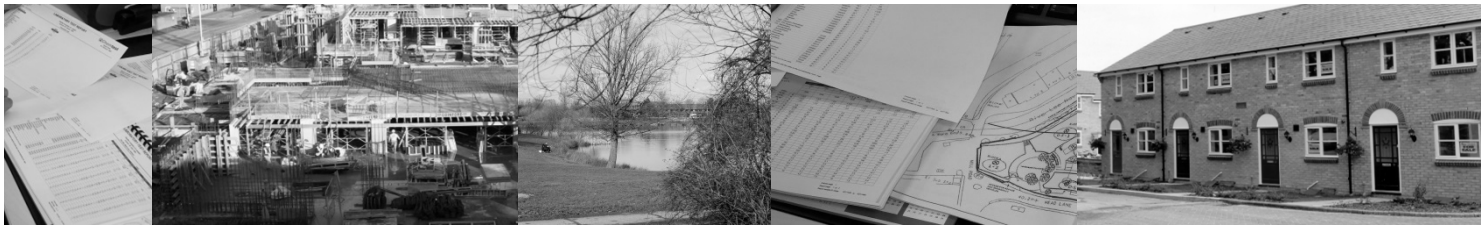

PHASE II GROUND INVESTIGATION & GENERIC RISK ASSESSMENT REPORT
Land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH

Project Reference:
CON219-DUNM-001

Site Address:
Land to the rear of Canada Cottages
Stortford Road
Great Dunmow
CM6 1SH

Report Date:
8 September 2022

Version Number:
Version 1.0

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Stansted Environmental Services Limited has been commissioned by Taylor Gray Holdings Ltd, to undertake a Phase II Ground Investigation and Generic Risk Assessment of the site known as Land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH. The site may be located by National Grid Reference TL 613218.

It is the intention for the existing buildings on the site to be demolished and the construction of four new dwellings.

The report has been prepared to assess contamination in relation to the proposed re-development of the application site and develops the Conceptual Site Model given in the earlier Phase I report.

A desk top study was undertaken by SES Ltd and presented under reference CON219-DUNM-001, Phase I Desk Study and Preliminary Risk Assessment, Land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH, Dated 17 August 2022. The research identified evidence of made ground remains on site which could represent a potential source of contamination as normally containing PAHs, TPHs, asbestos and heavy metals. Considering the amount of made ground observed, the risk posed by them was judged to be low to moderate.

The risk to groundwater was considered to be negligible as the site is underlain by the unproductive cohesive strata of the Lowestoft Formation and the London Clay Formation.

The Intrusive investigation was undertaken by SES on the 24th August 2022 comprising six hand dug trial pits across the site. Suitable samples of both Made Ground and natural ground were taken and subjected to a range of contaminant testing.

A limited thickness of Made Ground was encountered to a maximum depth of 0.40m bgl and was underlain by deposits considered to be representative of the Lowestoft Formation. Groundwater was not encountered during the excavation of the trial pits.

Suitable samples were selected and submitted to a MCerts laboratory for analysis. The results were screened against S4ULs/C4SLs for a 'Residential with Homegrown Produce (RwHP)' end-use. Contamination analysis indicated the presence of speciated PAHs exceeding the respective S4UL in one sample (TP2 at 0.10m bgl, TP04 at 0.10m bgl).

This risk assessment has identified the presence of individual speciated PAHs (Benzo(b)fluoranthene, Dibenzo(ah)anthracene, Benzo(a)pyrene) within the Made Ground at the location TP02 and TP04. Relevant pollutant linkages have been identified, as demonstrated in the updated conceptual model.

Therefore, some limited remediation will be required in the garden area of the proposed development, but this should be limited to a minimum thickness of clean cover. To this end, in areas of proposed private gardens and landscaped areas, at least 491mm thickness of verified clean cover, comprising at least 150mm of organic topsoil, should be provided to break these pathways to future site users.
On completion of the works, a Validation Report will then be required, confirming that the remediation measures outlined above have been completed successfully.

This desktop study was produced to assist in the discharge the Planning Condition 14 (UTT/19/2016/FUL, dated 21st February 2020), relating to land contamination.

1. INTRODUCTION

Stansted Environmental Services Limited (SES) has been commissioned by Taylor Gray Holdings Ltd, the Client, to provide a Phase II Ground Investigation Report for the land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH

The report has been prepared to assess contamination in relation to the proposed re-development of the application site and develops the Conceptual Site Model given in the earlier Phase I report.

It is the intention for the existing buildings on the site to be demolished and the construction of four new dwellings.

The existing and proposed site layouts are included in Appendix A.

1.1 Planning Status

The proposed scheme, covered by Uttlesford District Council Planning Permission UTT/19/2016/FUL (dated 21st February 2020), is for the demolition of buildings, cease the use of the site as a builder's yard and construction of four dwellings.

A plan showing the proposed development is given in Appendix A.

The permission has the following condition attached:

14 *Prior to the commencement of the development, a scheme to deal with land contamination shall be submitted to and approved in writing by the local planning authority.*
The scheme shall include the following steps:

A Phase I site investigation report carried out by a competent person, to include a desk study, site walkover, the production of a site conceptual model and an assessment of risk to receptors including human health, the water environment and building services. The investigation shall be undertaken in accordance with BS 10175: 2011 Investigation of Potentially Contaminated Sites - Code of Practice.

If any contamination is found during the phase 1 investigation, no development shall take place until a detailed remediation scheme to bring the site to a condition suitable for the intended use has been submitted to and approved in writing by the Local Planning Authority. The scheme must include all works to be undertaken, proposed remediation objectives and remediation criteria. The scheme must ensure that the site will not qualify as contaminated land under Part 2A of the Environmental Protection Act 199.

The approved remediation scheme shall thereafter be implemented and within 2 months of the completion of measures identified, a validation report that demonstrates the effectiveness of the remediation carried out must be submitted to and approved in writing by the Local Planning Authority.

If, during development, contamination not previously identified is found to be present at the site then no further development (unless otherwise agreed in writing with the local planning authority) shall be carried out until the developer has submitted, and obtained written approval from the local planning authority for, a remediation strategy detailing how this unsuspected contamination shall be dealt with. The remediation strategy shall be implemented as approved.

REASON: To ensure that the historic/current commercial use of the site does not prejudice the health of future occupants of the dwellings by reason of contamination in accordance with ULP Policy ENV14 of the Uttlesford Local Plan (adopted 2005).

1.2 Project Objectives

The overall objective of the work has been to obtain and provide adequate information on the presence and extent of any potential contamination and should it be confirmed, provide a strategy for progression in support of the proposed development.

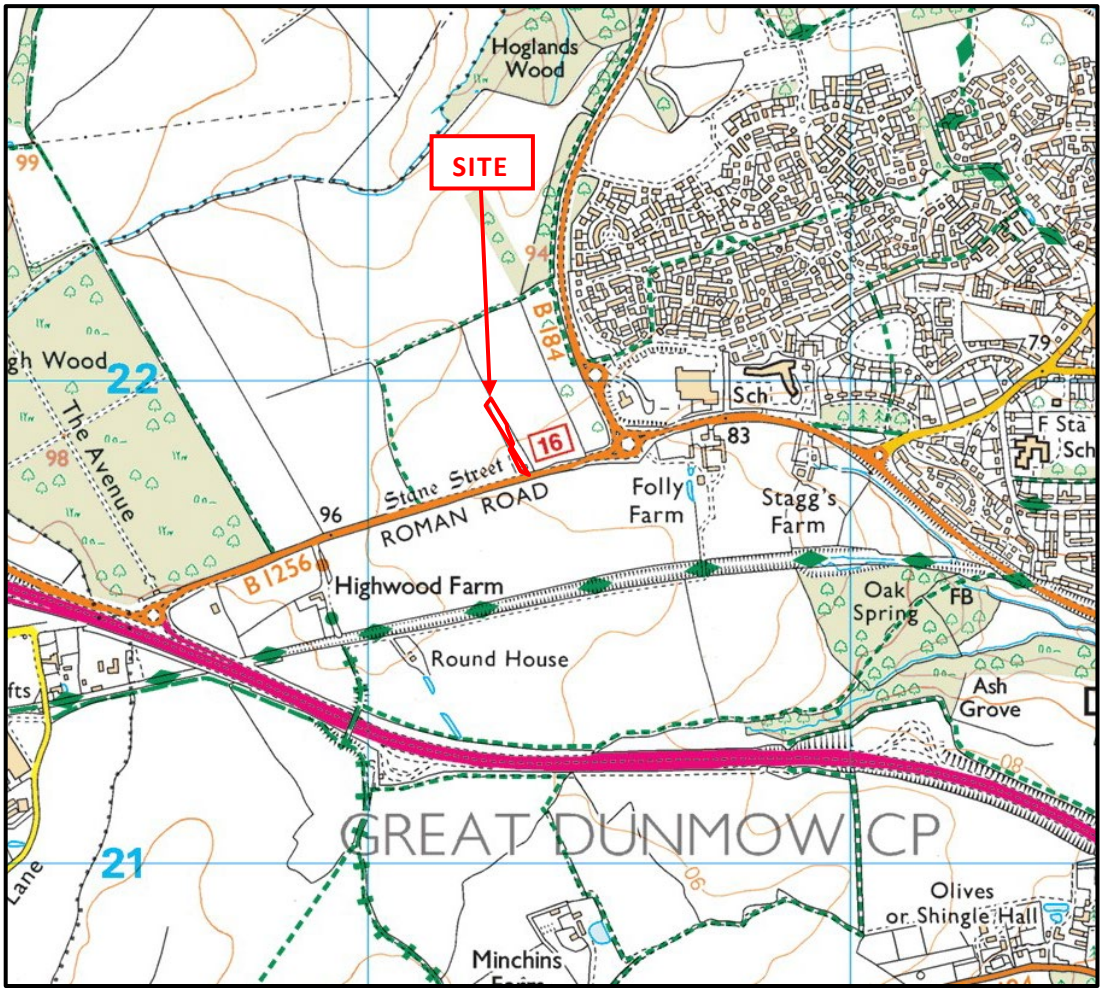
Attention is drawn to the fact that whilst every effort has been made to ensure the accuracy of the data supplied and any analysis derived from it, there is the potential for variations in ground conditions and contamination between and beyond the specific locations investigated. No liability can be accepted for any such variations. Furthermore, any recommendations are specific to the clients' requirements and no liability will be accepted should these be used by third parties without prior consultation with SES.

2. SITE SETTING

2.1 Site Location

The site is located at the land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH. he site location is shown in Figure 1.

FIGURE 1: Site Location Plan



2.2 Site Description

The proposed development site is irregular in shape, covering an area of approximately 0.2 hectares and is roughly level. The site is immediately bounded by the Canada Cottages and Stortford Road to the south, and by a new housing development to the west, the north and the east.

2.3 Geological Setting

Details of the geology underlying the site have been obtained from the British Geological Survey website www.bgs.ac.uk.

The website indicates that the site is underlain by the Lowestoft Formation and, in turn by the London Clay Formation.

The Lowestoft Formation has been identified as a Secondary Undifferentiated Aquifer and the London Clay Formation has been identified as an Unproductive Strata by the Environment Agency. The site in the Total catchment (Zone 3) of the Groundwater Source Protection Zone; presumably due to the White Chalk Subgroup Principal Aquifer at depth.

