**	0.50	0.30			
Reporting Date: 21/10/2013	**QTSE Sample No**	82427	82428			

Determinand	Unit	MDL	Accreditation					
Asbestos Screen (S)	N/a	N/a	ISO17025	None Detected	None Detected			
pH	pH Units	N / a	MCERTS	7.1	6.9			
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2			
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	NONE	0.12	0.03			
Sulphide	mg/kg	< 5	NONE	< 5	< 5			
Organic Matter	%	< 0.1	NONE	4.6	5.2			
Total Organic Carbon (TOC)	%	< 0.1	NONE	2.7	3			
Arsenic (As)	mg/kg	< 2	MCERTS	22	9			
Beryllium (Be)	mg/kg	< 0.5	NONE	2	1.1			
W/S Boron	mg/kg	< 1	NONE	2.1	1.6			
Cadmium (Cd)	mg/kg	< 0.5	MCERTS	1.5	< 0.5			
Chromium (Cr)	mg/kg	< 2	MCERTS	28	24			
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2			
Copper (Cu)	mg/kg	< 4	MCERTS	45	44			
Lead (Pb)	mg/kg	< 3	MCERTS	474	65			
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1			
Nickel (Ni)	mg/kg	< 3	MCERTS	32	18			
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3			
Vanadium (V)	mg/kg	< 2	NONE	39	33			
Zinc (Zn)	mg/kg	< 3	MCERTS	766	136			
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2			
VPH (C6 - C10)	mg/kg	< 0.05	NONE					
EPH (C10 - C40)	mg/kg	< 6	MCERTS					

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis (S)

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 13-17146	**Date Sampled**	01/10/13	01/10/13	01/10/13	01/10/13	01/10/13
Soils Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Great Grovehurst Farm	**TP / BH No**	TP1	TP3	TP8	TP9	TP12
Project / Job Ref: 13838	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	**Depth (m)**	0.30	0.20	0.30	0.20	0.20
Reporting Date: 21/10/2013	**QTSE Sample No**	82422	82423	82424	82425	82426

Determinand	Unit	MDL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.11	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.20	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.28	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.82	< 0.1	0.14
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	5.51	< 0.1	1.02
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	1.03	< 0.1	0.16
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	6.06	0.12	0.98
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	4.65	< 0.1	0.68
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	2.26	< 0.1	0.29
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	2.44	< 0.1	0.43
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	1.90	< 0.1	0.29
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.81	< 0.1	0.14
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	1.55	< 0.1	0.19
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.69	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.12	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.59	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	29	< 1.6	4.3

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 13-17146	**Date Sampled**	01/10/13	01/10/13			
Soils Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Great Grovehurst Farm	**TP / BH No**	TP13	TP16			
Project / Job Ref: 13838	**Additional Refs**	None Supplied	None Supplied			
Order No: None Supplied	**Depth (m)**	0.50	0.30			
Reporting Date: 21/10/2013	**QTSE Sample No**	82427	82428			

Determinand	Unit	MDL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Phenanthrene	mg/kg	< 0.1	MCERTS	0.37	< 0.1			
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluoranthene	mg/kg	< 0.1	MCERTS	0.45	0.24			
Pyrene	mg/kg	< 0.1	MCERTS	0.39	0.20			
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.19	< 0.1			
Chrysene	mg/kg	< 0.1	MCERTS	0.27	0.15			
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.34	0.14			
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.16	< 0.1			
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.25	< 0.1			
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.19	< 0.1			
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.20	< 0.1			
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	2.8	< 1.6			

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - PCB (7 Congeners)						
QTS Environmental Report No: 13-17146	**Date Sampled**	01/10/13				
Soils Ltd	**Time Sampled**	None Supplied				
Site Reference: Great Grovehurst Farm	**TP / BH No**	TP16				
Project / Job Ref: 13838	**Additional Refs**	None Supplied				
Order No: None Supplied	**Depth (m)**	0.30				
Reporting Date: 21/10/2013	**QTSE Sample No**	82428				

