

**Link Road,
Dunsbury Hill Farm,
Park Lane, Cowplain,
Waterlooville**

**Supplementary Ground Investigation and
Remediation Strategy Report**

On behalf of **Portsmouth City Council**

Document Control Sheet

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1 Introduction

1.1 Background

Peter Brett Associates LLP (PBA) has been commissioned by Portsmouth City Council (the Client) to carry out a supplementary ground investigation and Remediation Strategy in order to discharge the planning conditions A14 (Contaminated Land – Scheme) for the proposed Link Road as part of the Dunsbury Hill Farm Development, Park Lane, Cowplain, Waterloooville.

A number of studies and investigations have been carried out at the site for the proposed Dunsbury Hill Development and the Link Road. In December 2014, a supplementary intrusive ground investigation has been carried out to provide information on the ground conditions and the potential for contamination to be present at the Link Road site. The fieldwork was carried out by Peter Brett Associates. The factual results of the investigation and laboratory certificates are presented in this report.

The purpose of this document is to confirm the geoenvironmental conditions at the site and to set out the requirements for any remediation, if required, and an agreed protocol in the case of discovery of an unidentified source of contamination during the work for the proposed development. The document is aimed to fully discharge Planning Condition A14 for the Link Road site.

Unless stated otherwise, detailed information from ground investigation has not been included in this report and, where referenced, the report presenting this information should be read in conjunction with this report.

Guidance on the context of this report and any general limitations or constraints on its content and usage are given in a guidance note included after the text of this report.

2 The Site

2.1 Site Location and General Description

The site is situated in the valley of the Hermitage Stream between the A3(M) and northern outskirts of Havant and comprising mainly agricultural undeveloped land. A site Location Plan is presented as **Figure 1**.

The Hermitage Stream is crossing the site flowing from the west in general direction to the southeast and south. The natural ground level falls from the northeast and southwest towards the valley of the Hermitage Stream.

The A3(M) was constructed immediately to the west of the site by the late 1970s. The A3(M) motorways Junction 3 is constructed on a two stage embankment about 15 m above the natural ground levels. The Hermitage Stream culverted under the A3(M) embankment and the stream crosses the site flowing from west and northwest to the south in a concrete channel.

The B2150 a carriageway between the M3(M) Junction 3 roundabout and Havant comprising the southwest section of the site and is constructed on a raised embankment.

A Site Layout Plan is presented as **Figure 2**.

2.2 Geology

According to the British Geological Survey (BGS) 1:50,000 scale geological map (BGS, 1998), the solid geology at the southern part of the site comprises the London Clay Formation. The Bognor Sand Member is a member of the London Clay Formation, described by the BGS as a glauconitic fine and medium sand, is shown to outcrop immediately to the northeast of the Hermitage Stream. The London Clay is underlain by the Lambeth Group and the Chalk at depth. The solid geology is shown to be overlain by superficial Head Deposits within the valley of the Hermitage Stream.

Made Ground is recorded above the natural soils associated with the A3(M) Junction 3 roundabout and the B2150 carriageway. In addition, Made Ground is recorded to the southeast of the site about 0.2 km to the southeast of the A3(M) Junction 3 roundabout.

2.3 Hydrogeology

The published groundwater vulnerability maps available on the Environment Agency Website (January 2015) indicates the Head Deposits and the Bognor Sand Member are classified as Secondary Aquifer (former minor aquifer), which are formations of variable permeability that, although seldom producing large quantities of water for abstraction, may be important for local supplies and in supplying base flow to rivers.

The London Clay Formation is classified as an Unproductive Strata (formerly non-aquifer). These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The latest indicative maps included in the Environment Agency website (January 2015) indicate that the site is located in an inner groundwater Source Protection Zone (SPZ) for a subsurface activity (Zone 1c). The SPZ is related to a groundwater abstraction well from the Upper Chalk at depth. Groundwater source protection zones are defined as the groundwater catchment zones for significant public water supply and private wells or boreholes that supply water to potable or equivalent standards. The main hydrogeological significance of the London Clay Formation, and to a lesser extent the Lambeth Group, is to confine the aquifer in the Chalk. As such, the proposed development is not considered to have an impact on the Chalk Aquifer at depth.

2.4 Hydrology

The Hermitage Stream crossing the site flowing from the west and northwest in general direction to the southeast and south towards the Langstone Channel about 4 km to the south of the site.

2.5 Landfill

According to the Environment Agency database on their website (January 2015) there is a record of an historical landfill situated within the northern part of Dunsbury Hill Farm Development situated about 0.2 km to the north of the Link Road site. According to the available information the landfill received inert waste with a Waste Licence Reference: 13/3, FHA17. Further details such as the quantities, dates of receiving waste or the landfill operator name are not available.

Given the distance to the site and the type of the waste materials deposited, the landfill is not considered to represent a particular risk of environmental hazard to the Link Road site. Similarly development on the Link Road site will not impact the landfill.

2.6 Proposed Development

It is proposed to construct a Link Road off the B2150 carriageway through the Dunsbury Hill Farm Development to the northern outskirts of Havant. The road will be constructed on an embankment with a bridge crossing over the Hermitage Stream.

3 Ground Investigations

3.1 Introduction

A number of ground investigations and studies were carried out as part of the Dunsbury Hill Farm Development. Some of the studies and investigation cover the whole development including the Link Road, as such, these studies are refed to in the following sections of this report.

3.2 Previous Investigations and Studies

Previously in 2002, a Baseline Ground Conditions Report for the Dunsbury Hill Farm Development was carried out by Campbell Reith Hill LLP, a copy of which was not made available at the time of writing this report.

In 2010 a Stage 1 Feasibility Study (Atkins 2010) that included a review of readily available published information was carried out to assess the ground conditions on the Site including the potential for contamination to be present associated with previous and present uses of the Site and the surrounding areas.

Subsequently, in 2011 an intrusive ground investigation was carried out by Environmental Scientific Group Limited acting under the technical direction of Atkins (ESG, 2011). The ground investigation comprised the sinking of six boreholes between 10 and 15 m depth denoted BH101 to BH106, the excavation of nine trial pits to 4 m depth denoted TP201 to TP209 and four hand dug pits to locate a gas main denoted GTP01 to GTP04.

In 2012 a Ground Conditions and Contaminated Land Chapter was completed by Atkins (2012) as part of the Environmental Statement for the proposed development.

In March 2014 a supplementary ground investigation and a Geotechnical Design Report (GDR) were completed by Mayer Brown Limited for the proposed Link Road (MBL, 2014). The 2014 ground investigation comprised the sinking of a single borehole to 10 m depth denoted BH1, and the sinking of ten window sampling boreholes to a maximum depth of 3.0 m depth.

3.3 Summary of Geoenvironmental Information

Evidence of site wide or significant contamination was not identified in the previous intrusive investigations at the site. The 2010 Stage 1 report and the ES Chapter identified possible land contamination associated with a landfill in the north part of the Dunsbury Hill Farm Development about 0.2 km to the north of the Link Road. According to the reports the landfill was filled with materials from the A3(M) construction works mainly comprising excess spoil for the motorway earthworks (Atkins, 2010 & 2012). Overall, the existing investigations and studies conclude that the presence of significant quantities of substances harmful to environmental or human receptors for the proposed Link Road is unlikely (Atkins, 2010 & 2012).

3.4 PBA 2014 Ground Investigation

The aim of the present investigation was to confirm the findings of the previous studies and investigations and provide additional detailed geoenvironmental information on the near-surface ground conditions within the area of site.

A ground investigation was carried out on 17 and 18 December 2014 by Peter Brett Associates. The scope of the investigation comprised the excavation of 13 trial pits designated TP01 to TP13 to between 2.0 and 4.0 m below existing ground level.

The records of the exploratory holes are presented in **Appendix 1**. The location of exploratory holes for the previous and current ground investigations on and the vicinity of the Link Road are shown on the site Layout Plan, **Figure 2**.

3.5 Geochemical Laboratory Testing

A programme of geochemical laboratory testing was carried out on 11 soil samples to determine the concentrations of a range of commonly occurring potential contaminants. The samples of soil for geochemical testing were taken from the near surface materials encountered at selected locations investigated.

The geochemical analyses were scheduled by PBA and carried out by Derwentside Environmental Testing Services (DETS). The soil suites specified use methods that are accredited by MCERTS where available.

The results of the chemical analyses are presented in **Appendix 2**.

4 Ground Conditions

4.1 Introduction

The ground conditions in the area of the site as revealed by the previous and current ground investigations are in agreement with the published geological information and known history of the site, and comprise Head Deposits present at the majority of the locations investigated with the Bognor Sand Member and/or the London Clay Formation present at depth. Made Ground was found at all the locations investigated at the A3(M) Highway embankment and locally along the proposed Link Road.

4.2 Made Ground

Made Ground was found at all the locations investigated at the A3(M) Highway embankment and locally encountered along the proposed Link Road. The Made Ground was found to be typically CLAY with variable proportions of sand and gravel. Locally the Made Ground comprised slightly gravelly, silty SAND. The gravel size fraction comprised mainly flint, chalk, brick and locally organic materials and timber.

The thickness of the Made Ground at the A3(M) Highway embankment was found to be more than 2.5 m below ground level. Made Ground was not identified in the majority of the locations investigated off the Highway embankment, however, where present the Made Ground was found to be between 1.1 and 2.5 m depth.

Olfactory and visual signs of contamination were not noted during the investigations.

4.3 Head Deposits

Head Deposits were encountered at the surface or below a veneer of Made Ground (where present) at the majority of the locations investigated in the northern and central parts of the site, with the exceptions of two locations (WS305 and TP204) where the Bognor Sand Member was present at the surface. The Head Deposits typically comprise CLAY with variable proportions of sand and gravel. Locally in the northern part of the site the Head Deposits contain SAND with variable proportions of clay and gravel.

Where present the Head Deposits was found to be up to between 0.5 and 3.7 m depth and typically between about 1.5 and 2.5 m depth.

4.4 Bognor Sand Member

The Bognor Sand Member was found at all the locations investigated on the northern and central parts of the site with the exception of TP09 where the Made Ground was not fully penetrated and at TP5, TP10, and TP12 where the Head Deposits were not fully penetrated. The Bognor Sand Member was typically found to comprise orange, brown and grey fine SAND with little silt and/or clay.

It should be noted that the Bognor Sand Member was locally noted to be unstable in the trial pits excavated below the groundwater table.

Where present the Bognor Sand Member was found to a maximum depth of 5.8m m depth.

4.5 London Clay Formation

The London Clay Formation was found at all the location investigated at the central and southern parts of the Site and locally in the northern part of the site. The London Clay Formation typically comprised brown and grey CLAY locally with little sand.

Where present the London Clay Formation was proven to the maximum investigated depth of 12.5 m depth.

4.6 Groundwater

During the fieldworks groundwater seepage were recorded from the Bognor Sand Member in a number of the exploratory holes between about 2.8 and 3.5 m below ground level and locally at 1.9 m depth. Groundwater entry was recorded within the Bognor Sand in Borehole BH1 at 5.0 m depth and rose to 3.5 m depth after 20 minutes.

Groundwater seepage was locally noted within the Head Deposits between 1.2 and 2.8 m depth. It is possible that the groundwater entries noted within the Head Deposits are not representative of the groundwater table and is associated with perched groundwater in pockets in the Head Deposits.

5 Geoenvironmental Conditions

This section of the report discusses the measured concentrations of potential contaminants and assesses the geoenvironmental conditions on the site with respect to any hazards posed by the existing site conditions to the proposed development and the environment.

5.1 Geochemical Testing

Geochemical testing for a range of potential contaminants was carried out on 11 samples of natural soils and the Made Ground recovered as part of the investigation for a range of general industrial contaminants; of metals and hydrocarbons. Full results of the chemical analysis carried out are presented in **Appendix 2**.

5.2 Contamination Assessment Regime

The results of the geochemical testing on the soil samples have been compared to CLEA SGVs for land uses as commercial or industrial (EA, 2009). Where a CLEA SGV is not available the concentrations were compared against the Land Quality Management Ltd (LQM) Generic Assessment Criteria (GACs) for a commercial or industrial land use (CIEH, 2009). Full details of the assessment criteria are given in the guidance note presented in **Appendix 3**.

5.3 Assessment of Contamination

The measured concentrations of potential contaminants, are below the selected assessment values appropriate for land uses as commercial or industrial use.

A summary of the chemical analysis of the soil samples is presented in **Table 1** located after the text of this report.

Based on the previous investigations and studies and the recent ground investigation we consider that the potential for significant contamination to be present on the site is considered to be **Very Low**. As such, there is no significant risk to the ecology, controlled waters or human health associated with the proposed Link Road construction. Therefore, no specific measures need to be adopted to limit the risk associated with potential contamination for the Link Road construction as currently proposed.