The nearest water feature is a pond located 343m to the east of the site.

2.4 Proposed Development

It is understood that four residential units are to be constructed.

3. SUMMARY OF PHASE I DESK STUDY

A desk top study was undertaken by SES Ltd and presented under reference CON219-DUNM-001, Phase I Desk Study and Preliminary Risk Assessment, Land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH, Dated 17 August 2022.

At the time of the walkover, the site was no longer used as a builder yard and all the buildings reported in the most up to date map (2021) were not present anymore.
The site was covered by compacted made ground and two containers were present. The original ground level appeared to be stripped to a depth of about 0.30m across most of the site.
Several fragments of concrete, bricks, clinker, ceramic, glass, plastic, rusted metal objects, worn tyres and a butane gas tank were present on the ground surface. One fragment of possible asbestos cement was observed. A sawdust mound was observed.
A relict septic tank was present, as well as electric and water services. Overhead electric cables and posts were present by the western boundary of the site.
Deciduous trees were present on the western side of the access road up to 4m high, and by the northeastern boundary of the site up to 12m high. No public footpaths were evident on or close to the site.

The site appeared to have been undeveloped until the 1981 when four buildings were shown on site. The 1999 map showed the presence of other three small buildings in the northern part of the site. No further development occurred since that time. The surrounding area has only shown limited development since the first edition of the Ordnance Survey; predominantly with residential developments after the WWII around the village of Great Dunmow.

The research has identified potential sources of contamination which may form a pollutant linkage:

TABLE 1: Potential sources of contamination

Location	Source	Contaminant
On site (historical)	Building yard	TPHs, PAHs, heavy metals, asbestos
Off site (current)	Petrol filling station located 246m to the east of the site	TPHs, PAHs

As noted above, there are currently limited active pollutant linkages. However, the Conceptual Site Model considers the pollutant linkages that could become active as a result of residential development at the site.

TABLE 2: Outline Conceptual Site Model

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
On site – current and historical Builders yard	PAHs, PCBs, heavy metals, asbestos	Soil	Direct contact/ingestion	✓	Site users
			Inhalation of volatiles	✓	
			Airborne migration of soil or dust	✓	Off-site users
			Leaching of mobile contaminants	**x**	N/A
		Groundwater	Direct contact/ingestion	**x** **x**	Site users Off-site users
			Inhalation of volatiles	**x** **x**	Site users Off-site users
			Vertical and lateral migration in permeable strata	**x**	N/A

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
Off-site – current Petrol Station **Off-site – historical:** none	TPHs, PAHs	Groundwater	Direct contact/ingestion	**x**	Site users
			Inhalation of volatiles	**x**	Site users
		Service conduits	Direct contact/ingestion	**x**	Site users
			Inhalation of volatiles	**x**	Site users
On and off-site Made Ground / natural strata or bio-degradation of contamination	Carbon dioxide and methane	Ground Gas	Inhalation of ground gas	**x** **x**	Site users Off-site users
			Explosive risks	**x** **x**	Site users Off-site users

The risk to groundwater was considered to be negligible as the site is underlain by the unproductive cohesive strata of the London Clay Formation.

Therefore, pollutant linkages have been identified associated with the site and, therefore, further works were required with respect to contamination.

4. SITE WORK

The site work for the current phase of development was carried out on 24th August 2022 on the basis of the practices set out in BS 10175:2001+A2:2017, BS 5930:2015+A1:2020, ISO 1997:2007.

Six trial pits, designated TP01 to TP06, were excavated by hand at the positions shown on the exploratory hole plan, Appendix A. The depths of the trial pits and the descriptions of strata encountered are given on the exploratory holes records, Appendix B.

The scope designed by SES was intended to obtain contamination parameters of the soil on site.

Representative disturbed samples were taken at the depths shown on the trial pit records and despatched to the laboratory. Samples for environmental purposes were collected in appropriate containers and kept in a cool box prior to dispatch to the laboratory.

5. SUMMARY OF GROUND CONDITIONS

The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from the geological map.

Interpolation of strata depths between locations should be undertaken with caution, particularly for depths of Made Ground where structures are still observed at the time of the investigation.

TABLE 3: Summary of Ground Conditions

Strata Encountered	Depth Encountered (m bgl)		Maximum Measured Strata Thickness (m)
	From	To	
Made Ground	Ground Level	0.05 – 0.40	0.**40**
Lowestoft Formation	0.05 – 0.40	0.50 – 0.70	>0.50

5.1 Made Ground

All the exploratory holes encountered Made Ground to a maximum recorded depth of 0.40m in TP02. The Made Ground generally consisted of greyish brown sightly gravelly slightly sandy clay with rare fragments of bricks, concrete, clinker and ceramic. Sand is fine to coarse.

5.2 Lowestoft Formation

The Lowestoft Formation was encountered in all the trial pits from a depth of 0.05m bgl in TP01 to 0.70m bgl corresponding to the maximum depth dug. The Lowestoft Formation was generally described as very stiff orangish brown slightly gravelly slightly sandy clay. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse chalk, and rare flint.

5.3 Groundwater

No groundwater was encountered during the excavation of the trial pits.

6. LABORATORY ANALYSIS

In order to test the pollutant linkages identified in the Phase I Desktop Study Report, and assess whether the soils beneath the site could pose a significant risk to human and environmental receptors, samples of the Made Ground and underlying natural soils were selected for analysis. The samples were placed in laboratory prepared vessels with a minimum of headspace and labelled accordingly prior to being despatched to accredited analytical laboratory in cool boxes.

The suite of analysis was selected with reference to the findings of the Phase I report as well as onsite observations and included the following determinands:

- A suite of metals comprising AS, B (water soluble), Cd, Cr, CrVI, Cu, Pb, Hg, Ni, Se and Zn;
- Speciated PolyAromatic Hydrocarbons (USEPA 16);
- Total Petroleum Hydrocarbons (CWG speciated analysis);
- Benzene, Toluene, Ethylbenzene, Xylenes (BTEX) and MTBE;
- Total Cyanide;
- Phenols (total monohydric);
- Asbestos (identification only);
- Soil Organic Matter (SOM); and
- pH and Water Soluble Sulphate.

The results for this site are presented in Appendix C.

7. GENERIC RISK ASSESSMENTS

7.1 Results of Soil Analysis

The pH of the tested soils ranged from 8.1 to 8.5 with an average of 8.5. The Soil Organic Matter (SOM) of the samples ranged from 1.2% to 7.5%. Therefore, a SOM of 2.5% has been used in this assessment.

A summary of the metal concentrations recorded in the tested samples is presented in the below table:

TABLE 4: Results of Metals Analysis

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth bgl
Arsenic	6	6.20 – 8.9	TP02 at 0.10m
Water Soluble Boron	6	0.75 – 3.7	TP02 at 0.10m
Cadmium	6	0.12 – 0.26	TP05 and TP06 at 0.10m
Chromium	6	11 – 26	TP02 at 0.10m
Chromium VI	6	All results below Limit of Detection	
Copper	6	12 – 23	TP05 and TP06 at 0.10m
Lead	6	32 – 71	TP04 at 0.10m
Mercury	6	0.05 – 0.11	TP04 at 0.10m
Nickel	6	10 – 22	TP02 at 0.10m
Selenium	6	0.38 – 0.77	TP02 at 0.10m
Zinc	6	49 – 140	TP02 at 0.10m
Cyanide (Total)	2	0.70 – 3.9	TP06 at 0.10m

Concentrations of the sixteen PAH compounds analysed are summarised below:

TABLE 5: Results of PAH Analysis

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth bgl
Naphthalene	6	0.73 – 1.4	TP02 at 0.10m
Acenaphthylene	6	0.16 – 0.53	TP02 at 0.10m
Acenaphthene	6	0.35 – 3.3	TP04 at 0.10m
Fluorene	6	0.22 - 4.2	TP04 at 0.10m
Phenanthrene	6	0.19 – 26	TP04 at 0.10m
Anthracene	6	0.10 – 4.7	TP04 at 0.10m
Fluoranthene	6	0.16 - 31	TP04 at 0.10m
Pyrene	6	0.23 - 27	TP04 at 0.10m
Benzo(a)anthracene	6	0.19 - 10	TP04 at 0.10m
Chrysene	6	0.41 – 9.8	TP04 at 0.10m
Benzo(b)fluoranthene	6	0.54 – 12	TP04 at 0.10m
Benzo(k)fluoranthene	6	0.25 – 4.6	TP04 at 0.10m

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth bgl
Benzo(a)pyrene	6	0.40 – 9.0	TP04 at 0.10m
Indeno(123-cd)pyrene	6	0.73 – 5.0	TP04 at 0.10m
Dibenzo(ah)anthracene	6	0.58 – 1.5	TP04 at 0.10m
Benzo(ghi)perylene	6	0.82 – 4.8	TP04 at 0.10m

Monohydric phenols were recorded in excess of their respective Limits of Detection.

A summary of the recorded petroleum hydrocarbons and BTEX compounds are given in the table below:

TABLE 6: Results of TPH Analysis

Contaminant	Number of Samples Analysed	Range of Measured Concentration (mg/kg)	Location of Maximum Concentration and Depth bgl
TPH aromatic C_{16}-C_{21}	6	3.8	TP02 at 0.10m
TPH aromatic C_{21}-C_{35}	6	31	TP02 at 0.10m
Benzene	6	All results below LoD	
Toluene	6	All results below LoD	
Ethylbenzene	6	All results below LoD	
m/p Xylene	6	All results below LoD	
o Xylene	6	All results below LoD	

No asbestos was identified in any of the samples selected for analysis.

8.3 Generic Human Health Risk Assessment

The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, which was introduced by the Environment Act 1995, as;

'Land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.'

The definition of contaminated land is based on the principles of risk assessment. Risk is defined as a combination of:

- The probability, or frequency of exposure to a substance with the potential to cause harm; and
- The seriousness of the consequence.

The basis of an environmental risk assessment involves identifying a 'source' of contamination, a 'pathway' along which the contamination may migrate and a 'receptor' at risk from the contamination.

Current legislation defines the various elements of the pollution linkage as:

- A contaminant is a substance, which is in or under the ground and which has the potential to cause harm or to cause pollution of controlled waters;
- A pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected; and
- A receptor is either a living organism, an ecological system, a piece of land or property, or controlled water.

A pollutant linkage indicates that all three elements have been identified. The site can only be defined as 'Contaminated Land' if a pollutant linkage exists and the contamination meets the criteria in above.

It is understood that the proposed development will be a mix of dwellings with gardens and residential apartments with areas of soft landscaping.

In order to provide an indication of whether the soils present beneath the study area could pose a risk to human health, SES subjected the aforementioned chemical data to a Generic Risk Assessment (GRA). The initial screen of the chemical data was made against available Suitable 4 Use Levels (S4ULs) developed by LQM/CIEH (2015) and Category 4 Screening Levels (C4SLs) as developed by DEFRA (2014). Exceedances of assessment criteria may require further detailed/semi detailed quantitative risk assessment.