Determinand	Unit	MDL	Accreditation					
PCB Congener 28	mg/kg	< 0.008	NONE	< 0.008				
PCB Congener 52	mg/kg	< 0.008	NONE	< 0.008				
PCB Congener 101	mg/kg	< 0.008	NONE	< 0.008				
PCB Congener 118	mg/kg	< 0.008	NONE	< 0.008				
PCB Congener 138	mg/kg	< 0.008	NONE	< 0.008				
PCB Congener 153	mg/kg	< 0.008	NONE	< 0.008				
PCB Congener 180	mg/kg	< 0.008	NONE	< 0.008				
Total PCB (7 Congeners)	mg/kg	< 0.1	NONE	< 0.1				

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Organochlorine Pesticides						
QTS Environmental Report No: 13-17146	**Date Sampled**	01/10/13	01/10/13			
Soils Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Great Grovehurst Farm	**TP / BH No**	TP3	TP9			
Project / Job Ref: 13838	**Additional Refs**	None Supplied	None Supplied			
Order No: None Supplied	**Depth (m)**	0.20	0.20			
Reporting Date: 21/10/2013	**QTSE Sample No**	82423	82425			

Determinand	Unit	MDL	Accreditation					
Aldrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
alpha-HCH	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
beta-HCH	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
cis-chlordane	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
delta-HCH	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Dieldrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Endosulfan A	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Endosulfan B	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Endrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
gamma-HCH (Lindane)	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Heptachlor	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Heptachlor epoxide	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Hexachlorobenzene (HCB)	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Isodrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Methoxychlor	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
o,p' - DDD	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
o,p' - DDE	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
o,p' - DDT	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
p,p' - DDD	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
p,p' - DDE	mg/kg	< 0.02	NONE	0.04	0.11			
p,p' - DDT	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
trans-chlordane	mg/kg	< 0.02	NONE	< 0.02	< 0.02			
Trifluralin	mg/kg	< 0.02	NONE	< 0.02	< 0.02			

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{O}C

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Phenyl Urea Herbicides						
QTS Environmental Report No: 13-17146	**Date Sampled**	01/10/13	01/10/13			
Soils Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Great Grovehurst Farm	**TP / BH No**	TP3	TP9			
Project / Job Ref: 13838	**Additional Refs**	None Supplied	None Supplied			
Order No: None Supplied	**Depth (m)**	0.20	0.20			
Reporting Date: 21/10/2013	**QTSE Sample No**	82423	82425			

Determinand	Unit	MDL	Accreditation					
Chloroxuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Chlortoluron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Diflubenzuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Dimefuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Diuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Isoproturon (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Linuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Methabenzthiazuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Metoxuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Monolinuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Monuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Pencycuron (S)	mg/kg	< 0.1	NONE	< 0.1	< 0.1			

Analytical results are expressed on a dry weight basis where samples are dried at less than 30^{o}C
Subcontracted analysis (S)

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Sample Descriptions
QTS Environmental Report No: 13-17146
Soils Ltd
Site Reference: Great Grovehurst Farm
Project / Job Ref: 13838
Order No: None Supplied
Reporting Date: 21/10/2013

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
82422	TP1	None Supplied	0.30	17.1	Light brown clayey loam
82423	TP3	None Supplied	0.20	15.8	Light brown clayey loam with vegetation
82424	TP8	None Supplied	0.30	10.7	Light brown clayey gravel with rubble and stones
82425	TP9	None Supplied	0.20	16.3	Light brown clayey gravel with vegetation
82426	TP12	None Supplied	0.20	19.5	Light brown clayey loam with vegetation
82427	TP13	None Supplied	0.50	12	Brown clayey gravel with rubble and vegetation
82428	TP16	None Supplied	0.30	16	Light brown clayey sand with vegetation

Insufficient sample I/S
Unsuitable Sample U/S

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 13-17146
Soils Ltd
Site Reference: Great Grovehurst Farm
Project / Job Ref: 13838
Order No: None Supplied
Reporting Date: 21/10/2013

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

Key

D Dried
AR As Received

Appendix D
Human Health Assessment Criteria

Appendix D
Soil Guideline Values and General Assessment Criteria

D1 Assessment Criteria

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'.

D1.1 Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment Model (CLEA).