6 Remediation Strategy

6.1 Required Remediation Measures

The geoenvironmental conditions presented in **Section 5.0** indicates that any potential contaminants in the ground do not by themselves represent an unacceptable risk associated with the development of the Site as currently proposed. On this basis, no specific remediation and/or mitigation measures will, in general, be required to limit the potential risks associated with land contamination.

Notwithstanding the above, it is recommended that specific precautions are adopted to mitigate the potential risks to site workers of unforeseen contaminated materials that although unlikely, could be encountered during the construction works. These measures will also protect site workers from ingestion, inhalation or prolonged skin contact with the made ground. These measures should include (i) informing site workers of the potential risk through site induction and 'tool box talks' and steps to be taken if encountered; (ii) the provision of appropriate protective clothing and equipment to be worn by site workers; and (iii) the adoption of good standards of hygiene to prevent prolonged skin contact, inhalation and ingestion of soils during construction. In addition, in line with current regulations and best practice, appropriate methods of working should be implemented to limit disturbance of contaminated materials, where present, and the potential for air-borne dust to arise.

6.2 Management of Unidentified Sources of Contamination

There is a possibility that sources of contamination may be encountered during the site clearance or ground works that have not been identified by the ground investigation works.

Should visual and olfactory examination of any unusual solid materials or liquids encountered during the construction works identify areas of contamination, specific management procedures will need to be adopted. These procedures will allow for the short-term storage of the suspected material in stockpiles and/or storage tanks while verification testing for potential contamination is carried out. The storage area will be contained to ensure that contamination does not migrate and affect other areas of the site.

Once the nature, location and extent of the unexpected contamination have been identified appropriate remediation or mitigation measures will be adopted. Although these cannot be identified at this time the main emphasis will be on methods of isolating or treating the affected materials. If such measures are unlikely to be practical or effective in mitigating the risk from the identified contamination, consideration will be given to excavating and removing the contaminated material from site for disposal or treatment at a suitably licensed facility.

Where remediation of unexpected contaminants is required, an implementation and verification process will be established to identify the remediation activities required and to confirm that the remediation has been undertaken correctly. As part of this process, remediation objectives will be identified and remediation criteria selected for measuring compliance against these objectives in consultation with the Local Authority and other statutory consultees. Once any remediation of unexpected contaminants is complete, a verification report will be prepared demonstrating that the remediation objectives and criteria have been achieved. The report will provide a full record of all remediation activities carried out and data collected in accordance with the requirements of the verification plan and any monitoring and maintenance plan.

6.3 Verification Plan

In accordance with Planning Condition A15 (Contaminated land – mitigation) a Verification Plan will need to be prepared by the contractor or his appointed consultant to demonstrate full compliance with the requirements of the remediation strategy in the event that contamination that was not previously identified on site is found during the works. The Verification Plan shall include, but not be limited to provision of the following information:

- i) Details of any unidentified sources of contamination encountered during the works, including details of (i) the location, nature and extent of the contamination; (ii) the methods of treatment and/or excavation and off-site disposal carried out; and (iii) verification and validation testing carried out. In the event that any unidentified source of contamination is not encountered, a statement to this effect by a suitably qualified and experienced individual shall be provided.
- ii) Records demonstrating that all soil material transported off-site for treatment and/or disposal have been removed to an appropriately licensed facility in a safe and competent manner and in accordance with relevant Statutory Regulations. Such records to include but not be limited to (i) WAC (or other applicable) testing carried out to classify the material transported off-site and (ii) waste transfer notes counter-signed by the receiving party.
- iii) Calculations to indicate the volume of material removed from the site for treatment or disposal, including for each material the volume, type, date, disposal facility, location of excavation on-site, details of any analyses, and all other pertinent information.

7 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints they are described in the report text.

The opinions and recommendations expressed in this report are based on statute, guidance, and best practice current at the time of its publication. Peter Brett Associates LLP (PBA) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and the report should be returned to us and reassessed if required for re-use after one year from date of publication. Following delivery of the report PBA has no obligation to advise the Client or any other party of such changes or their repercussions.

Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third party data used. Historical maps and aerial photographs provide a “snap shot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the express written authorisation of PBA. Any such party relies upon the report at its own risk.

The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc, unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

8 References

- Atkins (2010) Phase 1: Feasability Study, Dunsbury Hill Farm Development, Document reference: 5095618 Dunsbury Hill Farm Feasibility Report V3.0.docx. Atkins.
- Atkins (2012) Environmental Statement Volume 1, Dunsbury Hill Farm
- BGS (1998) Farnham, England and Wales Sheet 316, Bedrock and Superficial Deposits, 1 to 50 000 scale. British Geological Survey, Keyworth, Notts
- CIEH (2009) The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition). The Chartered Institute of Environmental Health, Nottingham.
- EA (2009) Soil Guideline Value Reports. CLEA website <http://www.environment-agency.gov.uk/research/planning/33714.aspx> Environment Agency, Bristol.
- ESG (2011) Factual Report on Ground Investigation. Dunsbury Hill Farm Development. Report Reference O1143. Environmental Scientific Group, Maidstone, Kent.
- FES, (2000) Factual Report on Ground Investigation. A3/A3(M) Slope Repairs at Nine Locations, Ground Investigation Sites 1,3,4,8 & 9. Report Reference B00245. Fugro Engineering Services Limited (Former Foundation Exploration Services Limited) Basingstoke.
- MBL (2014) Geotechnical Design Road, Dunsbury Hill Farm (Spine Road) Leigh Park, Hampshire. Report Ref: 17441 - R/PCCDunsbury.9. Mayer Brown Limited, Woking, Surrey.

TABLES

Potential Contaminant		Measured Values			Critical Concentration	Outlier Test		Assessment Values								
		Number of Tests	Minimum	Maximum		Critical Value	Number Exceedng	Lower Value	Exceeding No	Cc	Middle Value	Exceeding No	Cc	Upper Value	Exceeding No	Cc
Arsenic	mg/kg	11	6	26	15	30	0	32 (1a)	0	-	35 (1b)	0	-	640 (1c)	0	-
Cadmium	mg/kg	11	0.2	0.9	0.6	1.4	0	10 (1a)	0	-	117 (1b)	0	-	230 (1c)	0	-
Chromium	mg/kg	11	17	65	50	99	0	300 (1a)	0	-	300 (1b)	0	-	30400 (1c)	0	-
Lead	mg/kg	11	7	21	17	31	0	450 (1a)	0	-	450 (1b)	0	-	750 (1c)	0	-
Mercury	mg/kg	11	<0.1	0.1	0.1	0.1	1	8 (1a)	0	-	15 (1b)	0	-	480 (1c)	0	-
Selenium	mg/kg	11	<0.5	<0.5	-	0.5	0	350 (1a)	0	-	595 (1b)	0	-	13000 (1c)	0	-
Nickel	mg/kg	11	5	48	27	79	0	130 (1a)	0	-	130 (1b)	0	-	1800 (1c)	0	-
TPH	mg/kg	11	<10	<10	-	10	0	500 (3a)	0	-	-	-	-	-	-	-
Total (of 16) PAHs	mg/kg	11	<0.1	<0.1	-	0.1	0	-	-	-	-	-	-	-	-	-

Notes

- (1) Denotes EA Soil Guideline Values for residential with plant uptake (1a) for residential without plant uptake (1b) and for commercial and industrial development (1c)
- (2) Denotes CIEH Generic Assessment Criteria for residential with plant uptake (2a) for residential without plant uptake (2b) and for commercial and industrial development (2c)
- (3) Denotes EA Waste Acceptance Criteria for inert (3a) non-hazardous (3b) and hazardous waste (3c)
- TPH Denotes Total Petroleum Hydrocarbons (Aliphatics & Aromatics >C5-C44)
- PAH Denotes Polynuclear Aromatic Hydrocarbons (US EPA-16)
- X Denotes Critical Concentration (Cc) exceeding assessment value

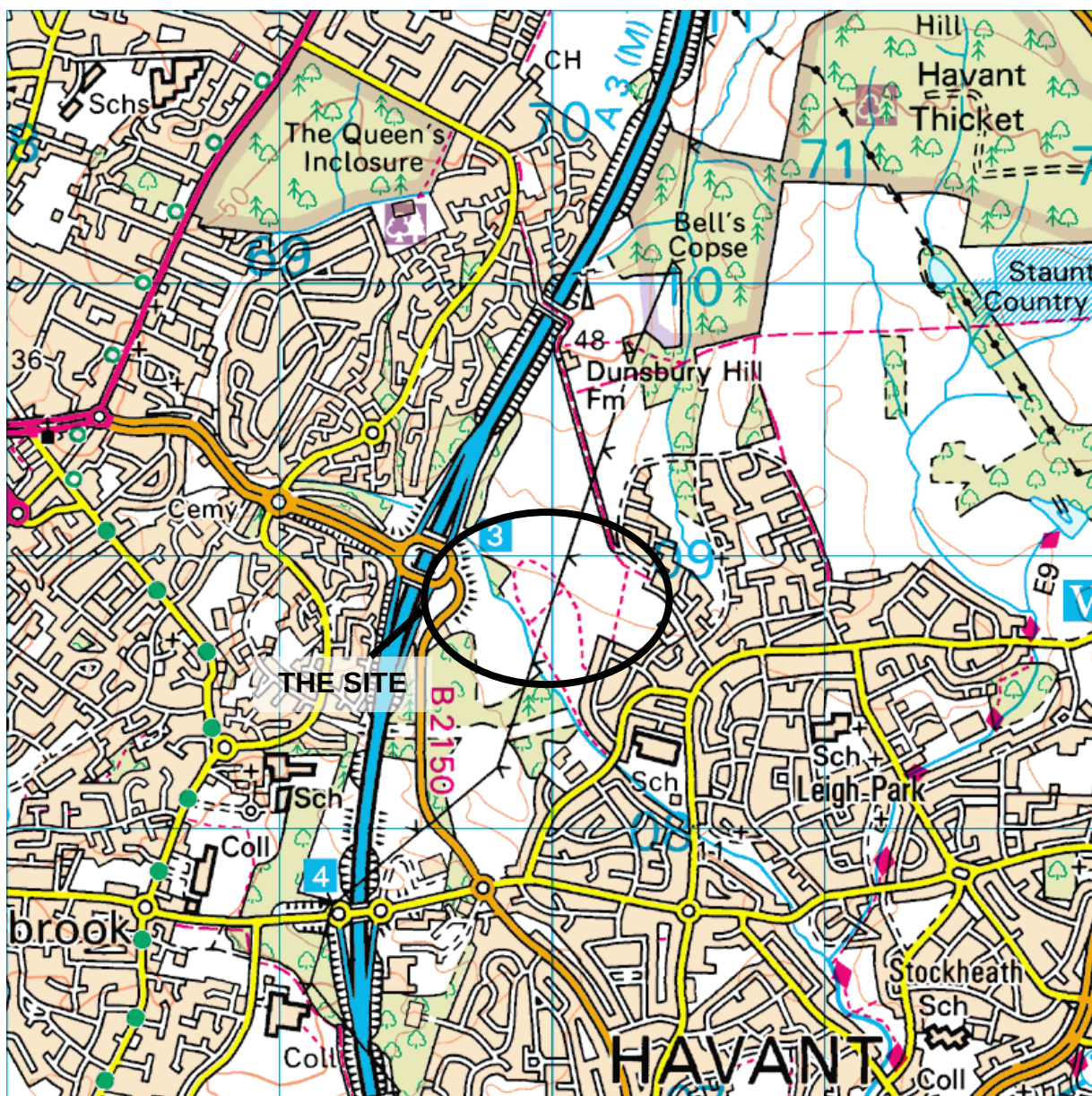
Critical Concentration is the concentration which the actual mean concentration will be below 19 times out of 20

Critical Value is the concentration above which values may be outliers of the data set. Critical Concentrations are determined including values exceeding Outlier Test Values below the Method Detection Limit taken to be equal to the Method Detection Limit

Critical Values and Critical Concentrations have been determined assuming the data forms a normally distributed dataset.