As the development includes private gardens which may be used for the growing of vegetables for consumption, the S4ULs for 'Residential with Homegrown Produce (RwHP)' have been adopted for this assessment. In this instance, the most sensitive receptor is judged to be a 6 year old female child.

The results of chemical analyses have been processed in accordance with recommendations set out in the CIEH and CL:AIRE document 'Guidance on Comparing Soil Contamination Data with a Critical Concentration'. Where the concentrations determined on site are at or below the respective Generic Assessment Criteria (GAC), they are considered not to pose a risk and are removed from further consideration, unless otherwise stated.

Further details of the adopted Generic Assessment Criteria are given in Appendix D.

A comparison of the recorded concentrations of metals with the corresponding S4ULs is presented in the following table:

TABLE 7: Metals Statistics

Contaminant	Key statistics				S4UL* (RwHP)	
	Number of detects	Min. Value (mg/kg)	Max. Value (mg/kg)	Mean Value (mg/kg)	S4UL (mg/kg)	No. Samples exceeding assessment criteria
Arsenic	6	6.2	8.9	7.2	37	0
Water Soluble Boron	6	0.75	3.7	1.81	290	0
Cadmium	6	0.12	0.26	0.21	11	0
Chromium III	6	11	26	16	910	0
Copper	6	12	23	18	2400	0
Lead#	6	32	71	55	200	0
Mercury	6	0.05	0.11	0.07	1.2	0

Nickel	6	10	22	15	180	0
Selenium	6	0.38	0.77	0.51	250	0
Zinc	6	49	140	80	3700	0

Notes to Table

** Most appropriate screening values are Sustainable 4 Use Level (S4UL) for a "Residential with Homegrown Produce" end use, a sandy loam soil type, pH of 7 and a soil organic matter (SOM) of 2.5%.*

 # Category 4 Screening Level (2014) use in absence of suitable S4UL.

As the above table shows, none of the determinands exceed their relevant S4UL/C4SL. Thereby, they are considered to have a negligible potential to pose a risk to human health via the direct contact, ingestion, dust inhalation and plant uptake exposure pathways.

A summary of the PAH compounds recorded by the analysis are included in the following table:

TABLE 8: PAH Statistics

Contaminant	Key statistics				S4UL* (RwHP)	
	Number of detects	Min. Value (mg/kg)	Max. Value (mg/kg)	Mean Value (mg/kg)	S4UL (mg/kg)	No. Samples exceeding assessment criteria
Naphthalene	3	0.73	1.4	1.1	5.6	0
Acenaphthylene	3	0.16	0.53	0.31	420	0
Acenaphthene	3	0.35	3.3	1.5	510	0
Fluorene	3	0.22	4.2	1.7	400	0
Phenanthrene	4	0.19	26	6.9	220	0
Anthracene	4	0.10	4.7	1.5	5400	0
Fluoranthene	6	0.16	31	6.9	560	0
Pyrene	6	0.23	27	6.5	1200	0
Benzo(a)anthracene	5	0.19	10	3.0	11	0
Chrysene	5	0.41	9.8	3.1	22	0
Benzo(b)fluoranthene	4	0.54	12	4.7	3.3	2
Benzo(k)fluoranthene	4	0.25	4.6	1.9	93	0
Benzo(a)pyrene	4	0.40	9.0	3.6	2.7	2
Indeno(123-cd)pyrene	3	0.73	5.0	2.5	36	0
Dibenzo(ah)anthracene	3	0.25	1.5	0.78	0.28	2
Benzo(ghi)perylene	3	0.82	4.8	2.5	340	0

Notes to Table

** Most appropriate screening values are Sustainable 4 Use Level (S4UL) for a "Residential with Homegrown Produce" end use, a sandy loam soil type, pH of 7 and a soil organic matter (SOM) of 2.5%.*

As the above table demonstrates, a number of individual PAH exceeded their relevant S4UL. These exceeded in the samples TP02 and TP04 taken both at 0.10m bgl.

It is therefore considered that there is a potential of PAHs to pose a significant risk to human receptors via the direct contact, ingestion, dust inhalation and volatilisation exposure pathways.

A summary of the petroleum hydrocarbon and BTEX concentrations recorded by the analysis in included in the following table:

TABLE 9: TPH Statistics

Contaminant	Key statistics				S4UL* (RwHP)	
	Number of detects	Min. Value (mg/kg)	Max. Value (mg/kg)	Mean Value (mg/kg)	S4UL (mg/kg)	No. Samples exceeding assessment criteria
TPH aromatic C_{16}-C_{21}	1	-	3.8	-	540	0
TPH aromatic C_{21}-C_{35}	1	-	31	-	1500	0

Notes to Table

** Most appropriate screening values are Sustainable 4 Use Level (S4UL) for a "Residential with Homegrown Produce" end use, a sandy loam soil type, pH of 7 and a soil organic matter (SOM) of 2.5%.*

As the above table demonstrates, none of the petroleum hydrocarbon or BTEX compounds detected by the analysis exceeded the corresponding S4ULs and as such it is considered that they are likely to pose a negligible risk to human receptors.

8. REVISED CONCEPTUAL SITE MODEL

8.1 General

In accordance with Environment Agency, CLR11 (2004) and R&D Publication 66:2008, Guidance for the Safe Development of Housing on Land Affected by Contamination, SES has developed the basic Conceptual Site Model (as contained within the previously issued Phase I Desktop Study) which identified potential contamination sources, migration pathways, and receptors within the study area.

Potential Sources of Contamination

Potential on-site sources of contaminants include;

- Elevated PAHs (Benzo(b)fluoranthene, Dibenzo(ah)anthracene, Benzo[a]pyrene).

There are no off-site sources sufficiently close enough to impact the site.

Potential Receptors

SES has identified the following possible receptors:

- Future site users and construction workers.

Generic pathways

The potential pathways for contaminants have been identified as;

- Direct ingestion, such as inhalation of dust and swallowing water.
- Indirect ingestion – absorption through skin.
- Plant uptake

8.2 Discussion of the Revised Conceptual Site Model

The intrusive investigations have shown that there may be pollutant linkages due to elevated PAHs within the Made Ground.

It is the intention to build four new dwellings.

As noted above, there are currently limited active pollutant linkages. However, the Conceptual Site Model considers the pollutant linkages that could become active as a result of residential development at the site.

TABLE 10: Updated Conceptual Site Model and Risk Assessment

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
On site – current and historical Made Ground	Benzo(b)fluoranthene, Dibenzo(ah)anthracene, Benzo[a]pyrene	Soil	Direct contact/ingestion	✓	Site users
			Inhalation of volatiles	x	
			Airborne migration of soil or dust	✓	Off-site users
			Leaching of mobile contaminants	x	N/A
		ground water	Direct contact/ingestion	✓ ✓	Site users Off-site users

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors
			Inhalation of volatiles	x x	Site users Off-site users
			Vertical and lateral migration in permeable strata	x	N/A

The risk assessment is based upon the available information relating to the site. Should ground conditions inconsistent with those outlined in this report be encountered, SES should be contacted to enable further assessment. The findings of the CSM should be confirmed upon finalisation of the proposed redevelopment plans.

9. MANAGEMENT OF CONTAMINATION

9.1 Remediation & Verification

The risk management framework set out in the Model Procedures for the Management of Land Contamination, CLR 11, is applicable to the redevelopment of sites that may be affected by contamination.

The risk management process set out in the Model Procedures has three main components:

- Risk assessment
- Options appraisal
- Implementation

This risk assessment has identified the presence of individual speciated PAHs (Benzo(b)fluoranthene, Dibenzo(ah)anthracene, Benzo[a]pyrene) in excess of the adopted GAC, protective of human health within the Made Ground at the location TP02 and TP04. Relevant pollutant linkages have been identified, as demonstrated in the updated conceptual model.

The remediation strategy will need to review methods of reducing or controlling the identified unacceptable risks. This could be done by removing or treating the sources of contamination, removing or modifying the pathways or removing or modifying the behaviour of the receptors, to ensure there is no significant risk of significant harm to either human health or controlled waters from the identified contamination, in relation to the proposed end use.

On completion of the works, a Validation Report will then be required, confirming that the remediation measures outlined above have been completed successfully. Any unexpected conditions encountered during the remediation works should also be detailed within the Validation Report.

An important part of the risk management process is identifying and informing all stakeholders with an interest in the outcome of the risk management project. To this end, if the regulators have not yet been contacted with regard to the redevelopment of this site, it is recommended that they be supplied with a copy of both the Phase I Desktop Study Report and this Phase II Ground Investigation Report in order to enable liaison to be undertaken with them.

Following liaison with the relevant regulatory bodies, a remediation strategy should be formulated, which should incorporate an options appraisal and summarise in detail the chosen remedial approach, along with the verification proposals. The remediation strategy should then be approved by the relevant regulatory authorities prior to implementation.

Where remediation is required, a verification report will need to be formulated following implementation of the remediation strategy, which should provide a complete record of all remedial activities conducted on site and include all the data obtained to support the remedial objectives and demonstrate that the remediation has been effective. Any unexpected conditions encountered during the remedial works should also be detailed within the verification report.

9.2 Proposed Strategy

The remediation strategy should be applied to all areas of general landscaping at ground level.

In areas that are to be covered by buildings or hard standing, no pathway is likely to exist between any source of contamination and the human receptors by ingestion or dermal contact, therefore no further remedial action is likely to be required.

In soft landscaped area, a capping layer of 'inert' material could be provided to break the pathway between the identified contamination and end users of the site. The required thickness of the capping layer could be determined using guidance provided by BRE465: Cover Systems for Land Regeneration, and has been calculated at approximately 491mm based on a mixing thickness of 600mm. With regards to the thickness of the mixing zone for landscaped areas, consideration has been given to the following points:

Depth of earthworm activity: Worms can cause intermixing of the soils, including bringing soils from depth to the surface. However, research indicates that the main worm activity within the soil profile is within the upper 150mm, reducing rapidly with depth. The temporary shallow sub-horizontal burrows, which are more likely to lead to soil intermixing (due to their regular collapse) are generally to depths of up to 300mm.

Depth of burrows from burrowing animals: The main burrowing animals that are likely to affect soil cover in gardens are rats, mice moles, rabbits, badgers and foxes. As the site is a proposed residential development within an urban area the presence of such animals will not present an obstacle to the implementation of the cover system (as they will be actively discouraged by the residents or prefer alternative locations in the fields surrounding the site).

Effects from plant/tree roots: Plants tend to have a shallow root mat influenced by:

- soil density;
- availability of nutrients; and
- availability of moisture.

Ranges of the minimum soil layer thickness required for various plants include: 150mm for grass; 200mm to 300mm for garden crops and up to 400mm for shrubs. However, it is considered that significant root penetration can be reduced if shallow soils have suitable nutrients and moisture.

Therefore, it is recommended that all the Made Ground is removed to a minimum depth of 491mm from proposed landscaped areas and the resultant void backfilled with clean imported material. The clean imported material must comprise at least 150mm of organic topsoil. If Made Ground is still present at the full depth of the excavation, then a capillary break comprising either 100mm clean crushed concrete or a geotextile membrane should be placed at the base of the excavation to prevent intermixing.

Where large shrubs/trees are proposed then it may be necessary to increase the depth of the capping layer in order to accommodate the root systems.