The CLEA Guidance comprises the following documents:

1) EA Science Report SC050021/SR2: *Human health toxicological assessment of contaminants in soil.*
2) EA Science Report SC050021/SR3: *Updated technical background to the CLEA model.*
3) EA CLEA Bulletin (2009).
4) CLEA software version 1.04 (2009)
5) Toxicological reports and SGV technical notes.

The CLEA guidance and tools:

- *do not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures.*
- *do not cover risks to the environment, such as groundwater, ecosystems or buildings.*
- *do not provide a definitive test for telling when human health risks are significant.*
- *are not a legal requirement in assessing land contamination risks. They are not part of the legal regime for Part 2A of the Environmental Protection Act 1990.*

The CLEA guidance derives soil concentrations of contaminants above which (in the opinion of the EA) there may be a concern that warrants further investigation. It does not provide a definitive test for establishing that the risk is significant.

D1.2 Land-use Scenarios

The CLEA model uses a range of standard land-use scenarios to develop conceptual exposure models as follows:

1 Residential

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil and indoor dust ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours.
- Building type is a two-storey small terraced house.

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur.

2) Allotments

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours.
- There is no building.

3) Commercial/Industrial

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

- Critical receptor is a working female adult (aged 16 to 65 years old).
- Exposure duration is a working lifetime of 49 years.
- Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours.
- Building type is a three-storey office (pre 1970).

D1.3 Soil Guideline Values

The EA are publishing a series of SGV reports for a selection of common contaminants relevant to the assessment of land contamination.

SGV's are generic assessment criteria based on CLEA standard land-uses and can be used to simplify the assessment of human health risks from long-term exposure to chemical contamination in soil. They do not cover short-term exposure (i.e. construction and maintenance workers), acute exposure or other risks such as fire, suffocation or explosion, as might arise from an accumulation of gases such as methane and carbon dioxide, or either odour or aesthetic issues.

SGV's represent 'trigger values', indicators that soil concentrations above the SGV level may pose a possibility of *significant harm* to human health. The converse, where soil concentrations are less that the SGV, is that the long-term human health risks are considered to be tolerable or minimal.

D1.4 Generic Assessment Criteria

If an SGV is not available for a substance identified in the soil then the range of Generic Assessment Criteria published from a collaborative research by Land Quality Management Limited (LQM) and the Chartered Institute of Environmental Health will be used. For derivation of these Generic Assessment Criteria reference must be made to:

Nathanial, P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A., Ogden, R., Scott, D. *The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition)*. **Land Quality Press**. 2009.

In the case of Lead, the AtRisk Soil SSV have been used.

D1.5 Detailed Quantitative Risk Assessments (DQRA)

Where the adoption of an SGV/GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a DQRA may be undertaking to develop site specific values for relevant soil contaminants.

⇒ Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.

⇒ Developing more accurate parameters using site data.

D1.6 Ongoing development of CLEA based guidance

The EA is involved in a programme of publishing SGV's and related toxicity data (the TOX reports). As at July 2009 ten SGV's and matching TOX reports had been published.

Soil Assessment Criteria (SAC's) may be derived using toxicity data from the updated TOX reports, where these are published, or from the original TOX reports. SGV reports also take account of recent updates for plant uptake and other factors.

⇒ GAC's developed by CLEA guidance and given in this report will need to be assessed against updated TOX reports and SGV's when these are published.

⇒ SGV reports may give values that differ from the GAC's used in this report.

⇒ These variations may materially alter the remediation requirement for the site, requiring either an increase or decrease in the extent, type and cost of remediation.

D1.7 Phytotoxicity

CLEA guidance only addresses human health toxicity; assessment of plant toxicity (phytotoxicity) is based on threshold trigger values obtained from the following source:

• ICRCL 70/90: *Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing*.

D1.8 Statistical Tests

DEFRA R&D Publication CLR 7 (DOE 1994) addressed the statistical treatment of test results and their comparison to Soil Guideline Values.

Consideration must be given to the appropriate area of land to be considered termed the critical averaging area.

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot.