	Client 	SUMMARY OF CHEMICAL ANALYSIS OF SOIL SAMPLES GENERAL INDUSTRIAL CONTAMINANTS [All Samples] CHARLIE RATCHFORD EXTRA-CARE SCHEME, CROGSLAND ROAD, CAMDEN	Date	January 2015
			A4 Scale	nts
			Drawn	az
			Checked	az
			Table	
Caversham Bridge House, Waterman Place, Reading, RG1 8DN Tel 0118 950 0761 Fax 0118 959 7499				

FIGURES



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National Grid Reference SU 699 089

Coordinates N50:52:34 W1:00:28

Nearest Post Code PO9 4EQ



Caversham Bridge House, Waterman Place, Reading, RG1 8DN
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Client

**PORTSMOUTH
CITY COUNCIL**

SITE LOCATION PLAN

**DUNSBURY HILL FARM, PARK
LANE, COWPLAIN,
WATERLOOVILLE**

Date Feb 2015

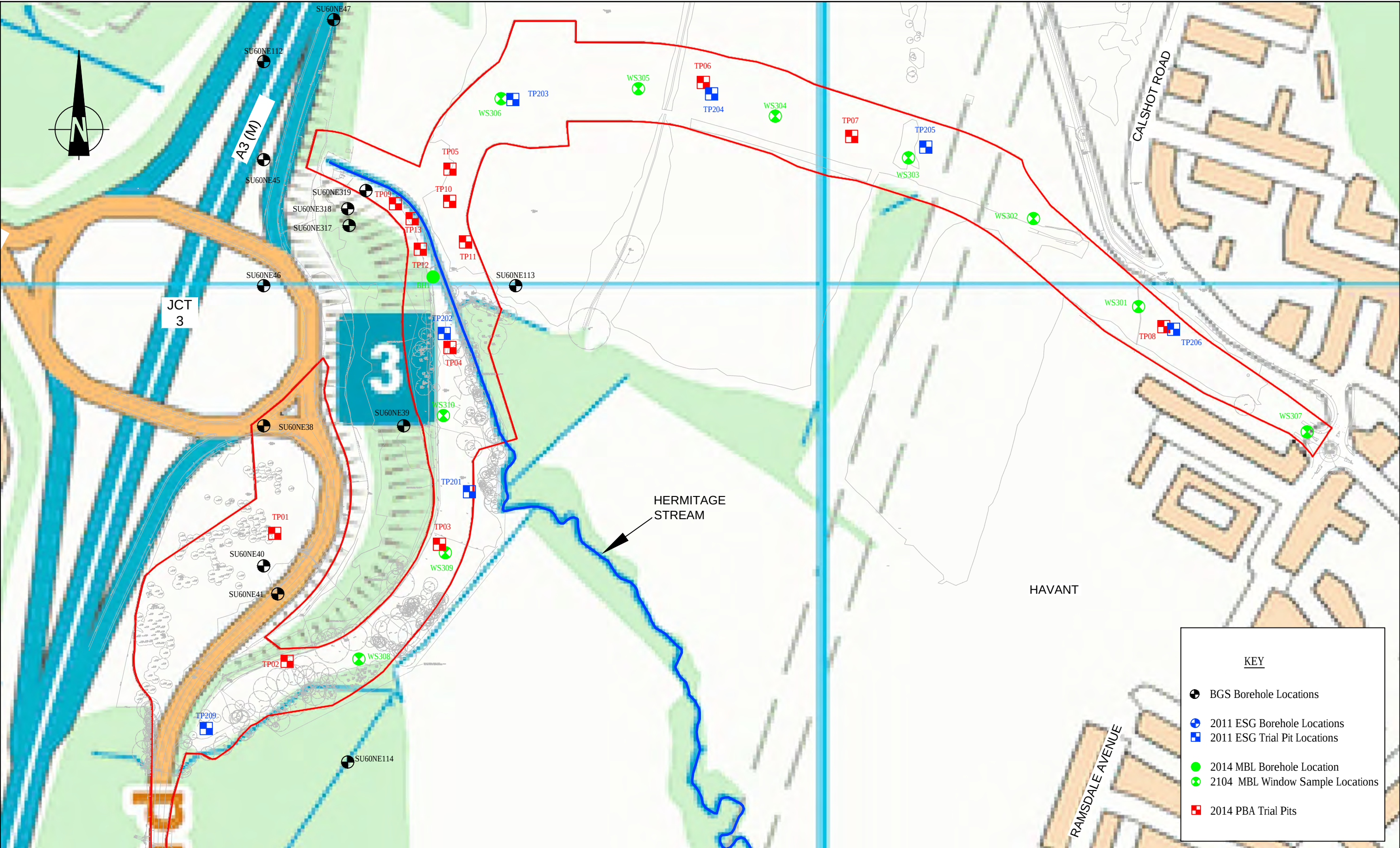
A4 Scale 1:25 000

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Figure

1



KEY	
	BGS Borehole Locations
	2011 ESG Borehole Locations
	2011 ESG Trial Pit Locations
	2014 MBL Borehole Location
	2014 MBL Window Sample Locations
	2014 PBA Trial Pits

Date	27.01.2015
A3 Scale	1:2500
Drawn by	davco
Checked by	AZ
Figure Number	2

APPENDIX 1

1 Introduction

A Tier 2 Risk Assessment is a quantitative assessment using published (generic) criteria to “screen” the site-specific contamination testing data and identify potential hazards to specific receptors.

The aim of this document is to present an explanation for the selection of the assessment criteria routinely used by PBA when undertaking a Tier 2 risk assessment. This document is divided into general introductory text and sections on soils, waters and soil gases. This document should be read in conjunction with another entitled “PBA Methodology for Assessment of Land Contamination” which summarises the legislative regime and our approach to ground contamination and risk assessment.

2 General Notes

Any deviation from the routine criteria and/or selection of criteria for parameters not covered in this document will be described in the report text. The report will also comment on the appropriateness of the routine criteria for project objectives or ground conditions.

Any PBA interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any tables included in this document are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

SGV/GAC provide an aid to decision-making, but they do not replace the need for sound professional judgement in risk assessment (EA, 2006b).

3 Criteria for Assessing Soil Results

3.1 Potential Harm to Human Health

Defra has yet to produce a comprehensive list of assessment criteria that on its own, would be sufficient to enable the assessment of the potential risks posed by soil contaminants (to human health). A number of industry-driven initiatives have developed to generate contaminated land assessment criteria. This has led to the publication of a series of non-statutory non-Governmental contaminated land assessment criteria. It should be noted that the published DEFRA guidance is also non-statutory.

The criteria routinely used by PBA as Tier 2 soil screening values for the protection of human

health are the Governmental Soil Guidance Values (SGVs) and various non-Governmental Generic Assessment Criteria (GAC), these criteria are presented in Table 1.

Both the Governmental and non Governmental sets of criteria have been generated using the Contaminated Land Exposure Assessment model (CLEA) and supporting technical guidance (EA, 2009a, 2009b, 2009c).

PBA has reviewed these publications and consider that the non-Governmental criteria are authoritative and robust, and therefore we will refer to such criteria until such time that DEFRA derive and publish Governmental SGVs to replace the non Governmental GACs.

It is important to note that because the GACs are not published by the UK Government, they may be subject to challenge by a regulatory body or their representative. If the use of the GACs is challenged, it may be necessary to carry out modelling to generate site-specific assessment criteria.

Soil Guideline Values (SGVs) - Governmental

The first series of SGVs were generated using a probabilistic version of the CLEA model. However, on 22 July 2008 DEFRA announced the withdrawal of these SGVs and revised SGVs were calculated for all substances except lead using a deterministic version of the CLEA model (v1.05). These SGVs have not been withdrawn but it should be noted that they were developed using assumptions for body weight and inhalation rates that have been revised since publication.

The CLEA model calculates a tolerable daily soil intake (TDSI) for a specified chemical using a set of ten exposure pathways (Ingestion (outdoor soil, indoor dust, homegrown vegetables and soil attached to homegrown vegetables), Dermal Contact (outdoor soil and indoor dust) and Inhalation (outdoor dust, indoor dust, outdoor vapours and indoor vapours)). There are exposure pathways not included in the CLEA model such as the permeation of organics into plastic water supply pipes.

The presence and/or significance of each of the potential exposure pathways is dependant on the land use being considered. The model uses standard land use scenarios as follows:-

Residential – habitation of a dwelling up to two storeys high with various default material and design parameters, access to either private or nearby community open space with soil track back to form indoor dust. Assumes ingestion of homegrown produce.

Allotments – the model has default parameters for use and consumption of vegetables but not animals or their products (eggs).

Industrial/commercial – assumes office or light

physical work in a permanent three storey structure with breaks taken outside and that the site is NOT covered in hardstanding

Generic Assessment Criteria (GAC) - Non Governmental

. The SGVs for BTEX compounds and phenol assume that the 'host' soil has 6% organic matter.

UK soils often have organic matter concentrations below 6% and that it may therefore not be conservative to use the published SGVs when assessing the potential risks from these chemicals as organic matter acts to immobilise organic contaminants. The on-line Contaminated Land Strategies Digest (CLSD) formed a consortium of ten practitioners (including representatives from local authorities), to prepare generic assessment criteria for a number of contaminants at more conservative organic matter contents of 1% and 3% for the same end uses. The consortium also reproduced the SGVs and PBA independently verified the results published using CLEA v1.06 (v1.05 was replaced to allow password protection to be re-established). These criteria will be used by PBA where appropriate.

In addition the CLSD consortium derived GACs for selected substances for an additional end use, that being residential without plant uptake (CLSD, 2009).

In July 2009, GAC for 82 substances were published by the Chartered Institute of Environmental Health (CIEH) (LQM and CIEH, 2009) using the then current version of the CLEA software v1.04. These GAC replace those generated in 2006 using the original version of the model CLEA UK *beta*.

In January 2010, GAC for 35 substances were published by the Environmental Industries Commission (EIC), Association of Geotechnical and Geoenvironmental Specialists (AGS) and Contaminated Land: Applications in Real Environments (CL:AIRE), (CL:AIRE, 2010) using the then current version of the CLEA software v1.05. These substances are more rarely found to be contaminants of concern during contaminated land investigations and hence are not routinely tested for. The CL:AIRE GAC are not reproduced in Table 1 but may be utilised as required.

Note on Appropriate Use of SGV/GAC The SGVs and GACs are based on numerous and complex assumptions. The appropriateness of these assumptions in a site-specific context requires confirmation on a project by project basis.

In general, SGVs/GACs have been developed using highly conservative assumptions and exceedance does not indicate that a site is statutorily contaminated and/or necessarily unsuitable for use in the planning context. Recent guidance (Defra 2012) provided new clarity on the assessment of risk where soil concentrations

exceed the SGV. The guidance introduces a four stage classification system where Category 1 sites are obviously contaminated and Category 4 sites uncontaminated as defined by EPA 1990. Outside of these categories further specific risk assessment is required to determine if the site should fall into Category 2 contaminated or category 3 uncontaminated. Category 4 screening values are considered to be more pragmatic than the current published SGV/GAC criteria but still strongly precautionary with the aim of allowing rapid identification of sites where the risk is above minimal but still low/acceptable (within the context of Part 2A).

At the end of 2013 technical guidance in support of Defra's revised Statutory Guidance (SG) was published (CL:AIRE 2013) which provided:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space (POS); and
- A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

Following issue of an Erratum in December 2014 a Policy Companion Document was published (Defra 2014B).

A letter from Lord de Mauley dated 3rd September 2014 provides more explicit direction to local authorities on the use of the C4SL in a planning context. The letter identifies four key points:

- 1) that the screening values were developed expressly with the planning regime in mind
- 2) their use is recommended in DCLG's planning guidance
- 3) soil concentrations below a C4SL limit are considered to be 'definitely not contaminated' under Part IIA of the 1990 Environmental Protection Act and pose at most a 'low level of toxicological concern' and
- 4) exceedance of a C4SL screening value does not mean that land is definitely contaminated, just that further investigation may be warranted.

Table 6 summarises the C4SL (DEFRA 2014B) for each of the six substances. PBA will use the criteria for lead and may use the other criterion, depending on site specific conditions.

Note on Mercury, Chromium and Arsenic Assessment The analytical testing routinely undertaken by PBA determines total concentration, however, the toxicity depends on the form of the contaminant (species).

If a source of Mercury, Chromium or Arsenic is identified or the total concentration exceeds the relevant worst case speciated criteria it will be desirable/necessary to undertake additional speciated testing and further assessment.

Note on Asbestos

Asbestos in soil and made ground is currently under review by a number of bodies. There are no current published guidance values for asbestos in soil other than the waste classification values given in the EA's Technical Guidance WM2, Hazardous Waste – Interpretation of the definition and classification of hazard waste (3d Edition, 2013). This guidance is only appropriate for soils that are being discarded as waste.

Testing for asbestos will be carried out on selected samples of made ground encountered during investigation, initially samples will be subjected to an asbestos screen and, if asbestos is found to be present, subjected to quantification. The reader is directed to the report text for guidance on the approach adopted in respect to any asbestos found to be present. Further guidance is also available in the 2014 CIRIA publication C733, Asbestos in soil and made ground: a guide to understanding and managing risks..