In order to minimise the impact on future maintenance workers, where services are to be placed at a depth that puts them at or below the level of the source of contamination, it would be prudent to line the trenches and surround the services with clean inert material.

Where material is being imported to raise site levels and/or finish landscaped areas following excavation, it must be obtained from a reputable source and the supplier should provide a certificate of analysis confirming the chemical and physical nature of the material prior to importation. Independent analysis should then be undertaken when the material is imported to the site in order to confirm its chemical composition. Samples must be analysed in an accredited laboratory for a range of contaminants, the results of which can be screened against current criteria for residential end use.

Removal of the Made Ground would also reduce the impact on controlled waters.

A watching brief must be kept by the developer during all ground works. The excavation of material across the site must be documented by photographs and waste consignment documentation.

All design proposals must be approved by the Local Authority prior to development commencing.

9.3 Management of Unidentified Sources of Contamination

There is the possibility that sources of contamination may be present on the site, which was not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, this should be dealt with accordingly. A number of options are available for handling this material, which include:

- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal;
- Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area; and
- Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

9.4 Risk Management During Site Works

During ground works, some simple measures may have to be put in place to mitigate the risk of any known or previously unidentified contamination affecting the site workers and the environs. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure;
- Where appropriate, the provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of the contamination;
- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first;
- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne; and
- Where contaminated materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

10. CONCLUSIONS

This Phase II Ground Geoenvironmental Assessment has considered a variety of sources of information regarding the past land uses of the former gasworks site on Tayfen Road, Bury St Edmunds, IP33 1TB.

Stansted Environmental Services Limited has been commissioned by Taylor Gray Holding Ltd, to undertake a Phase II Ground Investigation and Generic Risk Assessment of the site known as Land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH. The site may be located by National Grid Reference TL 613218.

It is the intention for the existing buildings on the site to be demolished and the construction of four new dwellings.

The report has been prepared to assess contamination in relation to the proposed re-development of the application site and develops the Conceptual Site Model given in the earlier Phase I report.

A desk top study was undertaken by SES Ltd and presented under reference CON219-DUNM-001, Phase I Desk Study and Preliminary Risk Assessment, Land to the rear of Canada Cottages, Stortford Road, Great Dunmow, CM6 1SH, Dated 17 August 2022. The research identified evidence of made ground remains on site which could represent a potential source of contamination as normally containing PAHs, TPHs, asbestos and heavy metals. Considering the amount of made ground observed, the risk posed by them was judged to be low to moderate.

The risk to groundwater was considered to be negligible as the site is underlain by the unproductive cohesive strata of the Lowestoft Formation and the London Clay Formation.

Intrusive investigation was undertaken by SES on the 24th August 2022 comprising six hand dug trial pits across the site. Suitable samples of both Made Ground and natural ground were taken and subjected to a range of contaminant testing.

A limited thickness of Made Ground was encountered to a maximum depth of 0.40m bgl and was underlain by deposits considered to be representative of the Lowestoft Formation. Groundwater was not encountered during the excavation of the trial pits.

Suitable samples were selected and submitted to a MCerts laboratory for analysis. The results were screened against S4ULs/C4SLs for a 'Residential with Homegrown Produce (RwHP)' end-use. Contamination analysis indicated the presence of speciated PAHs exceeding the respective S4UL in one sample (TP2 at 0.10m bgl, TP04 at 0.10m bgl).

This risk assessment has identified the presence of individual speciated PAHs (Benzo(b)fluoranthene, Dibenzo(ah)anthracene, Benzo(a)pyrene) within the Made Ground at the location TP02 and TP04. Relevant pollutant linkages have been identified, as demonstrated in the updated conceptual model.

Therefore, some limited remediation will be required in the garden area of the proposed development, but this should be limited to a minimum thickness of clean cover. To this end, in areas of proposed private gardens and landscaped areas, at least 491mm thickness of verified clean cover, comprising at least 150mm of organic topsoil, should be provided to break these pathways to future site users.

On completion of the works, a Validation Report will then be required, confirming that the remediation measures outlined above have been completed successfully.

This desktop study was produced to assist in the discharge the Planning Condition 14 (UTT/19/2016/FUL, dated 21st February 2020), relating to land contamination.

APPENDICES

A. PLANS & FIGURES
B. EXPLORATORY HOLE RECORDS
C. RESULTS OF LABORATORY ANALYSIS
D. SOIL ASSESSMENT CRITERIA & GENERIC RISK ASSESSMENT

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A. PLANS & FIGURES

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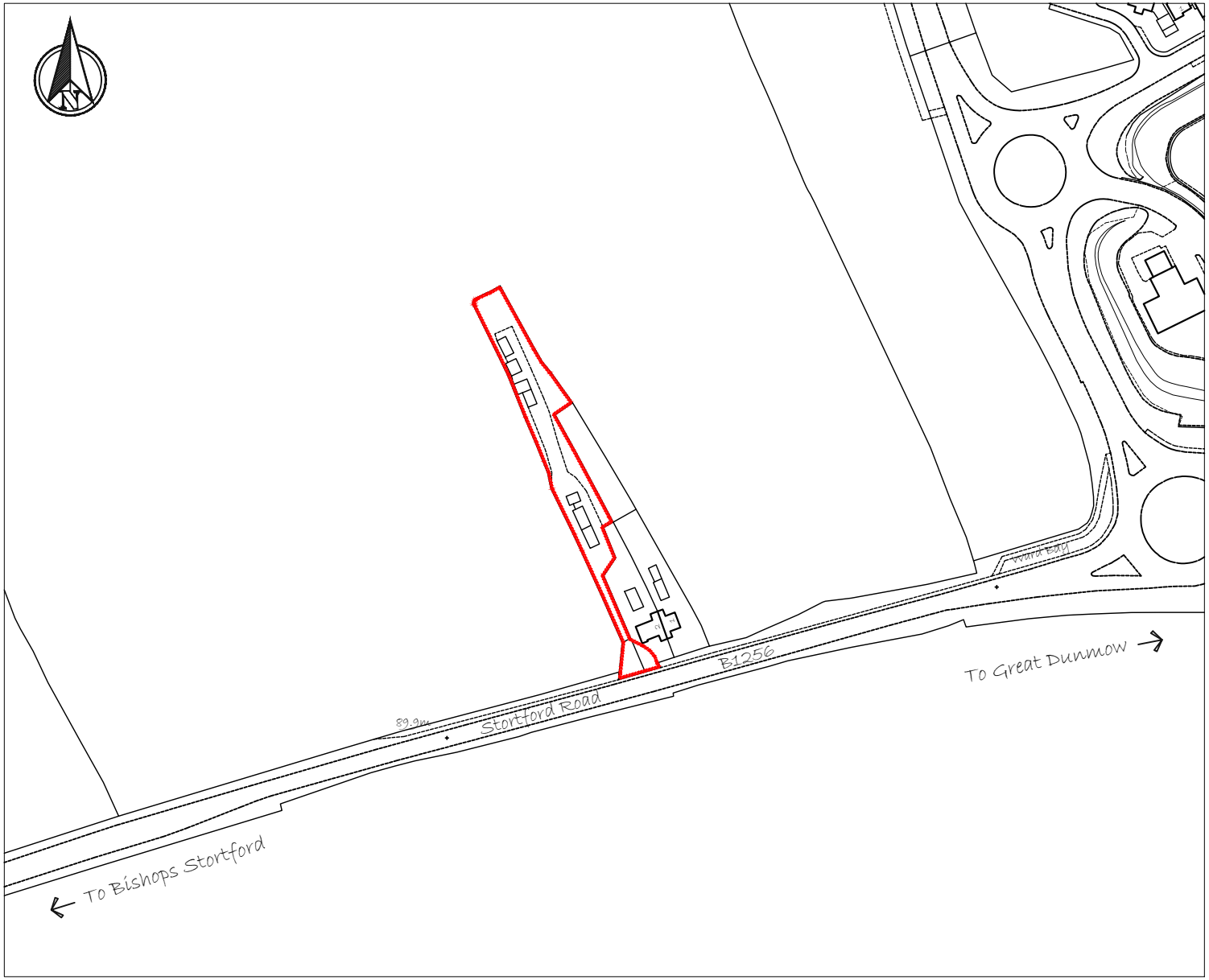


Location Plan - 1:2500

Scale @ 1:2500

0 50m 100m 150m 200m

Andrew Stevenson Associates
ARCHITECTURAL & BUILDING SURVEYING SERVICES

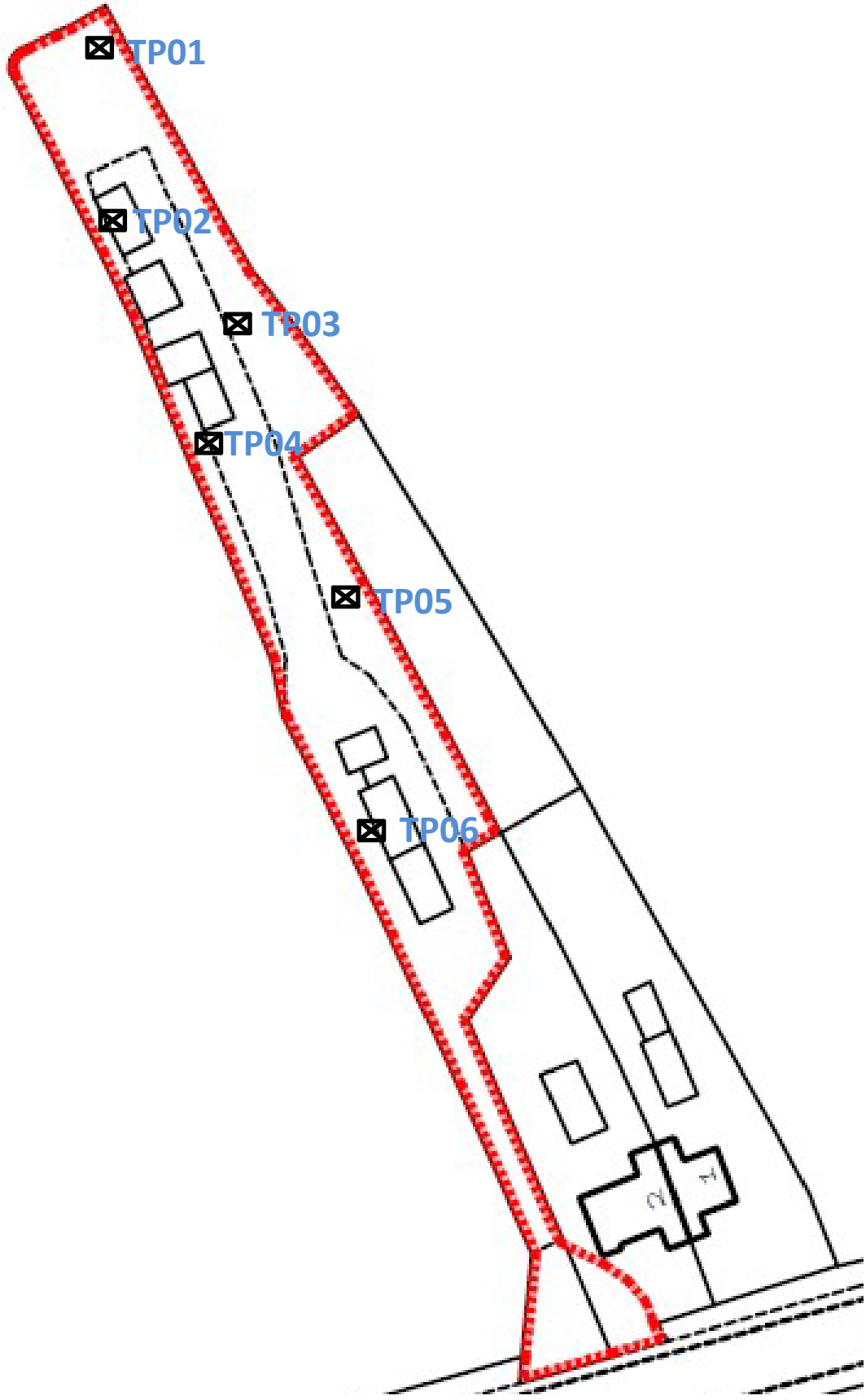
CLIENT
MRS BLACKWELL

PROJECT TITLE
PROPOSED DEVELOPMENT @ LAND REAR OF CANADA COTTAGES, STORTFORD RD, DUNMOW, ESSEX, CM61SH

DRAWING TITLE
LOCATION PLAN

PROJECT No	DRAWING	REVISION
4687	101	
SCALE	DATE	DRAWN
1:2500 @ A4	JUL '19	KW

21A HIGH STREET , GREAT DUNMOW , ESSEX , CM6 1AB . TEL:01371 874807
FAX: 01371 876435 Email : design@asarics.co.uk