It may be appropriate to compare the upper 95th percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

The DEFRA discussion paper Assessing risks from land contamination – a proportionate approach ('the way forward') (CLAN06/2006) aimed to increase understanding of the role that statistics can play in quantifying the uncertainty attached to the estimates of the mean concentration of contaminants in soil. In direct response CLAIRE/CIEH published a joint report, *Guidance in comparing soil contamination data with a critical concentration* (CLAIRE/CIEH 2008). A software implementation of the statistical techniques given in the report was published by ESI International (2008).

Treatment of Hot-Spots

⇒ A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.

⇒ Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.

D2 Soil Guideline Values and General Acceptance Criteria

Soil Guideline Values and General Acceptance Criteria used in the preparation of this report is tabulated in the following pages:

DEFRA CLEA 1.04 Soil Guideline Values (as at July 2012)

(Sandy Loam, pH 7, SOM 6%)

Contaminant	Residential (mg/kg DW)	Allotments (mg/kg DW)	Commercial (mg/kg DW)
Inorganic			
Arsenic	32	43	640
Cadmium	10	1.8	230
Mercury			
- Elemental	1.0	26	26
- Inorganic	170	80	3600
- Methyl	11	8	410
Nickel	130	230	1800
Selenium	350	120	13000
Organic May not be protective if SOM <6%			
Phenol	420	280	3200 (38,000*)
Benzene	0.33	0.07	95
Toluene	610	120	4400
Ethylbenzene	350	90	2800
Xylenes			
- o-xylene	250	160	2600
-m-xylene	240	180	3500
-p-xylene	230	160	3200
Dioxins			
Sum of PCDDs, PCDFs and dioxin-like PCB's.	8	8	240

* Based on a threshold protective of direct skin contact with phenol (guideline in brackets based on health affects following long term exposure provided for illustration only)

Atkins AtRisk SSV Guideline Values For Lead (mg/kg)

Contaminant	Residential With Plant Uptake	Residential Without Plant Uptake	Commercial & Industrial	Open spaces
Lead 1% SOM sand soil	276	383	6490	1590
Lead 6% SOM sandy loam soil	342	383	6490	1590

LQM CIEH General Assessment Criteria (2nd edition) (mg/kg)

Contaminant	Residential	Allotment	Commercial
Metals			
Beryllium	51	55	420
Boron	291	45	192000
Chromium (III)	3000	34600	30400
Chromium (VI)	4.3	2.1	35
Copper	2330	524	71700
Vanadium	140	150	4250
Zinc	3750	618	665000

LQM CIEH General Assessment Criteria

General Assessment Criteria For Polycyclic Aromatic Hydrocarbons (PAH's) (mg/kg)

Determinants		Residential	Allotments	Commercial
Acenapthene	1.0% SOM	210	34	85,000 (57) [sol]
	2.5% SOM	480	85	98,000 (141) [sol]
	6.0% SOM	100	200	100,000
Acenapthylene	1.0% SOM	170	28	84,000 (86) [sol]
	2.5% SOM	400	69	97,000 (212) [sol]
	6.0% SOM	850	160	100,000
Anthracene	1.0% SOM	2,300	380	530,000
	2.5% SOM	4,900	950	540,000
	6.0% SOM	9,200	2200	540,000
Benzo(a)anthracene	1.0% SOM	3.1	2.5	90
	2.5% SOM	4.7	5.5	95
	6.0% SOM	5.9	10	97
Benzo(a)pyrene	1.0% SOM	0.83	0.6	14
	2.5% SOM	0.94	1.2	14
	6.0% SOM	1.0	2.1	14
Benzo(b)flouranthene	1.0% SOM	5.6	3.5	100
	2.5% SOM	6.5	7.4	100
	6.0% SOM	7.0	13	100
Benzo(ghi)perylene	1.0% SOM	44	70	650
	2.5% SOM	46	120	660
	6.0% SOM	47	160	660
Benzo(k)flouranthene	1.0% SOM	8.5	6.8	140
	2.5% SOM	9.6	14	140
	6.0% SOM	10	23	140
Chrysene	1.0% SOM	6.0	2.6	140
	2.5% SOM	8.0	5.8	140
	6.0% SOM	9.3	12	140
Dibenzo(ah)anthracene	1.0% SOM	0.76	0.76	13
	2.5% SOM	0.86	1.5	13
	6.0% SOM	0.90	2.3	13
Flouranthene	1.0% SOM	260	52	23,000
	2.5% SOM	460	130	23,000
	6.0% SOM	670	290	23,000
Flourene	1.0% SOM	160	27	64,000 (31) [sol]
	2.5% SOM	380	67	69,000
	6.0% SOM	780	160	71,000
Indeno(123-cd)pyrene	1.0% SOM	3.2	1.8	60
	2.5% SOM	3.9	3.8	61
	6.0% SOM	4.2	7.1	62
Napthalene	1.0% SOM	1.5	4.1	200 (76) [sol]
	2.5% SOM	3.7	9.9	480 (183) [sol]
	6.0% SOM	8.7	23	1100 (432) [sol]
Phenanthrene	1.0% SOM	92	16	22,000
	2.5% SOM	200	38	22,000
	6.0% SOM	380	90	23,000
Pyrene	1.0% SOM	560	110	54,000
	2.5% SOM	1,000	270	54,000
	6.0% SOM	1,600	620	54,000