3.2 Potential Harm to the Built Environment

Land contamination can pose risks to buildings, building materials and services (BBM&S) in a number of ways. Volatile contaminants and gases can accumulate and cause explosion or fire. Foundations and buried services can be damaged by corrosive substances and contaminants such as steel slags can create unstable ground conditions through expansion causing structural damage. PBA use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm the built environment.

- i) Approved Document C - Site Preparation and Resistance to Contaminants and Moisture. (DCLG 2010);
- ii) Concrete in aggressive ground SD1 (BRE 2005);
- iii) Guidance for the selection of water supply pipes to be used in brownfield sites (UKWIR 2011);
- iv) Protocols published by agreement between Water UK and the Home Builders Federation providing supplementary guidance which includes the Risk Assessment for Water Pipes (the 'RA') (Water UK 2014).
- v) Performance of Building Materials in Contaminated Land report BR255 (BRE 1994).
- vi) Risks of Contaminated Land to Buildings, Building Materials and Services. A Literature Review - Technical Report P331 (EA 2000).
- vii) Guidance on assessing and managing risks to buildings from land contamination - Technical

Report P5 035/TR/01 (EA 2001).

3.3 Potential to Harm Ecosystems, Animals, Crops etc

The criteria routinely used by PBA as Tier 2 screening values to assess the potential of soil chemistry to harm ecosystems are taken from the following guidance and summarised in are given in Table 2.

- i) Ecological Risk Assessment (ERA) Science Report Series SC070009, published by the Environment Agency, Bristol (EA, 2008);
- ii) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing (ICRCL 70/90, 1990); and
- iii) Code of Practice for Agricultural Use of Sewage Sludge 2nd Edition (DOE, 2006).
- iv) BS 3882:2007 Specification for topsoil and requirements for use. Unless stated in the report the assessment is solely for phytotoxic parameters and additional assessment is required to determine suitability as a growing medium.

4 Criteria for Assessing Liquid Results

4.1 Potential Harm to Human Health

The criteria routinely used by PBA as Tier 2 water screening values (Table 3) are taken from the Water Supply (Water Quality) Regulations (Defra 2010). It should be noted that some of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of iron and manganese are controlled because they may taint potable water with an undesirable taste, odour or colour or may potentially deposit precipitates in water supply pipes.

4.2 Potential to Harm Controlled Waters

Controlled Waters are rivers, estuaries, coastal waters, lakes and groundwaters. . Water in the unsaturated zone is not groundwater but does come within the scope of the term "ground waters" as used and defined in the Water Resources Act 1991. It will continue to be a technical decision for the Environment Agency to determine what is groundwater in certain circumstances for the purposes of the Regulations. The approach adopted by PBA considers the objectives of the Water Framework Directive (WFD) and the Groundwater Daughter Directive (GWDD) (refer to PBA Methodology).

When assessing ground condition data the aim is to identify whether there could be an environmentally significant input to groundwater. An environmentally insignificant input into groundwater would be one that could not have any

effect on (i) any of the receptors noted in the Water Framework/GWDD definition of pollution (ii) the chemical status of a groundwater body; or (iii) could give rise to a significant and sustained rising trend in the concentrations of pollutants in groundwater as noted in those directives. PBA uses the approach presented in Groundwater Protection Policy and Practice (GP3) (EA 2013). The criteria routinely used by PBA as Tier 2 screening values (Tables 3, 4 and 5) are taken from directions to the Environment Agency (EA 2010). Reference is also made to Directive 2013/39/EU (12 August 2013) amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy. While the Directive has yet to be transposed, it is intended that the standards it sets will apply for the purposes of the second cycle of river basin plans.

The 2014 Water Framework Directive implementation in England and Wales: new and updated standards to protect the water environment - Directions to the Environment Agency relating to the Groundwater Directive (Directive 2006/118/EC) informs interested parties of the new and updated environmental standards to be used in the second cycle of Water Framework Directive (2000/60/EC) river basin management planning process in England and Wales. It also presents new and updated assessment criteria for biological elements that must be monitored to assess the ecological status of surface water bodies. This document does not cover any standards and biological assessment criteria that are unchanged for second cycle. The document should be read alongside the draft updated Ministerial Guidance to the Environment Agency and Natural Resources Wales on River Basin Management Planning which refers to the standards in Chapter 9. The relevant Directions to the Environment Agency and Natural Resources Wales (referred to hereafter as the Agencies) will be updated to give legal effect to the standards (currently not updated).

5 Criteria for Assessing Gas Results

PBA use the following primary guidance on gas monitoring methods and strategy, the assessment of risk posed by soil gases (including Volatile Organic Compounds (VOCs)) and mitigation measures/risk reduction during site development.

- i) BS 8576:2013 – Guidance on Ground Gas Investigations: Permanent gases and Volatile Organic Compounds (VOCs). (BSI 2013)
- ii) A pragmatic approach to Ground Gas Risk Assessment. CL:AIRE Research Bulletin

RB17 (Card 2012)

- iii) The VOCs Handbook. C682 (CIRIA 2009).
- iv) Assessing risks posed by hazardous gases to buildings C665 (CIRIA 2007);
- v) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC 2007); and
- vi) Code of practice for the characterization and remediation from ground gas in affected developments BS 8485 (BSI 2007)

Gas and borehole flow data are used to obtain the gas screening value (GSV) for methane and carbon dioxide. The GSV is used to establish the characteristic situation and to make recommendations for gas protection measures for buildings if required.

Radon

PBA use the following primary guidance to assess the significance of the radon content of soil gas.

- i) Radon: guidance on protective measures for new dwellings. Report BR211 (BRE, 2007); and
- ii) Radon Atlas of England, R290 (NRPB, 1996).

6 References

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Rationale for Selection of Criteria for Tier 2 (Generic) Land Contamination Assessment

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- CL:AIRE (2013) SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report published by Contaminated Land: Applications in Real Environments (CL:AIRE) 20th December 2013
- CLAN2-05 Contaminated land advice note 02 from September 2005. Department for the Environment, Food and Rural Affairs, London.
- CLSD (2009) Contaminated-Land-Strategies Digest - 30 Apr 2009 to 1 May 2009 - Special issue (#2009-89). Posting titled: "JISCMail GACs for SGV substances: April 2009 and subsequent postings".
- DCLG (2013) Approved Document C - Site preparation and resistance to contaminants and moisture (2004 Edition incorporating 2010 and 2013 amendments).
- Defra (2010) The Water Supply (Water Quality) Regulations, 2010. Statutory Instrument 2010 No 944, Department of the Environment, Transport and the Regions, London.
- Defra (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance.
- Defra (2014) Water Framework Directive implementation in England and Wales: new and updated standards to protect the water environment
- Defra (2014B) SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document. Department for Environment, Food and Rural Affairs December 2014
- DoE (2006) Code of Practice for Agricultural Use of Sewage Sludge. Department of the Environment, London.
- EA (2004) Guidance on Assessment of Risks from Landfill Sites. Environment Agency, Bristol.
- EA (2006b) CLEA update No. 4. Environment Agency, Bristol.
- EA (2008) Ecological Risk Assessment (ERA). Science Report Series SC070009, Environment Agency, Bristol.
- EA (2009a) Using Soil Guideline Values. Science Report SC050021/SGV Introduction. Environment Agency, Bristol.
- EA (2009b) Updated Technical Background to the CLEA model. Science Report SC050021/SR3 Introduction. Environment Agency, Bristol.
- EA (2009c) Human health toxicological assessment of contaminants in soil. Science Report SC050021/SR2. Environment Agency, Bristol.
- EA (2009d) Compilation data for priority organic contaminants for derivation of soil guideline values Science Report SC50021/SR7
- EA (2009e) CLEA Software (Version 1.05) Handbook Science Report SC050021/SR4
- EA (2010) River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) England and Wales) Directions 2010.
- EA (2013) Groundwater Protection Policy and Practice (GP3) August 2013 Version 1.1
- ICRCL (1990) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 70/90. Interdepartmental Committee on the Redevelopment of Contaminated Land, London.
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- LQM & CIEH (2009) The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition). Land Quality Press, Nottingham. ISBN 0-9547474-7-X.
- NRPB (1996) Radon Atlas of England. R290, National Radiological Protection Board, Didcot, Oxfordshire.
- NHBC (2007) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. National House Building Council.
- UKWIR (2011) Guidance for the selection of Water Pipes to be used in Brownfield Sites.
- Water UK 2014 Contaminated Land Assessment Guidance

Rationale for Generic Assessment Criteria Routinely Used by PBA

Table 1: Tier 2 Criteria for the Assessment of Potential Contaminant Concentrations in Soil – Protection of Human Health

Determinand	Allotments	Residential with plant uptake	Residential without plant uptake	Commercial/ Industrial
Metals/Metalloids				
Arsenic (Inorganic)	43 ^a	32 ^a	35 ^f	640 ^a
Beryllium	55 ^c	51 ^c	-	420 ^c
Boron	45 ^c	291 ^c	-	192,000 ^c
Cadmium	1.8 ^a	10 ^a	117 ^f	230 ^a
Chromium (trivalent)	34,600 ^c	3000 ^c	-	30,400 ^c
Chromium (hexavalent)	2.1 ^c	4.3 ^c	-	35 ^c
Copper	524 ^c	2330 ^c	-	71,700 ^c
Lead*	30	82	130	1100
Mercury (elemental)	1 ^a	26 ^a	-	26 ^a
Mercury (inorganic)	80 ^a	170 ^a	235 ^f	3600 ^a
Methyl Mercury	8 ^a	11 ^a	-	410 ^a
Nickel	230 ^a	130 ^a	130 ^f	1800 ^a
Selenium	120 ^a	350 ^a	595 ^f	13000 ^a
Vanadium	18 ^c	75 ^c	-	3160 ^c
Zinc	618 ^c	3750 ^c	-	665,000 ^c
BTEX Compounds (1%, 3% and 6% SOM)^d				
Benzene	0.02 ^f / 0.04 ^f / 0.07 ^a	0.08 ^f / 0.18 ^f / 0.33 ^a	0.27 ^f / 0.56 ^f / 1.0 ^f	28 ^f / 57 ^f / 95 ^a
Toluene	22 ^f / 60 ^f / 120 ^a	120 ^f / 320 ^f / 610 ^a	600 ^f / 1500 ^f / 2700 ^f	870 ^f / 2200 ^f / 4400 ^a
Ethylbenzene	16 ^f / 45 ^f / 90 ^a	65 ^f / 180 ^f / 350 ^a	165 ^f / 450 ^f / 840 ^f	520 ^f / 1400 ^f / 2800 ^a
Xylenes #	28 ^f / 80 ^f / 160 ^a	42 ^f / 120 ^f / 230 ^a	53 ^f / 145 ^f / 285 ^f	475 ^f / 1300 ^f / 2600 ^a
Polycyclic Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)^d				
Acenaphthene	34 ^c / 85 ^c / 200 ^c	210 ^c / 480 ^c / 1000 ^c	-	85000 ^c / 98000 ^c / 100000 ^c
Acenaphthylene	28 ^c / 69 ^c / 160 ^c	170 ^c / 400 ^c / 850 ^c	-	84000 ^c / 97000 ^c / 100000 ^c
Anthracene	380 ^c / 950 ^c / 2200 ^c	2300 ^c / 4900 ^c / 9200 ^c	-	530000 ^c / 540000 ^c / 540000 ^c
Benzo(a)anthracene	2.5 ^c / 5.5 ^c / 10 ^c	3.1 ^c / 4.7 ^c / 5.9 ^c	-	90 ^c / 95 ^c / 97 ^c
Benzo(a)pyrene	0.60 ^c / 1.2 ^c / 2.1 ^c	0.83 ^c / 0.94 ^c / 1.0 ^c	-	14 ^c / 14 ^c / 14 ^c
benzo(b)fluoranthene	3.5 ^c / 7.4 ^c / 13 ^c	5.6 ^c / 6.5 ^c / 7.0 ^c	-	100 ^c / 100 ^c / 100 ^c
benzo(g,h,i)perylene	70 ^c / 120 ^c / 160 ^c	44 ^c / 46 ^c / 47 ^c	-	650 ^c / 660 ^c / 660 ^c
benzo(k)fluoranthene	6.8 ^c / 14 ^c / 23 ^c	8.5 ^c / 9.6 ^c / 10 ^c	-	140 ^c / 140 ^c / 140 ^c
Chrysene	2.6 ^c / 5.8 ^c / 12 ^c	6.0 ^c / 8.0 ^c / 9.3 ^c	-	140 ^c / 140 ^c / 140 ^c
Dibenzo(a,h)anthracene	0.76 ^c / 1.5 ^c / 2.3 ^c	0.76 ^c / 0.86 ^c / 0.90 ^c	-	13 ^c / 13 ^c / 13 ^c
Fluoranthene	52 ^c / 130 ^c / 290 ^c	260 ^c / 460 ^c / 670 ^c	-	23000 ^c / 23000 ^c / 23000 ^c
Fluorene	27 ^c / 67 ^c / 160 ^c	160 ^c / 380 ^c / 780 ^c	-	64000 ^c / 69000 ^c / 71000 ^c
Indeno(1,2,3-cd)pyrene	1.8 ^c / 3.8 ^c / 7.1 ^c	3.2 ^c / 3.9 ^c / 4.2 ^c	-	60 ^c / 61 ^c / 61 ^c
Naphthalene	4.1 ^c / 9.9 ^c / 23 ^c	1.5 ^c / 3.7 ^c / 8.7 ^c	-	200 ^c / 480 ^c / 1100 ^c
Phenanthrene	16 ^c / 38 ^c / 90 ^c	92 ^c / 200 ^c / 380 ^c	-	22000 ^c / 22000 ^c / 23000 ^c
Pyrene	110 ^c / 270 ^c / 620 ^c	560 ^c / 1000 ^c / 1600 ^c	-	54000 ^c / 54000 ^c / 54000 ^c
Aliphatic/Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)^d				
TPH Aliphatic >C5-6	740 ^c / 1700 ^c / 3900 ^c	30 ^c / 55 ^c / 110 ^c	-	3400 ^c / 6200 ^c / 13000 ^c
TPH Aliphatic >C6-8	2300 ^c / 5600 ^c / 13000 ^c	73 ^c / 160 ^c / 370 ^c	-	8300 ^c / 18000 ^c / 42000 ^c
TPH Aliphatic >C8-10	320 ^c / 770 ^c / 1700 ^c	19 ^c / 46 ^c / 110 ^c	-	2100 ^c / 5100 ^c / 12000 ^c
TPH Aliphatic >C10-12	2200 ^c / 4400 ^c / 7300 ^c	93 ^c / 230 ^c / 540 ^c	-	10000 ^c / 24000 ^c / 49000 ^c
TPH Aliphatic >C12-16	11000 ^c / 13000 ^c / 13000 ^c	740 ^c / 1700 ^c / 3000 ^c	-	61000 ^c / 83000 ^c / 91000 ^c