LEGEND

Trial pit location

Site boundaries

Originator	MC	**LAND REAR OF CANADA COTTAGES, GREAT DUNMOW** **CON219-DUNM-001**	SES STANSTED ENVIRONMENTAL SERVICES
Checked & Approved	WGG	**EXPLORATORY HOLE LOCATION PLAN**	

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B. EXPLORATORY HOLE RECORDS

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Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Land to rear of Canada Cottages, Great Dunmow	**Trial Pit Number** **TP01**	
Method : Hand digging tools	**Dimensions** 0.40m x 0.40m	**Ground Level (mOD)**	**Client** Taylor Gray Holding Ltd	**Job Number** CON219-DUNM-001
	Location	**Dates** 24/08/2022	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.40	ES1				0.05 (0.45) 0.50	MADE GROUND: Greyish brown slightly gravelly slightly sandy CLAY with occasional rootlets and rare fragments of bricks, clinker and ceramic. Sand is fine to coarse. Gravel is subangular fine to coarse flint.		
						Very stiff orangish brown slightly gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse chalk. [LOWESTOFT FORMATION]		
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered during excavation.
Trial pit backfilled with arisings after completion.

Scale (approx)	Logged By	Figure No.
1:50	MC	CON219-DUNM-001

Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Land to rear of Canada Cottages, Great Dunmow	**Trial Pit Number** **TP02**	
Method : Hand digging tools	**Dimensions** 0.40m x 0.40m	**Ground Level (mOD)**	**Client** Taylor Gray Holding Ltd	**Job Number** CON219-DUNM-001
	Location	**Dates** 24/08/2022	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10	ES1				0.05 (0.65) 0.70	MADE GROUND: Greyish brown slightly gravelly slightly sandy CLAY with occasional roots and rootlets, and rare fragments of bricks, tiles, clinker and ceramic. Sand is fine to coarse. Gravel is subangular fine to coarse flint. Very stiff orangish brown slightly gravelly slightly sandy CLAYwith low cobble content. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse chalk. Cobbles are chalk. [LOWESTOFT FORMATION] Complete at 0.70m		

Plan

Remarks

No groundwater encountered during excavation.
Trial pit backfilled with arisings after completion.

Scale (approx)	Logged By	Figure No.
1:50	MC	CON219-DUNM-001

Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Land to rear of Canada Cottages, Great Dunmow		**Trial Pit Number** **TP03**
Method : Hand digging tools	**Dimensions** 0.40m x 0.40m	**Ground Level (mOD)**	**Client** Taylor Gray Holding Ltd	**Job Number** CON219-DUNM-001
	Location	**Dates** 24/08/2022	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10	ES1				0.05 (0.45) 0.50	MADE GROUND: Greyish brown slightly gravelly slightly sandy CLAY with occasional roots and rootlets and rare fragments of bricks, concrete, clinker and ceramic. Sand is fine to coarse. Gravel is subangular fine to coarse flint.		
						Very stiff orangish brown slightly gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse chalk. [LOWESTOFT FORMATION]		
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered during excavation.
Trial pit backfilled with arisings after completion.

Scale (approx)	Logged By	Figure No.
1:50	MC	CON219-DUNM-001

Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Land to rear of Canada Cottages, Great Dunmow		**Trial Pit Number** **TP04**
Method : Hand digging tools	**Dimensions** 0.40m x 0.40m	**Ground Level (mOD)**	**Client** Taylor Gray Holding Ltd	**Job Number** CON219-DUNM-001
	Location	**Dates** 24/08/2022	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10	ES1				0.05 (0.45) 0.50	MADE GROUND: Greyish brown slightly gravelly slightly sandy CLAY with occasional rootlets and rare fragments of bricks, clinker and ceramic. Sand is fine to coarse. Gravel is subangular fine to coarse flint.		
						Very stiff orangish brown slightly gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse chalk and rare flint. [LOWESTOFT FORMATION]		
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered during excavation.
Trial pit backfilled with arisings after completion.

Scale (approx)	Logged By	Figure No.
1:50	MC	CON219-DUNM-001

Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Land to rear of Canada Cottages, Great Dunmow	**Trial Pit Number** **TP05**	
Method : Hand digging tools	**Dimensions** 0.40m x 0.40m	**Ground Level (mOD)**	**Client** Taylor Gray Holding Ltd	**Job Number** CON219-DUNM-001
	Location	**Dates** 24/08/2022	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10	ES1				0.05 (0.45) 0.50	MADE GROUND: Greyish brown slightly gravelly slightly sandy CLAY with occasional rootlets and rare fragments of bricks, clinker and ceramic. Sand is fine to coarse. Gravel is subangular fine to coarse flint.		
						Very stiff orangish brown slightly gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse chalk. [LOWESTOFT FORMATION]		
						Complete at 0.60m		

Plan

Remarks

No groundwater encountered during excavation.
Trial pit backfilled with arisings after completion.

Scale (approx)	Logged By	Figure No.
1:50	MC	CON219-DUNM-001

Stansted Environmental Services Limited The Stansted Centre, Parsonage Road Takeley,Essex,CM22 5PU	**Site** Land to rear of Canada Cottages, Great Dunmow	**Trial Pit Number** **TP06**	
Method : Hand digging tools	**Dimensions** 0.40m x 0.40m	**Ground Level (mOD)**	**Client** Taylor Gray Holding Ltd	**Job Number** CON219-DUNM-001
	Location	**Dates** 24/08/2022	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10	ES1				0.05 (0.45) 0.50	MADE GROUND: Light brown and greyish brown slightly gravelly slightly sandy CLAY with occasional rootlets and rare fragments of bricks, clinker and ceramic. Sand is fine to coarse. Gravel is subangular fine to coarse flint.		
						Very stiff orangish brown slightly gravelly slightly sandy CLAY with occasional rootlets. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse chalk. [LOWESTOFT FORMATION]		
						Complete at 0.70m		

Plan

Remarks

No groundwater encountered during excavation.
Trial pit backfilled with arisings after completion.

Scale (approx)	Logged By	Figure No.
1:50	MC	CON219-DUNM-001

KEY TO EXPLORATORY HOLE RECORDS

Samples

D	Small Disturbed Sample
B	Bulk Disturbed Sample
ES	Environmental Sample (Tub, jar and vial)
U	Undisturbed Sample (100mm nominal diameter) with Number of Blows to Achieve 450mm Penetration
UT	Undisturbed Thin Walled Sample (100mm nominal diameter)
U38	Hand Driven 'Undisturbed' Sample (38mm nominal diameter)
P	Undisturbed Piston Sample
W	Water Sample
ICBR	Insitu California Bearing Ration Sample
*	Denotes No Sample Recovery

Tests

S	Standard Penetration Test (using spoon)
C	Standard Penetration Test (using cone)
N	SPT/CPT 'N' Value (number of blows for full 300mm penetration)
	50/225 Number of Blows/Total Penetration (mm) for SPT/CPT
	25/25SP As Above for Seating Drive Only
Vh	Insitu Hand Vane Test (kPa)
m	Insitu CBR Test using MexeProbe
V	Insitu Field Vane Test (kPa)
pp	Pocket Penetrometer (kg/cm²)
ppm	Total Volatile Organic Compound (parts per million)

Observations, Backfill & Installations

▼	Groundwater Strike (depth shown in metres below ground level)
	Gravel Backfill
	Bentonite Backfill
	Arisings Backfill
	Concrete Backfill
	Plain Pipe
	Slotted Pipe

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C. RESULTS OF LABORATORY ANALYSIS

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Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-32407-1		
Initial Date of Issue:	31-Aug-2022		
Client	Stansted Environmental Services		
Client Address:	The Stansted Centre Parsonage Road Takeley Hertfordshire CM22 6PU		
Contact(s):	Enquiries Gavin Greenwood		
Project	CON219-DUNM-007 Canada Cottages, Great Dunmow		
Quotation No.:	Q19-17925	**Date Received:**	24-Aug-2022
Order No.:		**Date Instructed:**	24-Aug-2022
No. of Samples:	6		
Turnaround (Wkdays):	4	**Results Due:**	30-Aug-2022
Date Approved:	31-Aug-2022		
Approved By:			
Details:	Stuart Henderson, Technical Manager		

Results - Soil

Project: CON219-DUNM-007 Canada Cottages, Great Dunmow

Client: Stansted Environmental Services		**Chemtest Job No.:**			22-32407	22-32407	22-32407	22-32407	22-32407	22-32407
Quotation No.: Q19-17925		**Chemtest Sample ID.:**			1493892	1493893	1493894	1493895	1493896	1493897
		Sample Location:			TP01	TP02	TP03	TP04	TP05	TP06
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.40	0.10	0.10	0.10	0.10	0.10
		Date Sampled:			24-Aug-2022	24-Aug-2022	24-Aug-2022	24-Aug-2022	24-Aug-2022	24-Aug-2022
		Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	10	7.9	2.9	6.5	8.4	12
pH	U	2010		4.0	8.2	8.2	8.1	8.5	8.3	8.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.7	3.7	1.3	1.9	1.5	0.75
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.25	0.13	0.046	< 0.010	0.49	0.079
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.70	3.9
Arsenic	U	2455	mg/kg	0.5	6.8	8.9	6.7	6.2	7.1	7.5
Beryllium	U	2455	mg/kg	0.5	0.6	0.9	0.6	0.5	0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	0.19	0.25	0.19	0.12	0.26	0.26
Chromium	U	2455	mg/kg	0.5	12	26	16	14	16	11
Copper	U	2455	mg/kg	0.50	16	20	14	12	23	23
Mercury	U	2455	mg/kg	0.05	0.07	0.07	0.08	0.05	0.11	0.06
Nickel	U	2455	mg/kg	0.50	13	22	17	14	16	10
Lead	U	2455	mg/kg	0.50	38	54	32	71	69	63
Selenium	U	2455	mg/kg	0.25	0.49	0.77	0.51	0.46	0.45	0.38
Vanadium	U	2455	mg/kg	0.5	19	41	24	22	25	14
Zinc	U	2455	mg/kg	0.50	65	140	67	49	75	83
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.2	5.6	2.9	4.0	1.8	4.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	3.8	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	31	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: CON219-DUNM-007 Canada Cottages, Great Dunmow