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.
[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

General Assessment Criteria For TPH (mg/kg)

Determinants		Residential	Allotments	Commercial
Aliphatic				
EC 5-6	1.0% SOM	30	740	3,400 (304) [sol]
	2.5% SOM	55	1,700	6,200 (558) [sol]
	6.0% SOM	110	3,900	13,000 (1150) [sol]
EC >6-8	1.0% SOM	73	2,300	8,300 (144) [sol]
	2.5% SOM	160	5,600	18,000 (322) [sol]
	6.0% SOM	370	13,000	42,000 (736) [sol]
EC >8-10	1.0% SOM	19	320	2,100 (78) [sol]
	2.5% SOM	46	770	5,100 (118) [vap]
	6.0% SOM	110	1,700	12,000 (451) [vap]
EC >10-12	1.0% SOM	93 (48) [vap]	2,200	10,000 (48) [sol]
	2.5% SOM	230 (118) [vap]	4,400	24,000 (118) [vap]
	6.0% SOM	540 (283) [vap]	7,300	49,000 (283) [vap]
EC >12-16	1.0% SOM	740 (24) [sol]	11,000	61,000 (24) [sol]
	2.5% SOM	1,700 (59) [sol]	13,000	83,000 (59) [sol]
	6.0% SOM	3,000 (142) [sol]	13,000	91,000 (142) [sol]
EC >16-35	1.0% SOM	45,000 (8.48) [sol]	260,000	1,600,000
	2.5% SOM	64,000 (21) [sol]	270,000	1,800,000
	6.0% SOM	76,000	270,000	1,800,000
EC >35-44	1.0% SOM	45,000 (8.48) [sol]	260,000	1,600,000
	2.5% SOM	64,000 (21) [sol]	270,000	1,800,000
	6.0% SOM	76,000	270,000	1,800,000
Aromatic				
EC 5-7	1.0% SOM	65	13	28,000 (1220) [sol]
	2.5% SOM	130	27	49,000 (2260) [sol]
	6.0% SOM	280	57	90,000 (4710) [sol]
EC >7-8	1.0% SOM	120	22	59,000 (869) [vap]
	2.5% SOM	270	51	110,000 (1920) [sol]
	6.0% SOM	611	120	190,000 (4360) [vap]
EC >8-10	1.0% SOM	27	8.6	3,700 (613) [vap]
	2.5% SOM	65	21	8,600 (1500) [vap]
	6.0% SOM	151	51	18,000 (3580) [vap]
EC >10-12	1.0% SOM	69	13	17,000 (364) [sol]
	2.5% SOM	160	31	29,000 (899) [sol]
	6.0% SOM	346	74	34,500 (2150) [sol]
EC >12-16	1.0% SOM	140	23	36,000 (169) [sol]
	2.5% SOM	480	57	37,000
	6.0% SOM	770	130	37,800
EC >16-21	1.0% SOM	250	46	28,000
	2.5% SOM	480	110	28,000
	6.0% SOM	770	260	28,000
EC >21-35	1.0% SOM	890	370	28,000
	2.5% SOM	1,100	820	28,000
	6.0% SOM	1,230	1,600	28,000
EC >35-44	1.0% SOM	890	370	28,000
	2.5% SOM	1,100	820	28,000
	6.0% SOM	1,230	1,600	28,000
Aromatic & Aliphatic				
EC >44 - 70	1.0% SOM	1200	1200	28,000
	2.5% SOM	1300	2100	28,000
	5.0% SOM	1300	3000	28,000