Rationale for Generic Assessment Criteria Routinely Used by PBA

Determinand	Allotments	Residential with plant uptake	Residential without plant uptake	Commercial/ Industrial
TPH Aliphatic >C16-35	260000 ^c / 270000 ^c / 270000 ^c	45000 ^c / 64000 ^c / 76000 ^c	-	1600000 ^c / 1800000 ^c / 1800000 ^c
TPH Aliphatic >C35-44	260000 ^c / 270000 ^c / 270000 ^c	45000 ^c / 64000 ^c / 76000 ^c	-	1600000 ^c / 1800000 ^c / 1800000 ^c
TPH Aromatic >C5-7 (benzene)	13 ^c / 27 ^c / 57 ^c	65 ^c / 130 ^c / 280 ^c	-	28000 ^c / 49000 ^c / 90000 ^c
TPH Aromatic >C7-8 (toluene)	22 ^c / 51 ^c / 120 ^c	120 ^c / 270 ^c / 611 ^c	-	59000 ^c / 110000 ^c / 190000 ^c
TPH Aromatic >C8-10	8.6 ^c / 21 ^c / 51 ^c	27 ^c / 65 ^c / 151 ^c	-	3700 ^c / 8600 ^c / 18000 ^c
TPH Aromatic >C10-12	13 ^c / 31 ^c / 74 ^c	69 ^c / 160 ^c / 346 ^c	-	17000 ^c / 29000 ^c / 34500 ^c
TPH Aromatic >C12-16	23 ^c / 57 ^c / 130 ^c	140 ^c / 310 ^c / 593 ^c	-	36000 ^c / 37000 ^c / 37800 ^c
TPH Aromatic >C16-21	46 ^c / 110 ^c / 260 ^c	250 ^c / 480 ^c / 770 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aromatic >C21-35	370 ^c / 820 ^c / 1600 ^c	890 ^c / 1100 ^c / 1230 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aromatic >C35-44	370 ^c / 820 ^c / 1600 ^c	890 ^c / 1100 ^c / 1230 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aliphatic + Aromatic >C44-70	1200 ^c / 2100 ^c / 3000 ^c	1200 ^c / 1300 ^c / 1300 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
Chlorinated Hydrocarbons (1%, 2.5% and 6% SOM)^d				
1,2-dichloroethane	0.0046 ^c / 0.0083 ^c / 0.016 ^c	0.0054 ^c / 0.0080 ^c / 0.014 ^c	-	0.71 ^c / 1.0 ^c / 1.8 ^c
1,1,1 Trichloroethane (TCA)	48 ^c / 110 ^c / 240 ^c	6.2 ^c / 13 ^c / 28 ^c	-	700 ^c / 1400 ^c / 3100 ^c
1,1,1,2 Tetrachloroethane	0.79 ^c / 1.9 ^c / 4.4 ^c	0.90 ^c / 2.1 ^c / 4.8 ^c	-	120 ^c / 260 ^c / 590 ^c
1,1,2,2 Tetrachloroethane	0.41 ^c / 0.89 ^c / 2.0 ^c	1.4 ^c / 2.9 ^c / 6.3 ^c	-	290 ^c / 580 ^c / 1200 ^c
Tetrachloroethene (PCE)	1.6 ^c / 3.7 ^c / 8.7 ^c	0.94 ^c / 2.1 ^c / 4.8 ^c	-	130 ^c / 290 / 660 ^c
Tetrachloromethane	0.16 ^c / 0.37 ^c / 0.85 ^c	0.018 ^c / 0.039 ^c / 0.089 ^c	-	3.0 ^c / 6.6 / 15 ^c
Trichloroethene (TCE)	0.43 ^c / 0.95 ^c / 2.2 ^c	0.11 ^c / 0.22 ^c / 0.49 ^c	-	12 ^c / 25 ^c / 55 ^c
Trichloromethane/Chloroform	0.36 ^c / 0.70 ^c / 1.5 ^c	0.75 ^c / 1.3 ^c / 2.7 ^c	-	110 ^c / 190 ^c / 370 ^c
Vinyl Chloride/Chloroethene	0.00055 ^c / 0.0010 ^c / 0.0018 ^c	0.00047 ^c / 0.00064 ^c / 0.00099 ^c	-	0.063 ^c / 0.081 ^c / 0.12 ^c
Pesticides and Other Organic Compounds (1%, 2.5% and 6% SOM)^d				
Aldrin	1.3 ^c / 2.6 ^c / 4.0 ^c	1.7 ^c / 2.0 ^c / 2.1 ^c	-	54 ^c / 54 ^c / 54 ^c
Atrazine	0.037 ^c / 0.085 ^c / 0.2 ^c	0.24 ^c / 0.56 ^c / 1.3 ^c	-	870 ^c / 880 ^c / 880 ^c
Dichlorvos	0.044 ^c / 0.091 ^c / 0.20 ^c	0.29 ^c / 0.6 ^c / 1.3 ^c	-	842 ^c / 872 ^c / 893 ^c
Dieldrin	0.13 ^c / 0.32 ^c / 0.73 ^c	0.69 ^c / 1.4 ^c / 2.2 ^c	-	90 ^c / 91 ^c / 92 ^c
Endosulfan	0.47 ^c / 1.2 ^c / 2.7 ^c	2.9 ^c / 7.0 ^c / 16 ^c	-	2310 ^c / 2990 ^c / 3390 ^c
Carbon Disulphide	4.8 ^c / 10 ^c / 23 ^c	0.10 ^c / 0.20 ^c / 0.44 ^c	-	12 ^c / 23 ^c / 50 ^c
Chlorobenzene	5.9 ^c / 14 ^c / 32 ^c	0.33 ^c / 0.73 ^c / 1.7 ^c	-	59 ^c / 130 ^c / 310 ^c
Hexachloro-1,3-butadiene	0.25 ^c / 0.61 ^c / 1.4 ^c	0.21 ^c / 0.51 ^c / 1.2 ^c	-	32 ^c / 69 ^c / 120 ^c
Hexachlorobenzene	0.18 ^c / 0.42 ^c / 0.92 ^c	0.59 ^c / 1.0 ^c / 1.4 ^c	-	48 ^c / 53 ^c / 55 ^c
Pentachlorobenzene	1.2 ^c / 3.1 ^c / 7.1 ^c	5.2 ^c / 10 ^c / 17 ^c	-	650 ^c / 770 ^c / 830 ^c
Pentachlorophenol	0.084 ^c / 0.21 ^c / 0.49 ^c	0.55 ^c / 1.3 ^c / 2.96 ^c	-	1200 ^c / 1300 ^c / 1400 ^c
Phenol (1, 3, 6% SOM)	66 ^f / 158 ^f / 280 ^a	184 ^f / 316 ^f / 420 ^a	310 ^f / 441 ^f / 519 ^f	3200 ^a
Dioxins, Furans and dioxin-like PCBs ^e	0.008 ^a	0.008 ^a		0.24 ^a

Units mg/kg

* C4SL

most conservative of the three isomers selected for each scenario

a Soil Guideline Value (2009) with SOM of 6%

b Soil Guideline Value (2002)

c Generic Assessment Criteria (LQM & CIEH 2009)

d Where three values are presented, SGV/GAC for soils with SOM of 1%, 2.5% and 6% or 1%, 3% and 6% are given as detailed in the table. SOM denotes Soil Organic Matter.

e Refer to Table 2 of the supporting guidance for suite

f Generic Assessment Criteria generated using CLEA v 1.04 by an independent contaminated land working group and independently verified by PBA (CLSD, 2009)

Table 2 Tier 2 Criteria for the Assessment of Potential Contaminant Concentrations in Soil – Protection of Ecological Systems

Parameter	ICRCL 70/90 ^a		Proposed SSVs ^b	Code of Practice for Agricultural Use of Sewage Sludge ^c	BS 3882:2007 Specification for topsoil and requirements for use
	Maximum				
	Livestock mg/kg	Crop Growth mg/kg			
Benzo(a)pyrene			0.15		
Arsenic	500	1000		50	
Cadmium	30	50	1.15	3	
Chromium			21.1	400	
Copper	500	250	88.4	80/ 100/ 135/ 200 ^e	<100/<135/<200 ^f
Fluoride	1000			500	
Lead	1000		167.9	300	
Mercury			0.06	1	
Molybdenum				4	
Nickel			25.1	50/ 60/ 75/ 110 ^e	<60/<75/<110 ^f
Pentachlorobenzene			0.029		
Pentachlorophenol			0.6		
Selenium				3	
Tetrachloroethene			0.01		
Toluene			0.3		
Zinc	3000	1000	90.1	200/200/200/300 ^e	<200/<200/<300 ^f

Notes

- Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.
- Proposed Soil Screening Values (SSVs) – Consultation, Environment Agency 2008. Threshold which if exceeded prompts further assessment.
- Maximum permissible concentration of potentially toxic elements from the Code of Practice for Agricultural Use of Sewage Sludge. Second Edition. DOE 2006.
- Concentrations are for contamination derived from mine spoil. In other situations the speciation may be more available. Factors include total concentration, speciation, particle size, pH, species of plant, type of animal/grazing habit.
- Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0
- Where three values are presented, concentrations are for soils with pH values <6.0/ 6.0-7.0/ >7.0

Rationale for Generic Assessment Criteria Routinely Used by PBA

Table 3: Tier 2 Criteria for Screening Selected Contaminants in Groundwater

Parameter	Protection of Human Health	Protection of Controlled Waters			
	Water Supply (Water Quality) Regulations 2000	Test 2 Minimum	Test 2 Maximum	Test 4	Test 5
Metal/Semi Metal:					
Antimony (µg/l)	5				
Arsenic (µg/l)	10	51.6	199	7.5	
Boron (µg/l)	1000			750	
Cadmium (µg/l)	5	0.2	1.1	3.75	
Chromium (µg/l)	50	5	27.6	37.5	
Copper (µg/l)	2000	10.1	57.8	1500	
Iron (µg/l)	200				
Lead (µg/l)	25 (10 from 25/12/13)	7.3	39.8	18.8	
Manganese (µg/l)	50				
Mercury (µg/l)	1			0.75	
Nickel (µg/l)	20	20.2	116	15	
Selenium (µg/l)	10				
Zinc (µg/l)	-	75.8	414	3750	
Other:					
Ammonium NH ₄ (mg/l)	0.5				
Ammonia NH ₃ (mg/l)	-	0.3	1.73	0.29	0.29
Chloride (mg/l)	250			188	187.5
Cyanide (ug/l)	50				
Electrical Conductivity (µS/cm)	2500			1880	
pH (pH units)	6.5 to 10				
Nitrate NO ₃ (mg/l)	50			42	42
Sulphate (mg/l)	250			188	188
Organics:					
Anthracene		0.1	0.55		
Benzene (µg/l)	1	10.1	55.2	0.75	0.75
Benzo(a)pyrene (µg/l)	0.01			0.075	
Chloroform (µg/l)	100 a	2.53	13.8	75	75
1,2-Dichloroethane (µg/l)	3			2.25	2.25
Fluoranthene		0.1	0.6		
Naphthalene (µg/l)	-	2.4	13.2		
Phenol Total (mg/l)	0.5	15.2	82.8		
PAHs (µg/l)	0.1 b				
Pesticides (ug/l)	0.03c				
Toluene (µg/l)	-	50.5	276		
Trichloroethene TCE (µg/l)	10 d	10.1	55.2	7.5	7.5
Tetrachloroethene PCE (µg/l)	10 d	10.1	57.8	7.5	7.5
Tetrachloromethane (ug/l)	3				
Vinyl Chloride (µg/l)	0.5				
Xylene (µg/l)	-	30.3	166		