Client: Stansted Environmental Services			**Chemtest Job No.:**		22-32407	22-32407	22-32407	22-32407	22-32407	22-32407
Quotation No.: Q19-17925			**Chemtest Sample ID.:**		1493892	1493893	1493894	1493895	1493896	1493897
			Sample Location:		TP01	TP02	TP03	TP04	TP05	TP06
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.40	0.10	0.10	0.10	0.10	0.10
			Date Sampled:		24-Aug-2022	24-Aug-2022	24-Aug-2022	24-Aug-2022	24-Aug-2022	24-Aug-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	35	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	35	< 10	< 10	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	1.4	< 0.10	1.3	< 0.10	0.73
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	0.53	< 0.10	0.25	< 0.10	0.16
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	0.83	< 0.10	3.3	< 0.10	0.35
Fluorene	U	2700	mg/kg	0.10	< 0.10	0.61	< 0.10	4.2	< 0.10	0.22
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	0.19	< 0.10	26	0.65	0.91
Anthracene	U	2700	mg/kg	0.10	< 0.10	0.69	< 0.10	4.7	0.10	0.29
Fluoranthene	U	2700	mg/kg	0.10	0.16	7.3	0.23	31	0.72	2.2
Pyrene	U	2700	mg/kg	0.10	0.23	8.1	0.38	27	0.78	2.2
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	3.3	0.19	10	0.46	1.1
Chrysene	U	2700	mg/kg	0.10	< 0.10	3.2	0.41	9.8	0.55	1.4
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	4.6	< 0.10	12	0.54	1.7
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	2.0	< 0.10	4.6	0.25	0.72
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	3.7	< 0.10	9.0	0.40	1.3
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	1.7	< 0.10	5.0	< 0.10	0.73
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	0.58	< 0.10	1.5	< 0.10	0.25
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	2.0	< 0.10	4.8	< 0.10	0.82
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	41	< 2.0	150	4.5	15
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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D. ASSESSMENT CRITERIA & GENERIC RISK ASSESSMENT

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Assessment Criteria

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

Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment model (CLEA) which comprises the following documents:

1. EA Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil
2. EA Science Report SC050021/SR3: Updated technical background to the CLEA Model
3. EA CLEA Bulletin (2009)
4. CLEA Software version 1.06 (2009)
5. Toxicological reports and SGV technical notes

The CLEA guidance and tools:

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

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

Land-use Scenarios

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

Residential (with home grown produce) (RwHP): Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch. In this scenario the critical receptor is a young female child (<6 years old); the exposure duration is 6 years; exposure pathways include direct soil and dust ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor dust and vapours; building type is a two storey house. A subset of this land-use is residential apartments with communal landscape gardens where the consumption of homegrown vegetables will not occur (***Residential without Homegrown Produce – RwoHP***).

Allotments: Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits. Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered. In this scenario the critical receptor is a young female child (<6 years old); the exposure duration is 6 years; exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours; there is no building.

Commercial/Industrial: The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-

based or relatively light physical work. In this scenario the critical receptor is a working female adult (between 16 to 65 years old); the exposure duration is a working lifetime of 49 years; exposure pathways include direct soil and indoor ingestion, skin contact with soils and dusts and inhalation of dust and vapours; building type is pre1970s three storey office block.

LQM/CIEH Suitable for Use Levels (S4ULs)

The LQM/CIEH proposed additional land-use scenarios. The LQM/CIEH S4UL for a given land use is the concentration of the contaminant in soil at which the predicted daily exposure, as calculated by the CLEA software, equals the Health Criteria Value. The final output for each contaminant represents a synthesis of new toxicological (and fate and transport) reviews published since the preparation of the 2nd edition LQM/CIEH GAC's (Nathanial et al., 2009).

In the derivation of LQM/CIEH S4UL's the principles of 'minimal' or 'tolerable' risk enshrined in SR2, which has not been withdrawn, has been maintained. S4UL's have been derived for the basic CLEA land-uses, as described above, and for two new land uses:

Public Open Spaces near Residential Housing (POS_{resi}): **This i**ncludes the predominantly grassed areas adjacent to high density housing, the central green area on many 1930's – 1970's housing estates, and smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soils with planting. It is assumed that the close proximity to the place of residence will allow tracking back of soil to occur.

Public Park (POS_{park}): This is an area of open space, usually owned and maintained by the local authority, provided for recreational uses including family visits and picnics, children's play area, informal sporting activities (not a dedicated sports pitch), and dog walking. It is assumed that tracking back of soils into places of residence will be negligible.

Further details are contained in:

- Nathanial, P., McCaffrey, C., Gillet, A., Ogden, R., Nathanial, J. The LQM/CIEH S4UL's for Human Health Risk Assessment. Land Quality Press. 2015

Category 4 Screening Levels (C4SLs)

In the case of Lead, no SGV or GAC has been published to date. This is likely to be due to the toxicity review that is being undertaken by the Environment Agency. In the absence of updated toxicity information the SGV derived using CLEA 1.06 methodology and related toxicity will be used.

The overall objective of the C4SLs research project was to assist the provision of technical guidance in support of DEFRA's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 (Part 2A) (Defra, 2012a). Specifically, the project aimed to deliver:

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

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised Statutory Guidance presented a new four category system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high. More specific guidance on what type of land should be considered as Category 4 (Human Health) is provided in Paragraphs 4.21 and 4.22 of the revised guidance, as follows:

"4.21 The local authority should consider that the following types of land should be placed into Category 4: Human Health:

(a) Land where no relevant contaminant linkage has been established.

(b) Land where there are only normal levels of contaminants in soil, as explained in Section 3 of this Guidance.

(c) Land that has been excluded from the need for further inspection and assessment because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of this Guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of this Guidance.

(d) Land where estimated levels of exposure to contaminants in soil are likely to form only a small proportion of what a receptor might be exposed to anyway through other sources of environmental exposure (e.g. in relation to average estimated national levels of exposure to substances commonly found in the environment, to which receptors are likely to be exposed in the normal course of their lives).

4.22 The local authority may consider that land other than the types described in paragraph 4.21 should be placed into Category 4: Human Health if following a detailed quantitative risk assessment it is satisfied that the level of risk posed is sufficiently low."

The C4SLs are intended as "relevant technical tools" (in relation to Paragraph 4.21(c)) to help local authorities and others when deciding to stop further assessment of a site, on the grounds that it falls within Category 4 (Human Health).

The Impact Assessment (IA), which accompanied the revised guidance (Defra, 2012b) provides further information on the nature and potential role of the C4SLs. Paragraph 47(h) of the IA states that:

"The new statutory guidance will bring about a situation where the current SGVs/GACs are replaced with more pragmatic (but still strongly precautionary) Category 4 screening levels (C4SLs) which will provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land."

A key distinction between the Soil Guideline Values (SGVs) and the C4SLs is the level of risk that they describe. As described by the Environment Agency (2009a):

"SGVs are guidelines on the level of long-term human exposure to individual chemicals in soil that, unless stated otherwise, are tolerable or pose a minimal risk to human health."

The implication of Paragraph 47(h) of the IA is that minimal risk is well within Category 4 and that the C4SLs should describe a higher level of risk which, whilst not minimal, can still be considered low enough to allow a judgement to be made that land containing substances at, or below, the C4SLs would typically fall within Category 4. This reflects Paragraph 4.20 of the revised SG, which states:

"4.20 The local authority should not assume that land poses a significant possibility of significant harm if it considers that there is no risk or that the level of risk posed is low. For the purposes of this Guidance, such land is referred to as a "Category 4: Human Health" case. The authority may decide that the land is a Category 4: Human Health case as soon as it considers it has evidence to this effect, and this may happen at any stage during risk assessment including the early stages."

C4SLs, therefore, should not be viewed as "SPOSH levels" and they should not be used as a legal trigger for the determination of land under Part 2A.

The generic screening values referred to before usually take the form of risk based Soil Guideline Values (SGVs) or other Generic Assessment Criteria (GACs) that are most typically derived using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) model, as described in the Environment Agency's SR2, SR3 and SR7 reports (EA, 2009b & c; EA, 2008). It is anticipated that C4SLs will be used in a similar manner; as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the SGVs.

The suggested approach to the development of C4SLs consists of the retention and use of the CLEA framework, modified according to considerations of the underlying science within the context of DEFRA's policy objectives relating to the revised Statutory Guidance. Within this context, it is suggested that the development of C4SLs may be achieved in one of three ways, namely:

- By modifying the toxicological parameters used within CLEA (while maintaining current exposure parameters);
- By modifying the exposure parameters embedded within CLEA (while maintaining current toxicological "minimal risk" interpretations); and
- By modifying both toxicological and exposure parameters.

There is also a suggested check on "other considerations" (e.g., background levels, epidemiological data, sources of uncertainty) within the approach, applicable to all three options.

It is suggested that a new term is defined for the toxicological guidance values associated with the derivation of C4SLs – a Low Level of Toxicological Concern (LLTC). A LLTC should represent an intake of low concern that remains suitably protective of health, and definitely does not approach an intake level that could be defined as SPOSH.

CL:AIRE Generic Risk Assessment (GAC)

For derivation of the CL:AIRE Generic Assessment Criteria (GAC) reference should be made to the following report:

- CL:AIRE: The Soil Generic Assessment Criteria for Human Health Risk Assessment. Contaminated Land: Applications in the Real Environment. 2009.

Within this report CL:AIRE provided Generic Assessment Criteria (GAC's) in accordance with the CLEA software and the principles outlined above for a further 35 contaminants sometime encountered on land affected by contamination.

Detailed Quantitative Risk Assessments (DQRA)

Where the adoption of an S4UL/GAC/C4SL is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses then a DQRA may be undertaking to develop site specific values for relevant soil contaminants.

- Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.
- Developing more accurate parameters using data.

Phytotoxicity

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

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

Statistical Tests

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

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

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot. It may be appropriate to compare the upper 95th percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

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

- A statistical test is applied to establish whether the data is part of a single set, or whether outliers are present.
- Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, hotspot(s) may be excluded and the mean of the remaining data assessed.