Note: a) *SOM = Soil Organic Matter Content (%) b)LQM CIEH GAC not set for Allotment land-use*

ICRCL 70/90 *Restoration of metalliferous mining areas* (mg/kg)

Phytotoxicity (Harmful to Plants) Threshold Trigger Values	
Copper	250
Zinc	1000

Notes: Many cultivars and specifically grasses have a high tolerance and there will be no ill-effect at the threshold trigger values given for neutral or near neutral pH. Site observation of plant vitality may give additional guidance.

LQM CIEH General Assessment Criteria

Volatile and Semi-Volatile Organic Compounds (mg/kg)

Contaminant	Residential	Allotment	Commercial
Chloroalkanes & alkenes			
1,2 Dichloroethane			
1.0% SOM	0.0054	0.0046	0.71
2.5% SOM	0.0080	0.0083	1.00
6.0% SOM	0.014	0.016	1.80
1,1,2,2 Tetrachloroethane			
1.0% SOM	1.4	0.41	290
2.5% SOM	2.9	0.89	580
6.0% SOM	6.3	2.0	1200
1,1,1,2 Tetrachloroethane			
1.0% SOM	0.90	0.79	120
2.5% SOM	2.1	1.9	260
6.0% SOM	4.8	4.4	590
Tetrachloroethene			
1.0% SOM	0.94	1.6	130
2.5% SOM	2.1	3.7	290
6.0% SOM	4.8	8.7	660
1,1,1 Trichloroethane			
1.0% SOM	6.2	48	700
2.5% SOM	13	110	1400
6.0% SOM	28	240	3100
Tetrachloromethene			
1.0% SOM	0.018	0.16	3.0
2.5% SOM	0.039	0.37	6.6
6.0% SOM	0.089	0.85	15
Trichloroethene			
1.0% SOM	0.11	0.43	12
2.5% SOM	0.22	0.95	25
6.0% SOM	0.49	2.2	55
Trichloromethane			
1.0% SOM	0.75	0.36	110
2.5% SOM	1.3	0.70	190
6.0% SOM	2.7	1.5	370
Vinyl Chloride			
1.0% SOM	0.00047	0.00055	0.063
2.5% SOM	0.00064	0.0010	0.081
6.0% SOM	0.00099	0.0018	0.12

Contaminant	Residential	Allotment	Commercial
Explosives			
2,4,6 Trinitrotoluene			
1.0% SOM	1.6	0.24	1000
2.5% SOM	3.7	0.58	1000
6.0% SOM	8.0	1.4	1100
RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)			
1.0% SOM	3.5	0.52	6400
2.5% SOM	7.4	1.1	6400
6.0% SOM	16	2.5	6400
HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)			
1.0% SOM	5.7	0.86	110,000
2.5% SOM	13	1.9	110,000
6.0% SOM	26	3.9	110,000
Atrazine			
1.0% SOM	0.24	0.037	870
2.5% SOM	0.56	0.085	880
6.0% SOM	1.3	0.20	880
Pesticides			
Aldrin			
1.0% SOM	1.7	1.3	54
2.5% SOM	2.0	2.6	54
6.0% SOM	2.1	4.0	54
Dieldrin			
1.0% SOM	0.69	0.13	90
2.5% SOM	1.4	0.32	91
6.0% SOM	2.2	0.73	92
Dichlorvos			
1.0% SOM	0.29	0.044	942
2.5% SOM	0.6	0.091	972
6.0% SOM	1.3	0.2	983
Alpha - Endosulfan			
1.0% SOM	2.9	0.47	2310 (0.003)^{vap}
2.5% SOM	7.0	1.2	2990 (0.007) ^{vap}
6.0% SOM	16	2.7	3390
Beta - Endosulfan			
1.0% SOM	2.8	0.44	2580 (0.00007)^{vap}
2.5% SOM	6.6	1.1	3160 (0.0002) ^{vap}
6.0% SOM	15	2.6	3480
Alpha -Hexachlorocyclohexanes			
1.0% SOM	19	3.0	14000
2.5% SOM	46	7.4	14600
6.0% SOM	100	18	14900
Beta -Hexachlorocyclohexanes			
1.0% SOM	1.7	0.26	1120
2.5% SOM	3.9	0.64	1130
6.0% SOM	8.5	1.5	1130
Gamma -Hexachlorocyclohexanes			
1.0% SOM	0.58	0.089	532
2.5% SOM	1.4	0.22	546
6.0% SOM	3.0	0.52	552