Notes

- TV Threshold Values for each groundwater body are given in the River Basin Management Plans (RBMP)
- Test 2 Groundwater Impacts on Surface Water – Minimum is the lowest TV for any RBMP
- Test 4 Groundwater Drinking Water Protected Areas – designed to be equivalent to a 95% standard
- Test 5 General Quality of Groundwater Body – designed to be equivalent to a 95% standard
- Sum for Tri-halomethanes – chloroform, bromoform, dibromochloromethane, bromodichloromethane
 - Concentration for sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene
 - Sum for Aldrin, Dieldrin, Heptachlor and Heptachlor epoxide
 - Sum of TCE and PCE

Table 4a : Specific Pollutants – Currently Inforce

Pollutant	Rivers and Freshwater Lakes	Transitional and Coastal Waters
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.3 (1.3)*	0.3 (1.3)*
2,4-Dichlorophenol	20	20
Ammonia (Un-ionised) as Nitrogen	Not applicable	21
Arsenic #	50	25
Chlorine (total available)	2 (5)*	(10)*
Chromium VI	3.4	0.6 (32)*
Chromium III	4.7	(32)*
Copper – standard is hardness dependant for freshwater	1/ 6 /10/ 28	5
Cyanide	1 (5)*	1 (5)*
Cypermethrin as ng/l	0.1 (0.4)*	0.1 (0.4)*
Diazinon	0.01 (0.02)*	0.01 (0.1)*
Dimethoate	0.48 (4)*	0.48 (4)*
Iron as mg/l	1	1
Linuron	0.5 (0.9)*	0.5 (0.9)*
Mecoprop	18 (187)*	18 (187)*
Permethrin	(0.01)	(0.01)
Phenol	7.7 (46)*	7.7 (46)*
Toluene	50 (380)*	40 (370)*
Zinc – standard is hardness dependant for freshwater	8/ 50/ 75/ 125	40

- All units ug/l unless otherwise stated.
- The standard is the annual mean standard over a period of 12 consecutive months unless otherwise stated.
- Values in brackets () indicates the 95-percentile standard where the standard is exceeded if the measured concentration is above the standard for 5% or more of the time.
- Values marked * indicate that the standard is not to be used for the purpose of classifying the ecological status or potential of bodies of surface water.
- # indicates that the standard is the dissolved fraction obtained by filtration through a 0.45um filter.
- Where four values are presented, concentrations are for soils with CaCO₃ concentration <50/50-100/100-250/>250 mg/l

Reproduced from Part 4 of The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Direction 2010.

Table 4b Proposed Standards for 29 specific pollutants

Substances	CONCENTRATION ug/l				Standard Status (Existing-E/ Revised-R/ New-N)
	Fresh water		Salt water		
	Long-term (Mean)	Short- term (95 %ile)	Long-ter m (95 %ile)	Short- term (95 %ile)	
Unionised ammonia	---	---	21	---	E
Arsenic	50	---	25	---	E
Benzyl butyl phthalate	7.5	51	0.75	10	N
Carbendazim	0.15	0.7	---	---	N
Chlorothalonil	0.035	1.2	---	---	N
Chromium(III)	4.7	32	---	---	E
Chromium(VI)	3.4	---	0.6	32	E
Chlorine	2	5	---	10	E
Copper	1µg/l bioavailable		3.76 µg/l dissolved, where DOC ≤1mg/l 3.76 + (2.677 x ((DOC/2) – 0.5)) µg/l		R
Cyanide	1	5	1	5	E
Cypermethrin ¹	0.1	0.4	0.1	0.4	E
Diazinon	0.01	0.02	0.01	0.26	R/E
2,4- dichlorophenol	4.2	140	0.42	6	R
2,4- dichlorophenoxyacetic acid (2,4-D)	0.3	1.3	0.3	1.3	E
3,4- dichloroaniline	0.2	5.4	0.2	5.4	N
Dimethoate	0.48	4.0	0.48	4.0	E
Glyphosate	196	398	196	398	N
Iron	1	---	1	---	E
Linuron	0.5	0.9	0.5	0.9	E
Manganese	123µg/l bioavailable	---	---	---	N
Mecoprop	18	187	18	187	E
Methiocarb	0.01	0.77	---	---	N
Pendimethalin	0.3	0.58	---	---	N
Permethrin	0.001	0.01	0.0002	0.001	R
Phenol	7.7	46	7.7	46	E
Tetrachloroethane	140	1848	---	---	N
Triclosan	0.1	0.28	0.1	0.28	N
Toluene	74	380	74	370	R/E
Zinc	10.9 bioavailable plus Ambient Background Concentration		6.8 dissolved plus Ambient Background Concentration		R

¹ Note that cypermethrin becomes a Priority Substance under 2013/39/EU but there will be a transitional period before the PS standards apply.

Rationale for Generic Assessment Criteria Routinely Used by PBA

Table 5: Surface Waters - Priority Substances – Standards for Chemical Status

Pollutant	Annual Average		Maximum Allowable Concentration	
	Inland	Other	Inland	Other
Alachlor	0.3	0.3	0.7	0.7
Anthracene	1.0 (0.1)	1.0 (0.1)	0.1	0.1
Atrazine	0.6	0.6	2.0	2.0
Benzene	10	8	50	50
Brominated diphenylether	0.0005 (NA)	0.0005 (NA)	0.14	0.014
Cadmium (and its compounds) # – hardness dependant	<0.08/ 0.08/ 0.09/ 0.15/ 0.25	0.2	<0.45/ 0.45/ 0.6/ 0.9 / 1.5	<0.45/ 0.45/ 0.6/ 0.9/ 1.5
Carbon tetrachloride	12	12	NA	NA
C10-13 Chloroalkanes	0.4	0.4	1.4	1.4
Chlorfenvinphos	0.1	0.1	0.3	0.3
Chlorpyrifos	0.03	0.03	0.1	0.1
Aldrin, Dieldrin, Endrin, Isodrin (Sum)	0.01	0.005	NA	NA
DDT Total	0.025	0.25	NA	NA
Para-para-DDT	0.01	0.01	NA	NA
1,2-Dichloroethane	10	10	NA	NA
Dichloromethane	20	20	NA	NA
Di(2-ethylhexyl)-phthalate (DEHP)	1.3	1.3	NA	NA
Diuron	0.2	0.2	1.8	1.8
Endosulfan	0.005	0.0005	0.01	0.004
Fluoranthene	0.1 (0.0063)	0.1 (0.0063)	0.12	0.12
Hexachlorobenzene	0.01 (NA)	0.01 (NA)	0.05	0.05
Hexachlorobutadiene	0.1 (NA)	0.1 (NA)	0.6	0.6
Hexachlorocyclohexane	0.02	0.002	0.04	0.02
Isoproturon	0.3	0.3	1	1
Lead (and its compounds) #	7.2 (1.2)	7.2 (1.3)	14	14
Mercury (and its compounds) #	0.05 (NA)	0.05 (NA)	0.07	0.07
Naphthalene	2.4 (2.0)	1.2 (2.0)	130	130
Nickel (and its compounds) #	20 (4)	20 (8.6)	34	34
Nonylphenol	0.3	0.3	2	2
Octylphenol	0.1	0.01	NA	NA
Pentachlorobenzene	0.007	0.0007	NA	NA
Pentachlorophenol	0.4	0.4	1	1
Benzo(a)pyrene (v)	0.05 (0.00017)	0.05 (0.00017)	0.27	0.027
Benzo(b)fluoranthene (v)	0.03 (NA)	0.03 (NA)	NA	NA
Benzo(k)fluoranthene (v)	0.03 (NA)	0.03 (NA)	0.017	0.017
Benzo(ghi)perylene (v)	0.002 (NA)	0.002 (NA)	0.017	0.017
Indeno(1,2,3-cd)pyrene (v)	0.002 (NA)	0.002 (NA)	0.017	0.017
Simazine	1	1	4	4
Tetrachloroethylene	10	10	NA	NA
Trichloroethylene	10	10	NA	NA
Tributyl tin compounds	0.0002	0.0002	0.0015	0.0015
Trichlorobenzenes	0.4	0.4	NA	NA
Trichloromethane	2.5	2.5	NA	NA
Tifluralin	0.03	0.03	NA	NA
Dicofol	0.0013	0.000032	NA	NA
PFOS (9.1)	0.00065	0.00013	36	7.2
Quinoxifen	0.15	0.015	2.7	0.54
Dioxins and like compounds			NA	NA

Rationale for Generic Assessment Criteria Routinely Used by PBA

Pollutant	Annual Average		Maximum Allowable Concentration	
	Inland	Other	Inland	Other
Aclonifen	0.12	0.012	0.12	0.012
Bifenox	0.012	0.0012	0.04	0.004
Cybutryne	0.0025	0.0025	0.016	0.016
Cypermethrin	0.00008	0.000008	0.0006	0.00006
Dichlorvos	0.0006	0.00006	0.0007	0.00007
HBCDD	0.0016	0.0008	0.5	0.05
Heptachlor and heptachlor epoxide	2×10^{-7}	1×10^{-8}	3×10^{-4}	3×10^{-5}
Terbutryn	0.065	0.0065	0.34	0.034

- Units ug/l
- The EQS are expressed as total concentrations in the whole water sample except for #.
- # indicates that the EQS is dissolved concentration obtained by filtration through 0.45um filter.
- Inland = surface waters encompassing rivers and lakes and related artificial or heavily modified water bodies.
- Hardness Classifications; Where five values are presented, concentrations are for soils with CaCO₃ concentration <40/ 40-50/ 50-100/ 100-200/>200 mg/l
- For the group of priority substances of polycyclic aromatic hydrocarbons (PAHs) benzo(a)pyrene can be considered a marker for the other PAHs and therefore only this substance need be monitored

New or revised substance in Directive 2013/39/EU BUT currently without revised Direction – the additions and revisions are considered as proposed. The proposed revised concentration is presented in brackets

Reproduced from Part 5 of The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Direction 2010 and Directive 2013/39/EU

Table 6: Category 4 Screening Levels (C4SL) – Table taken from SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (Department for Environment, Food and Rural Affairs December 2014)

	Residential (with home-grown produce)	Residential (without home-grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37	40	49	640	79	170
Benzene	0.87	3.3	0.18	98	140	230
Benzo(a)pyrene	5.0	5.3	5.7	77	10	21
Cadmium	22	150	3.9	410	220	880
Chromium VI	21	21	170	49	21	250
Lead	200	310	80	2300	630	1300

All in mg/kg

Public Open Space 1 – for grassed area adjacent to residential housing

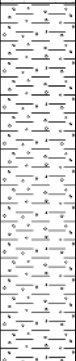
Public Open Space 2 - Park Type Public Open Space Scenario

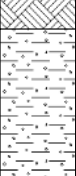
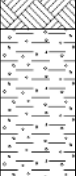
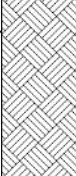
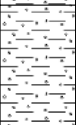
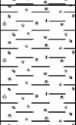
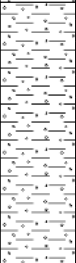
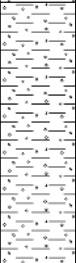
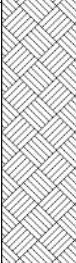
APPENDIX 2