Generic Assessment Criteria

Based on current UK guidance, the Generic Assessment Criteria used in this report are tabulated below:

Determinand	Residential with Plant Uptake			Residential without Plant Uptake			POS Residential			POS Park			Commercial			Allotments		
Soil Organic Matter (SOM)	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%
Metals																		
Arsenic	37			40			79			170			640			43		
Beryllium	1.7			1.7			2.2			63			12			35		
Boron	290			11,000			21,000			46,000			240,000			45		
Cadmium	11			85			120			532			190			1.9		
Chromium III	910			910			1,500			33,000			8,600			18,000		
Chromium VI	6.0			6.0			7.7			220			33			1.8		
Copper	2,400			7,100			12,000			44,000			68,000			520		
Lead[1]	200			310			630			1,300			2,330			80		
Mercury (inorganic)	40			56			120			240			1,100			19		
Nickel	180			180			230			3400			980			230		
Selenium	250			430			1,100			1,800			12,000			88		
Vanadium	410			1,200			2,000			5,000			9,000			91		
Zinc	3,700			40,000			81,000			170,000			730,000			620		
PolyAromatic Hydrocarbons (PAH)																		
Naphthalene	2.3	5.6	13	2.3	5.6	13	4,900	4,900	4,900	1,200 (76.4)[2]	1,900 (183)[2]	3,000	190 (76.4)[2]	460 (183)[2]	1,100 (432)[2]	4.1	10	24
Acenaphthylene	170	420	920	2,900 (86)[2]	4,600 (212)[2]	6,000 (506)[2]	15,000	15,000	15,000	29,000	30,000	30,000	83,000 (86)[2]	97,000 (212)[2]	100,000	34	85	200
Acenaphthene	210	510	1100	3,000 (57)[2]	4,700 (141)[2]	6,000 (336)[2]	15,000	15,000	15,000	29,000	30,000	30,000	84,000 (57)[2]	97,000 (141)[2]	100,000	28	69	160
Fluorene	170	400	860	2,800 (30)[2]	3,800 (76)[2]	4,500 (183)[2]	9,900	9,900	9,900	20,000	20,000	20,000	63,000 (30)[2]	68,000	71,000	27	67	160
Phenanthrene	95	220	440	1,300 (36)[2]	1,500	1,500	3,100	3,100	3,100	6,200	6,200	6,300	22,000	22,000	23,000	15	38	90
Anthracene	2,400	5,400	11,000	31,000 (1.17)[3]	35,000	37,000	74,000	74,000	74,000	150,000	150,000	150,000	52,000	54,000	54,000	380	950	2,200
Fluoranthene	280	560	890	1,500	1,600	1,600	3,100	3,100	3,100	6,300	6,300	6,400	23,000	23,000	23,000	52	130	290
Pyrene	620	1,200	2,000	3,700	3,800	3,800	7,400	7,400	7,400	15,000	15,000	15,000	54,000	54,000	54,000	110	270	620
Benz(a)anthracene	7.2	11	13	11	14	15	29	29	29	49	56	62	170	170	180	0.97	2.0	3.5
Chrysene	15	22	27	30	31	32	57	57	57	93	110	120	350	350	350	4.1	9.4	19
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4.0	4.0	7.1	7.2	7.2	13	15	16	44	44	45	0.99	2.1	3.9
Benzo(k)fluoranthene	77	93	100	110	110	110	190	190	190	370	410	440	1,200	1,200	1,200	37	75	130
Benzo(a)pyrene	2.2	2.7	3.0	3.2	3.2	3.2	5.7	5.7	5.7	11	12	13	35	35	36	0.97	2.0	3.5
Indeno(123-cd)pyrene	27	36	41	45	46	46	82	82	82	150	170	180	500	510	510	9.5	21	39
Dibenzo(ah)anthracene	0.24	0.28	0.30	0.31	0.32	0.32	0.57	0.57	0.58	1.1	1.3	1.4	3.5	3.6	3.6	0.14	0.27	0.43
Benzo(ghi)perylene	320	340	350	360	360	360	640	640	640	1,400	1,500	1,600	3,900	4,000	4,000	290	470	640
Coal Tar (BaP as surrogate marker)	0.79	0.98	1.1	1.2	1.2	1.2	2.2	2.2	2.2	4.4	4.7	4.8	15	15	15	0.32	0.67	1.2
Total Petroleum Hydrocarbons (TPH)																		
Aliphatic C5-C6	42	78	160	42	78	160	570,000 (304)[2]	590,000	600,000	95,000 (304)[2]	130,000 (558)[2]	180,000 (1,150)[2]	3,200 (304)[2]	5,900 (558)[2]	12,000 (1,150)[2]	730	1,700	3,900
Aromatic C5-C7 (ben)	70	140	300	370	690	1,400	56,000	56,000	56,000	76,000 (1,220)[2]	84,000 (2,260)[2]	92,000 (4,710)[2]	26,000 (1,220)[2]	46,000 (2,260)[2]	86,000 (4,710)[2]	13	27	57
Aliphatic C6-C8	100	230	530	100	230	530	600,000	610,000	620,000	150,000 (144)[2]	220,000 (322)[2]	320,000 (736)[2]	7,800 (144)[2]	17,000 (322)[2]	40,000 (736)[2]	2,300	5,600	13,000
Aromatic C7-C8 (tol)	130	290	660	860	1,800	3,900	56,000	56,000	56,000	87,000 (869)[2]	95,000 (1,920)[2]	100,000 (4,360)[3]	56,000 (869)[3]	110,000 (1,920)[2]	180,000 (4,360)[3]	22	51	120
Aliphatic C8-C10	27	65	150	27	65	150	13,000	13,000	13,000	14,000 (78)[2]	18,000 (190)[3]	21,000 (451)[3]	2,000 (78)[2]	4,800 (190)[3]	11,000 (451)[3]	320	770	1,700

Determinand	Residential with Plant Uptake			Residential without Plant Uptake			POS Residential			POS Park			Commercial			Allotments		
Soil Organic Matter (SOM)	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%
Aromatic C8-C10	34	83	190	47	110	270	5,000	5,000	5,000	7,200 (613)[3]	8,500 (1500)[3]	9,300 (3580)[3]	3,500 (613)[3]	8,100 (1500)[3]	17,000 (3580)[3]	8.6	21	51
Aliphatic C10-C12	130 (48)[3]	330 (118)[3]	760 (283)[3]	130 (48)[3]	330 (118)[3]	770 (283)[3]	13,000	13,000	13,000	21,000 (48)[2]	23,000 (118)[3]	24,000 (283)[3]	9,700 (48)[2]	23,000 (118)[3]	47,000 (283)[3]	2,200	4,400	7,300
Aromatic C10-C12	74	180	380	250	590	1,200	5,000	5,000	5,000	9,200 (364)[2]	9,700 (899)[2]	10,000	16,000 (364)[3]	28,000 (899)[3]	34,000 (2,150)[3]	13	31	74
Aliphatic C12-C16	1,100 (24)[2]	2,400 (59)[2]	4,300 (142)[2]	1,100 (24)[2]	2,400 (59)[2]	4,400 (142)[2]	13,000	13,000	13,000	25,000 (24)[2]	25,000 (592)[2]	26,000 (142)[2]	59,000 (24)[2]	82,000 (59)[2]	90,000 (142)[2]	11,000	13,000	13,000
Aromatic C12-C16	140	330	660	1,800	2,300 (419)[2]	2,500	5,100	5,100	5,000	10,000	10,000	10,000	36,000 (169)[2]	37,000	38,000	23	57	130
Aliphatic C16-C21	65,000 (8.5)[2]	92,000 (21)[2]	11,0000	65,000 (8.5)[2]	92,000 (21)[2]	110,000	250,000	250,000	250,000	450,000	480,000	490,000	1,600,000	1,700,000	1,800,000	260,000	270,000	270,000
Aromatic C16-C21	260	540	930	1,900	1,900	1,900	3,800	3,800	3,800	7,600	7,700	7,800	28,000	28,000	28,000	46	110	260
Aliphatic C21-C35	65,000 (8.5)[2]	92,000 (21)[2]	11,0000	65,000 (8.5)[2]	92,000 (21)[2]	110,000	250,000	250,000	250,000	450,000	480,000	490,000	1,600,000	1,700,000	1,800,000	260,000	270,000	270,000
Aromatic C21-C35	1,100	1,500	1,700	1,900	1,900	1,900	3,800	3,800	3,800	7,800	7,800	7,900	28,000	28,000	28,000	370	820	1,600
Aliphatic C35-C44	65,000 (8.5)[2]	92,000 (21)[2]	11,0000	65,000 (8.5)[2]	92,000 (21)[2]	110,000	250,000	250,000	250,000	450,000	480,000	490,000	1,600,000	1,700,000	1,800,000	260,000	270,000	270,000
Aromatic C35-C44	1,100	1,500	1,700	1,900	1,900	1,900	3,800	3,800	3,800	7,800	7,800	7,900	28,000	28,000	28,000	370	820	1,600
Aliphatic & Aromatic C44-70	1,600	1,800	1,900	1,900	1,900	1,900	3,800	3,800	3,800	7,800	7,800	7,900	28,000	28,000	28,000	1,200	2,100	3,000
Organic Compounds																		
MTBE[5]	49	84	160	73	120	220							7900	13 000	24 000	23	44	90
Benzene	0.087	0.17	0.37	0.38	0.7	1.4	72	72	73	90	100	110	27	47	90	0.017	0.034	0.075
Toluene	130	290	660	880(869)	1,900	3,900	56,000	56,000	56,000	87,000 (869)	95,000 (1,920)	100,000(4,360)	56,000(869)	110,000(1,920)	180,000(4,360)	22	51	120
Ethyl Benzene	47	110	260	83	190	440	24,000	24,000	25,000	17,000 (518)	22,000 (1,220)	27,000 (2,840)	5,700 (518)	13,000 (1220)	27,000 (2840)	16	39	91
Xylene-m	59	140	320	82	190	450	41,000	42,000	43,000	17,000 (625)	24,000 (1,470)	32,000 (3,460)	6,200 (625)	14,000 (1,470)	31,000 (3,460)	31	74	170
Xylene-o	60	140	330	88	210	480	41,000	42,000	43,000	17,000 (478)	24,000 (1,120)	33,000 (2,620)	6,600 (478)	15,000 (1,120)	33,000 (2,620)	28	67	160
Xylene-p	56	130	310	79	180	430	41,000	42,000	43,000	17,000 (576)	23,000 (1,350)	31,000 (3,170)	5,900 (576)	14,000 (1,350)	30,000 (3,170)	29	69	160
Phenol (monohydric)	280	550	1,100	750	1,300	2,300	760[4]	1,500[4]	3,200[4]	760[4]	1,500[4]	3,200[4]	760[4]	1,500[4]	3,200[4]	66	140	280
Total Cresols[5]	80	180	400	3700	540	6900							160,000	180,000*	480,000*	12	27	63
Tributyl Tin Oxide (TBTO)	0.5	0.59	1.3	1.4	3.1	5.7							130*	180*	200*	0.042	0.10	0.24
Dioxins & D like PCBs		0.008												0.24			0.008	
PCBs		0.39			0.39									9				
Volatile Organic Compounds (VOC) & &SemiVolatile Organic Compounds (SVOC)																		
Chloromethane[5]	0.0083	0.0098	0.013	0.0085	0.0099	0.013							1.0	1.2	1.6	0.066	0.13	0.23
Chloroethane[5]	8.3	11	18	8.4	11	18							960	1300	2100	110	200	380
Dichloromethane[5]	0.58	0.98	1.7	2.1	2.8	4.5							270	360	560	0.10	0.19	0.34
1,1-Dichloroethane[5]	2.4	3.9	7.4	2.5	4.1	7.7							280	450	850	9.2	17	35
1,2-Dichloroethane (1,2-DCA)	0.0071	0.011	0.019	0.0092	0.013	0.023	29 (300)	29	29	21	24	28	0.67	0.97	1.7	0.0046	0.0083	0.016
1,1 Dichloroethene[5]	0.23	0.40	0.82	0.23	0.41	0.82							26	46	92	2.8	5.6	12
Cis-1,2-Dichloroethene[5]	0.11	0.19	0.37	0.12	0.20	0.39							14	24	47	0.26	0.50	1.0
Trans-1,2-Dichloroethene[5]	0.19	0.34	0.70	0.19	0.35	0.71							22	4	81	0.93	1.9	4.0
1,1,1-Trichloroethane	8.8	18	39	9	18	40	140,000	140,000	140,000	57,000 (1,425)[3]	76,000 (2,915)[3]	100,000 (6,392)[3]	660	1,300	3,000	48	110	240
1,1,2 Trichloroethane[5]	0.60	1.2	2.7	0.88	1.8	3.9							94	190	400	0.28	0.61	1.4
1,1,2,2 Tetrachloroethane	1.6	3.4	7.5	3.9	8	17	1,400	1,400	1,400	1,800	2,100	2,300	270	550	1,100	0.41	0.89	2
1,1,1,2 Tetrachloroethane	1.2	2.8	6.4	1.5	3.5	8.2	1,400	1,400	1,400	1,500	1,800	2,100	110	250	560	0.79	1.9	4.4