Chlorobenzenes			
Chlorobenzene			
1.0% SOM	0.33	5.9	59
2.5% SOM	0.73	14	32
6.0% SOM	59	130	310
1,2-Dichlorobenzene			
1.0% SOM	16	94	2100 (571) [sol]
2.5% SOM	39	230	5100 (1370) [sol]
6.0% SOM	91	540	12000 (3240) [sol]
1,3-Dichlorobenzene			
1.0% SOM	0.29	0.25	32
2.5% SOM	0.70	0.61	77
6.0% SOM	1.7	1.5	180
1,4-Dichlorobenzene			
1.0% SOM	30	15	4500 (224)[vap]
2.5% SOM	72	37	10000 (540)[vap]
6.0% SOM	167	88	22000 (1280)[vap]
1,2,3,-Trichlorobenzene			
1.0% SOM	1.0	4.7	110
2.5% SOM	2.6	12	270
6.0% SOM	6.1	28	620
1,2,4,-Trichlorobenzene			
1.0% SOM	1.8	31	230
2.5% SOM	4.5	75	560
6.0% SOM	11	180	1300
1,3,5,-Trichlorobenzene			
1.0% SOM	0.23	4.7	24
2.5% SOM	0.57	12	57.8
6.0% SOM	1.3	28	140
1,2,3,4,-Tetrachlorobenzene			
1.0% SOM	12	4.4	1800 (122)[vap]
2.5% SOM	4.5	75	3200 (304)[vap]
6.0% SOM	11	180	4500 (728)[vap]
1,2,3,5,- Tetrachlobenzene			
1.0% SOM	0.49	0.38	52 (39.4)[vap]
2.5% SOM	1.2	0.94	120 (98.1)[vap]
6.0% SOM	2.8	2.2	250 (235)[vap]
1,2,4, 5,- Tetrachlobenzene			
1.0% SOM	0.30	0.064	44 (19.7)[sol]
2.5% SOM	0.68	0.16	73 (49.1)[sol]
6.0% SOM	1.4	0.37	97
Pentachlrobenzene			
1.0% SOM	5.2	1.2	650 (43.0)[sol]
2.5% SOM	10	3.1	770 (107)[sol]
6.0% SOM	17	7.1	830
Hexachlorobenzene			
1.0% SOM	0.59 (0.20)[vap]	0.18	48 (0.20)[vap]
2.5% SOM	1.0 (0.50)[vap]	0.42	53
6.0% SOM	1.4	0.92	55
Phenols & Chlorophenols			
Chlorophenols (4 Congeners)			
1.0% SOM	0.87	0.13	3500
2.5% SOM	2.0	0.30	4000
6.0% SOM	4.4	0.70	4200
Pentachlorophenols			
1.0% SOM	0.55	0.084	1200
2.5% SOM	1.3	0.21	0.49
6.0% SOM	1200	1300	1400

Others			
Carbon Disulphide			
1.0% SOM	0.10	4.8	12
2.5% SOM	0.20	10	23
6.0% SOM	0.44	23	50
Hexachloro-1,3-Butadiene			
1.0% SOM	0.21	0.25	32
2.5% SOM	0.51	0.61	69
6.0% SOM	1.2	1.4	120

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.
[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