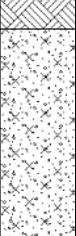
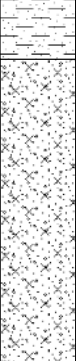
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Client Portsmouth City Council				Start Date 18/12/2014				End Date 18/12/2014		TP01
Contractor Peter Brett Associates				Ground Level 30.50m OD						
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469608 E 108824 N		Logged By: CW		Sheet 1 of 1		
						Checked By: AZ		Scale 1:25		
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation/Backfill	
	Depth	Type	Results							
1	0.50	ES1			(0.10)	30.40		TOPSOIL: Dark brown slightly gravelly slightly sand CLAY. Gravel is fine to medium angular to subangular of flint. MADE GROUND: Very stiff red brown gravelly slightly sandy CLAY. Sand is fine to medium grained. Gravel is fine to coarse angular to subrounded of chalk, bricks and flint. Fragments of Chalk up to 200mm diameter.		
					0.10					
					(1.60)					
	1.00	ES2			1.70	28.80		MADE GROUND: Grey slightly sandy slightly clayey GRAVEL. Gravel is fine to coarse angular to subangular of chalk, brick and flint. Very stiff dark grey mottled orange brown CLAY. [LONDON CLAY FORMATION]		
					(0.20)					
2				1.90	28.60					
				(0.50)						
3				2.40	28.10		End of Trial Pit at 2.40m			
4										
5										
General Remarks Groundwater not encountered. Trial pit was backfilled with compacted arisings.						Water Strike: Standing: Flow:		Stability: Stable Pit Dimensions 2.00 m 0.60 m 		

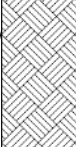
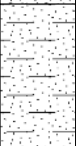
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Client Portsmouth City Council				Start Date 18/12/2014				End Date 18/12/2014		TP02
Contractor Peter Brett Associates				Ground Level 21.50m OD						
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469617 E 108732 N		Logged By: CW		Sheet 1 of 1		
						Checked By: AZ		Scale 1:25		
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrum entation /Backfill	
	Depth	Type	Results							
1	0.50	ES1		▼		(0.10) 0.10 (1.90)	21.40	TOPSOIL: Dark brown slightly sandy CLAY with rootlets. Sand is fine to coarse. Stiff orange brown mottled grey CLAY. [LONDON CLAY FORMATION]		
								<i>from 0.6m becoming very stiff</i>		
2	1.00	ES2		▼				<i>from 0.9m becoming brown mottled grey</i>		
2						2.00	19.50	End of Trial Pit at 2.00m		
3										
4										
5										
General Remarks Slow groundwater inflow at 0.10m and 0.80m depth.Trial pit was backfilled with compacted arisings.							Water Strike: 0.10 m Standing: Flow:		Stability: Stable Pit Dimensions 0.60 m 2.00 m	

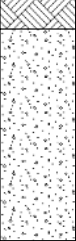
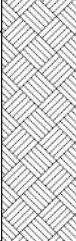
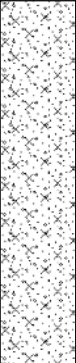
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Client Portsmouth City Council				Start Date 18/12/2014				End Date 18/12/2014		TP03
Contractor Peter Brett Associates				Ground Level 19.00m OD						
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469725 E 108816 N		Logged By: CW		Sheet 1 of 1		
						Checked By: AZ		Scale 1:25		
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation/Backfill	
	Depth	Type	Results							
1	0.50	ES1				(0.10) 0.10 (1.90)	18.90	TOPSOIL: Dark brown slightly sandy CLAY. Sand is fine to medium. Stiff orange brown mottled grey CLAY. [LONDON CLAY FORMATION]		
	1.00	ES2								
2						2.00	17.00	from 1.1m becoming orange mottled grey		
3										
4										
5										
General Remarks Slow groundwater inflow at 0.10m and 1.90m depth. Trial pit was backfilled with compacted arisings.							Water Strike: 1.90 m Standing: Flow:		Stability: Stable Pit Dimensions 0.60 m 2.00 m	

Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502				TRIAL PIT		
Client Portsmouth City Council				Start Date 18/12/2014				End Date 18/12/2014		TP04
Contractor Peter Brett Associates				Ground Level 18.50m OD						
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469733 E 108956 N		Logged By: CW		Sheet 1 of 1		
						Checked By: AZ		Scale 1:25		
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation/Backfill	
	Depth	Type	Results							
1	0.50	ES1			(0.20)	18.30	TOPSOIL: Dark brown slightly sandy CLAY with occasional rootlets.			
					0.20 (1.20)		Stiff dark brown mottled grey gravelly CLAY. Gravel is fine to coarse angular to subrounded of flint. [HEAD DEPOSITS]			
	1.00	ES2			1.40 (0.30)	17.10	Stiff grey mottled orange brown CLAY. [LONDON CLAY FORMATION]			
					1.70 (0.30)	16.80	Stiff grey mottled black CLAY. [LONDON CLAY FORMATION]			
2					2.00	16.50	End of Trial Pit at 2.00m			
3										
4										
5										
General Remarks Slow groundwater inflow at 0.20m and medium inflow 1.85m depth. Trial pit was backfilled with compacted arisings.							Water Strike: 1.85 m Standing: Flow:		Stability: Stable Pit Dimensions 0.60 m 	

Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502				TRIAL PIT		
Client Portsmouth City Council				Start Date 17/12/2014				End Date 17/12/2014		TP05
Contractor Peter Brett Associates				Ground Level 21.50m OD						
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469732 E 109084 N		Logged By: CW		Sheet 1 of 1		
						Checked By: AZ		Scale 1:25		
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation/Backfill	
	Depth	Type	Results							
1	0.50	ES1				(0.10)	21.40	TOPSOIL: Brown slightly gravelly silty CLAY. Gravel is fine to coarse angular to subrounded of flints. Very stiff orange brown mottled grey slightly gravelly CLAY. Gravel is fine to coarse subangular to rounded of flint. [HEAD DEPOSITS]		
						0.10				
						(0.50)				
2	1.00	ES2				0.60	20.90	Orange brown mottled grey gravelly cobbly CLAY. Gravel is fine to coarse subangular to rounded of flint. Cobbles are rounded of flint. [HEAD DEPOSITS]		
						(0.40)				
						1.00				
3						1.00	20.50	Grey brown slightly gravelly CLAY. Gravel is fine angular of flint. [HEAD DEPOSITS]		
						(1.00)				
						2.00				
4						2.00	19.50	End of Trial Pit at 2.00m		
5										
General Remarks Slow groundwater inflow at 0.10m and fast inflow 1.90m depth. Trial pit was backfilled with compacted arisings.							Water Strike: 0.10 m Standing: Flow:		Stability: Stable Pit Dimensions 2.00 m 0.60 m	

Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502			TRIAL PIT		
Client Portsmouth City Council				Start Date End Date 17/12/2014 17/12/2014			TP06		
Contractor Peter Brett Associates				Ground Level 27.00m OD			Logged By: CW		
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469914 E 109145 N		Checked By: AZ		Sheet 1 of 1 Scale 1:25	
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation/Backfill
	Depth	Type	Results						
1	0.50	ES1			(0.10)	26.90		TOPSOIL: Brown gravelly silty CLAY. Gravel is fine to coarse angular to subrounded of flint. Orange brown mottled grey slightly gravelly silty SAND. Sand is fine to medium. Gravel is fine to medium subangular to rounded of flint. [HEAD DEPOSITS]	
					0.10				
					(0.70)				
1	1.00	ES2			0.80	26.20		Stiff orange brown mottled grey slightly sandy CLAY. Sand is fine to medium. [HEAD DEPOSITS]	
					(0.20)				
					1.00				
					(1.00)				
2					2.00	25.00	End of Trial Pit at 2.00m		
3									
4									
5									
General Remarks Groundwater not encountered. Trial pit was backfilled with compacted arisings.						Water Strike: Standing: Flow:		Stability: Stable Pit Dimensions 2.00 m 0.60 m 	

Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502				TRIAL PIT		
Client Portsmouth City Council				Start Date 17/12/2014				End Date 17/12/2014		TP07
Contractor Peter Brett Associates				Ground Level 27.00m OD						
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 470020 E 109107 N		Logged By: CW		Sheet 1 of 1		
						Checked By: AZ		Scale 1:25		
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation/Backfill	
	Depth	Type	Results							
1	0.50	ES1			(0.10)	26.90	TOPSOIL: Brown slightly gravelly silty CLAY with frequent rootlets. Gravel is fine to coarse angular to subrounded of flint. Orange brown clayey slightly gravelly SAND. Sand is fine. Gravel is fine to medium angular to subrounded of flints. [HEAD DEPOSITS] Orange brown mottled grey slightly clayey SAND. Sand is fine. [BOGNER SAND MEMBER]			
					0.10					
					(0.40)					
	1.00	ES2			0.50	26.50				
(1.00)										
2					1.50	25.50	Orange brown mottled grey SAND. Sand is fine to medium. [BOGNER SAND MEMBER]			
					(0.50)					
2					2.00	25.00	End of Trial Pit at 2.00m			
3										
4										
5										
General Remarks Slow groundwater inflow at 1.90m depth. Trial pit was backfilled with compacted arisings.						Water Strike: 1.90 m Standing: Flow:		Stability: Stable Pit Dimensions 0.60 m 2.00 m		

Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502				TRIAL PIT		
Client Portsmouth City Council				Start Date 17/12/2014				End Date 17/12/2014		TP08
Contractor Peter Brett Associates				Ground Level 26.00m OD						
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 470243 E 108971 N		Logged By: CW		Sheet 1 of 1		
						Checked By: AZ		Scale 1:25		
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill	
	Depth	Type	Results							
1	0.50	ES1				(0.10) 0.10 (0.70)	25.90	TOPSOIL: Dark brown slightly sandy CLAY with frequent rootlets. Brown silty slightly gravelly SAND. Gravel is fine to medium subangular to rounded of flint. Sand is fine. [HEAD DEPOSITS]		
1	1.00	ES2				0.80 (1.20)	25.20	Orange brown slightly silty slightly gravelly SAND. Gravel is fine to medium subangular to rounded of flint. Sand is fine. [HEAD DEPOSITS] <i>from 1.2m becoming orange brown mottled grey</i>		
2						2.00	24.00	End of Trial Pit at 2.00m		
3										
4										
5										
General Remarks Groundwater not encountered.Trial pit was backfilled with compacted arisings.							Water Strike: Standing: Flow:		Stability: Stable Pit Dimensions 0.60 m 2.00 m	

Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502				TRIAL PIT			
Client Portsmouth City Council				Start Date 18/12/2014				End Date 18/12/2014		TP09	
Contractor Peter Brett Associates				Ground Level 19.00m OD				Logged By: CW		Sheet 1 of 1	
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469702 E 109058 N		Checked By: AZ		Scale 1:25			
(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description		Instrumentation / Backfill	
	Depth	Type	Results								
1	0.50	ES1			(0.10)	18.90	TOPSOIL: Dark brown slightly sandy CLAY.				
					0.10		MADE GROUND: Stiff brown and grey gravelly sandy CLAY. Gravel is fine to coarse angular to subrounded of flint and chalk.				
					(0.50)						
2	1.00 1.00	ES2 D3			0.60	18.40	MADE GROUND: Very stiff grey with some mottled pink CLAY with sand inclusions and with occasional decomposed tree routes. Sand is brown fine to medium.				
					(0.60)						
3	2.20	D4			1.20	17.80	MADE GROUND: Very stiff brown and grey very gravelly CLAY. Gravel is fine to coarse subrounded to rounded of flint. Gravel is possible drainage backfill.				
					(1.30)						
4					2.50	16.50	End of Trial Pit at 2.50m				
5											
General Remarks Pit terminated due to collapse and fast groundwater ingress at 2.50m depth. Trial pit was backfilled with compacted arisings.						Water Strike: 2.50 m Standing: Flow:		Stability: Stable Pit Dimensions 2.00 m 0.60 m			

Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502			TRIAL PIT	
Client Portsmouth City Council				Start Date End Date 17/12/2014 17/12/2014			TP10	
Contractor Peter Brett Associates				Ground Level 20.00m OD				
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469734 E 109050 N		Logged By: CW		Sheet 1 of 1
						Checked By: AZ		Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.10) 0.10 (1.50)	19.90	TOPSOIL: Brown silty slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of flint. With frequent rootlets. Very stiff orange brown mottled grey CLAY. [HEAD DEPOSITS]	
	0.50 0.50	D3 ES1		▼					
1	1.00	ES2							
						1.60 (1.20)	18.40	Stiff orange brown slightly sandy gravelly CLAY. Gravel is fine to medium angular to subangular of flint. [HEAD DEPOSITS]	
2									
						2.80 (0.70)	17.20	Orange brown silty SAND. Sand is fine. [BOGNER SAND MEMBER]	
3	3.00	D4							
				▼		3.50 (0.50)	16.50	Grey SAND. Sand is fine to medium. [BOGNER SAND MEMBER]	
						4.00	16.00	----- End of Trial Pit at 4.00m	
4									
5									