Determinand	Residential with Plant Uptake			Residential without Plant Uptake			POS Residential			POS Park			Commercial			Allotments		
Soil Organic Matter (SOM)	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%
Tetrachloroethene (PCE)	0.18	0.39	0.9	0.18	0.4	0.92	1,400	1,400	1,400	810 (424)[2]	1,100 (951)[2]	1,500	19	42	95	0.65	1.5	3.6
Tetrachloroethane	0.026	0.056	0.13	0.026	0.056	0.13	890	920	950	190	270	400	2.9	6.3	14	0.45	1	2.4
Trichloroethene (TCE)	0.016	0.034	0.075	0.017	0.036	0.08	120	120	120	70	91	120	1.2	2.6	5.7	0.041	0.091	0.21
Trichloromethane	0.91	1.7	3.4	1.2	2.1	4.2	2,500	2,500	2,500	2,600	2,800	3,100	99	170	350	0.42	0.83	1.7
Chloroethene (vinyl chloride)	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	3.5	3.5	3.5	4.8	5	5.4	0.059	0.077	0.12	0.00055	0.001	0.0018
1,2 Dichloropropane[5]	0.04	0.042	0.084	0.024	0.042	0.085							3.3	5.9	12	0.62	1.2	2.6
Hexachloroethane[5]	0.20	0.48	1.1	0.22	0.54	1.3							22*	53*	120*	0.27	0.67	1.6
2,4 Dinitrotoluene[5]	1.5	3.2	7.2	170[2]	170	170							3,700*	3,700*	3,800*	0.22	0.49	1.1
2,6 Dinitrotoluene[5]	0.78	1.7	3.9	78	84	87							1,900*	1,900*	1,900*	0.12	0.27	0.61
2,4,6 Trinitrotoluene (TNT)	1.6	3.7	8.1	65	66	66	130	130	130	260	270	270	1,000	1,000	1,000	0.24	0.58	1.4
α-Hexachlorocyclohexane	0.23	0.55	1.2	6.9	9.2	11	24	24	24	47	48	48	170	180	180	0.035	0.087	0.21
β-Hexachlorocyclohexane	0.085	0.2	0.46	3.7	3.8	3.8	8.1	8.1	8.1	15	15	16	65	65	65	0.013	0.032	0.077
γ-Hexachlorocyclohexane	0.06	0.14	0.33	2.9	3.3	3.5	8.2	8.2	8.2	14	15	15	67	69	70	0.0092	0.023	0.054
Chlorobenzene	0.46	1.0	2.4	0.46	1	2.4	11,000	13,000	14,000	1,300 (675)[2]	2,000 (1520)[2]	2,900	56	130	290	5.9	14	32
Styrene[5]	8.1	19	43	35	78	170							3,300*	6,500*	11,000*	1.6	3.7	8.7
Isopropylbenzene[5]	11	27	64	12	28	67							1,400*	3,300*	7,700*	32	79	190
Propylbenzene[5]	35	82	190	40	97	220							4,100*	9,700*	21,000*	34	83	200
1,2-Dichlorobenzene	23	55	130	24	57	130	90,000	95,000	98,000	24,000 (571)[2]	36,000 (1,370)[2]	51,000 (3,240)[2]	2,000 (571)[2]	4,800 (1,370)[2]	11,000 (3,240)[2]	94	230	540
1,3-Dichlorobenzene	0.4	1.0	2.3	0.44	1.1	2.5	300	300	300	390	440	470	30	73	170	0.25	0.6	1.5
1,4-Dichlorobenzene	61	150	350	61	150	350	17,000	17,000	17,000	36,000 (224)[3]	36,000 (540)[3]	36,000 (1280)[3]	4400 (224)[3]	10000 (540)[3]	25000 (1280)[3]	15	37	88
1,2,3-Trichlorobenzene	1.5	3.6	8.6	1.5	3.7	8.8	1,800	1,800	1,800	770 (134)[3]	1,100 (330)[3]	1,600 (789)[3]	102	250	590	4.7	12	28
1,2,4-Trichlorobenzene	2.6	6.4	15	2.6	6.4	15	15,000	17,000	19,000	1,700 (318)[3]	2,600 (786)[3]	4,000 (1880)[3]	220	530	1,300	55	140	320
1,3,5-Trichlorobenzene	0.33	0.81	1.9	0.33	0.81	1.9	1,700	1,700	1,800	380 (36.7)[3]	580 (90.8)[3]	860 (217)[3]	23	55	130	4.7	12	28
1,2,4 Trimethylbenzene[5]	0.35	0.85	2.0	0.41	0.99	2.3							42	99	220	0.38	0.93	2.2
1,2,3,4-Tetrachlorobenzene	15	36	78	24	56	120	830	830	830	1,500 (122)[3]	1,600	1,600	1,700 (122)[3]	3,080 (304)[3]	4,400 (728)[3]	4.4	11	26
1,2,3,5-Tetrachlorobenzene	0.66	1.6	3.7	0.75	1.9	4.3	78	79	79	110 (39)[3]	120	130	49 (39.4)[3]	120 (98.1)[3]	240 (235)[3]	0.38	0.9	2.2
1,2,4,5-Tetrachlorobenzene	0.33	0.77	1.6	0.73	1.7	3.5	13	13	13	25	26	26	42 (19.7)[2]	72 (49.1)[2]	96	0.06	0.16	0.37
Pentachlorobenzene	5.8	12	22	19	30	38	100	100	100	190	190	190	640 (43)[2]	770 (107)[2]	830	1.2	3.1	7
Hexachlorobenzene	1.8 (0.2)[3]	3.3 (0.50)[3]	4.9	4.1 (0.2)[3]	5.7 (0.5)[3]	6.7 (1.2)[3]	16	16	16	30	30	30	110 (0.2)[3]	120	120	0.47	1.1	2.5
Bromobenzene[5]	0.87	2.0	4.7	0.91	2.1	4.9							97	220	520	3.2	7.6	18
Bromodichloromethane[5]	.016	0.03	0.061	0.019	0.034	0.07							2.1	6.7	7.6	0.016	0.032	0.068
2-Chloronaphthalene[5]	3.7	9.2	22	3.8	9.3	22							390*	960*	2200*	40	98	230
2,4-Dimethylphenol[5]	19	43	97	210	410	730							16000*	24000*	30000*	3.1	7.2	17
Biphenyl[5]	66[2]	160	360	220[2]	500[2]	980[2]							18,000*	33,000*	48,000*	14	35	83
Chlorophenols	0.87	2	4.5	94	150	210	620	620	620	1,100	1,100	1,100	3,500	4,000	4,300	0.13	0.3	0.7
Pentachlorophenol	0.22	0.52	1.2	27 (16.4)[3]	29	31	60	60	60	110	120	120	400	400	400	0.03	0.08	0.19
Carbon Disulphide	0.14	0.29	0.62	0.14	0.29	0.62	11,000	11,000	11,000	1,300	1,900	2,700	11	22	47	4.8	10	23
Hexachlorobutadiene	0.29	0.7	1.6	0.32	0.78	1.8	25	25	25	48	50	51	31	66	120	0.25	0.61	1.4

Determinand	Residential with Plant Uptake			Residential without Plant Uptake			POS Residential			POS Park			Commercial			Allotments		
Soil Organic Matter (SOM)	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%	1.0%	2.5%	6.0%
Diethylphthalate[5]	120*	260*	570*	1,800*	3,500*	6,300*							150,000*	220,000*	290,000*	19*	41*	94*
Di-n-butylphthalate[5]	13*	31*	67*	450*	450*	450*							15,000*	15,000*	15,000*	2.0	5.0	12
Bis-(2-ethylhexyl)-phthalate[5]	280*	610*	1,100*	2,700*	2,800*	2,800*							85,000*	86,000*	86,000*	47*	120*	280*
Butyl-benzyl-phthalate[5]	1,400*	3,300*	7,200*	42,000*	44,000*	44,000*							940,000*	940,000*	950,000*	220*	550*	1,.300*
Miscellaneous Compounds																		
RDX	120	250	540	13,000	13,000	13,000	26,000	26,000	27,000	49,000 (18.7)[2]	51,000	53,000	210,000	210,000	210,000	17	38	85
HMX	5.7	13	26	6,700	6,700	6,700	13,000	13,000	13,000	23,000 (0.35)[3]	23,000 (0.39)[3]	24,000 (0.48)[3]	110,000	110,000	110,000	0.86	1.9	3.9
Aldrin	5.7	5=6.6	7.1	7.3	7.4	7.5	18	18	18	30	31	31	170	170	170	3.2	6.1	9.6
Dieldrin	0.97	2	3.5	7	7.3	7.4	18	18	18	30	30	31	170	170	170	0.17	0.41	0.96
Atrazine	3.3	7.6	17.4	610	620	620	1,200	1,200	1,200	2,300	2,400	2,400	9,300	9,400	9,400	0.5	1.2	2.7
Dichlorvos	0.032	0.066	0.14	6.4	6.5	6.6	16	16	16	26	26	27	140	140	140	0.0049	0.01	0.022
Endosulfan	7.4	18	41	160 (0.003)[3]	280 (0.007)[3]	410 (0.016)[3]	1,200	1,200	1,200	2,400	2,400	2,500	5,600 (0.003)[3]	7,400 (0.007)[3]	8,400 (0.016)[3]	1.2	2.9	6.8
Cyanide (free)	34			34									1400					

NOTES:

GAC based on LQM/CIEH S4UL unless stated and presented as mg/kg

1. Based on C4SL
2. Figure in brackets represents the soil saturation limit
3. Figure in brackets represents the vapour saturation limit
4. Figure based represents the GAC based on direct skin contact
5. Based on CL:AIRE GAC (asterisk denotes value exceeds the saturation limit)