Appendix E
Soakage Test Data

Soakage Test Data

Trial Pit No. TP19		
Time (min)	**Depth to water (m BGL)**	**Notes**
0.00	1.252	
1.00	1.253	
2.00	1.254	
3.00	1.255	
5.00	1.263	
10.00	1.270	
15.00	1.278	
21.00	1.290	
31.00	1.308	
45.00	1.326	
65.00	1.347	
98.00	1.389	
121.00	1.412	
155.00	1.439	
200.00	1.455	

Trial Pit Dimensions	
Top Length (m)	2.5
Top Width (m)	1.2
Base Length (m)	1.3
Base Width (m)	1.0
Depth (m)	2.1 (At start of test)

Soakage Test Data

Trial Pit No. TP20		
Time (min)	**Depth to water (m BGL)**	**Notes**
0.00	1.390	Water seepage at 2.0m
1.00	1.390	
2.00	1.390	
3.00	1.391	
5.00	1.391	
17.00	1.393	
23.00	1.398	
35.00	1.398	
45.00	1.398	
60.00	1.398	
90.00	1.398	
124.00	1.398	
147.00	1.398	
180.00	1.398	
200.00	1.398	

Trial Pit Dimensions	
Top Length (m)	2.5
Top Width (m)	1.1
Base Length (m)	1.8
Base Width (m)	1.0
Depth (m)	2.5 (At start of test)

Soakage Test Data

Trial Pit No. TP21		
Time (min)	**Depth to water (m BGL)**	**Notes**
0.00	1.230	
1.00	1.234	
2.00	1.235	
3.00	1.235	
5.00	1.236	
8.00	1.237	
15.00	1.240	
20.00	1.245	
28.00	1.247	
35.00	1.247	
41.00	1.254	
55.00	1.257	
65.00	1.264	
107.00	1.269	
180.00	1.283	
205.00	1.284	
230.00	1.296	
256.00	1.297	

Trial Pit Dimensions	
Top Length (m)	2.6
Top Width (m)	1.2
Base Length (m)	0.8
Base Width (m)	1.0
Depth (m)	1.8 (At start of test)

Soakage Test Data

Trial Pit No. TP22		
Time (min)	**Depth to water (m BGL)**	**Notes**
0.00	1.287	
1.00	1.289	
2.00	1.297	
3.00	1.301	
5.00	1.309	
8.00	1.324	
15.00	1.330	
20.00	1.344	
34.00	1.367	
53.00	1.380	
92.00	1.426	
158.00	1.465	
188.00	1.479	
216.00	1.490	
240.00	1.513	

Trial Pit Dimensions	
Top Length (m)	2.5
Top Width (m)	1.1
Base Length (m)	1.5
Base Width (m)	0.9
Depth (m)	2.1 (At start of test)

Soakage Test Data

Trial Pit No. TP23		
Time (min)	**Depth to water (m BGL)**	**Notes**
0.00	1.320	
1.00	1.321	
2.00	1.323	
3.00	1.325	
5.00	1.327	
10.00	1.329	
15.00	1.330	
30.00	1.338	
46.00	1.343	
118.00	1.348	
147.00	1.352	
175.00	1.358	
212.00	1.360	

Trial Pit Dimensions	
Top Length (m)	2.4
Top Width (m)	1.1
Base Length (m)	1.7
Base Width (m)	1.0
Depth (m)	2.2 (At start of test)

Soakage Test Data

Trial Pit No. TP24		
Time (min)	**Depth to water (m BGL)**	**Notes**
0.00	1.255	
1.00	1.258	
2.00	1.259	
3.00	1.245	
5.00	1.250	
12.00	1.252	
18.00	1.257	
32.00	1.272	
49.00	1.285	
64.00	1.297	
135.00	1.350	
164.00	1.369	
196.00	1.388	
240.00	1.405	

Trial Pit Dimensions	
Top Length (m)	2.5
Top Width (m)	1.2
Base Length (m)	1.4
Base Width (m)	1.0
Depth (m)	2.1 (At start of test)

Date: 1-2 October 2013

Job No.: 13838

Job Name: Great Grovehurst Farm

soils LIMITED
Geotechnical & Environmental Consultants