General Remarks Slow groundwater inflow at 0.60m and 3.50m depth. Trial pit was backfilled with compacted arisings.		Water Strike: 3.50 m Standing: Flow:	Stability: Stable Pit Dimensions 0.60 m
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Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502			TRIAL PIT	
Client Portsmouth City Council				Start Date End Date 17/12/2014 17/12/2014			TP11	
Contractor Peter Brett Associates				Ground Level 19.50m OD				
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469744 E 109031 N		Logged By: CW		Sheet 1 of 1
						Checked By: AZ		Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
1	0.50	D3				(0.10)	19.40	TOPSOIL: Brown slightly gravelly silty CLAY. Gravel is fine to medium angular to subrounded of flint. Very stiff orange brown mottled grey CLAY. [HEAD DEPOSITS]	
	0.50	ES1				0.10 (1.50)			
2	1.00	ES2					17.90	Stiff orange brown slightly sandy gravelly CLAY. Gravel is fine to coarse angular to subangular of flint. [HEAD DEPOSITS]	
						1.60 (0.80)			
3	2.50	D4				2.40 (0.20)	17.10	Stiff dark grey CLAY. [LONDON CLAY FORMATION/ HEAD DEPOSITS]	
						2.60 (0.90)	16.90	Orange brown silty SAND. Sand is fine and medium. [BOGNER SAND MEMBER]	
						3.50 (0.30)	16.00	Dark grey SAND . Sand is fine. [BOGNER SAND MEMBER]	
						3.80	15.70	End of Trial Pit at 3.80m	
4									
5									

General Remarks Pit terminated at depth. Slow water inflow at 3.50m.		Water Strike: 3.50 m Standing: Flow:	Stability: Stable Pit Dimensions 0.60 m
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Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502			TRIAL PIT	
Client Portsmouth City Council				Start Date End Date 18/12/2014 18/12/2014			TP12	
Contractor Peter Brett Associates				Ground Level 18.50m OD				
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469720 E 109026 N		Logged By: CW		Sheet 1 of 1
						Checked By: AZ		Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
1						(0.10)	18.40	TOPSOIL: Dark brown slightly sandy CLAY.	
						0.10		MADE GROUND: Stiff red brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded of flint and chalk.	
						(0.80)			
2						0.90	17.60	MADE GROUND: Stiff dark grey mottled black slightly sandy CLAY.	
						(0.20)			
						1.10	17.40	MADE GROUND: Stiff brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is fine to medium angular to subangular of chalk flint and fabric.	
						(1.30)			
2.50	D1					2.40	16.10	Stiff brown mottled grey slightly gravelly CLAY. Gravel is fine to medium angular to subangular of flint. [HEAD DEPOSITS]	
						(0.50)			
3						2.90	15.60	End of Trial Pit at 2.90m	
4									
5									

General Remarks Slow groundwater inflow at 0.10m depth. Pit terminated due to collapse and fast groundwater ingress at 2.80m depth. Trial pit was backfilled with compacted arisings.		Water Strike: 0.10 m Standing: Flow:	Stability: Collapse at depth Pit Dimensions 2.00 m 0.60 m
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Project Name Dunsbury Hill Farm, Havant				Project No: 30142/4502			TRIAL PIT	
Client Portsmouth City Council				Start Date End Date 18/12/2014 18/12/2014			TP13	
Contractor Peter Brett Associates				Ground Level 19.00m OD			Logged By: CW Checked By: AZ	
Method/Plant 13 tonne tracked 360 degree excavator				Coordinates 469713 E 109048 N		Sheet 1 of 1 Scale 1:25		

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation/Backfill
	Depth	Type	Results						
						(0.10) 0.10 (0.90)	18.90	TOPSOIL: Brown gravelly CLAY with frequent rootlets. Gravel is fine to coarse angular to subrounded of flint. MADE GROUND: Stiff brown gravelly CLAY. Gravel is fine to coarse angular to subrounded of flint.	
1						1.00 (0.90)	18.00	Stiff grey sandy CLAY. Sand is fine. [HEAD DEPOSITS]	
2						1.90 (1.10)	17.10	Stiff dark grey very gravelly sandy CLAY. Sand is fine. Gravel is fine to coarse angular to subangular of flints. [HEAD DEPOSITS]	
3						3.00	16.00	End of Trial Pit at 3.00m	
4									
5									

General Remarks Fast groundwater inflow at 1.10m, 1.40m and 2.90m depth. Pit terminated due to groundwater ingress and collapse. Trial pit was backfilled with compacted arisings.		Water Strike: 1.10 m Standing: Flow:	Stability: Collapse at depth Pit Dimensions 0.60 m 2.00 m
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APPENDIX 3



Certificate of Analysis

Certificate Number 14-23820

06-Jan-15

Client Peter Brett Associates
Caversham Bridge House
Waterman Place
Reading
Berkshire
RG1 8DN

Our Reference 14-23820

Client Reference 30142

Contract Title DUNSBURY HILL FARM

Description 11 Soil samples.

Date Received 23-Dec-14

Date Started 23-Dec-14

Date Completed 06-Jan-15

Test Procedures Identified by prefix DETSn (details on request), Asbestos Analysis DETSC 1101.

Notes Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read 'Rob Brown'.

Rob Brown
Business Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 14-23820

Client Ref 30142

Contract Title DUNSBURY HILL FARM

Lab No	750116	750117	750118	750119	750120	750121	750122
Sample ID	TP05	TP11	TP08	TP10	TP07	TP06	TP01
Depth	0.50	1.00	0.50	1.00	0.50	1.00	0.50
Other ID							
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	17/12/14	17/12/14	17/12/14	17/12/14	17/12/14	17/12/14	18/12/14
Sampling Time	0830	0940	1030	1140	1200	1240	0800

Test	Method	LOD	Units							
Preparation										
Stones >10mm	DETSC 1003*	1	% m/m	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Moisture Content	DETSC 1004*	0.1	%	23	26	18	24	22	23	28
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg	26	12	5.7	12	5.7	6.3	8.9
Cadmium	DETSC 2301#	0.1	mg/kg	0.8	0.5	0.3	0.6	0.2	0.2	0.6
Chromium	DETSC 2301#	0.15	mg/kg	44	45	17	48	19	26	42
Lead	DETSC 2301#	0.3	mg/kg	21	16	10	15	6.7	7.3	17
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	0.06	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	19	21	5.1	26	6.0	7.5	23
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Petroleum Hydrocarbons										
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg							< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg							< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg							< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg							< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg							< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg							< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg							< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg							< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg							< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg							< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg							< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg							< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg							< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg							< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg							< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg							< 10
TPH Ali/Aro	DETSC 3072*	10	mg/kg							< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10	
Benzene	DETSC 3321#	0.01	mg/kg							< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg							< 0.01
Toluene	DETSC 3321#	0.01	mg/kg							< 0.01
Xylene	DETSC 3321#	0.01	mg/kg							< 0.01
MTBE	DETSC 3321	0.01	mg/kg							< 0.01

Summary of Chemical Analysis

Soil Samples

Our Ref 14-23820

Client Ref 30142

Contract Title DUNSBURY HILL FARM

Lab No	750116	750117	750118	750119	750120	750121	750122
Sample ID	TP05	TP11	TP08	TP10	TP07	TP06	TP01
Depth	0.50	1.00	0.50	1.00	0.50	1.00	0.50
Other ID							
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	17/12/14	17/12/14	17/12/14	17/12/14	17/12/14	17/12/14	18/12/14
Sampling Time	0830	0940	1030	1140	1200	1240	0800

Test	Method	LOD	Units							
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Total PAH - USEPA 16	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Summary of Chemical Analysis

Soil Samples

Our Ref 14-23820

Client Ref 30142

Contract Title DUNSBURY HILL FARM

Lab No	750123	750124	750125	750126
Sample ID	TP02	TP03	TP04	TP09
Depth	1.00	0.50	0.50	0.50
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	18/12/14	18/12/14	18/12/14	18/12/14
Sampling Time	0845	0920	1020	1120

Test	Method	LOD	Units				
Preparation							
Stones >10mm	DETS 1003*	1	% m/m	< 1.0	< 1.0	< 1.0	< 1.0
Moisture Content	DETS 1004*	0.1	%	31	41	23	23
Metals							
Arsenic	DETS 2301#	0.2	mg/kg	11	19	13	11
Cadmium	DETS 2301#	0.1	mg/kg	0.6	0.9	0.6	0.5
Chromium	DETS 2301#	0.15	mg/kg	56	65	49	44
Lead	DETS 2301#	0.3	mg/kg	17	17	17	13
Mercury	DETS 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETS 2301#	1	mg/kg	23	18	30	48
Selenium	DETS 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Petroleum Hydrocarbons							
Aliphatic C5-C6	DETS 3321*	0.01	mg/kg				< 0.01
Aliphatic C6-C8	DETS 3321*	0.01	mg/kg				< 0.01
Aliphatic C8-C10	DETS 3321*	0.01	mg/kg				< 0.01
Aliphatic C10-C12	DETS 3072#	1.5	mg/kg				< 1.5
Aliphatic C12-C16	DETS 3072#	1.2	mg/kg				< 1.2
Aliphatic C16-C21	DETS 3072#	1.5	mg/kg				< 1.5
Aliphatic C21-C35	DETS 3072#	3.4	mg/kg				< 3.4
Aliphatic C5-C35	DETS 3072*	10	mg/kg				< 10
Aromatic C5-C7	DETS 3321*	0.01	mg/kg				< 0.01
Aromatic C7-C8	DETS 3321*	0.01	mg/kg				< 0.01
Aromatic C8-C10	DETS 3321*	0.01	mg/kg				< 0.01
Aromatic C10-C12	DETS 3072#	0.9	mg/kg				< 0.9
Aromatic C12-C16	DETS 3072#	0.5	mg/kg				< 0.5
Aromatic C16-C21	DETS 3072#	0.6	mg/kg				< 0.6
Aromatic C21-C35	DETS 3072#	1.4	mg/kg				< 1.4
Aromatic C5-C35	DETS 3072*	10	mg/kg				< 10
TPH Ali/Aro	DETS 3072*	10	mg/kg				< 10
EPH (C10-C40)	DETS 3311#	10	mg/kg	< 10	< 10	< 10	
Benzene	DETS 3321#	0.01	mg/kg				< 0.01
Ethylbenzene	DETS 3321#	0.01	mg/kg				< 0.01
Toluene	DETS 3321#	0.01	mg/kg				< 0.01
Xylene	DETS 3321#	0.01	mg/kg				< 0.01
MTBE	DETS 3321	0.01	mg/kg				< 0.01

Summary of Chemical Analysis

Soil Samples

Our Ref 14-23820

Client Ref 30142

Contract Title DUNSBURY HILL FARM

Lab No	750123	750124	750125	750126
Sample ID	TP02	TP03	TP04	TP09
Depth	1.00	0.50	0.50	0.50
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	18/12/14	18/12/14	18/12/14	18/12/14
Sampling Time	0845	0920	1020	1120

Test	Method	LOD	Units				
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03
Total PAH - USEPA 16	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10

Summary of Asbestos Analysis

Soil Samples

Our Ref 14-23820

Client Ref 30142

Contract Title DUNSBURY HILL FARM

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
750122	TP01 0.50	SOIL	NAD	none	Jeff Cruddas
750126	TP09 0.50	SOIL	NAD	none	Jeff Cruddas

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 14-23820
 Client Ref 30142
 Contract DUNSBURY HILL FARM

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
750116	TP05 0.50 SOIL	17/12/14	GJ 250ml, GV x2, PT 1L		
750117	TP11 1.00 SOIL	17/12/14	GJ 250ml, GV x2, PT 1L		
750118	TP08 0.50 SOIL	17/12/14	GJ 250ml, GV x2, PT 1L		
750119	TP10 1.00 SOIL	17/12/14	GJ 250ml, GV x2, PT 1L		
750120	TP07 0.50 SOIL	17/12/14	GJ 250ml, GV x2, PT 1L		
750121	TP06 1.00 SOIL	17/12/14	GJ 250ml, GV x2, PT 1L		
750122	TP01 0.50 SOIL	18/12/14	GJ 250ml, GV x2, PT 1L		
750123	TP02 1.00 SOIL	18/12/14	GJ 250ml, GV x2, PT 1L		
750124	TP03 0.50 SOIL	18/12/14	GJ 250ml, GV x2, PT 1L		
750125	TP04 0.50 SOIL	18/12/14	GJ 250ml, GV x2, PT 1L		
750126	TP09 0.50 SOIL	18/12/14	GJ 250ml, GV x2, PT 1L		

Key: G-Glass P-Plastic J-Jar V-Vial T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time and/or inappropriate containers are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
 Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
 The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
 Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months